C.S.E.C. PHYSICS

TOPIC BY TOPIC

(Paper 2)

2010 – 2020

SECTION ***Page***

SECTION A : MECHANICS

TABLE OF CONTENTS

TOPIC *Page Number*

SCIENTIFIC METHOD

Jan 2012 #2 a)

2. (a) (i) Complete Table 2 relating fundamental quantities and their base unit symbols.

TABLE 2: FUNDAMENTAL QUANTITIES AND THEIR BASE UNITS

Name	Symbol	Base (SI) Unit
Mass	m	kg
Time		
Current		
Temperature		
Length		

(4 marks)

(ii) State the difference between a 'linear scale' and a 'non-linear scale'.

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(2 marks)

(iii) You are provided with the following three measuring instruments.

Metre rule, Clinical thermometer, Conical flask

Which of the instruments listed above has a non-linear scale?

_____

(1 mark)

June 2012 #2

2. (a) Complete Table 2 which relates the physical quantities and their derived SI units.

TABLE 2

(i)

Physical Quantity	Derived SI Units
Area	_____
Volume	_____
_____	$Kg\ m^{-3}$

(3 marks)

(ii) State TWO fundamental quantities and their corresponding SI units.

Fundamental Quantity	SI Units
1.	
2.	

(4 marks)

(b) (i) Calculate the density of gasoline which occupies 150 cm^3 of space and has a mass of 102 g.

(3 marks)

(ii) If 325 g of mercury of density 13.6 gcm^{-3} occupies a certain space, determine the volume of the space.

(3 marks)

(iii) Calculate the relative density of gasoline using the density of mercury as the base quantity for the comparison.

(2 marks)

Total 15 marks

Jan 2013 #2 a)

2. **(a)** Complete Table 2 which shows physical quantities and the instruments used to measure them.

TABLE 2

Quantity	Instrument
Diameter of a wire	
Volume of a liquid	
	Thermometer
	Spring balance
Time	

(5 marks)

Jan 2015 #1

SECTION A

Answer ALL questions.

You MUST write your answers in this answer booklet.

1. A Form 4 Physics student was investigating how the square of the period, T^2, of a simple pendulum varied with its length, l. Her objective was to determine the acceleration due to gravity. Table 1 shows her results.

TABLE 1

Length of Pendulum, $l(m)$	Time for 20 Oscillations, $t(s)$	Time for 1 Oscillation (period), $T(s)$	Period Squared $T^2(s^2)$
0.20	18.00		
0.30	21.91		
0.40	25.40		
0.50	28.28		
0.60	31.10		
0.70	33.80		

(a) Complete Table 1 to determine values for plotting a graph. **(6 marks)**

(b) On the graph paper provided on page 3, plot a graph of Period Squared (T^2) on the vertical axis versus length (l) on the horizontal axis. Start each axis at zero. **(7 marks)**

(c) Calculate the gradient of this graph.

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(4 marks)

(d) The acceleration due to gravity, g, is related to T^2 and l by the equation

$$g = 4\pi^2 \times \frac{1}{\left(\frac{T^2}{l}\right)} \qquad [\pi = 3.14]$$

Use the gradient of the graph to calculate the value of g.

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(4 marks)

(e) Draw a clearly labelled diagram of a simple pendulum as it was used in this investigation.

(4 marks)

Total 25 marks

Jan 2016 #2 a)

(2).(a) Complete the graphic below by drawing an arrow from each physical quantity to its respective unit. **(2 marks)**

Physical Quantity	Unit
Density	$N\,m$
Moment	$N\,s$
Linear Momentum	$kg\,m^{-3}$

Jan 2019 #2 a)

2.(a) Complete Table 2 by inserting the appropriate physical quantities and derived SI units. **(5 marks)**

TABLE 2 PHYSICAL QUANTITIES AND UNITS

Physical Quantity	Derived SI Units
Volume	(i) .....
(ii)	$kg\ m^{-3}$
(iii)	N
Pressure	(iv) ..... (v) .....

VECTORS

Jan 2013 #2 c) (ii)

(ii) Figure 2 is a vector diagram representing a cricket ball's velocity, OA, and the wind's velocity, OB.

a) By accurate scale drawing on Figure 2 below, determine the resultant vector.

Scale 1 cm = 2 ms^{-1}

Figure 2

(3 marks)

b) State its magnitude in m s^{-1} and its direction in degrees from OA.

(2 marks)

Total 15 marks

STATICS

Jan 2012 #1

SECTION A

Attempt ALL questions.

You MUST write your answers in this answer booklet.

1. A Form 4 Physics student performed an activity to determine the mass of a lump of plasticine, M_p. A diagram of the setup of the apparatus used is seen in Figure 1 below. The Principle of Moments was used.

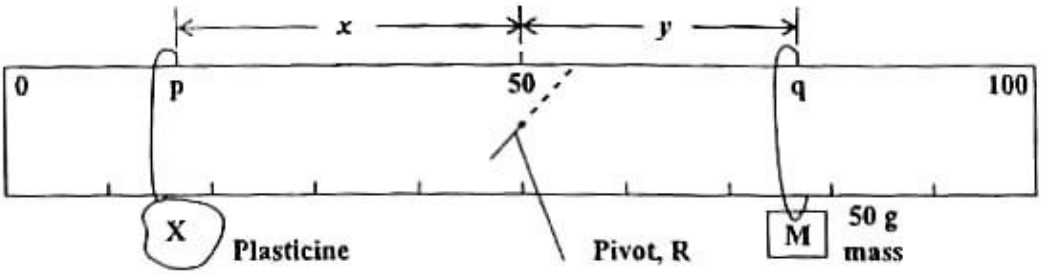

Figure 1. Setup of the activity

The results of the activity were recorded in Table 1 below.

TABLE 1: RESULTS OF THE ACTIVITY

Position of Plasticine, p/cm	Position of 50 g mass q/cm	x/cm	y/cm
10.0	86.0	40.0	
20.0	76.2	30.0	
30.0	66.0		16.0
35.0	62.8		12.8
40.0	57.9	10.0	
45.0	53.6	5.0	

(a) Complete Table 1 by calculating the values of x and y. **(3 marks)**

(b) Use the results from the completed Table 1 to plot a graph of y/cm against x/cm, on the graph paper provided on page 3. **(6 marks)**

(c) From your graph, calculate the slope, z.

(5 marks)

(d) Use your graph to determine how far the 50 g mass needs to be placed if it balances when the plasticine was placed 27.5 cm from the pivot, R.

(1 mark)

(e) State the Principle of Moments.

(4 marks)

(f) The weight of the plasticine, W_p, is related to the weight of the 50 g mass, W_m, by the formula,

$$W_p = \text{gradient} \times W_m.$$

(i) Determine the weight of the plasticine, W_p.

(ii) Calculate the mass of the plasticine, M_p.

[g = 10 N kg^{-1}] **(2 marks)**

Total 25 marks

June 2012 #3 a) – c)

3. The yacht shown in Figure 1 has a mass of 8300 kg.

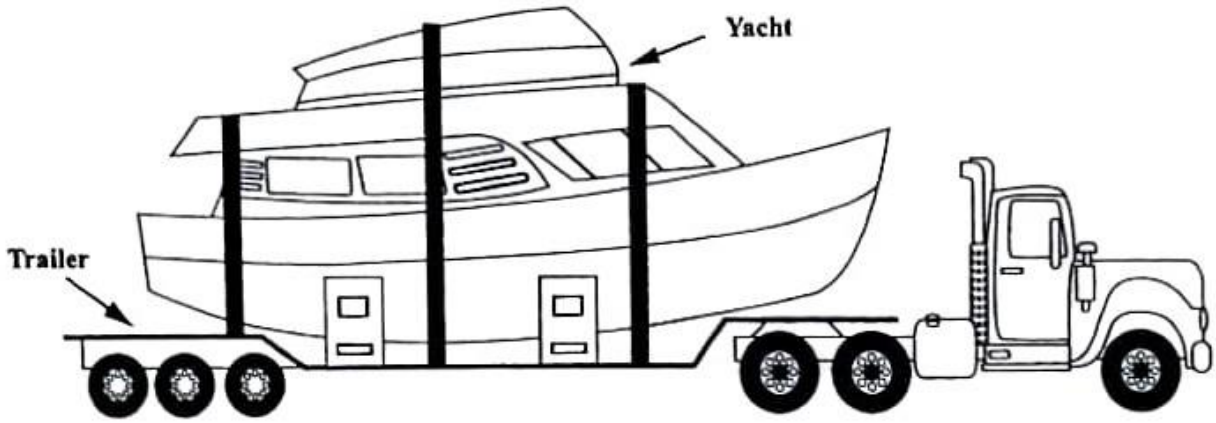

Figure 1. Diagram showing a yacht on a trailer

(a) Determine its weight in air.

[Acceleration due to gravity, g = 10 N Kg^{-1}]

(2 marks)

(b) For land transport, the yacht is secured on a trailer. Each tyre on the trailer can support up to a maximum of 7000 Newtons. What is the LEAST number of tyres the trailer should have to support the yacht adequately?

(c) (i) Many forces act on the yacht yet it is in equilibrium. State TWO conditions that must be satisfied for an object to be in equilibrium.

1. _____

_____

2. _____

_____

(2 marks)

(ii) State the effect that the position of the centre of gravity of an object has on its stability.

_____

_____

(1 mark)

Jan 2013 #2 b) - c) (i)

(b) A child, drops a stone as shown in Figure 1.

Figure 1

(i) Identify the force which acts on the stone, causing it to fall.

_____

_____

(1 mark)

(ii) Describe the change in motion of the stone as a result of this force.

_____

_____

(1 mark)

(c) (i) Given that the mass of a cricket ball is 0.06 kg, calculate its weight in newtons.

(3 marks)

[Acceleration due to gravity, $g = 10\ m\ s^{-2}$]

SECTION A

Attempt ALL questions.

You MUST write your answers in this answer booklet.

1. Table 1 shows the results obtained by a student who performed an experiment to investigate how the length of a spring varies with the load applied to the end of the spring.

TABLE 1

Load, F/N	Length, L/m
2.0	0.36
4.0	0.35
6.0	0.40
8.0	0.46
10.0	0.51

(a) Plot, on page 3, a graph of length (L) on the vertical axis versus Load (F). Start each axis at zero.

(7 marks)

(b) Determine the gradient of the graph.

(4 marks)

(c) What information about the spring does the gradient of the graph provide?

(1 mark)

(d) (i) Use the graph to find the original length of the spring.

(2 marks)

(ii) Use the gradient to calculate the extension of the spring if a 0.7 kg mass hangs freely from the end of the spring. Hence calculate the length of the spring with the mass attached.

(6 marks)

[g = 10 N kg^{-1}]

(iii) If the spring was stretched beyond its elastic limit how would this affect the shape of the graph?

(1 mark)

(e) (i) How would you identify the region where proportionality exists?

(2 marks)

(ii) Classify EACH quantity shown in Table 2, as a scalar or vector by inserting a tick (✓) in the appropriate column.

TABLE 2

Quantity	Scalar	Vector
Load		
Extension		

(2 marks)

Jan 2014 #2

2. (a) (i) Figure 1 shows some physical quantities and their units. Draw an arrow from EACH quantity to its unit.

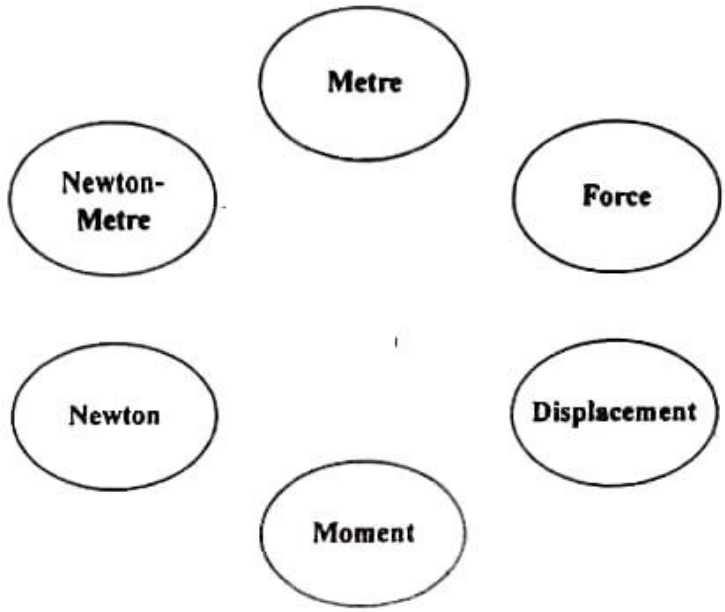

Figure 1

(3 marks)

(ii) Complete Table 2 to show the names of three forces and a situation in which EACH force acts.

TABLE 2

Force	Situation
1. _____	A javelin falling in the air
2. Upthrust	_____
3. _____	_____

(4 marks)

(b) Patrick and Patricia showed their class a 'magical' balancing act. They both sat on one side of a uniform 6.0 m plank. Patrick sat 1.0 m from the pivot located 0.5 m from the centre of the plank. Patricia sat 0.5 m from the pivot, on the same side as Patrick.

Figure 2 shows the 'magical' balancing act. X represents the pivot point.

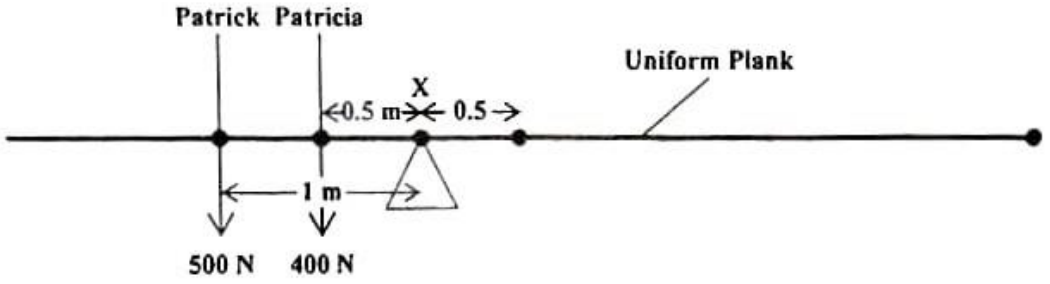

Figure 2

(i) Label, as W, the point on Figure 2 where the weight of the plank acts. **(1 mark)**

(ii) Calculate the weight of the plank, W.

(4 marks)

(iii) If Patrick sat alone on the plank, calculate where he would have to sit in order to maintain his 'magical' balancing act. The pivot remains as before.

(3 marks)

Total 15 marks

Jan 2017 #3

3. (a)(i) Fill in the blanks in the following passage about the moments of forces.

The ..... of moments states that when a body is in equilibrium the sum of the ..... about any ..... is equal to the sum of the ..... about the same ..... **(4 marks)**

(ii) Apart from the 'seesaw', identify TWO situations in which a force will result in a turning effect. **(2 marks)**

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(b) Figure 2 shows Kyle and Keion balanced on a seesaw. Kyle's weight is 500 N and Keion's weight is 300 N. The seesaw is made of a uniform plank of weight 800 N which is 4 m long, pivoted at its centre.

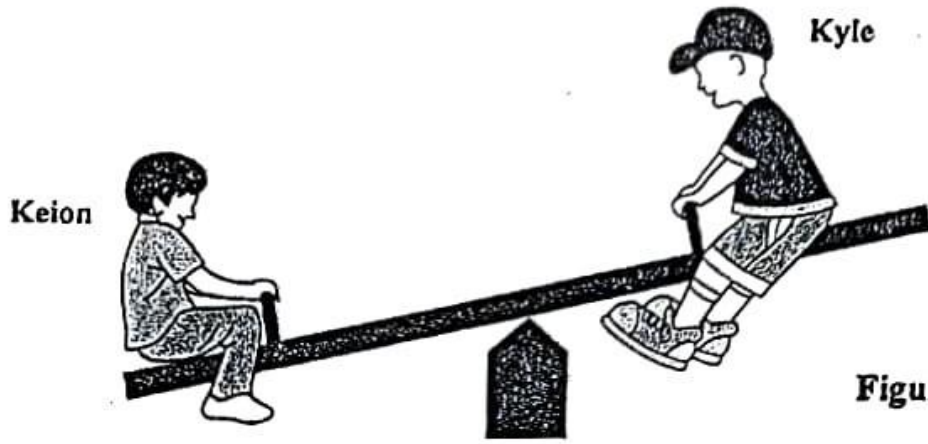

Figure 2

(i) By taking moments about the pivot, calculate the distance, x, that Keion must sit from the pivot to balance the plank if Kyle sits 1 m from one end of the plank. **(4 marks)**

(ii) If balanced, calculate the reaction force at the pivot. **(4 marks)**

(iii) What is the moment of the reaction force about the pivot? **(1 mark)**

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Total 15 marks

June 2018 #5 a) - b)

5. (a)(i) State Hooke's Law. **(3 marks)**

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(ii) With the aid of a labelled, sketched graph, explain what is meant by 'elastic limit'. **(3 marks)**

(b) A steel spring has a spring constant of 2×10^2 N m^{-1}.

Calculate the weight of an object which when attached to the unloaded spring produces an extension of 50 mm. The elastic limit is NOT exceeded.

$$\left[\text{Spring Constant} = \frac{\text{Force}}{\text{Extension}}\right]$$

(5 marks)

Jan 2019 #3 b) - c)

(b)(i) Define the term 'force'. **(1 mark)**

.....

.....

(ii) Many types of forces are applied in various situations.

Complete Table 2 by inserting the appropriate types of forces and examples. **(4 marks)**

TABLE 2: TYPES OF FORCES AND EXAMPLES OF WHERE THE FORCES ARE EXPERIENCED

Type of Force	Example of Where the Force is Experienced
	A satellite falling in the earth's atmosphere
Nuclear	
	When a rubbed comb picks up a small piece of paper
Magnetic	

(c) A class of Physics students conducted a School-Based Assessment on the relationship between force (F) and extension (e) for a rubber band.

One of the groups produced the following graph from the results.

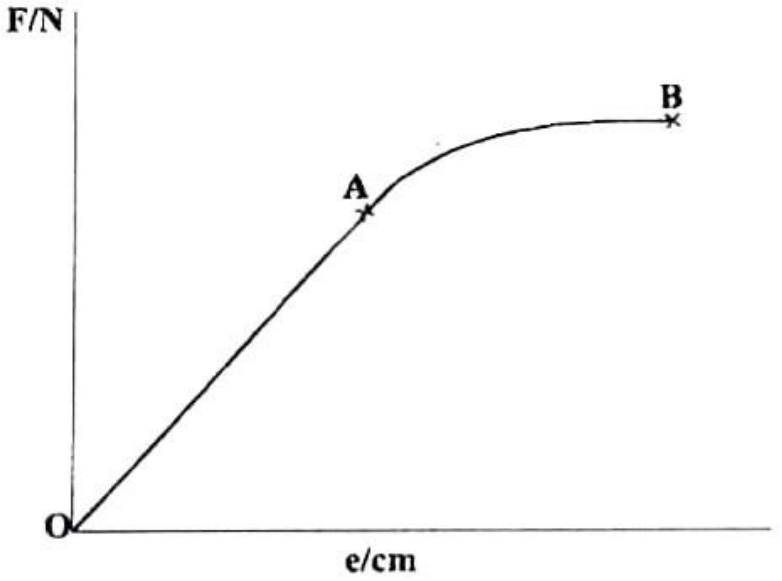

Figure 4. Graph of Force (F) against extension (e)

(i) State the mathematical relationship between force and extension in the segment OA. **(2 marks)**

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(ii) State the point at which the elastic limit is located. **(1 mark)**

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(iii) Give a reason for the shape of segment AB in the graph. **(1 mark)**

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Total 15 marks

DYNAMICS

Jan 2010 #2

2. (a) (i) Complete the following table, by inserting the correct quantity, formula and unit.

Quantity	Formula	Unit
	$F = ma$	
Potential Energy		
		$kgms^{-1}$

(3 marks)

(ii) State the 'law of conservation of linear momentum'.

(4 marks)

(b) (i) "BIG CRASH ON THE HIGHWAY"

"Two trucks of equal mass collided head-on at the same speed on the busy East-West Highway. They both remained stationary on impact."

Explain this crash in terms of conservation of linear momentum. Assume the masses of other contents of the trucks are equal.

(4 marks)

(ii) A police recruit, while training, shot at a stationary target of mass 5.0 kg, with a bullet of mass 0.1 kg. The target was mounted on low-fiction wheels and as soon as the bullet struck the target. the target with the embedded bullet sped off with a velocity of 6.0 m s^{-1}.

Calculate the velocity of the bullet just before it hit the stationary target.

(4 marks)

Total 15 marks

June 2010 #2

2. (a) Define EACH of the following terms.

(i) Velocity

_____

_____

(2 marks)

(ii) Acceleration

_____

_____

(2 marks)

(iii) Linear momentum

_____

_____

(2 marks)

(b) In 2008, at the Beijing Olympics, Usain Bolt of Jamaica reclaimed his title as the world's fastest man. He completed the 100 m final in a world record time of 9.69 s. He accelerated uniformly from rest for the first 6.5 seconds, covering 60 m before coasting at maximum speed to the finish.

(i) Calculate his average speed for the first 6.5 s. **(2 marks)**

(ii) What was his maximum speed?

(2 marks)

(iii) What was his acceleration during the first 6.5 s?

(2 marks)

(iv) a) What MAJOR form of energy did BOLT possess when he crossed the finish line?

_____

(1 mark)

b) Calculate the value of this energy if his mass was 86 kg.

(2 marks)

Jan 2011 #1

SECTION A

Attempt ALL questions.

You MUST write your answers in this answer booklet.

1. A popular sprinter of mass 60 kg, was running a 100 m race. Her velocity was measured over a 10.0 s period. The results are recorded in Table 1.

TABLE 1

Velocity, v/ms^{-1}	0.0	2.5	5.0	7.5	10.0	10.0
Time, t/s	0.0	2.0	4.0	6.0	8.0	10.0

(a) Define the following terms:

Velocity

_____

_____

(2 marks)

Acceleration

_____

_____

(2 marks)

(b) Use the results from Table 1 to plot a graph of Velocity versus Time on page 3.

(7 marks)

(c) Determine the slope of the graph over the first 6.0 s of the race.

(4 marks)

(d) How is the slope of the graph related to the acceleration of the sprinter?

_____

(2 marks)

(e) Calculate the resultant force acting on the sprinter after 6.0 s.

(3 marks)

(f) Using the graph drawn on page 3, determine how far from the finish line the sprinter would be after 10.0 s.

(5 marks)

Total 25 marks

June 2011 #1

SECTION A

Attempt ALL questions.

You MUST write your answers in this answer booklet.

1. A taxi driver was taking his friends to a popular 20/20 cricket match. Table 1 shows the vehicle's velocity for the first minute of the journey.

TABLE 1

Velocity, V/ms^{-1}	Time, t / s
0.0	0.0
11.0	10.0
23.0	20.0
34 .0	30.0
47.0	40.0
57.0	50.0
69.0	60.0

(a) Plot on page 3, a graph of velocity (V) versus time (t). **(7 marks)**

(b) From the graph, calculate the slope, p.

(4 marks)

(c) What quantity does the slope, p, represent?

_____

(1 mark)

(d) For the next minute, the vehicle's velocity was constant, then for the final minute, the vehicle decelerated uniformly to a stop on reaching the stadium.

(i) Continue the velocity-time graph on page 3, to show this information and use the graph to determine the total distance travelled.

(4 marks)

(ii) Calculate the average velocity of the taxi for the **complete** journey.

(2 marks)

(iii) If the total mass of the loaded taxi was 1 500 kg, determine the momentum of the vehicle when it is travelling at constant velocity.

(3 marks)

(e) (i) Define the term 'displacement'.

_____

_____

(2 marks)

(ii) Complete Table 2 by ticking (√) the appropriate column that represents the quantity, given in the table.

TABLE 2

Quantity	Scalar	Vector
Displacement		
Acceleration		

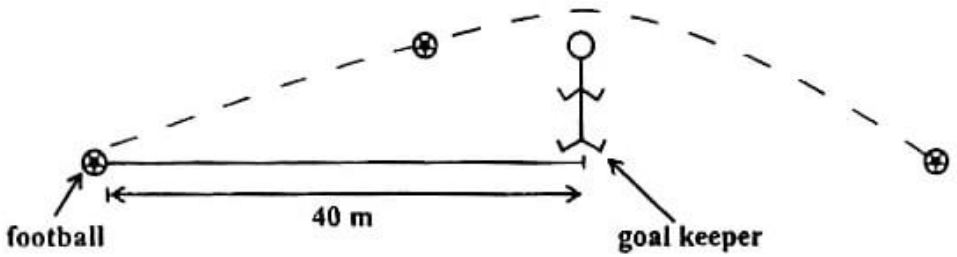
(2 marks)

Total 25 marks

Jan 2013 #6

6. (a) Discuss the importance of alternative energy to the Caribbean with reference to two sources and their uses. **(6 marks)**

(b) A football is kicked from rest looping over the head of a goalkeeper who is 40 m away.



(i) Describe the energy changes taking place in the ball from when it was kicked to when it hit the ground behind the goalkeeper. (Assume no energy losses.) **(4 marks)**

(ii) After 1s, the ball of mass m kg and velocity v ms^{-1} is located h m from the ground.

Derive an expression in terms of m, h and v for the difference between the potential and the kinetic energy of the ball. **(2 marks)**

(iii) During a game, the ball of mass 0.43 kg hit the head of one of the players of height 1.5 m. The player was standing vertically. If the velocity of the ball at the point of contact with the player's head was 7 m s^{-1}, what momentum was transferred to the player? **(3 marks)**

Acceleration due to gravity, g = 10 N kg^{-1} **Total 15 marks**

June 2013 #4

SECTION B

Attempt ALL questions.

You MUST write your answers in the spaces provided after each question.

4. (a) (i) State the law of conservation of linear momentum. **(3 marks)**

(ii) Describe a situation that demonstrates the law of conservation of linear momentum. **(3 marks)**

(b) A truck, of mass 1250 kg, heading north crossed the median on the Jasper Highway, then slammed head-on at 25 ms^{-1} into a 625 kg car heading south at 30 m s^{-1}.

(i) What was the initial momentum of the truck?

(ii) What was the initial momentum of the car?

(iii) Assuming the car and truck move as one following the collision, what is the speed and direction of the wreck right after the collision?

(9 marks)

Total 15 marks

June 2015 #4

SECTION B

Answer ALL questions.

4. (a) State Newton's three laws of motion.

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(6 marks)

(b) In a crash test, a car travelling at a constant velocity of 26 m s^{-1} crashes into a wall and is brought to rest.

(i) Calculate the initial momentum of a 70 kg test dummy in the car before the crash.

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(3 marks)

(ii) Calculate the average force exerted on the dummy by the seatbelt during the crash if the duration of the collision is 0.1 seconds.

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(3 marks)

(iii) With the removal of all protective features, the dummy was subjected to another crash test with the same initial speed. This time it was subjected to a 'lethal' decelerating force of 45 000 N. Calculate the duration of this collision.

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(3 marks)

Total 15 marks

Jan 2016 #1

SECTION A

Answer ALL questions.

You MUST write your answers in this answer booklet.

1. A motor car travelled from rest and its velocity over an 80-second period was measured. The results are shown in Table 1.

TABLE 1

Velocity, v (m s^{-1})	0.	30	30	30	0
Time, t (s)	0	20	40	60	80
Point	A	B	C	D	E

(a) **On the grid provided on page 5,** plot the graph of velocity against time. **(7 marks)**

(b) Use the graph to determine EACH of the following:

(i) The acceleration during the interval AB. **(4 marks)**

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(ii) The velocity of the motorcar after 70 seconds (with the aid of dotted lines) **(1 mark)**

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(iii) The total distance travelled over the 80 second period. **(9 marks)**

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(c) From your graph, describe the velocity of the vehicle over the period BC. **(1 mark)**

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(d) This question investigated how velocity varied with time.
Define the term 'velocity'. **(3 marks)**

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Total 25 marks

June 2016 #2

2. (a) Complete the bubbles in Figure 1 by inserting the SI unit which matches EACH of the physical quantities. **(2 marks)**

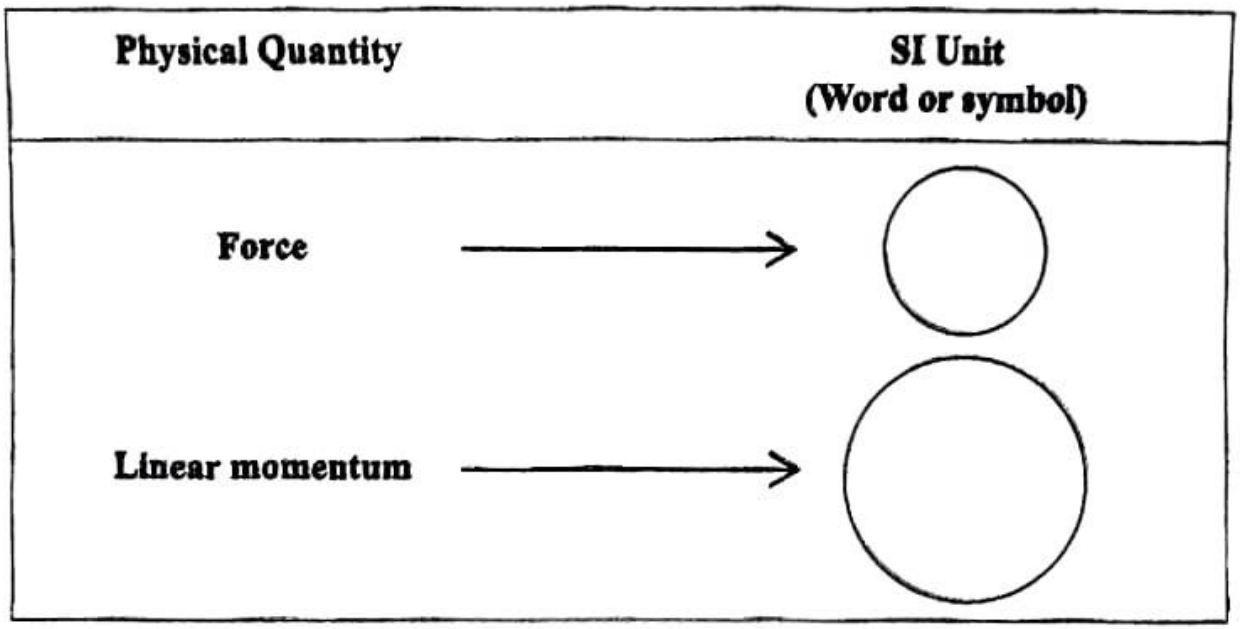

Figure 1

(b) (i) State Newton's third law of motion. **(3 marks)**

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(ii) A Caribbean airplane on its way from the Piarco International Airport to the Grantley Adams International Airport flies horizontally in mid-flight.

With the aid of a diagram, and using Newton's third law of motion, explain how this happens. **(4 marks)**

SPACE FOR DIAGRAM

(b) (ii) .....

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(c) (i) Define the term 'linear momentum'. **(2 marks)**

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(ii) **An 8 kg ball travelling** to the east at 10 ms^{-1}, collides with a 2 kg ball **travelling to the west** with a velocity of 5 ms^{-1}. After the collision, **they move together.**

Determine the final velocity of the balls. **Assume that there are no resistive forces.** **(4 marks)**

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Total 15 marks

SECTION B

Answer ALL questions.

4. (a) For a popular amusement park ride, patrons board a carriage at the top of a high tower and are subjected to a wild ride of 'terror'.

Name and state the Newton's Law which applies if the

(i) carriage is moving horizontally at a constant speed in a straight line

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(3 marks)

(ii) carriage is in free fall.

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(3 marks)

(b) (i) Calculate the length of time that the carriage in Part (a) **on page 14** is allowed to free fall if it reaches a speed of 64.8 km h^{-1} from rest.
[Use g = 10 ms^{-2}] **(5 marks)**

(ii) Determine the distance the carriage falls in (b) (i). **(4 marks)**

Total 15 marks

June 2018 #5 b) - c)

(b) A steel spring has a spring constant of 2×10^2 N m^{-1}.

Calculate the weight of an object which when attached to the unloaded spring produces an extension of 50 mm. The elastic limit is NOT exceeded.

$$\left[\text{Spring Constant} = \frac{\text{Force}}{\text{Extension}}\right]$$

(5 marks)

(c) The object attached to the spring in **(b)** fell from rest and hit the ground after two seconds. Calculate the velocity of the object on hitting the ground.

$[g = 10 \text{ m s}^{-2}]$

(4 marks)

Total 15 marks

Jan 2020 #1

SECTION A

Answer ALL questions.

1. A sprinter of mass **55 kg** was running a **100 m** race. Her velocity was measured at different intervals of a **11.0 s** period. The results are recorded in Table 1.

TABLE 1: RESULTS

Velocity, v/ms^{-1}	**0.00**	**1.20**	**3.75**	**8.75**	**10.00**	**10.00**
Time, t/s	**0.0**	**1.0**	**3.0**	**7.0**	**8.0**	**11.0**

(a) (i) Define the term 'velocity'. **(2 marks)**

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(ii) Complete the following statement. **(1 mark)**

Acceleration is defined as the rate of change of .....

.....

(b) Using the grid provided **on page 5**, plot a graph of **velocity, v/ms^{-1},** against **time, t/s.** **(8 marks)**

(c) Determine the slope of the graph over the first **7.0 s** of the race., **(4 marks)**

(d) (i) State the physical quantity relating to the motion of the sprinter which the slope of the graph represents. **(1 mark)**

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(ii) Describe the sprinter's motion from **8 s** to **10 s.** **(1 mark)**

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.....

(e) Calculate the resultant force acting on the sprinter after **7.0 s.** **(3 marks)**

(f) Using the graph drawn **on page 5**, determine how far from the finish line the sprinter would be after **11.0 s.** **(5 marks)**

Total 25 marks

3.(a) (i) Define the term 'linear momentum'. **(1 mark)**

.....

.....

.....

(ii) State the SI unit for linear momentum. **(1 mark)**

.....

(b) (i) State the law of conservation of linear momentum. **(3 marks)**

.....

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(ii) State TWO real-life examples that demonstrate the law of conservation of linear momentum. **(2 marks)**

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3.(c) Trolley A and Trolley B collided head-on. Trolley A of mass **72.0 kg** was moving towards the west at **5.50 ms^{-1}**. Trolley B of mass **69.4 kg** was moving towards the east at **4.50 ms^{-1}**.

Calculate

(i) the initial momentum of Trolley A **(2 marks)**

(ii) the initial momentum of Trolley B **(2 marks)**

(d) Assuming the trolleys locked during the collision and that they moved off together in one direction, determine the speed and the direction of the joined trolleys immediately after the collision. **(4 marks)**

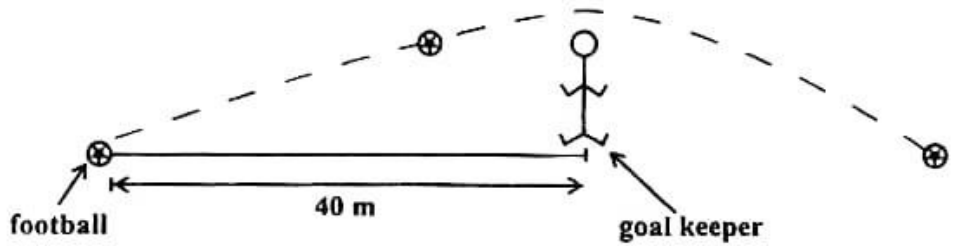
Total 15 marks

ENERGY

Jan 2013 #6

6. (a) Discuss the importance of alternative energy to the Caribbean with reference to two sources and their uses. **(6 marks)**

(b) A football is kicked from rest looping over the head of a goalkeeper who is 40 m away.



(i) Describe the energy changes taking place in the ball from when it was kicked to when it hit the ground behind the goalkeeper. (Assume no energy losses.) **(4 marks)**

(ii) After 1s, the ball of mass m kg and velocity v ms^{-1} is located h m from the ground.

Derive an expression in terms of m, h and v for the difference between the potential and the kinetic energy of the ball. **(2 marks)**

(iii) During a game, the ball of mass 0.43 kg hit the head of one of the players of height 1.5 m. The player was standing vertically. If the velocity of the ball at the point of contact with the player's head was 7 m s^{-1}, what momentum was transferred to the player? **(3 marks)**

Acceleration due to gravity, g = 10 N kg^{-1} **Total 15 marks**

June 2014 #2

2. (a) The unit of energy, the Joule, has two equivalent derived units.

(i) In Figure 1, indicate inside the bubbles, two equivalent derived units for the Joule.

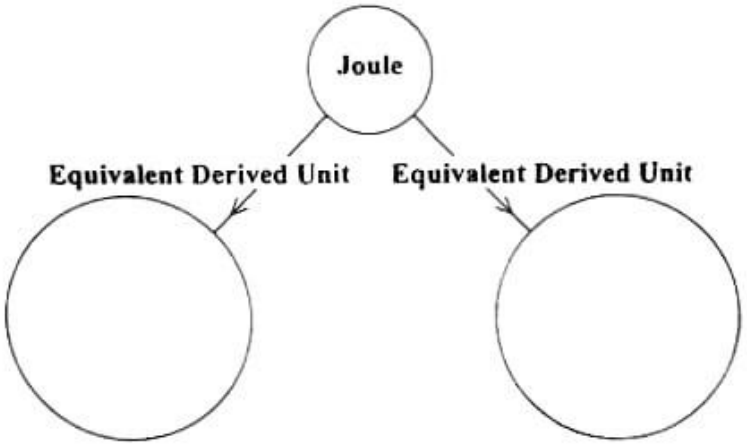


Figure 1.

(2 marks)

(ii) Solar energy is one of the popular alternative sources of energy. State ONE application of solar energy.

.....

.....

(1 mark)

(iii) State ONE advantage of using solar energy in the Caribbean.

.....

.....

(1 mark)

(iv) A variety of alternative energy technologies are being used in the Caribbean and globally. Other than solar energy, complete Table 3 to show three other types of alternative energy technologies and their sources.

TABLE 3

Alternative Energy	Source
(1)	
(2)	
(3)	

(3 marks)

(b)

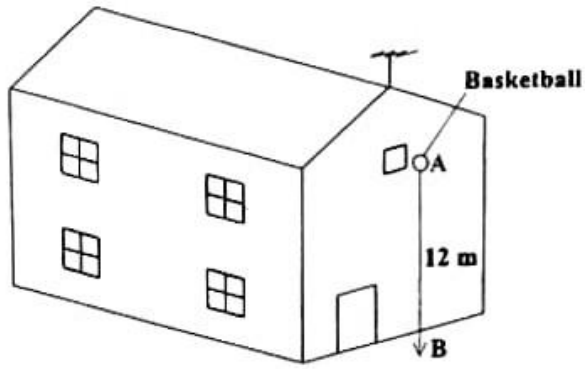


Figure 2.

A basketball of mass 0.44 kg was dropped vertically from rest at A, 12 m from the ground as seen in Figure 2. Calculate the

(i) gravitational potential energy of the ball at the point of release, A.

(3 marks)

(ii) final velocity of the ball on reaching the ground 1.56 seconds later (assume no loss of energy as the ball falls).

(3 marks)

(iii) ball's momentum when it hits the ground.

[Acceleration due to gravity, g, = 9.8 m s^{-2}]

(2 marks)
Total 15 marks

Jan 2015 #2

2. (a) (i) One of the things that physics is concerned with is the study of energy. Complete Table 2 to show two other major forms of energy and ONE example of each.

TABLE 2

Forms of Energy	Example
(1) Mechanical	A moving car/object.
(2)	
(3)	

(4 marks)

(ii) State the SI unit of energy.

.....

(1 mark)

(iii) Define the SI unit of energy named in (ii) above.

.....

.....

(2 marks)

(b) A bucket filled with cement of total mass 60 kg is raised vertically 150 m from the ground to the twelfth floor of a building under construction as shown in Figure 1.

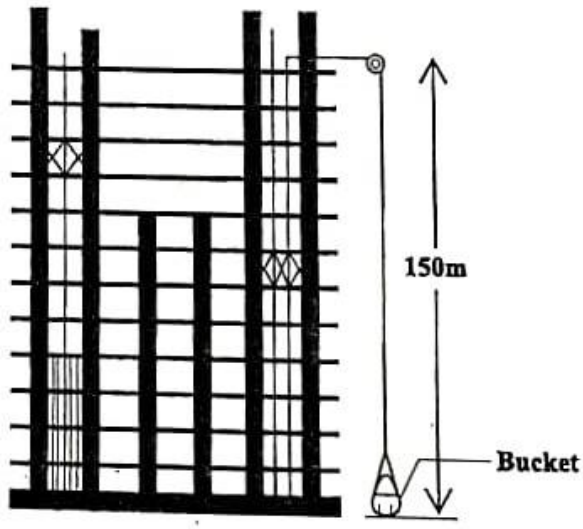


Figure 1

(i) Calculate the amount of energy that was needed to perform this activity. (Assume no frictional forces were present.)

.....

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(3 marks)

(ii) If this activity takes 25 seconds to complete, calculate the power utilized in kilowatts.

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(4 marks)

(iii) If friction was present, what effect if any, would this have on the power needed?

.....

.....

(1 mark)

(Gravitational field strength, $g = 10$ N kg^{-1})

Total 15 marks

(b) Complete the following statements:

(i) Kinetic energy is defined as.....

.....

(1 mark)

(ii) The potential energy of a body is defined as .....

.....

(1 mark)

(iii) The formula for the change in gravitational potential energy is .....

.....

(1 mark)

(iv) Waterfalls are commonly found across the Caribbean. Describe the energy changes taking place in a waterfall. (2 marks)

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(c) A pendulum swings from A through B to C and returns to A as seen in Figure 1.

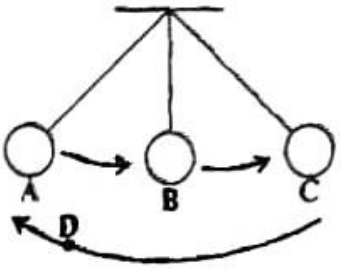

Figure 1

A and C are the furthest points with B being the midpoint.

State the type of energy that exists at

(i) A .....

.....

(1 mark)

(ii) B .....

.....

(1 mark)

(iii) C .....

.....

(1 mark)

(iv) Another point D, is situated midway between A and B.

If the pendulum is returning to A to complete an oscillation, explain whichtype of energy is increasing and why. **(2 marks)**

At D, the type of energy increasing is .....

.....

Reason: .....

.....

.....

(d) Netball is a popular sport played across the Caribbean.
If a netball has a mass of 0.4 kg and a velocity of 5 m s^{-1}, calculate its kinetic energy. **(3 marks)**

.....

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Total 15 marks

June 2016 #6 b)

(b) In Dominica, hydroelectricity is used to supply energy on a large scale.

(i) Describe how electricity is generated using the process of hydroelectricity. **(3 marks)**

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(ii) Discuss the rationale for the application of hydroelectricity as a viable alternative energy source in Dominica. **(6 marks)**

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Total 15 marks

3.(a) Define the term 'energy' and state its SI unit. **(2 marks)**

.....

.....

(b) (i) Complete Table 3 to show the MAIN form of energy associated with EACH of the following examples. **(3 marks)**

TABLE 3

Forms of Energy	Example
	Radioactive decay
	Radio waves, X-rays
	Objects in motion

(ii) State the MAIN energy conversions taking place when a flashlight is turned on.

.....

.....

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(2 marks)

(c) Figure 4 shows a pendulum of mass 0.5 kg oscillating in a vacuum. X is the lowest position of the pendulum, where its maximum speed is 1.8 ms^{-1}.

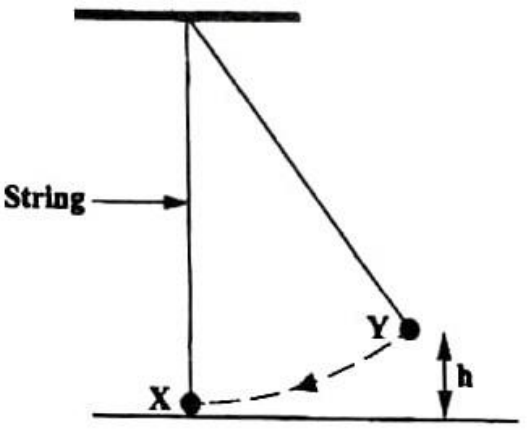

Figure 4. Simple pendulum

(c) (i) Calculate the maximum kinetic energy of the pendulum. **(3 marks)**

(ii) Use the principle of conservation of energy to find the maximum gravitational potential energy of the pendulum. **(2 marks)**

.....

.....

.....

(iii) Calculate the greatest height, h. **(3 marks)**

Total 15 marks

3.(a) (i) State the law of conservation of energy. **(2 marks)**

.....

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.....

(ii) A goalkeeper drops a football of mass 0.43 kg vertically downwards from rest at a height of 1.5 m.

Calculate the velocity of the ball as it makes contact with the ground. (Assume no air resistance or wind is present.) **(4 marks)**

[Acceleration due to gravity, $g = 10\ ms^{-2}$]

HYDROSTATICS

Jan 2012 #2 b)

(b) The container shown in Figure 2 is completely filled with cement.

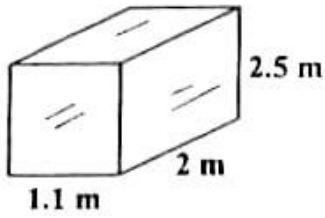

Figure 2. Container filled with cement

(i) If the mass of the cement is 15 000 kg, calculate the density of this cement sample in kg m^{-3}.

(4 marks)

(ii) What pressure, in Newtons, would the cement exert on the base of the container?

[g = 10 N kg^{-1}] **(4 marks)**

Total 15 marks

June 2012 #3 d)

(d) (i) State Archimedes' Principle.

(2 marks)

(ii) The yacht's hull is made of steel with density, ρ_s, equal 7850 kg m^{-3}. Explain how the yacht is able to float in sea water of density, ρ_w, 1025 kg m^{-3}.

(2 marks)

(iii) Calculate the volume of sea water displaced by the yacht as it floats.

(4 marks)

June 2019 #2 b)

(b) The concrete block shown in Figure 3 was made with cement.

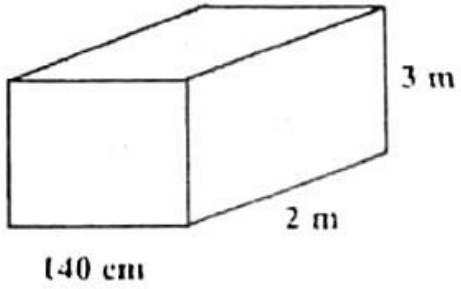

Figure 3. Concrete block

(i) Calculate the density of the concrete block, given that its mass is **20 160 kg.** **(4 marks)**

(ii) Define the term pressure. **(2 marks)**

.....

.....

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.....

(iii) Given that $g = 10\ N\ kg^{-1}$, calculate the pressure exerted on the floor by the base of the concrete block. **(4 marks)**

Total 15 marks

SECTION B : THERMAL PHYSICS AND KINETIC THEORY

TABLE OF CONTENTS

TOPIC *Page Number*

MACROSCOPIC PROPERTIES AND PHEMONENA

Jan 2010 #1

Attempt ALL questions.

You MUST write your answers in this answer booklet.

1. In an experiment to investigate Charles' Law, a Physics student used a fixed mass of dry air trapped in a glass capillary tube as seen in Figure 1. The student recorded in Table 1 how the length of the air column varied with temperature.

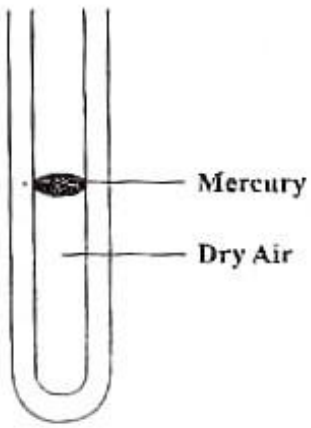

Figure 1. Diagram showing air trapped in a capillary tube

TABLE 1: RESULTS OF THE EXPERIMENT

Length of the air column, L/mm	152.0	158.0	163.0	170.0	179.0	182.0
Temperature, T/°C	14.0	29.0	40.0	57.5	78.0	85.0
Temperature, T / K						

(a) Complete Table 1 by calculating the temperature, T / K. **(3 marks)**

(b) Use the readings from the completed Table 1 to plot a graph of length of the air column (L/mm) against Temperature (T/K) on the graph page on page 2.

The L-axis starts at 140 mm and the T-axis starts at 270 K. **(6 marks)**

(c) From your graph, calculate the slope, S.

(4 marks)

(d) What information does the slope (gradient) of the graph provide?

_____

(1 mark)

(e) Use your graph to determine the value of the length of the air column at 273 K.

_____

(1 mark)

(f) State Charles' law.

_____

_____

_____

(4 marks)

(g) In a related practical activity, 2 litres of a gas were heated from 35 °C to 75 °C. If the pressure was kept constant, calculate the final volume of the gas.

(6 marks)

Jan 2010 #4 a)

SECTION B

Attempt ALL questions.

You MUST write your answers in the space provided after each question.

4. (a) A young student has just entered primary school. She is accustomed to having her home-cooked meal warmed up at lunch time in the microwave oven at her pre-school. She misses this and suggests to her parents that they buy her a flask similar to the one shown in Figure 3.

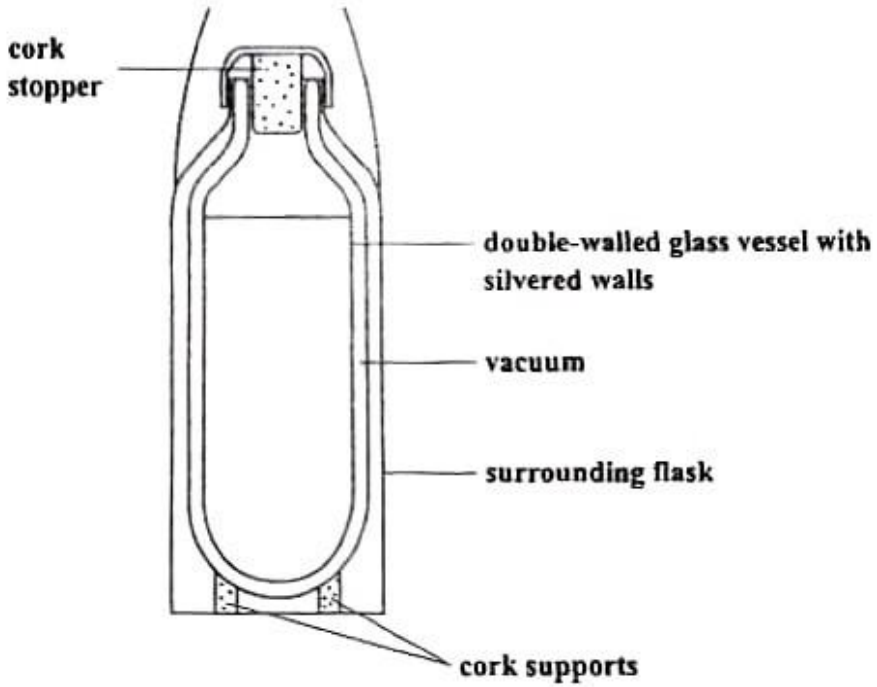

Figure 3. Cross-section of a vacuum flask

Using the information in Figure 3, explain how the home-cooked meal is kept warm.

(6 marks)

June 2012 #5 a)

5. (a) (i) State the equation for the General Gas Law.

_____

_____

(1 mark)

(ii) A little girl blew up a balloon during a Christmas celebration.
Explain, in terms of the kinetic theory, how pressure is exerted by the air in the balloon.

_____

_____

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_____

(5 marks)

Jan 2013 #3

3. (a) (i) Draw and label a mercury laboratory thermometer, clearly indicating the fixed points.

(4 marks)

(ii) Draw arrows in Table 3 from each thermometer to map it to its operating range.

TABLE 3

Type of Thermometer	Operating Temperature Range/°C
Clinical	−20 to 110
Laboratory thermometer	−250 to 800
Thermocouple	35 to 43

(3 marks)

(b) Figure 3 shows a scuba diver ascending from 20 m below the surface where the water temperature is 10 °C, to the surface, where the temperature is 25 °C and the pressure is 1.01×10^5 Pa.

Figure 3

(i) Calculate the pressure the diver is subjected to at 20 m below the surface of the water.

_____

_____

_____

_____

(3 marks)

[Density of water = 1025 kg m^{-3}]

[Acceleration due to gravity, g = 10 m s^{-2}]

(ii) **By using the general gas law, determine, as a result of the rise, the ratio of the final volume to the initial volume of a bubble.**

_____

_____

_____

_____

_____

_____

(5 marks)

Total 15 marks

June 2013 #2 a) (iii)

(iii) Write the formula for the General Gas Law, stating clearly what each letter represents.

(3 marks)

3. (a) State the physical property that varies with temperature in each of the following thermometers.

(i) A laboratory thermometer

_____

(1 mark)

(ii) A thermomcouple

_____

(1 mark)

(b) Complete Table 3 which relates the use of a thermometer to its design.

TABLE 3

Use of Thermometer	**Design Feature**
To measure body temperature	
To measure temperatures lower than −40°C	
	Junction of small mass

(3 marks)

(c) (i) State Charles' Law.

_____

_____

_____

_____

(2 marks)

(ii) In a sealed cylinder, the volume of gas is recorded as 40 cm^3 with a temperature of 30°C.

What is the **percentage** increase in volume of the gas if the cylinder is heated until the gas temperature reaches 70°C?

(8 marks)

Total 15 marks

June 2014 #3

3. (a) (i) State the equation for the general gas law for an ideal gas.

.....

(1 mark)

(ii) State the meaning of EACH symbol stated in the equation in (a) (i).

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(4 marks)

(b) (i) A car tyre is pumped to a pressure of $2 \times 10^5\ N\ m^{-2}$ in the morning when the temperature is 23°C. Later in the day, the temperature rises to 34°C. Calculate the new pressure in the tyre. The volume of air is kept constant.

(5 marks)

(ii) Using the kinetic theory of matter, explain why the increase in pressure occured.

.....

.....

.....

.....

(2 marks)

(iii) Calculate the ratio of new volume to old volume $\left(\frac{V_2}{V_1}\right)$ for the tyre, if the pressure is held constant while the temperature rises from 23°C to 34°C.

(3 marks)

Total 15 marks

3. (a) (i) Dr T likes to measure temperatures. From his temperature bag, shown in Figure 2, select the two temperatures to complete Table 3.

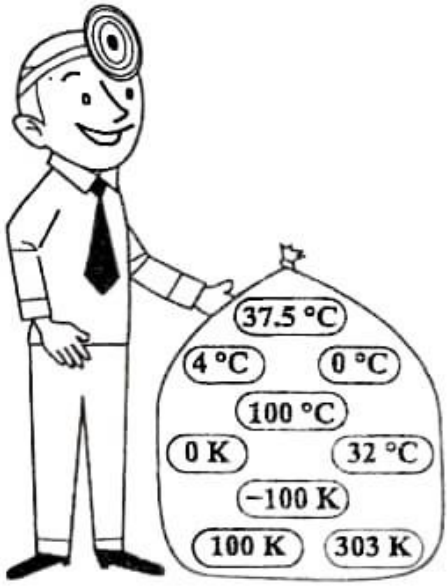

Figure 2

TABLE 3

Temperature – Fixed Points	Value from Dr T's Bag
(1) Upper fixed point	
(2) Lower fixed point	

(2 marks)

(ii) Define the term 'lower fixed point'.

.....

.....

(1 mark)

(iii) In Table 4, enter the names of two different types of thermometers and the corresponding physical quantity which varies with temperature.

TABLE 4

Type of Thermometer	Physical Quantity
(1)	
(2)	

(4 marks)

(b) A motor car tyre contained a fixed mass of air at 27 °C. Its pressure was 220 kN m^{-2} above atmospheric pressure. After a 60-minute drive, the air pressure rose to 250 kN m^{-2} above atmospheric pressure.

What was the new temperature of the air in the tyre, in degrees Celsius, if the volume of air remained constant?

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(8 marks)

(Atmospheric pressure = 100 k Nm^{-2})

5. (a) (i) **Describe how the graph of Volume versus Temperature (in Celsius) of a gas can be used to derive the Kelvin scale?**

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(4 marks)

(ii) **State the mathematical relationship between the Kelvin and Celsius temperature scales.**

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(2 marks

(b) A piston traps a mass of gas in a cylinder. At 25 °C, the pressure of the gas is 5 atmospheres when its volume is 50 ml.

(i) Calculate the volume of the gas if its pressure drops to 1 atmosphere at constant temperature.

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(4 marks)

(ii) After resetting the piston, the gas returns to its initial pressure and volume. If the volume is now fixed while the gas is heated to 60 °C, calculate the final pressure of the gas.

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(5 marks)

3. (a) Table 2 shows the type of thermometer, design feature and the reason for the design feature.
Complete the table by inserting the appropriate information. **(3 marks)**

Type of Thermometer	Design Feature	Reason For Design Feature
Mercury-in-glass laboratory thermometer	Narrow bore	
	Constriction in bore	Retaining a measured temperature
Thermocouple		Ability to measure rapidly changing temperatures

(b) Define the upper and lower fixed points on the Celsius temperature scale and state their respective values on that scale.

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(4 marks)

(c) Figure 2 shows a sealed flask which cintains a fixed mass of gas held at a constant volume.

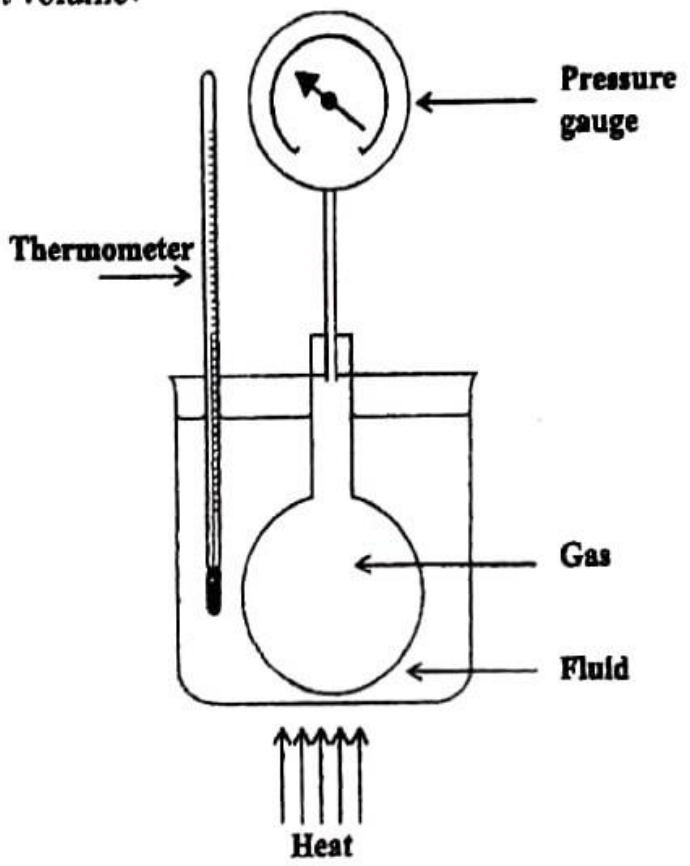

Figure 2

When heated, the temperature and pressure of the gas increase as shown in Table 3.

TABLE 3

Pressure (Pa)	Temperature (°C)	Temperature (K)
1.1×10^5	35	
1.2×10^5	63	
1.3×10^5	91	

(i) Complete Table 3 by converting the temperatures to Kelvin. **(3 marks)**

(ii) Is the 'Pressure Law' supported by this set of data? Explain. **(5 marks)**

.....

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.....

Total 15 marks

2.(a) Complete Table 2 to distinguish among solids, liquids and gases using the terms 'definite/ fixed', 'vibrate', 'move freely', 'very weak/negligibly weak', 'no fixed shape'. **(7 marks)**

TABLE 2

	Shape	**Volume**	**Movement of Molecules**	**Intermolecular Forces**
Solid		Definite/fixed		Strong
Liquid	Takes shape of container		Move amongst one another	
Gas		Full space		

Jan 2019 #4 b)

(b) (i) Define the pressure law. **(3 marks)**

.....

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.....

.....

(ii) The initial pressure of a sample of gas is 3 Pa, the final pressure is 9 Pa, while its volume remains unchanged.

If the initial temperature of the gas was 27°C, calculate the final temperature of the gas. **(6 marks)**

THERMAL MEASUREMENTS

Jan 2010 #4 b)

(b) A solar water heater system consists of a solar collector of area 5 m^2, a storage tank and hidden connecting pipes as shown in Figure 4.

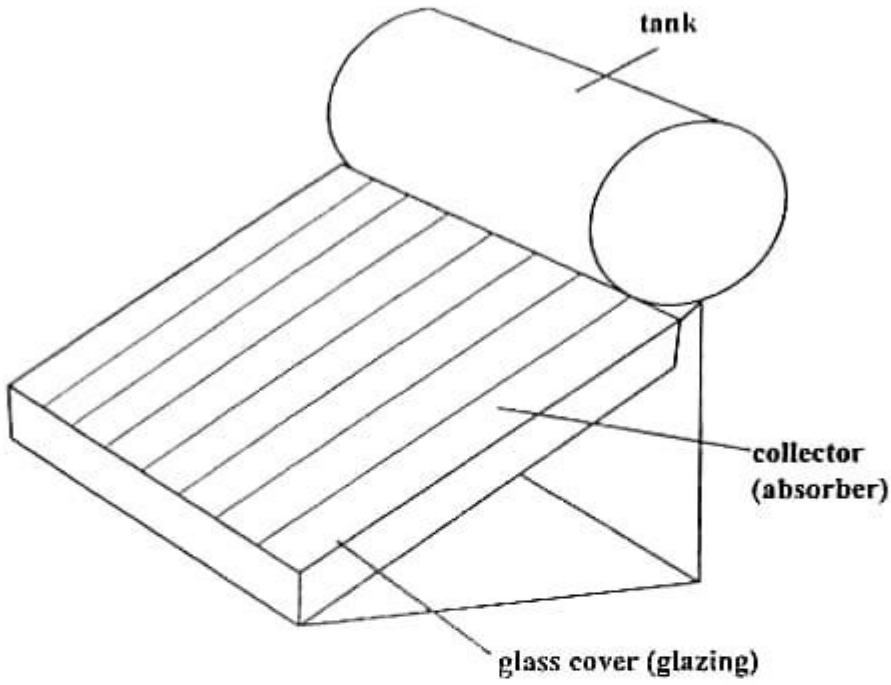

Figure 4. Diagram showing a solar water heater

Assume that the average solar radiation incident on Castries, St. Lucia is 5 $kWhm^{-2}$ per day, and the collector absorbs 95% of the solar radiation incident on it:

(i) Calculate the energy in kWh collected by the absorber per day. **(2 marks)**

(ii) Calculate how much energy per day can be used to heat water if the collector emits 50% of the heat energy it receives from the atmosphere. **(2 marks)**

(iii) A glass cover is now placed on the solar collector. The glass transmits 80% of the sunlight to the collector and allows 8% of the heat back into the atmosphere (the glass house effect). How much energy per day is now available to heat the water? **(2 marks)**

(iv) What mass of water can the glazed collector heat from 25°C to 55°C during the day? **(3 marks)**

1 kWh = 3.6×10^6J
Specific heat capacity of water, C = 4200 $J\ kg^{-1}\ k^{-1}$

Total 15 marks

June 2010 #5

5. (a) A CSEC Physics teacher gave two groups of students projects on Specific Heat Capacity. One group used an electrical method to calculate the specific heat capacity of a metal block. The circuit used in this method is shown in Figure 3.

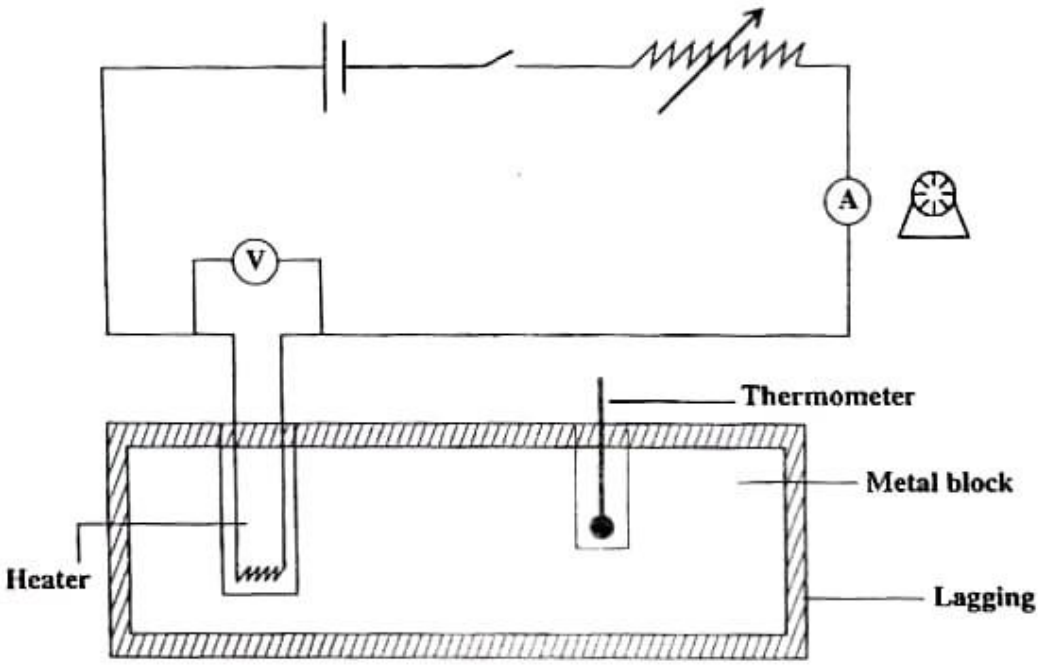

Figure 3

Describe the method used by this group to determine the specific heat capacity of the metal block. **(6 marks)**

(b) The second group of students determined the specific heat capacity of a liquid. One set of results is described below:

It took 300 s for the temperature of 0.1 kg of the liquid to be elevated from 25°C to 50°C. The energy supplied was 13.6 KJ during this period.

(i) Assuming that no heat was lost and ignoring the heat capacity of the container, determine the value of the specific heat capacity of the liquid. **(6 marks)**

(ii) If the liquid was heated twice as long, what impact, if any, would this have on the specific heat capacity of the liquid? **(1 mark)**

(iii) Justify your response in part (ii). **(2 marks)**

Total 15 marks

SECTION B

Attempt ALL questions.

You MUST write your answers in the space provided after each question.

4. (a) Describe how the apparatus shown in Figure 3 below may be used to show how the temperature of a substance such as naphthalene, varies during cooling. Include in your description any other equipment that may be necessary.

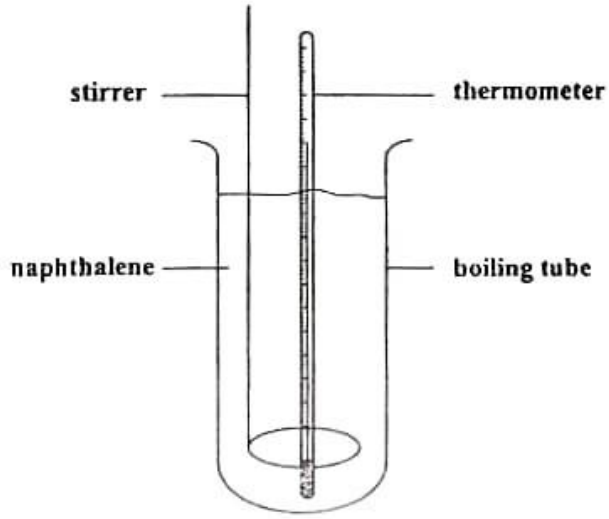

Figure 3

(6 marks)

(b) In an experiment to determine the specific latent heat of ice, the following results were obtained.

Initial mass of water at 30°C = 100 g
Final mass of water (initial water plus melted ice) at 20°C = 110 g

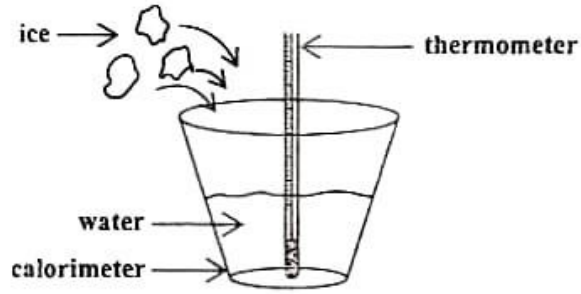

Figure 4

Assume the container has negligible heat capacity and that the heat lost to the surroundings is equal to the heat gained from the surroundings during the experiment.

(i) Determine the mass of the melted ice. **(1 mark)**

(ii) Calculate the heat lost by the water. **(3 marks)**

(iii) Write down an expression for the TOTAL heat gained by the ice in melting and the melted ice in warming to 20°C. **(2 marks)**

(iv) Hence calculate the specific latent heat of fusion of ice. **(3 marks)**

[Specific Heat Capacity of water = 4.2 $Jg^{-1} K^{-1}$]

Total 15 marks

Write your answer to Question 4 here.

June 2011 #2

2. (a) (i) Complete Table 3 by inserting the correct symbol and SI Unit which relate to the quantity shown in Column 1.

TABLE 3

Quantity	Symbol	SI Unit
Specific Heat Capacity	c	_____
Specific Latent Heat of Vaporization	_____	_____

(3 marks)

(ii) Define the term 'heat capacity of a substance'.

_____

_____

(2 marks)

(iii) Write the equation that relates specific heat capacity with heat capacity.

_____

(1 mark)

(b) A busy housewife left 25 g of ice in an open insulated container while she was answering her cellphone. When she returned, the ice at 0 °C was converted to water at 3.0 °C.

(i) Calculate the energy needed for the ice to totally melt and to reach its present temperature. Assume no heat losses.

[Specific Heat Capacity of water = 4 200 J $Kg^{-1}K^{-1}$
Specific Latent Heat of Fusion of Ice = 340 000 J Kg^{-1}]

(6 marks)

(ii) If this melting and heating activity took place over 300 s, calculate the rate at which the ice / water was receiving heat.

(3 marks)

Jan 2012 #5 b)

(b) Figure 6 shows the sketch of a natural convection solar water heating system.

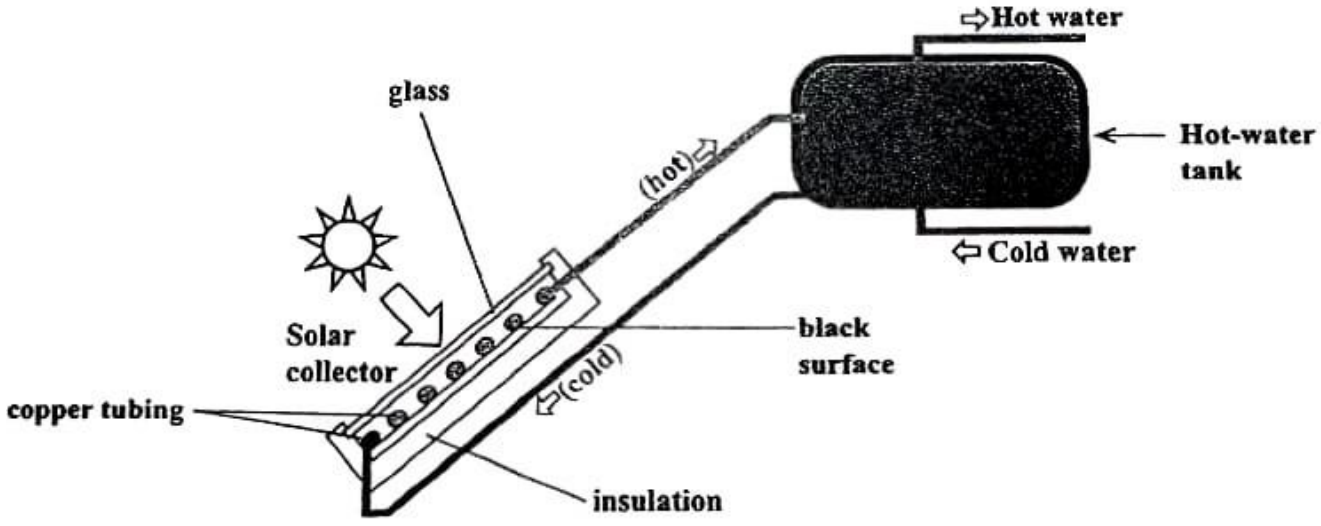

Figure 6. Solar water heating system

(i) The energy absorbed by the solar collector is 300 kJ and 40% of this is transferred to the 2 kg of water in the copper tubing. If the initial temperature of the water is 27 °C, calculate the final temperature of the water. **(6 marks)**

(ii) Outline which feature of the solar water heating system shown in Figure 6 demonstrates EACH of the following thermal energy principles:

a) Good absorption of heat

b) Heat transfer by convection

c) The green house effect

d) Good heat transfer by conduction

e) Reduction of heat transfer by conduction

[Specific heat capacity of water = 4.2×10^3 J kg^{-1} K^{-1}] **(5 marks)**

Total 15 marks

Write your answer to Question 5 here.

(b) (i) A block of ice of mass 2000 g was heated from 0 °C to steam at 100 °C. Calculate the energy used in Joules.

(6 marks)

(ii) If the activity at (b) (i) took place in 6000 s, how much power was utilized?

(3 marks)

[Specific latent heat of vaporization of steam = 2 250 000 J Kg^{-1}
Specific latent heat of fusion of ice = 330 000 J Kg^{-1}
Specific heat capacity of water = 4 200 J Kg^{-1} K^{-1}]

2. **(a)** (i) Define the term 'specific heat capacity' of an object.

_____

_____

(2 marks)

(ii) Complete Table 3 below by inserting the correct symbol and SI Unit which relate to the quantity shown in Column 1.

TABLE 3

Quantity	Symbol	SI Unit
Heat Capacity	C	
Specific Latent Heat of Fusion		$J\ kg^{-1}$

(2 marks)

(iii) Write the formula for the General Gas Law, stating clearly what each letter represents.

_____

_____

_____

_____

(3 marks)

(b) A physicist converts 8 kg of water at 33 °C to steam at 100 °C.

Assuming there is no heat lost, calculate the energy required

(i) to heat the water to 100 °C.

_____

_____

_____

(3 marks)

(ii) to convert the water to steam at 100 °C.

_____

_____

(iii) What is the total energy, in mega joules, required to heat the 8 kg of water at 33 °C to steam at 100 °C?

_____

_____

(2 marks)

[Specific heat capacity of water = 4 200 J $kg^{-1}K^{-1}$]

[Specific latent heat of vaporization of water = 2 300 000 J kg^{-1}]

June 2014 #1

SECTION A

Answer ALL questions.

You MUST write your answers in this answer booklet.

1. A Form Four class was given a School-Based Assessment activity on the change of phase of a substance while it is cooling. The class presented the results shown in Table 1.

TABLE 1

Temperature, θ/°C	90.0	74.5	70.0	70.0	70.0	70.0	65.0	57.5
Time, t/mins	0.0	5.0	10.0	15.0	20.0	25.0	30.0	35.0
Point on graph	A		B			C		D

(a) Plot, on page 3, a graph of Temperature (θ/°C) versus Time (t/mins). Begin both axes at the origin and insert the letters A, B, C and D on the graph. **(7 marks)**

(b) Using a dotted line on the graph, determine the melting point of the substance that was heated.

(2 marks)

(c) (i) In what state is the substance as it moves between points B and C?

.....

.....

(1 mark)

(ii) Explain why the temperature was constant between B and C.

.....

.....

(1 mark)

(d) (i) State the phase of the substance at C.

(1 mark)

(ii) Describe what is happening to the substance between C and D.

(1 mark)

(e) If 15 g of the substance was cooled from 90.0°C to 57.5°C, calculate the heat, in kilojoules, which was lost in this activity.

[Specific Heat Capacity of Substance = 1763 Jkg^{-1} K^{-1}]
[Specific Latent Heat of Fusion of Substance = 215 000 Jkg^{-1}.] **(8 marks)**

(f) Complete Table 2 to show the symbols and SI units for the physical quantities given.

TABLE 2

Physical Quantity	Symbol	SI Unit
Heat Capacity		
Specific Latent Heat of Vapourisation		

(4 marks)

June 2015 #2

2. (a) This question concerns thermal heat capacities.

(i) In the box below, state the equation that relates C to c.

(1 mark)

(ii) State the name of the physical quantity that each letter represents.

C: .....

.....

c: .....

.....

(2 marks)

(iii) Distinguish between 'C' and 'c'.

.....

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.....

(2 marks)

(b) A substance which has a melting point of 80 °C is cooled from 90 °C to a complete solid at its melting point.

Sketch a graph in Figure 1 to represent the statement above.

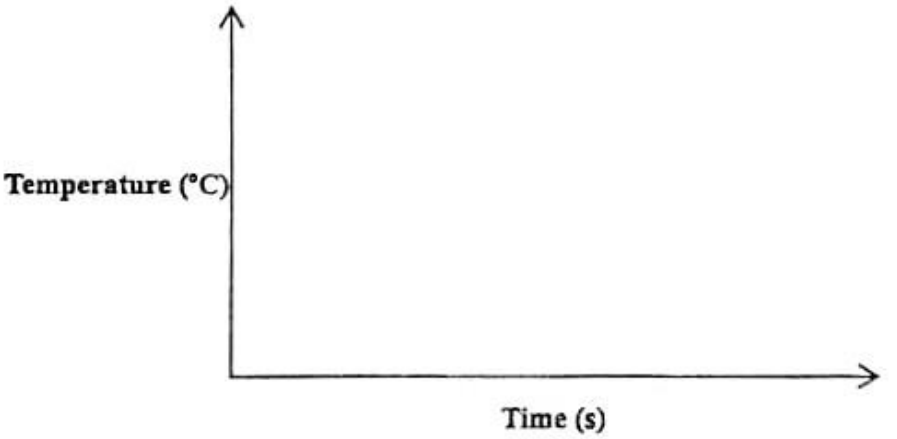

Figure 1

(2 marks)

(c) A physicist converted 2 kg of water at 37 °C to steam at 100 °C.

Assuming no heat is lost, calculate the amount of energy needed

(i) to heat the water to 100 °C

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.....

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.....

(4 marks)

(ii) to heat the water from 100 °C to steam at 100 °C.

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(3 marks)

(iii) to completely convert the water from 37 °C to steam at 100 °C.

.....

.....

(1 mark)

(Specific heat capacity of water = 4200 J kg^{-1} K^{-1}
Specific latent heat of vaporization of water = 2.3 × 10^6 J kg^{-1})

Total 15 marks

June 2016 #3

3.(a) State, in words, the quantity EACH symbol represents in the equation $E_H = mc\Delta\theta$. State the SI unit of EACH quantity as well. **(6 marks)**

E_H: .....

.....

c: .....

.....

$\Delta\theta$: .....

.....

(b) What does the symbol 'l' in the equation $E_H = ml$ represent? **(1 mark)**

.....

.....

(c) In an experiment to determine the specific latent heat of fusion of ice using a container with negligible heat capacity, a student obtained the following data:

Initial temperature of water = 30 °C
Final temperature of water + melted ice = 20 °C
Initial mass of water = 100 g
Final mass of water plus melted ice = 110 g

(i) Calculate the heat lost by the water. **(3 marks)**

(ii) Calculate the heat gained by the melted ice. **(2 marks)**

(iii) Assuming the heat lost by the water is equal to the heat gained by the ice, calculate the specific latent heat of fusion of ice. **(3 marks)**

[Specific heat capacity of water = 4.2 $Jg^{-1}K^{-1}$]

June 2016 #6 a)

6.(a) A student was given a sample of candle wax in a test tube located in a water bath. She was asked to demonstrate that temperature remains constant during a phase change.
Describe the procedure she should use. **(6 marks)**

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Jan 2017 #1

SECTION A

Answer ALL questions.

You MUST write your answers in this answer booklet.

1. A student carried out an experiment to investigate the temperature rise of 250 g of a liquid when heated by an electrical immersion heater. The results of the experiment are recorded in Table 1.

TABLE 1

Electrical Energy, E (kJ)	Temperature Rise of Water, ΔT (K)
0.0	0.0
3.7	3.0
7.0	6.0
10.5	9.0
14.5	12.0
18.0	15.0

(a) **On the grid provided on page 5,** plot the graph of electrical energy, E, against temperature rise, ΔT. **(8 marks)**

(b) Using your graph, calculate the slope, S, of the graph. **(5 marks)**

(c) What physical quantity does the slope represent? **(1 mark)**

(c) What physical quantity does the slope represent? **(1 mark)**

.....

(d) Use the value of the slope *S*, calculated in 1 (b) on page 4, to determine the specific heat capacity of the liquid in the units $Jg^{-1}k^{-1}$. Assume there is negligible heat transferred to or from the container holding the liquid. **(4 marks)**

(e) The initial temperature of the water was 10 °C below room temperature and the final temperature was 10 °C above room temperature.

(i) How does this procedure help in minimizing error in the experiment? **(2 marks)**

.....

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.....

.....

(ii) State ONE other useful precaution that the student should have taken. **(1 mark)**

.....

.....

(f) Given that the power supplied to the immersion heater was kept constant at 40 W, calculate the time taken for 18.0 kJ of energy to be supplied. **(4 marks)**

(b) The following data were obtained in an experiment using an immersion heater to determine the specific latent heat of vaporization of water.

Mass of can and water at start of boiling	m_1	= 0.28 kg
Mass of can and water at end of boiling	m_2	= 0.26 kg
Power of heater		= 150 W
Time of heating		= 5 minutes

(i) Using the data above, calculate the specific latent heat of vaporization of water, assuming negligible heat is lost to the surroundings.

(6 marks)

(ii) The coil of the immersion heater was NOT completely submerged. Explain how this would have affected the value for the specific latent heat of vaporization obtained in (b) (i) **on page 17.**

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(3 marks)

(b) Students in a fifth form Physics class used the apparatus in Figures 3a and 3b in an experiment to find the specific latent heat of vaporization of water, l_v.

Figure 3a shows the initial readings as the water begins to boil and Figure 3b shows readings taken after 5 minutes and 45 seconds.

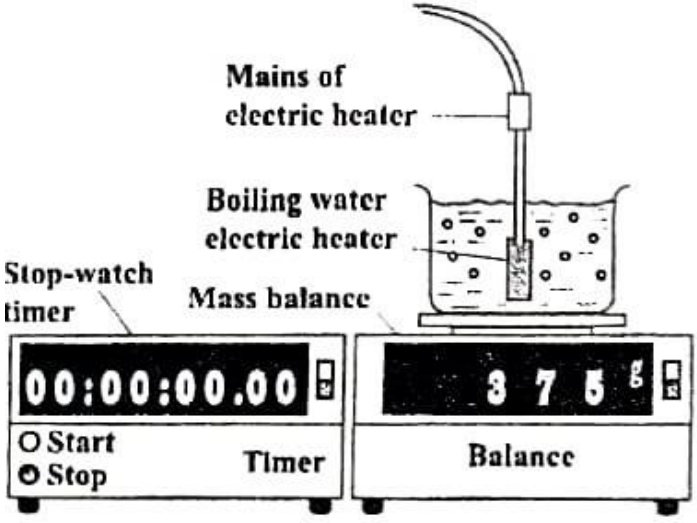

Figure 3a. Initial Readings

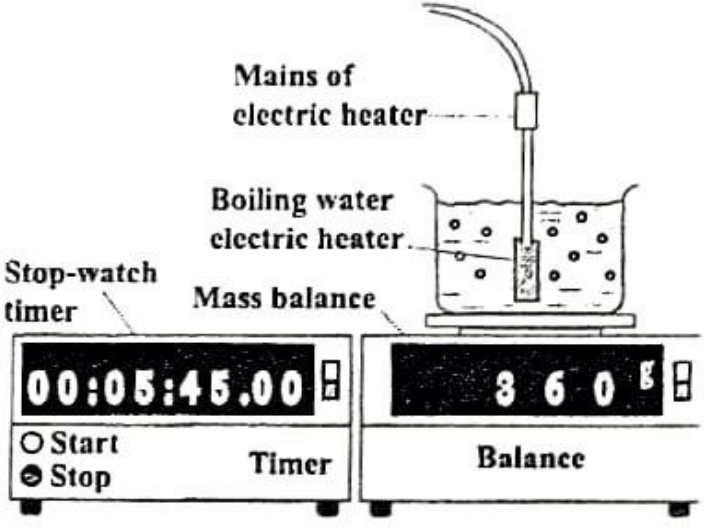

Figure 3b. Readings after 5 minutes and 45 seconds

(i) Convert the time recorded in Figure 3b to seconds.

(ii) Calculate the mass of water evaporated in the experiment.

(3 marks)

(c) The power of the electric heater used in the experiment was 100 W. Assuming no heat was lost to the surroundings, calculate the specific latent heat of vaporization of water, l_v.

(5 marks)

SECTION B

Answer ALL questions

4. (a) (i) Define each of the following terms. (5 marks)

Specific heat capacity.....

.....

.....

.....

.....

.....

Heat capacity.....

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(ii) Write the formula to show the relationship between the specific heat capacity, c, and heat capacity, C, of a body. (1 mark)

.....

.....

(b) Some students were asked to carry out an experiment to determine the specific heat capacity of a metal. They used the apparatus shown in Figure 5.

The switch was closed for a time interval of 900 s and the following readings were obtained.

Mass of metal block = 5 kg

Change in temperature = 50 °C

Ammeter reading = 8.5 A

Voltmeter reading = 12 V

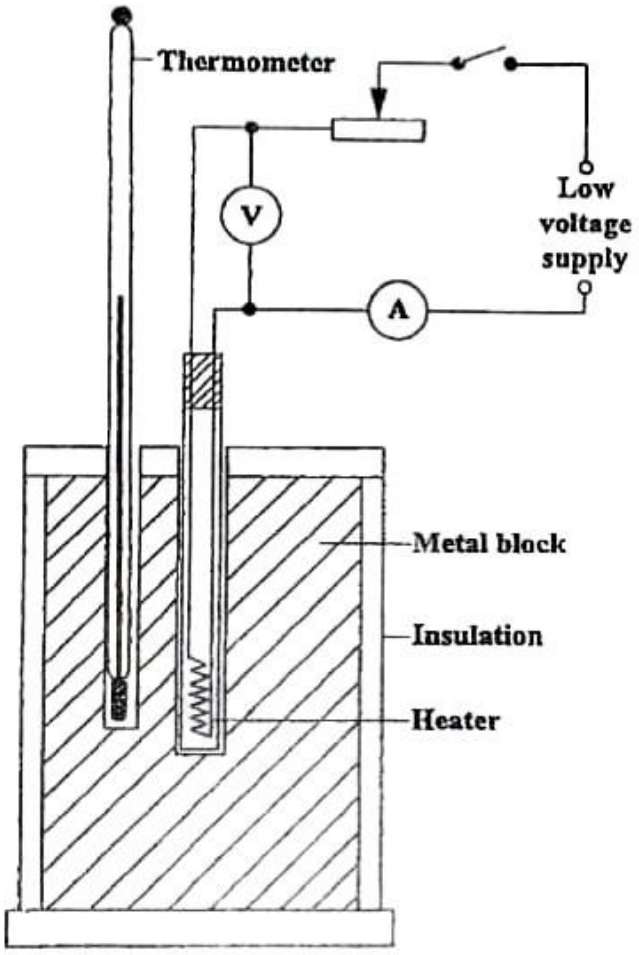

Figure 5. Apparatus to determine the specific heat capacity of a metal

Using the data **on page 13,** calculate the specific heat capacity of the metal, stating any assumption(s) made. **(9 marks)**

Jan 2019 #4 a)

SECTION B

Answer ALL questions.

4.(a) (i) Explain what is meant by the term 'the specific latent heat of vaporization of water'. **(3 marks)**

.....

.....

.....

.....

(ii) Calculate the heat energy required to convert 8 kg of water at 100°C to steam at 100°C. **(3 marks)**

(Specific latent heat of vaporization of water /. $l_V = 2\ 3000\ 000\ Jkg^{-1}$)

June 2019 #3

3.(a) (i) Define the term 'heat capacity'. **(2 marks)**

.....

.....

.....

.....

(ii) Define the term 'specific latent heat of vaporization'. **(2 marks)**

.....

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.....

(b) A substance which has a freezing point of **80° C** was cooled from **90° C** to a total solid at its freezing point.

Sketch a graph on Figure 4 to represent the statement above. **(2 marks)**

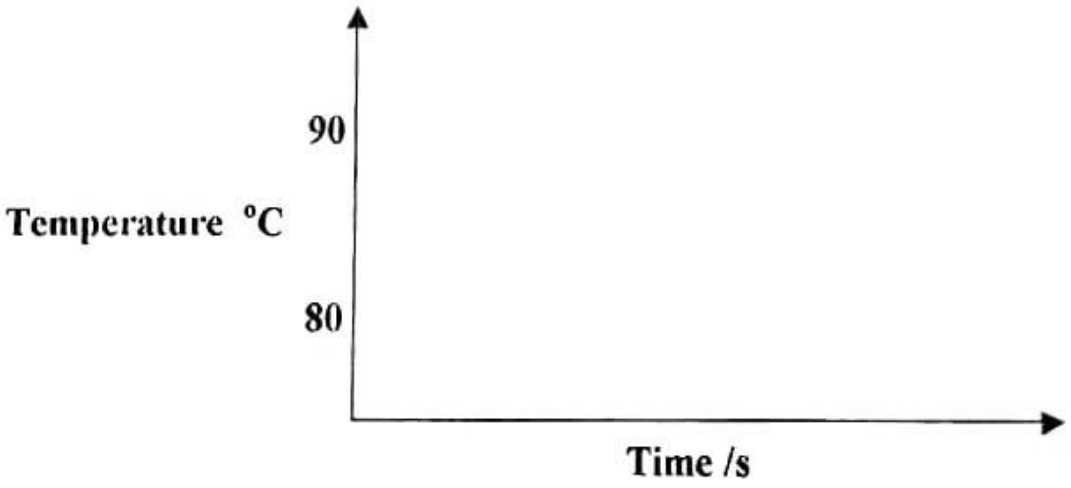

Figure 4. Cooling Curve

3.(c) A student conducted an experiment in which **1.5 kg** of water at **30 °C** was converted to steam at **100 °C.**

Assuming no heat is lost to the surroundings. calculate the amount of energy needed to

(i) heat the water from **30 °C** to **100 °C.** **(4 marks)**

(ii) convert the water at **100 °C** to steam at **100 °C.** **(3 marks)**

(iii) heat the water from **30 °C** to steam at **100 °C.** **(1 mark)**

(Specific heat capacity of water, $\mathbf{c}$, = **4200 J kg^{-1} K^{-1}**)
(Specific latent heat of vaporization of water, l_v = **2.3×10^6 J K^{-1}**)

Jan 2020 #2

2.(a) Define EACH of the following terms:

(i) Specific heat capacity **(3 marks)**

.....

.....

.....

.....

.....

.....

.....

(ii) Specific latent heat of fusion of ice **(3 marks)**

.....

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.....

(b) A block of ice, which has a mass of **2.5 kg** and a temperature of **−10 °C**, is placed in a container.

Specific heat capacity of water = 4.2×10^3 J kg^{-1}(°C)$^{-1}$
Specific heat capacity of ice = 2.1×10^3 J kg^{-1}(°C)$^{-1}$
Specific latent heat of fusion of ice = 3.3×10^5 J kg^{-1}

Calculate

(i) the heat energy required to change the temperature of the ice at **−10 °C** to ice at **0 °C.** **(3 marks)**

2.(b)(ii) the heat energy required to convert all the ice at $0^{\circ}C$ to water at $0^{\circ}C$. **(2 marks)**

(c) The water in the container is now heated to a temperature of $80^{\circ}C$ by an electrical heater, in **600 seconds**.

(i) Calculate the power output of the heater. **(3 marks)**

(ii) State ONE assumption which must be taken into account in **(c)(i)**. **(1 mark)**

.....

.....

Total 15 marks

TRANSFER OF THERMAL ENERGY

Jan 2012 #5 a)

5. (a) Figure 5 shows two blocks of copper that are placed in contact with each other. Block *A* initially has a temperature of 40 °C and block *B* has a temperature of 70 °C.

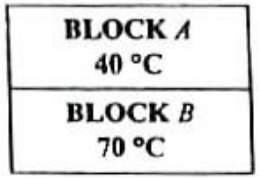


Figure 5. Two blocks of copper

(i) What is the direction of net heat transfer between the blocks? **(1 mark)**

(ii) The final equilibrium temperature of the blocks is 52 °C. Convert this temperature to Kelvin. **(3 marks)**

June 2017 #5 a)

5. (a) Four factors of the surface of a material on which the absorption and emission of radiation depend are:

- Texture (rough or smooth)
- Nature (dull or shiny)
- Colour (black or white)
- Area (large or small)

State, with a reason, the appropriate characteristics of TWO of the above factors in the design of

(i) a car radiator

.....

.....

.....

.....

.....

.....

(3 marks)

(ii) the roof of a Caribbean home.

.....

.....

.....

.....

.....

.....

(3 marks)

SECTION C : WAVES AND OPTICS

TABLE OF CONTENTS

TOPIC *Page Number*

WAVE MOTION

Jan 2010 #3 a) – c)

What is meant by the term 'longitudinal wave'?

_____

_____

_____

(2 marks)

(b) Figure 2 shows a wavetrain in which the points A to I and *w* to *z* are shown.

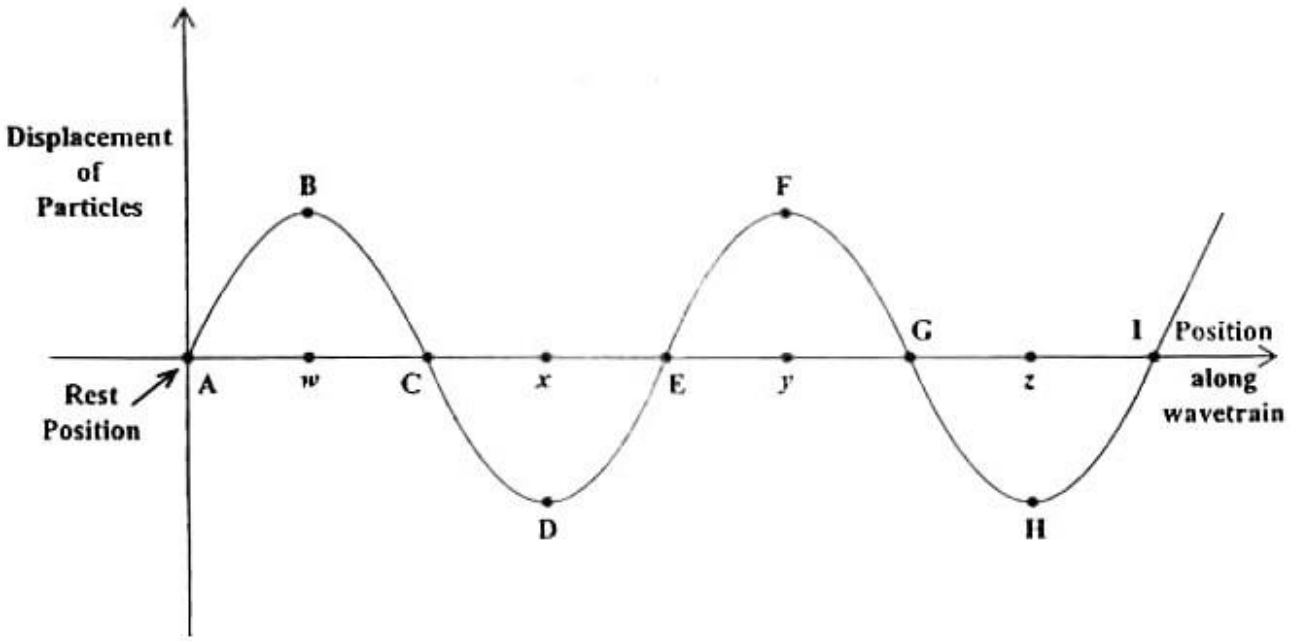


Figure 2. A wavetrain

Identify, using TWO letters, the distance between any TWO points of the following in the wavetrain:

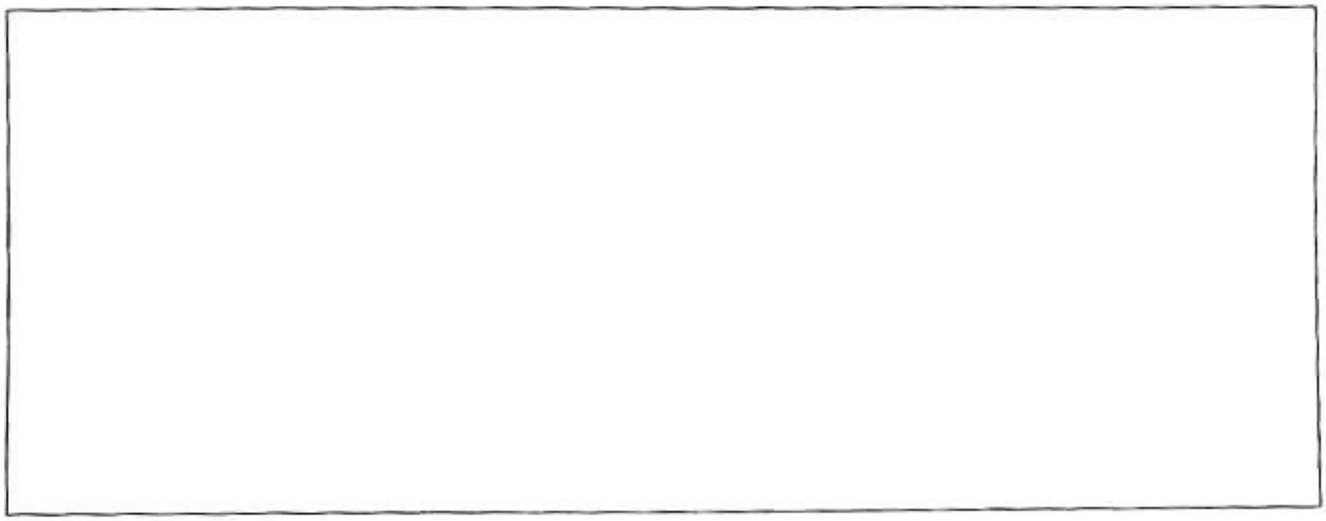
(i) A wavelength _____

(ii) The amplitude of the wave _____

(2 marks)

(c) A slinky spring can be used to generate a transverse waveform. In the box below, draw and label this waveform, clearly identifying

(i) particle movement
(ii) waveform movement
(iii) at least one crest and one trough.



(3 marks)

Jan 2012 #6 a)

6. (a) (i) What is the difference between 'longitudinal waves' and 'transverse waves'?

(2 marks)

(ii) Given that red light has a wavelength of 700×10^{-9} m, calculate its frequency.

(4 marks)

2.(a)(i) Distinguish between 'transverse' and 'longitudinal' waves.

.....

.....

.....

.....

(2 marks)

(ii) State ONE example **each** of transverse and longitudinal waves.

Example of transverse wave: .....

Example of longitudinal wave: .....

(2 marks)

(iii) In the wave equation, velocity (v), frequency (f) and wavelength (λ) are related. Write the equation.

.....

(1 mark)

(iv) A wave motion has a frequency of 10 Hz and a wavelength of 250 m. Calculate the speed of the wave.

.....

.....

.....

(2 marks)

(b) Figure 4 shows a sinusoidal wave.

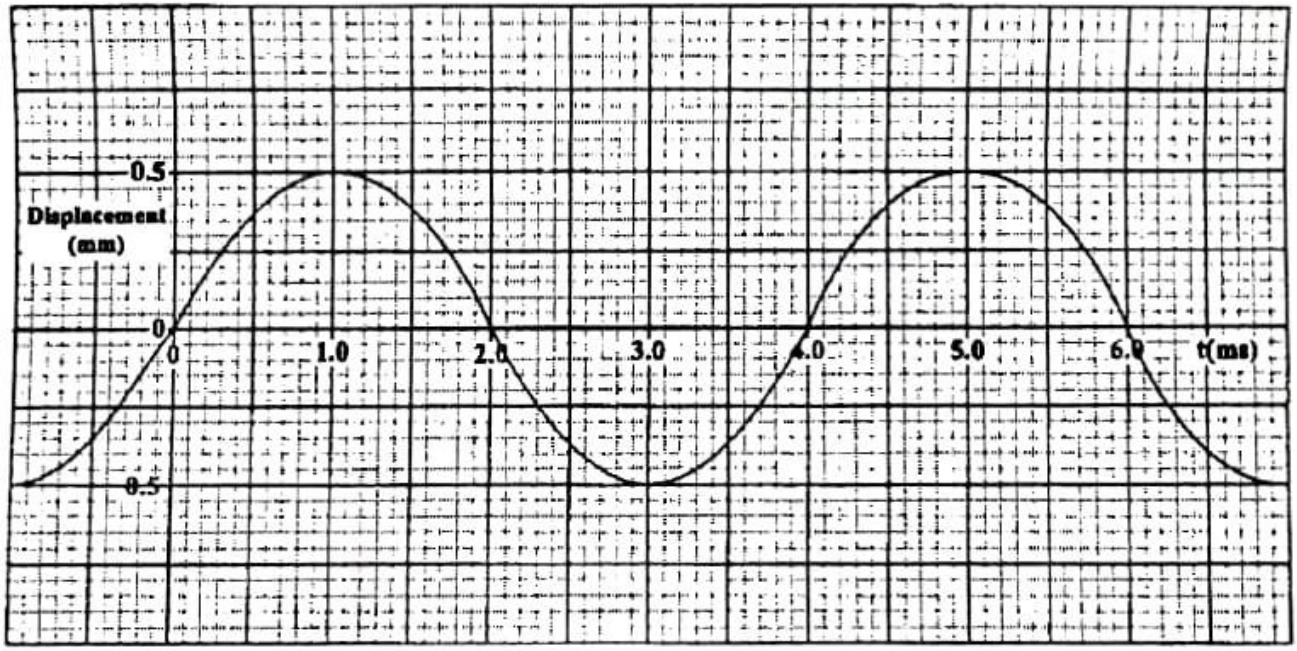


Figure 4

(i) Indicate on Figure 4 the amplitude of the wave. **(1 mark)**

Using Figure 4, determine the wave's

(ii) amplitude (in metres)

.....

(iii) period (in seconds)

.....

(iv) frequency (in hertz).

.....

(6 marks)

SOUND

Jan 2010 #3 d)

(d) (i) A steelpan produces a sound of frequency 0.350 KHz. The speed of sound in air is 340 m s^{-1}. What is the wavelength of the sound generated by the pan?

(4 marks)

(ii) If, this sound is generated under water instead, what is the frequency that would be detected?

(1 mark)

(iii) The sound wave generated under water is refracted at the water - air boundary. Calculate the refractive index of water, given that the wavelength of this sound in water is 1.29 m.

(3 marks)

Jan 2012 #6 b)

(b) In 2010, Sound Navigation and Ranging (SONAR) was used to detect the presence of submerged oil plumes in the Gulf of Mexico after a massive oil spill. Figure 7 shows a ship using SONAR to locate an oil plume.

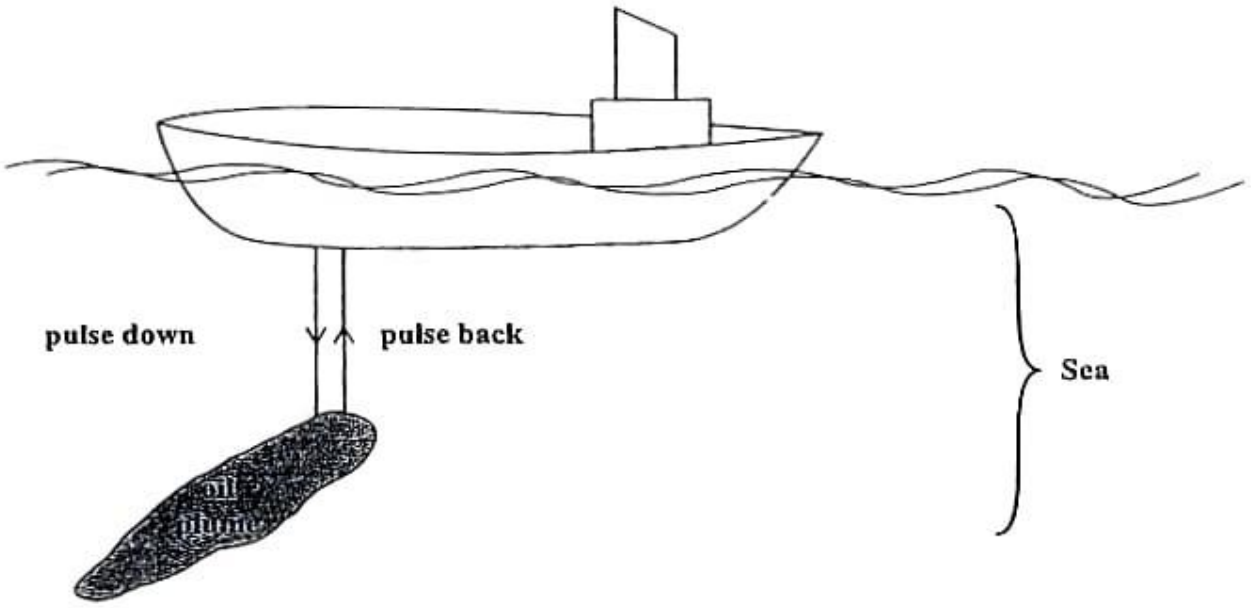


Figure 7. SONAR ship

(i) Explain, with reference to Figure 7, how SONAR was used to determine the depth of an oil plume. **(4 marks)**

(ii) If echoes are received 0.3 seconds after being sent, calculate the depth of the oil plume below the detector, given that Velocity $= \frac{\text{distance}}{\text{time}}$.

[Speed of sound in sea water = 1450 ms^{-1}]
[Speed of light in air = 3.0×10^8 ms^{-1}]

(5 marks)

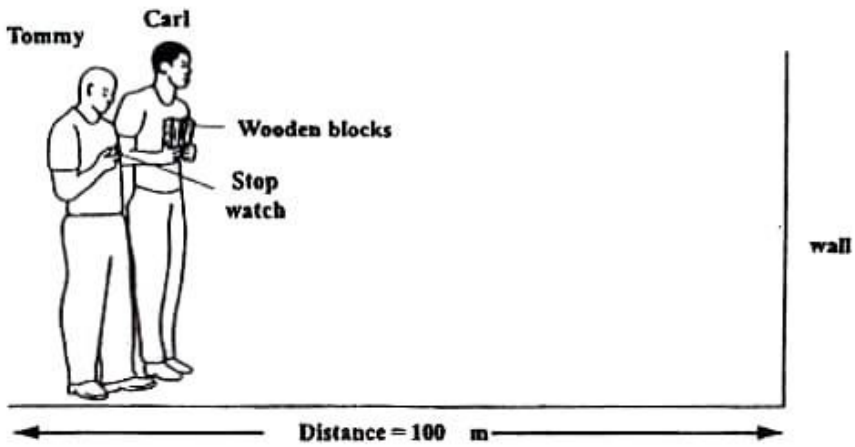
Total 15 marks

June 2012 #6

6. (a) (i) Outline THREE differences between 'light waves' and 'sound waves'.

(3 marks)

(b) Carl and his friend Tommy were doing a School-Based Assessment on estimating the speed of sound in air using an echo method.



Carl stands 100 m from a wall. Carl claps two wooden blocks to produce a series of echoes and Tommy who was standing beside him starts his stop watch. After 1 echo Tommy stops the watch. This process is repeated and the time for 50 echoes was calculated to be 30.3 s.

Calculate the speed of the sound generated.

(5 marks)

(c) A popular radio station broadcasts with a frequency of 100×10^6 Hz.

Calculate, in centimetres, the wavelength of the sound waves generated. **(4 marks)**

[Speed of radio waves = 3.0×10^8 m s^{-1}].

Jan 2019 #2 a) – b)

2.(a) State the factor on which EACH of the following characteristics of sound depends. **(2 marks)**

(i) Pitch.

.....

(ii) Loudness

.....

(b) A sound wave completes three cycles in 6 ms. Calculate its frequency. **(4 marks)**

ELECTROMAGNETIC WAVES

Jan 2011 #2 a) – b) (i)

2. Electromagnetic waves consist of visible light and radiations higher or lower than the wavelength of light.

(a) (i) Identify ONE type of radiation with wavelength:

a) longer than visible light _____

b) shorter than visible light. _____

(2 marks)

(ii) Complete Table 2 which relates to the sources and uses of electromagnetic waves.

TABLE 2

Name of Wave	Source	Use
X-ray		To take X-ray pictures
Gamma Ray		
Radio wave		

(5 marks)

(b) (i) If gamma rays have a wavelength of 3.0×10^{-12} m, calculate the frequency of this type of radiation.

_____

_____

_____

_____

_____

[Velocity of all electromagnetic waves $= 3.0 \times 10^{8} \text{m s}^{-1}$]

(3 marks)

June 2012 #6 a) (ii)

(ii) Electromagnetic waves have many properties. Write a paragraph describing at least THREE properties not referred to in Part (a) (i). **(3 marks)**

Jan 2014 #4

SECTION B

Answer ALL questions.

You MUST write your answers in the spaces provided after each question.

4. (a) (i) State TWO properties of electromagnetic waves. **(2 marks)**

(ii) Visible light is a type of electromagnetic wave. State TWO other types of electromagnetic waves indicating whether the wavelength of each is higher or lower than that of visible light. **(4 marks)**

(b)

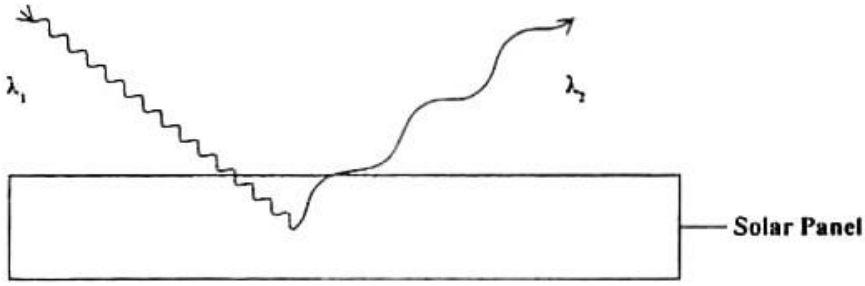


Figure 3

(i) Electromagnetic waves of one wavelength are absorbed by a solar panel and waves of a longer wavelength are emitted. If electromagnetic waves of wavelength $\lambda_1 = 2 \times 10^{-7}$ m are absorbed by a solar panel as shown in Figure 3 and waves of wavelength $\lambda_2 = 6.5 \times 10^{-5}$ m are emitted, calculate

a) the frequency in each case **(3 marks)**

b) the decrease in frequency, Δf. **(1 mark)**

(ii) We assume that the useful energy transferred to the solar panel is a constant, k, times the decrease in frequency of the e.m. waves. ($E = k\Delta f$). State the corresponding energy transferred, E_1, in terms of k. **(1 mark)**

(iii) With a change of conditions, the wavelength of the wave now absorbed by the panel increased to 6×10^{-7} m, but the emitted wavelength remains at $\lambda_2 = 6.5 \times 10^{-5}$ m. What fraction of E_1, the original energy transferred, is now transferred to the solar panel? **(4 marks)**

[Speed of light, $c = 3.0 \times 10^8$ m s^{-1}]

June 2017 #2 c)

(c) State ONE property of an electromagnetic wave.

.....

.....

(1 mark)

June 2016 #4

SECTION B

Answer ALL questions.

4.(a) List THREE types of electromagnetic waves in order of increasing wavelength. Identify a use of EACH type of wave. **(6 marks)**

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(b) Humans can 'see' electromagnetic radiation only between the wavelengths of about 4×10^{-7} m and 7×10^{-7} m.

This is called the visible part of the spectrum.

A rattlesnake can detect e.m. radiation of frequency 3.5×10^{14} Hz and a honeybee can detect e.m. radiation of 1×10^{15} Hz.

Calculate the wavelengths corresponding to EACH frequency. **(5 marks)**

(c) Thunder is heard 2.3 seconds after a flash of lightning is seen. If the lightning strike is 750 m away, calculate the speed for this event. **(4 marks)**

[Speed of light, $c = 3 \times 10^8$ ms^{-1}]

LIGHT WAVES

June 2010 #1

SECTION A

Answer ALL questions.

You MUST write your answers in the spaces provided in this booklet.

1. Testing of a new material to be used as an anti-reflective coating for eye glasses has yielded the results shown in Table 1.

TABLE 1

Angle of incidence, $\hat{i}$ / °	30.0	40.0	50.0	60.0	70.0
Angle of refraction, $\hat{r}$ / °	23.5	30.5	38.0	43.7	48.5
sin $\hat{i}$					
sin $\hat{r}$					

(a) Complete Table 1 by calculating the values for sin $\hat{i}$ and sin $\hat{r}$. **(4 marks)**

(b) Use the readings from the completed Table 1 to plot a graph of sin $\hat{i}$ against sin $\hat{r}$ on the graph paper on page 2. **(7 marks)**

(c) Calculate the gradient of the graph.

(4 marks)

(d) State the TWO laws of refraction.

(1) _____

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(2) _____

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(4 marks)

(e) Calculate the angle of refraction if the angle of incidence is 90° for this new material.

(3marks)

(f) The anti-reflective coating works best if its refractive index is the square root of the refractive index of the lens in the eye glasses. Determine the refractive index of the lens that gives the best result.

(3 marks)

Jan 2011 #2 b) (ii)

(ii) A ray of red light emerges from a glass block as shown in Figure 1.

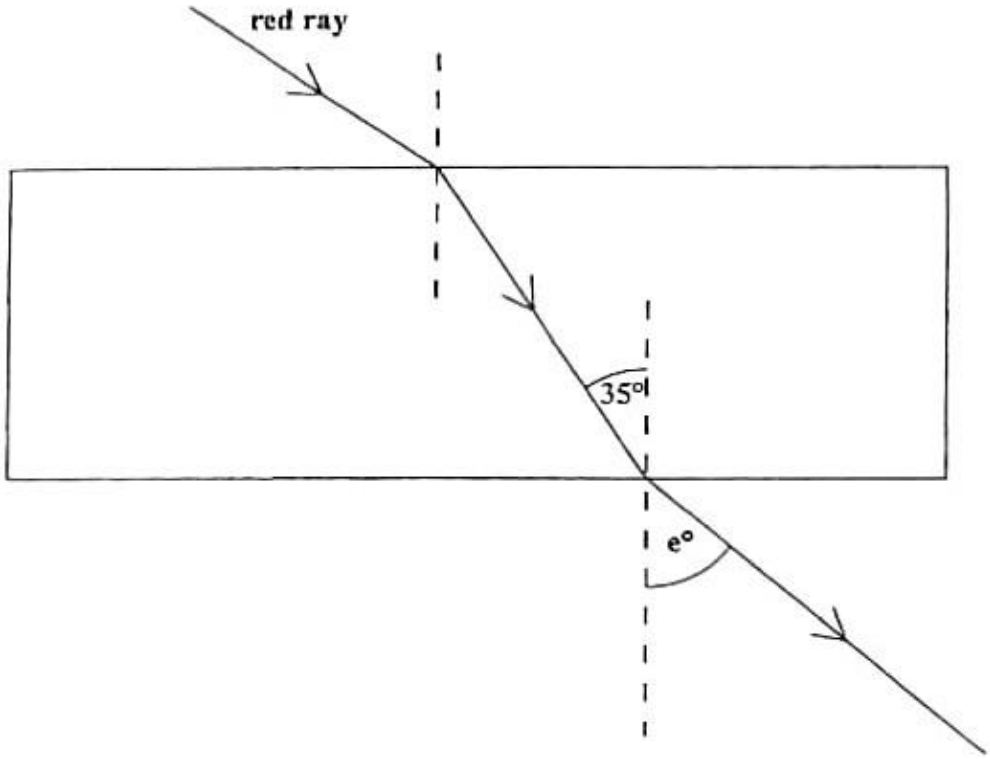

Figure 1

If the block has a refractive index of 1.5, determine the value of the angle e.

(5 marks)

June 2011 #4

SECTION B

Attempt ALL questions.

You MUST write your answers in the space provided after each question.

4. (a) Eron, a form five Physics student, has available to him a bright filament light in a ray box, an opaque screen with two closely spaced narrow slits, and a large white screen.

Describe how he can set up the apparatus to be able to observe an interference pattern of light and dark bands on the white screen **and** briefly explain why this pattern forms. **(6 marks)**

(b) Figure 2 shows a narrow beam of white light which is shone onto a triangular prism at an angle of incidence of 30°.

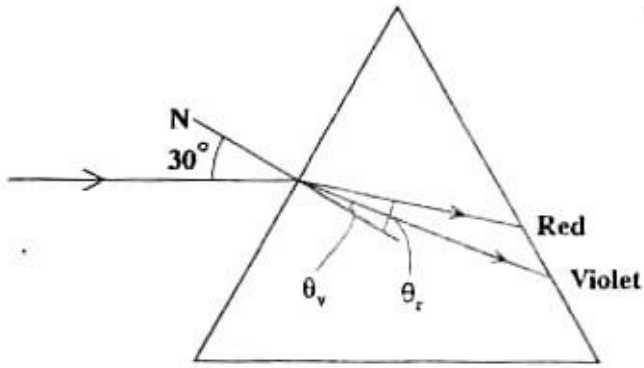

Figure 2

(i) If the angle of refraction for the violet light, θ_v, is 20°, what is the refractive index of this prism for violet light? **(3 marks)**

(ii) Calculate the speed of the violet light in the prism. **(3 marks)**

(iii) Calculate the frequency of violet light if the wavelength in air is 430 nm.

[1 nm = 10^{-9} m
Velocity of light in air = 3.0×10^8 m s^{-1}] **(3 marks)**

June 2012 #6 a) (i)

6. **(a)** **(i)** Outline THREE differences between 'light waves' and 'sound waves'.

(3 marks)

Jan 2013 #4

SECTION B

Attempt ALL questions.

You MUST write your answers in the spaces provided after each question.

4. (a) Describe EACH of the following terms as it relates to the laws of reflection:

(i) Normal

(ii) Angle of incidence

(iii) Angle of reflection

Describe what EACH of the terms means. **(3 marks)**

(b) In the description of the formation of an image produced in a plane mirror, a physics student recalled THREE features.

State the THREE features of an image produced in a plane mirror. **(3 marks)**

(c) Using a relevant physics concept, explain why the word **AMBULANCE** is painted in this manner at the front of some emergency vehicles. **(4 marks)**

(d) Figure 4 shows a ray of white light, AO, incident at 30° to the PS boundary of the rectangular glass block, PQRS.

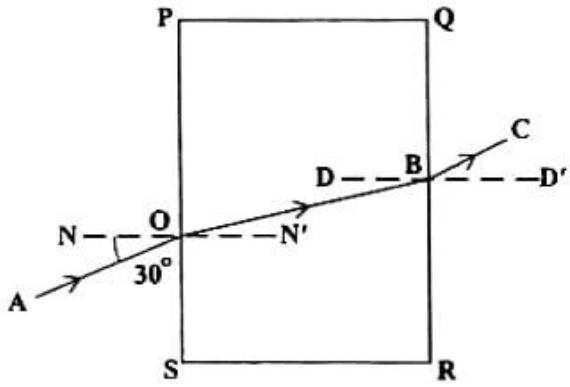

Figure 4

(i) Calculate the angle of refraction produced on the PS boundary.

(ii) Name the angle of refraction produced on the QR boundary. **(5 marks)**

[Refractive Index of glass = 1.5] **Total 15 marks**

June 2013 #3

3. **(a)** **(i)** **State Snell's Law.**

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(3 marks)

(b) (i) Describe the path into a prism and out of a prism when a ray of light is incident at 90° to the hypotenuse of a right-angled glass prism as shown in Figure 1.

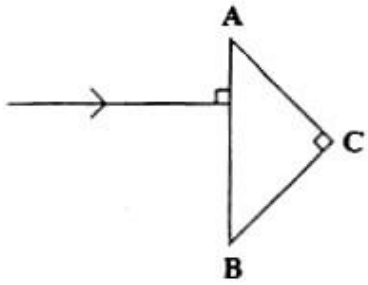

Figure 1

(7 marks)

(ii) Through what angle would the ray be turned after emerging?

(1 mark)

[Critical angle for glass = 42°]

June 2014 #4

SECTION B

AnswerALL questions.

4. (a) State the laws of refraction. **(6 marks)**

(b) Figure 3 shows the clown fish, Nemo, looking at point B. It sees the fisherman's net appearing as if it were at A.

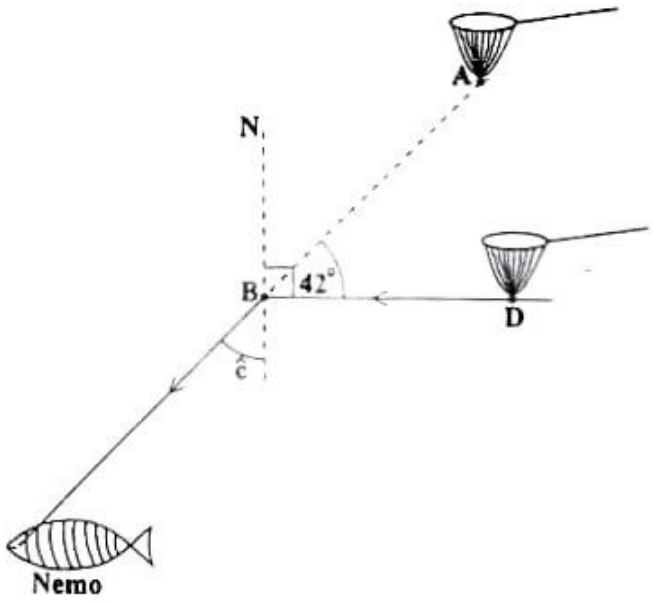

Figure 3.

(i) Calculate angle c, given that angle ABD is 42°. **(3 marks)**

(ii) Given that angle c is the critical angle for the air–water boundary, calculate the refractive index of the water. **(3 marks)**

(iii)

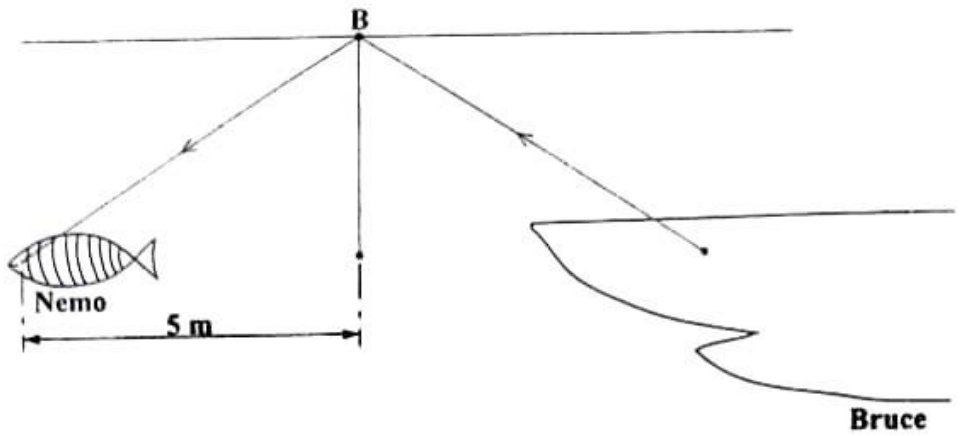

Figure 4.

Nemo swims away and his eye is now a horizontal distance of 5 metres from point B. Looking at point B he no longer sees the net but now sees Bruce, the shark.

If Bruce is at the same depth as Nemo, how far away is Bruce's eye from Nemo's eye. Explain your result. **(3 marks)**

Total 15 marks

Write your answer to Question 4 here.

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Jan 2015 #4

SECTION B

Answer ALL questions.

You MUST write your answers in the spaces provided after each question.

4. (a) (i) With the aid of a labelled diagram, state the laws of reflection. **(4 marks)**

(ii) The glare of light from oncoming vehicles when driving on a rainy nights can be annoying. With the aid of a labelled diagram, show how this glare results. **(2 marks)**

Write your answer to Question 4 (a) (i) here.

Diagram for Question 4 (a) (i)

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Write your answer to Question 4 (a) (ii) here.

Diagram for Question 4 (a) (ii)

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(b) A pencil is placed in a glass of water and appears to be bent as shown in Figure 3 below.

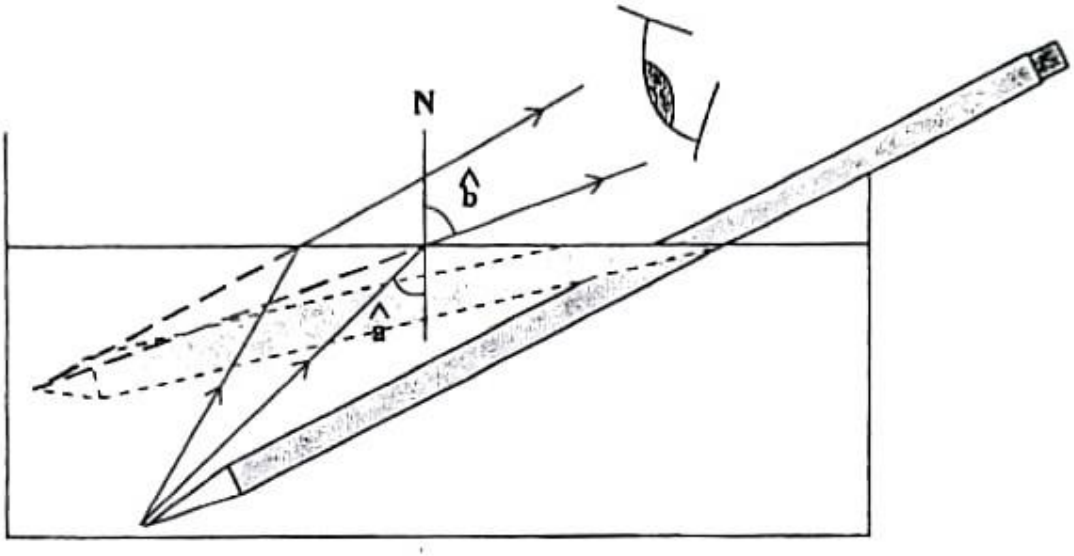

Figure 3

(i) Calculate the refractive index of the water which causes this apparent bending if angle $a = 32°$ and angle $b = 45°$. **(3 marks)**

(ii) If the pencil is now placed in ethanol with a refractive index of 1.36, calculate the new angle b given that angle a in the ethanol remains at 32°. **(4 marks)**

(iii) Does the pencil bend more or less in ethanol than in water? Justify your answer. **(2 marks)**

Jan 2016 #4

SECTION B

Answer ALL questions.

You MUST write your answers in this answer booklet.

4.(a) (i) "The angle of incidence is equal to the angle of reflection". This is one of the laws of reflection. State the other law. (3 marks)

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(ii) State THREE properties of the image in a plane mirror. (3 marks)

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(b) Figure 3 shows a car located 5 m behind a truck which id 8 m long. Assume the external mirror for the truck is a plane mirror and is in line with the front of the truck.

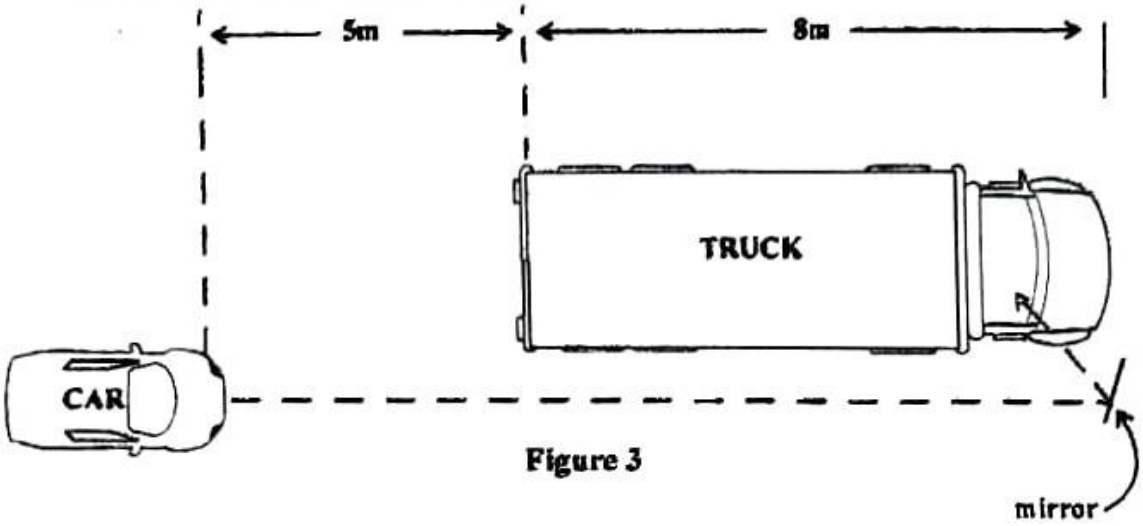

Figure 3

(i) Calculate the image distance of the car as seen by the truck driver. **(2 marks)**

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(ii) State a reason why the sign shown in Figure 4 is more likeky to be posted at the back of a truck rather than a car. **(2 marks)**

Figure 4

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(c) A ray of light passes through a block of material as shown in Figure 5.

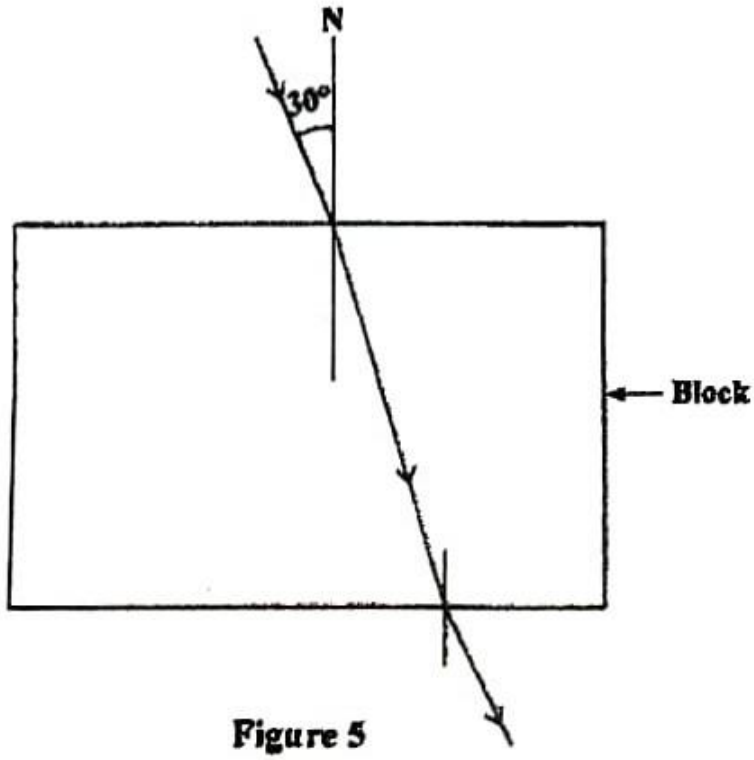

Figure 5

(i) If the refractive index of the material is 1.3, calculate the angle of refraction in the material given that the angle of incidence is 30°. **(4 marks)**

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(ii) If the refractive index of the material increased, why would the lateral displacement of the ray increase also? **(1 mark)**

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Jan 2017 #4

SECTION B

Answer ALL questions.

You MUST write your answers in this answer booklet.

4.(a)(i) State TWO examples of observations which provide evidence that light can be refracted. **(2 marks)**

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(ii) Figure 3 shows a ray of light travelling from air to water.

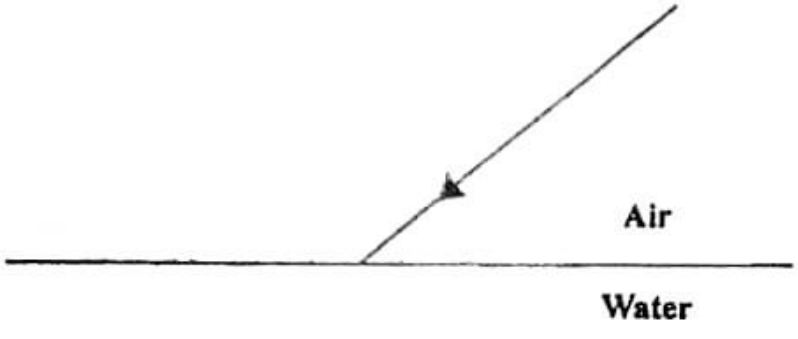

Figure 3

Complete Figure 3 by adding the normal at the point of incidence, the refracted ray, and indicating the angles of incidence and refraction. **(3 marks)**

(iii) As the light ray travels from air to water, determine if the speed of the light ray will increase or decrease. Give a reason for your response. **(2 marks)**

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(b) A glass prism, as shown in Figure 4, may be used to produce a spectrum.

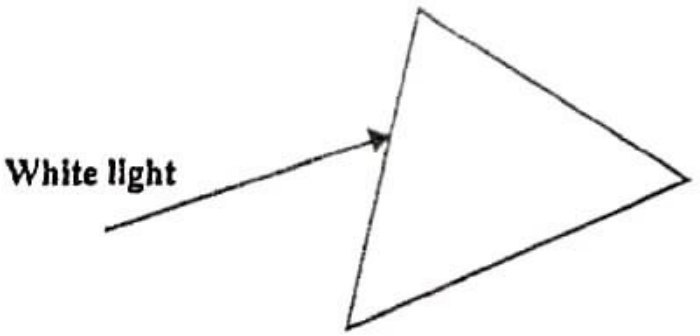

Figure 4

(i) What is the name of the effect that is created? **(1 mark)**

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(ii) On Figure 4 above, trace the path of the white light into and out of the prism indicating the red ray and the violet ray. **(2 marks)**

(c) An experiment was conducted to verify Snell's law of refraction by measuring the angle of incidence, i, and the angle of refraction, r, for a light ray entering a glass block. The data was recorded as shown in Table 2.

TABLE 2

Angle of Incidence, i	Angle of Refraction, r	sin i	sin r	sin i/sin r
30°	20°	0.50		1.47
50°	31°		0.52	
60°	35°	0.87	0.57	

(i) Complete Table 2 by inserting the missing values. **(2 marks)**

(ii) Determine the angle of refraction if an incident angle of 70° was recorded for this experiment. (Use the refractive index of glass as 1.52.) **(3 marks)**

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Total 15 marks

Jan 2018 #1

SECTION A

Answer ALL questions.

You MUST write your answers in this answer booklet.

1. (a) A student conducted an experiment on light travelling from glass to air. Figure 1 is a diagram showing light travelling from glass to air. The results of the experiment are recorded in Table 1.

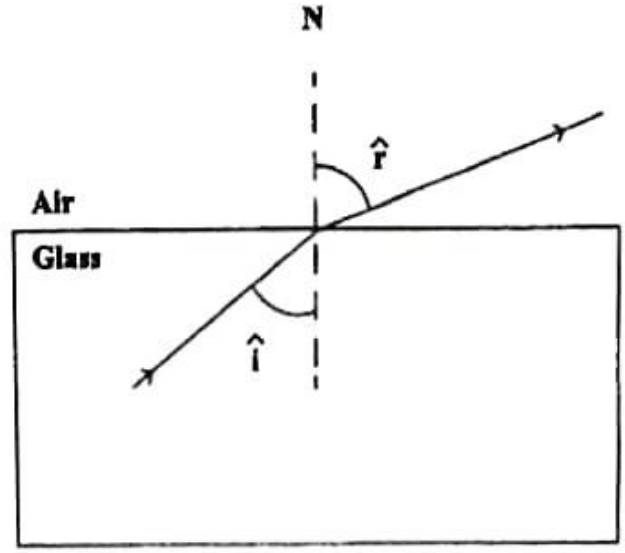

Figure 1. Light travelling from glass to air

TABLE 1

Angle of Refraction, $\hat{r}$	Angle of Incidence, $\hat{i}$	sin $\hat{r}$	sin $\hat{i}$
10.0	6.5		
30.0	19.0		
50.0	30.0		
70.0	38.0		
90.0	41.0		

(i) Complete Table 1 by calculating the values of sin $\hat{r}$ and sin $\hat{i}$. **(5 marks)**

(ii) Using the calculated values in Table 1, plot a graph of sin $\hat{r}$ against sin $\hat{i}$ on the grid **on page 5.** **(8 marks)**

(iii) Calculate the gradient of the graph.

(4 marks)

(b) State the name of the physical property represented by the gradient in (a) (iii).

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(1 mark)

(c) (i) Explain the term 'critical angle'.

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(2 marks)

(ii) Using Table 1, or otherwise, state the critical angle for the glass used in (a).

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(1 mark)

(d) Figure 2 shows light travelling in the core of a fibre optic cable as it reflects off the cladding.

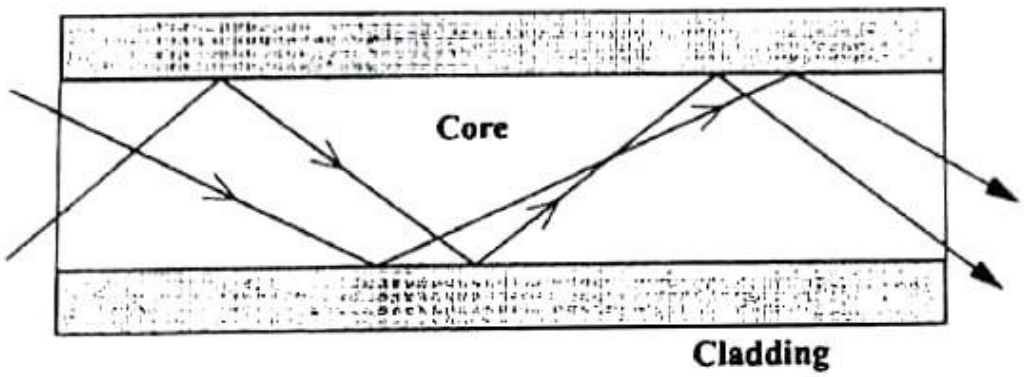

Figure 2. Light travelling in the core of the fibre optic cable

If the refractive index from the cladding to the core is 1.03, calculate the critical angle in the core.

(4 marks)

Jan 2018 #5 a)

5.(a) Newton and Huygens were two of the scientists who made significant contributions to the modern view of light as embracing both a wave and particle nature.

State what evidence each proposed and whether this evidence supported the wave theory or particle theory. **(4 marks)**

Newton.....

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Huygens.....

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Jan 2019 #1 c)

(c) Figure 2 shows the side AB of a rectangular glass block and CD which is normal at the point O.

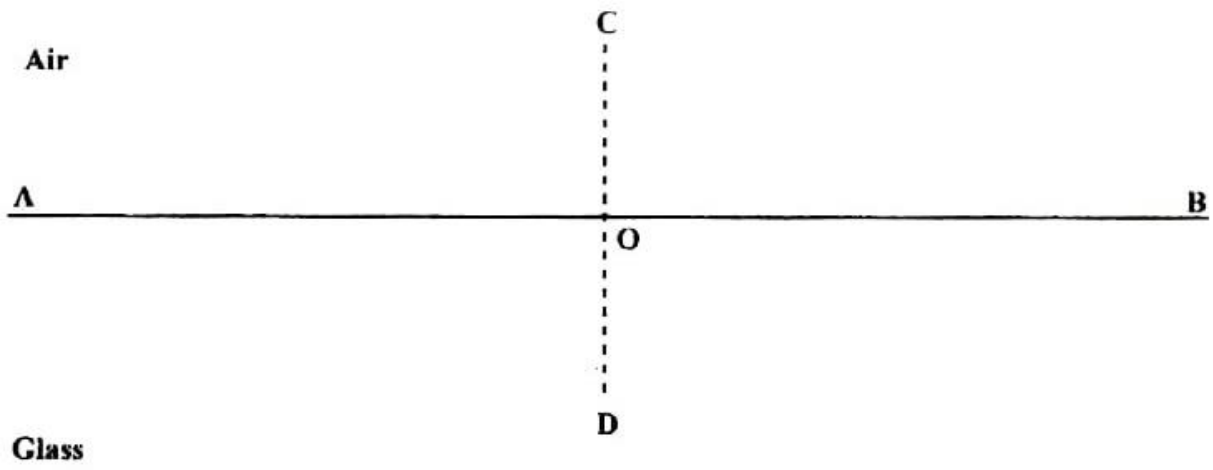

Figure 2. Glass block

(i) On Figure 2, draw the path taken by a ray of light which meets the the glass-air boundary at the point O at an angle of incidence equal to the critical angle.

Label the incident ray, the critical angle and the refracted ray (path taken by the ray). **(3 marks)**

(ii) The glass block has a refractive index of 1.5. Determine the value of the critical angle of the glass. **(4 marks)**

(iii) The ray of light now meets the glass-air boundary at the point O at an angle of incidence greater than the critical angle. On Figure 3, draw a diagram to show the new path taken by the ray of light. **(2 marks)**

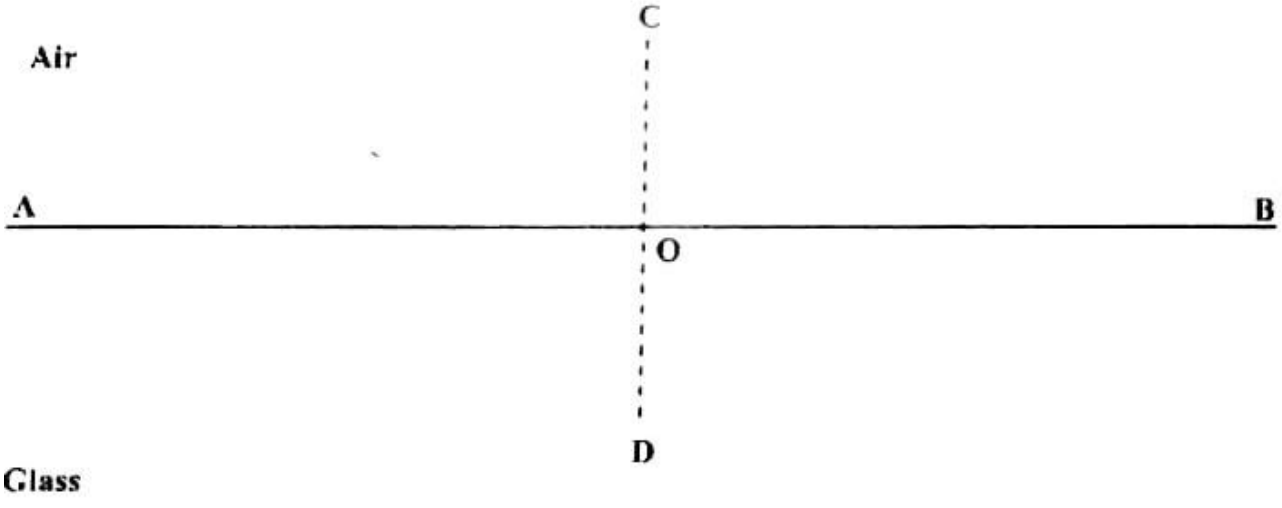

Figure 3. Glass block

June 2019 #4 a)

SECTION B

Answer ALL questions.

4.(a) (i) State THREE features of an image produced in a plane mirror. **(3 marks)**

Feature 1

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Feature 2

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Feature 3

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(ii) Explain why the word  is painted in this manner at the front of some emergency vehicles. **(3 marks)**

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Jan 2020 #4 a) – b)

SECTION B

Answer ALL questions.

4. (a) (i) With the aid of a labelled diagram, state the TWO laws of refraction. **(4 marks)**

Law 1 .....

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Law 2 .....

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(ii) When a diver under the sea shines a beam of light towards the surface of the water, the light does not pass through the water–air boundary into the air above but reflects into the sea.

State the name of the phenomenon which occurs and briefly explain why it occurs. **(2 marks)**

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4.(b) Another diver shines a beam of light into the water to see some fishes as shown in Figure 2.

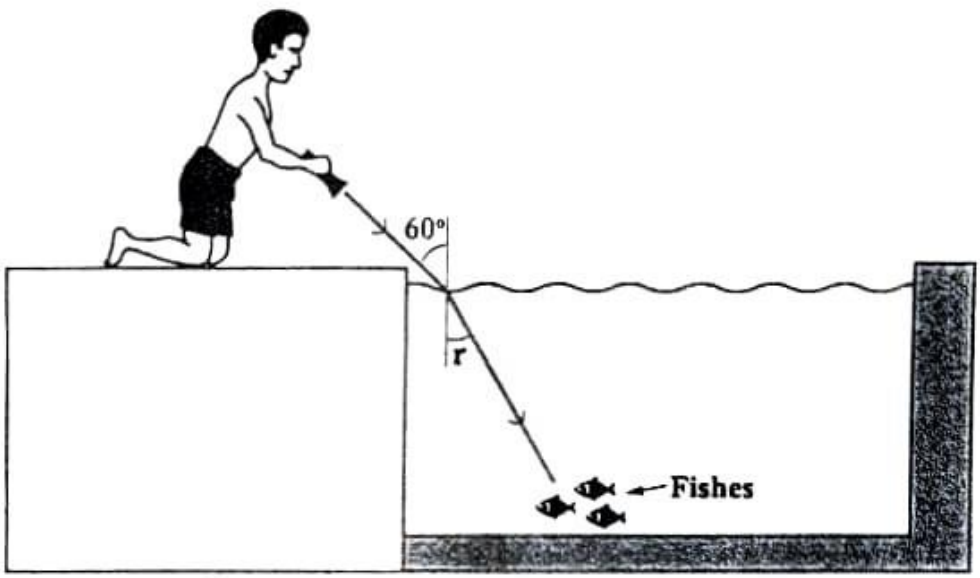

Figure 2. Diagram showing refraction

Given that the index of refraction for the water is **1.33** and the angle of incidence, $i = 60^{\circ}$, calculate the angle of refraction, r. **(3 marks)**

LENSES

June 2013 #3 a) (ii)

(ii) **In the space below, draw a labelled diagram using the converging lens to show clearly the following features:**

- **Principal axis**
- **Principal focus**
- **Focal length**
- **Focal plane**

(4 marks)

Jan 2014 #1

SECTION A

Answer ALL questions.

You MUST write your answers in this answer booklet.

1. Keshorn investigated the relationship between image size, I, and object size, O, while studying shadows.

His results are presented in Table 1.

TABLE 1

Image Size, I/cm	2.5	5.0	7.6	10.0	12.6	15.0
Object Size, O/cm	0.5	1.0	1.5	2.0	2.5	3.0

(a) On page 3, plot a graph of image size, I, versus object size, O. **(7 marks)**

(b) Calculate the gradient, G, of the line obtained.

(5 marks)

(c) State the physical quantity with which the gradient of the graph, G, is associated.

(1 mark)

(d) During the investigation, Keshorn talked with his friend Atiba about the term 'focal length'. Define the term 'focal length'.

(3 marks)

(e) With what piece of apparatus in physics is the term 'focal length' associated?

(1 mark)

(f) A 10 cm tall tablet computer was placed vertically 20 cm from a plane mirror. Its image distance was found to be 20 cm.

Use the data given to calculate

(i) the height of the image of the computer

(4 marks)

(ii) the magnification of this image.

(4 marks)

Total 25 marks

June 2015 #6

(a) (i) Copy Figure 3 and draw the ray shown as it emerges on the other side of the lens and its relation to the focus. Show the principal axis and the focal length.

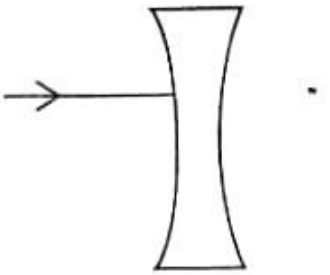

Figure 3

Space for diagram.

(5 marks)

(ii) Write, in words or symbols, the formula for the magnification of an object.

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(1 mark)

(b) An object *AB* is placed 20 cm in front of a converging lens of focal length F, 10 cm as seen in Figure 4.

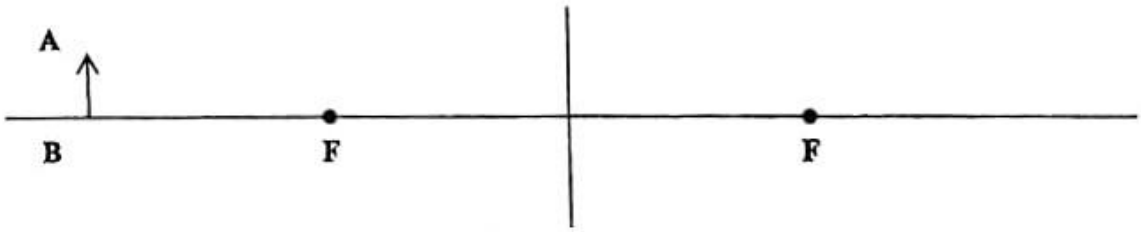

Figure 4

(i) Calculate the position of the image formed and state on what side of the lens it is located.

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(5 marks)

(ii) Calculate the magnification of the image formed.

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(3 marks)

(iii) Is the image formed real or virtual?

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(1 mark

Jan 2016 #5

5. (a) A converging lens can be used to form real or virtual images

(i) With reference to the focal length of the lens, describe the object distance required to produce EACH type of image. **(2 marks)**

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(ii) State the orientation of EACH image so produced. **(2 marks)**

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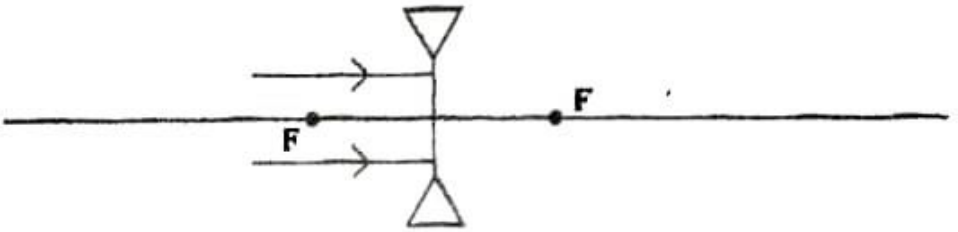
(iii) Complete the ray diagram shown in Figure 6. **(2 marks)**



(b) (i) Calculate the magnification where a lens produces an image height of 3.6 mm for an object 2.4 mm in height. **(3 marks)**

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(ii) For the same magnification, calculate the image distance given that the object distance is 20 cm. **(3 marks)**

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(iii) Calculate the focal length of this lens. **(3 marks)**

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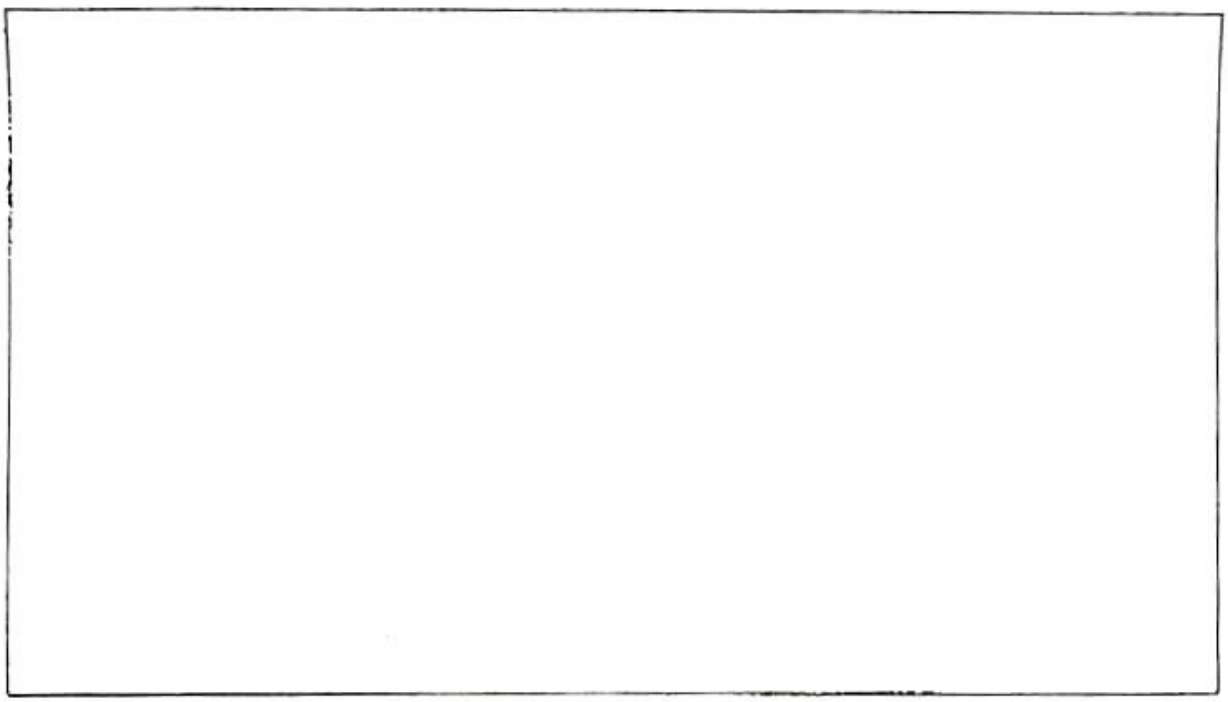
Total 15 marks

June 2017 #6

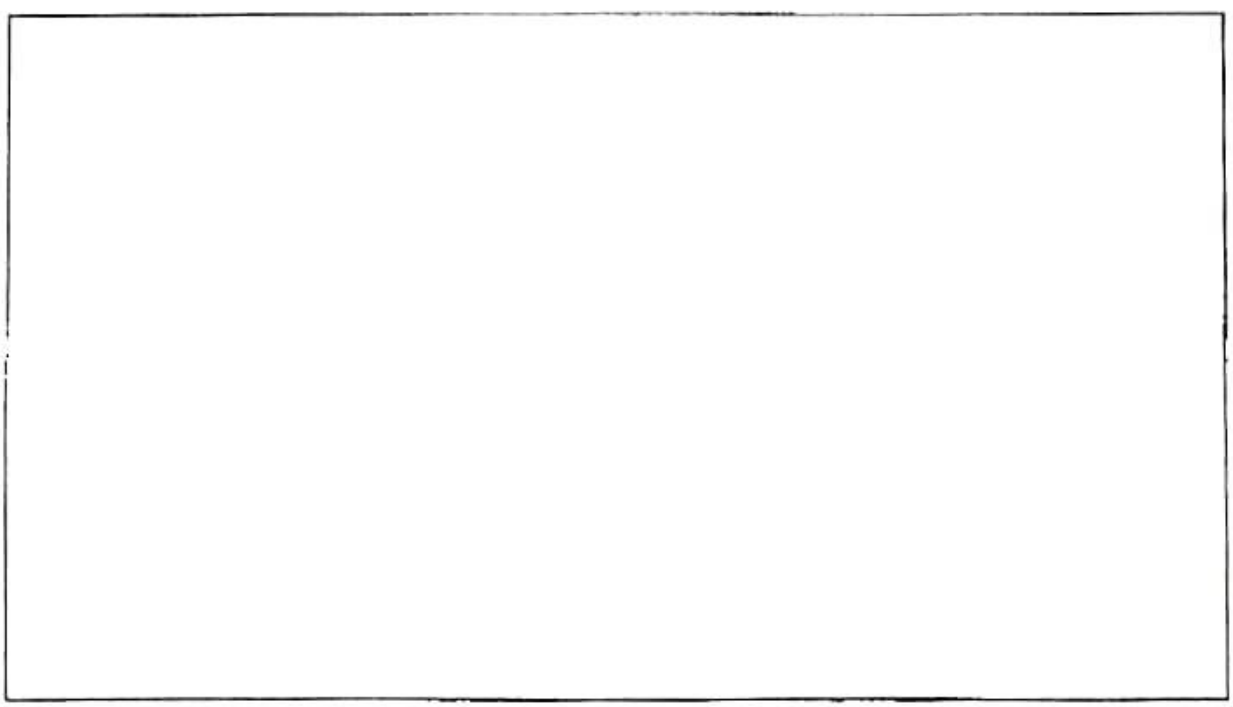
6. (a) Using fully labelled diagrams, define the principal focus of

(i) a converging lens



(3 marks)

(ii) a diverging lens.



(3 marks)

(b) An object of height 7.2 cm is placed 18.0 cm from a converging lens of focal length 12.0 cm. Determine

(i) the image distance

(3 marks)

(ii) the magnification

(3 marks)

(iii) the height of the image formed

(2 marks)

(iv) whether the image formed is real or virtual.

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(1 mark)

Jan 2018 #5 b)

(b) A homemade projector is constructed from a cardboard box, a cellphone, a cellphone stand to hold the phone upright and a magnifying glass embedded into one face of the box, as shown in Figure 5. The focal length of the lens is 15.0 cm.

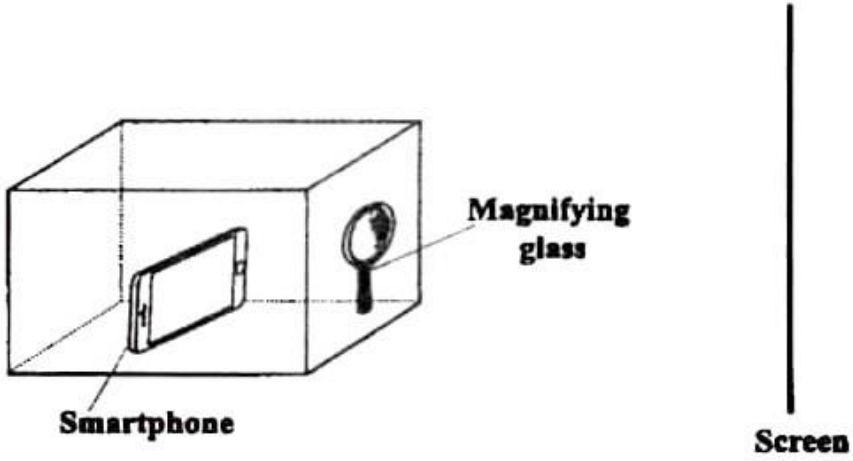

Figure 5. A diagram of a homemade projector

(i) Suggest, with a reason, an appropriate distance from the lens at which the phone should be placed in order to get a magnified image on an external screen.

(2 marks)

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(ii) If the phone is placed 20 cm from the lens, calculate the distance the screen must be placed from the lens in order to obtain a clear image of the phone. **(3 marks)**

(iii) Calculate the magnification of the image on the external screen formed in (b) (ii). **(3 marks)**

(iv) If the dimensions of the phone screen are 11.0 cm × 6.0 cm, calculate the dimensions of the image of the phone screen on the external screen. **(1 mark)**

(v) State whether the image formed in (b) (ii) is upright or inverted. **(1 mark)**

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(vi) Suggest one way in which the image formed in (b) (ii) can be made larger. **(1 mark)**

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June 2018 #1

SECTION A

Answer ALL questions

1. In an experiment to determine the focal length of a convex lens, a group of fifth form students set up the apparatus shown in Figure 1.

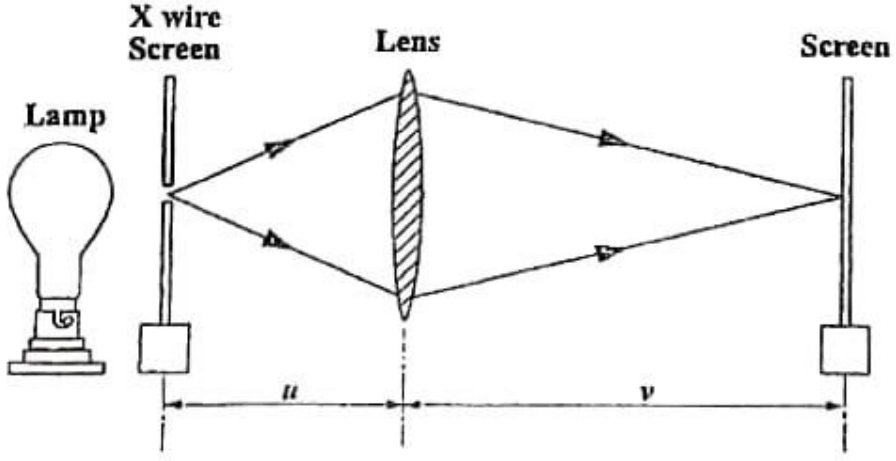

Figure 1. Apparatus to determine the focal length of a convex lens

The students measured object distances (u) and corresponding image distances (v) and recorded the information in Table 1.

TABLE 1: OBJECT DISTANCE (u) AND CORRESPONDING IMAGE DISTANCE (v

u/cm	$\frac{1}{u}$ [ ]	v/cm	$\frac{1}{v}$ [ ]
20.0		55.6	
30.0		30.2	
40.0		23.8	
50.0		22.2	
60.0		20.0	
70.0		19.2	

(a) Complete Table 1 to show values for $\frac{1}{u}$ and $\frac{1}{v}$. [Include units and calculate to three significant figures] **(6 marks)**

(b) On the grid provided **on page 5**, plot a graph of $\frac{1}{u}$ against $\frac{1}{v}$. **(7 marks)**

(c) (i) Calculate the gradient of the graph in (b) to one significant figure. **(4 marks)**

(c) (ii) State the value of the intercept, c, on the $\frac{1}{u}$ axis. **(1 mark)**

(d) Given that $c = \frac{1}{f}$, determine f, the focal point of the lens. **(4 marks)**

(e) Complete figure 2 to show the paths of rays 1, 2 and 3 as they pass through the convex lens represented by the dotted line. **(3 marks)**

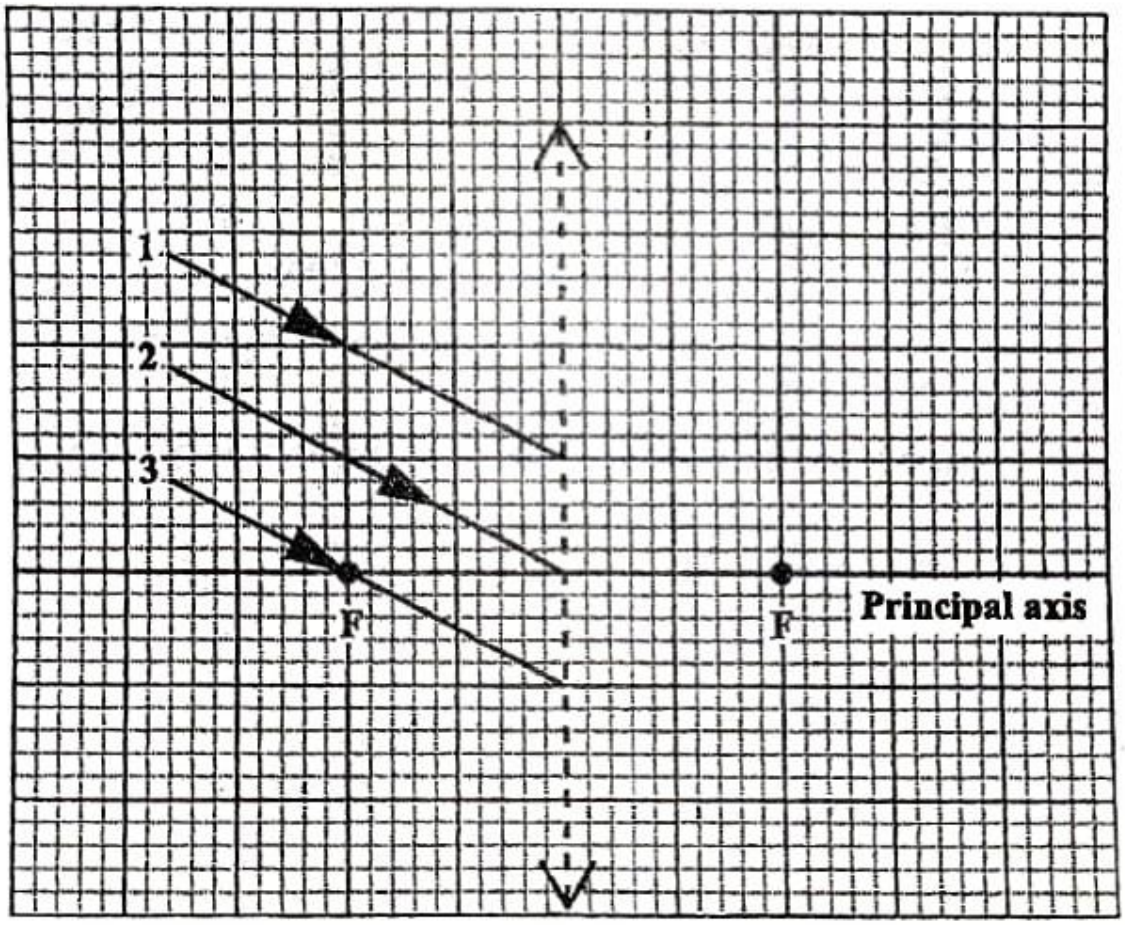

Figure 2. Paths of rays 1, 2 and 3

June 2019 #4 b) – c)

(b) Figure 5 shows an incomplete ray diagram.

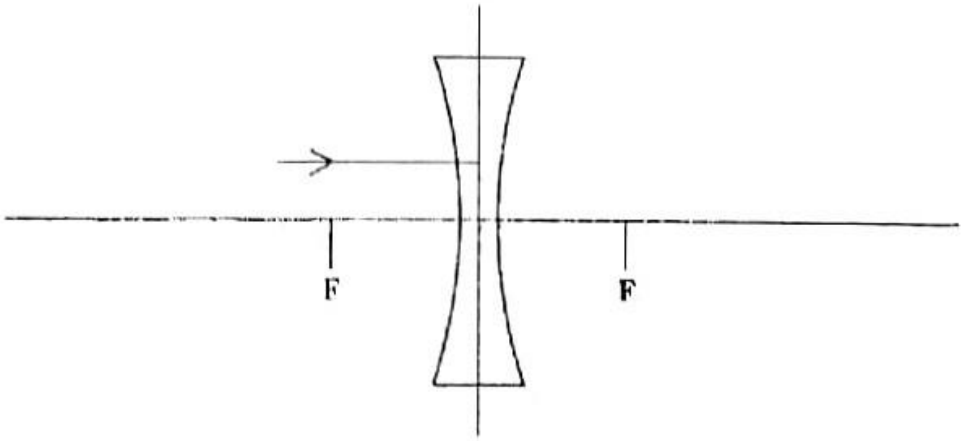

Figure 5. Incomplete ray diagram

(i) Complete the ray diagram to show the path of the emerging ray after it passes through the lens. **(2 marks)**

(ii) On the diagram, label the focal length, **f**. **(1 mark)**

(c) An object ***AB*** was placed **15 cm** in front of a converging lens of focal length **5 cm**.
Calculate the

(i) image distance **(3 marks)**

(ii) magnification of the image formed. **(3 marks)**

Total 15 marks

Jan 2020 #4 c)

(c) An object **2 cm** in height, is placed **10 cm** in front a converging lens with a focal length, f, of **6 cm**. Calculate

(i) the image distance, v. **(4 marks)**

(ii) the linear magnification, m. **(2 marks)**

SECTION D : ELECTRICITY AND MAGNETISM

TABLE OF CONTENTS

TOPIC *Page Number*

ELECTROSTATICS

June 2018 #3 a) – c)

3. (a) Define the term 'electric field'. **(3 marks)**

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(b) Draw the 'electric field' formed between the parallel plates shown in Figure 3. **(2 marks)**

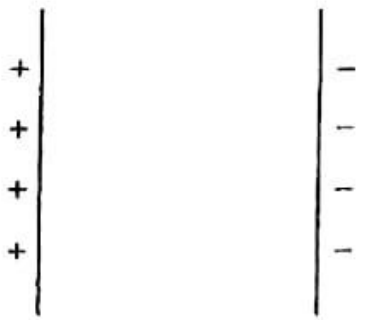

Figure 3. Parallel plates

(c) A lightning strike is an example of an electrostatic hazard.

(i) State ONE **other** hazard of static charge. **(1 mark)**

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(ii) State ONE useful application of static charge. **(1 mark)**

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CURRENT ELECTRICITY

June 2011 #3

3. Figure 1 shows a simple cell connected to a circuit.

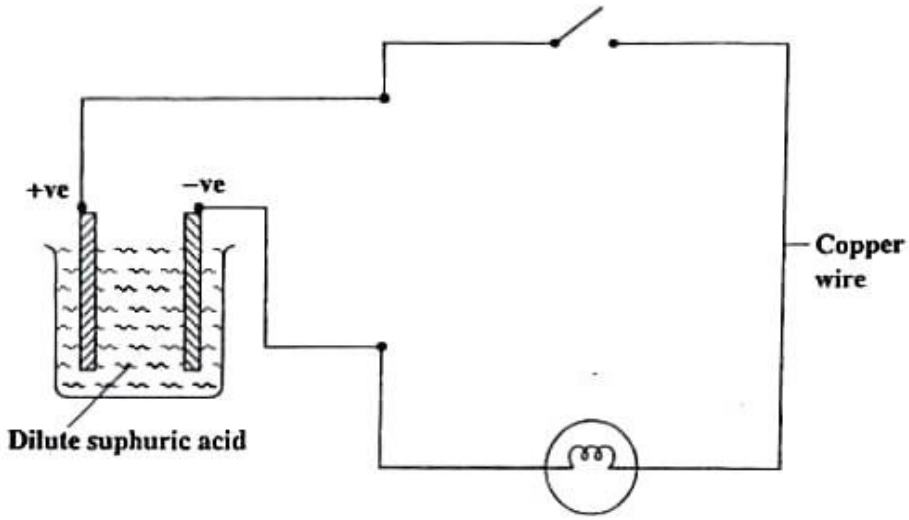

Figure 1

(a) (i) How does the flow of the current within the simple cell differ from that in a copper wire?

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(2 marks)

(ii) Name the material used for the positive terminal in a dry cell.

_____

(1 mark)

(iii) Name the material used for the negative terminal in a dry cell.

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(1 mark)

(iv) In the circuit in Figure 1, if the current is steady at 0.1 A, calculate the charge that goes through the copper wire in 60 s.

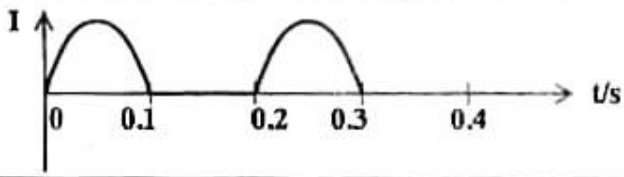
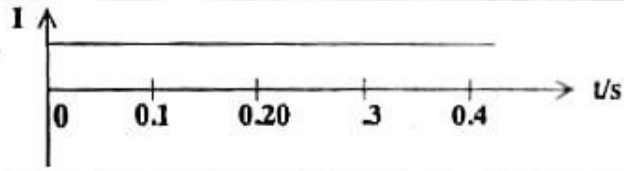
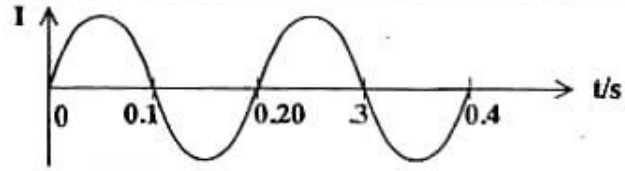
(3 marks)

(v) Determine how much charge goes through the simple cell in 60 s.

(1 mark)

(b) (i) Identify the type of current (d.c. or a.c.) which generated the specific waveforms A, B and C shown in Table 4.

TABLE 4

	Waveform	Type of Current
A		
B		
C		

(3 marks)

(ii) Determine the period and frequency for Waveform C.

(4 marks)

June 2016 #5

5. (a) (i) How does the electric current in a metal differ from that in an electrolyte? Compare EACH with 'conventional current'. **(4 marks)**

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(ii) State which of these two media (metal and electrolyte) has similar current flow to that in a semiconductor.
Give a reason for your answer. **(2 marks)**

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(b) The makers of a popular cellphone have upgraded its battery capacity from 4320 C to 9000 C.

(i) If the standard charger can deliver a current of 0.6A, how much more time will it take to charge the new battery than the old battery? **(7 marks)**

(ii) In order to maintain a competitive edge, the cellphone maker needs to keep the same charging time for the new model the same as the old model. What must be the current rating on a new charger to accomplish this? **(2 marks)**

June 2018 #3 d)

(d) The graph in Figure 4 shows the alternating voltage output from a generator.

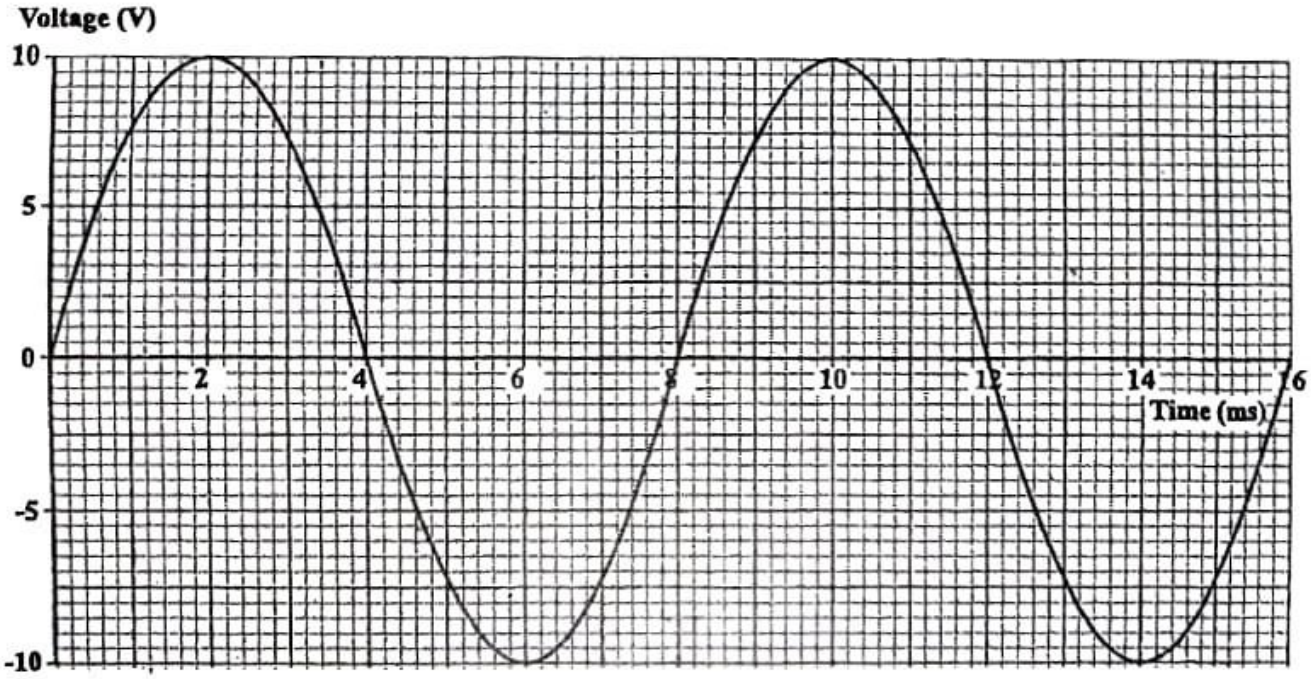

Figure 4. Alternating voltage output from a generator

Using the graph in Figure 4, determine the

(i) value of the peak to peak voltage **(2 marks)**

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(ii) period of the alternating voltage, in seconds **(2 marks)**

.....

.....

(iii) frequency of the alternating voltage from the supply. **(4 marks)**

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ELECTRICAL QUANTITIES

June 2014 #5

5. (a) Climate change is a major issue facing the global community. The average person can make a positive difference by conserving existing energy sources.

Describe THREE ways in which this can be done. State clearly what **form** of energy is conserved in EACH case. **(6 marks)**

(b) Home owner, Rasheed, is going on a two–week vacation. He has decided to leave on a 60W incandescent light bulb for security reasons.

(i) Calculate the total energy in kW h that the bulb will consume during the two–week period. **(4 marks)**

(ii) Given that Rasheed's electricity rate is \$0.26 per kWh, calculate his electricity charges for the bulb for the two weeks. **(1 mark)**

(iii) During the two–week period, 15.5 kWh of energy was lost as heat from the bulb. Determine the efficiency of the bulb. **(4 marks)**

Total 15 marks

Write your answer to Question 5 here.

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Jan 2017 #2 c)

(c) A solar module (power source) is used to charge a 12 V battery. During one phase of the charging, a constant current of 1 A is supplied for four hours.

(i) Calculate the charge added to the battery in Coulombs. **(4 marks)**

(ii) Calculate the energy, in kJ, added to the battery. **(4 marks)**

(iii) Suggest, with a reason, a value for the voltage of the solar module during battery charging. **(2 marks)**

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Jan 2019 #1

SECTION A

Answer ALL questions.

1. A group of students investigated the relationship between the electric power produced and the flow rate of water, which is channeled through a turbine.

Table 1 shows the recorded results of electric power (P)/W and the flow rate (F)/cm^3s^{-1}.

TABLE 1: RESULTS

Electric Power, P/W	Flow Rate, F/cm^3s^{-1}	(Flow Rate)^3, $F^3/(cm^3s^{-1})^3$
0.0	0.00	0.00
13.0	0.27	
25.5	0.34	
38.5	0.39	
51.0	0.43	
64.0	0.46	
77.0	0.49	

(a) Calculate the CUBE of the flow rate readings, F^3, rounded to two decimal places, to complete Table 1. **(6 marks)**

(b) **On page 5**, plot a graph of Electric Power, P/W, versus (Flow Rate)^3, $F^3/(cm^3s^{-1})^3$. **(7 marks)**

(c) Calculate the gradient of the graph. **(4 marks)**

(d) Use the graph to estimate the electric power produced if the flow rate, F, is 0.22 cm^3s^{-1}. **(2 marks)**

(e) Use your result from Part **(d)** to calculate the electrical energy, in joules, produced in 300 s. **(3 marks)**

(f) To determine the flow rate, the students used a stopwatch and measuring cylinder. State TWO precautions which students may have taken to ensure that the flow rate was accurately determined. **(2 marks)**

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(g) State the **major** energy conversion taking place in the turbine. **(1 mark)**

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CIRCUIT AND COMPONENTS

2010 #5

5. (a) With the aid of a CLEARLY labelled circuit diagram, explain how the I – V characteristics of an unknown electrical component, X, may be determined. **(6 marks)**

(b) The lights in a room are connected as shown in Figure 5. Each bulb has a resistance of 1000 Ω.

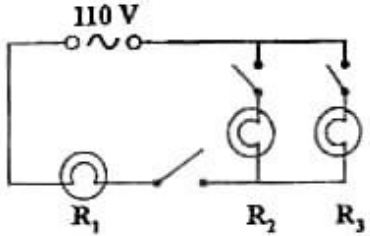


Figure 5. Circuit for lights in a room

Determine

(i) the total resistance

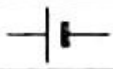
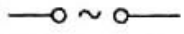
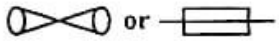
(ii) the current drawn from the supply if all three bulbs are lit. **(6 marks)**

(c) A microwave oven consumes 1100 W when operated on high power. What is the MINIMUM current rating for a fuse to be used to protect the oven if the mains potential difference is 110 V? **(3 marks)**

Jan 2011 #3

3. (a) Complete Table 3 which relates electrical circuit symbols to the names of electrical components.

TABLE 3

Circuit Symbol	Name of Components
	
	Variable resistor
	
	
	Semi-conductor diode
 or	

(6 marks)

(b) Figure 2 shows a circuit diagram.

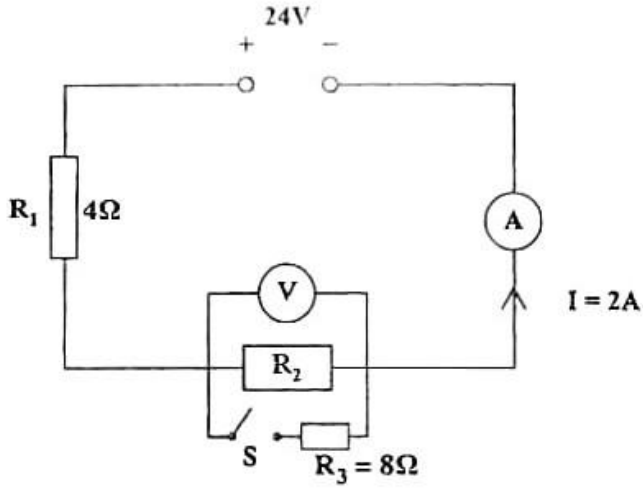


Figure 2

In the circuit shown in Figure 2, $R_1 = 4\Omega$, $R_3 = 8\Omega$ and the supply is 24V. With switch S open, the current I through the ammeter is 2 A.

(i) State the formula which relates voltage, V, current, I and resistance, R.

_____

(1 mark)

(ii) Calculate the value of R_2.

(3 marks)

(iii) What is the reading on voltmeter (V)?

(2 marks)

(iv) If switch S is closed, what would be the new reading on ammeter, (A)?

(3 marks)

June 2012 #1

SECTION A

Answer ALL questions.
You MUST write your answers in the spaces provided in this booklet.

1. A student investigated the relationship between the electrical potential difference across a device and the current flowing through that device. The results were recorded in Table 1.

TABLE 1

Potential difference (V)	1.5	4.0	10.0	18.0	30.0	45.0
Current (I)	0.02	0.05	0.15	0.24	0.40	0.60

(a) Plot on page 3, a graph of potential difference (V) versus current (I). **(8 marks)**

(b) Calculate the gradient of the line obtained in (a). (Do not use any point that coincides with a point from the table.)

(4 marks)

(c) State the physical property of the device with which the gradient is associated.

(1 mark)

(d) Using the information from the graph, comment on the relationship between the potential difference, (V), and the current (I).

_____

_____

(1 mark)

(e) Draw a labelled circuit diagram to show how the student should have connected his/her apparatus to conduct the investigation. **(4 marks)**

(f) With reference to 1 (e), describe the procedure used to conduct the investigation.

_____

_____

_____

_____

(4 marks)

(g) Three devices with resistances 8 Ω, 12 Ω and 15 Ω are connected in a circuit. Find the combined resistance of these devices when they are arranged in parallel.

(3 marks)

Jan 2013 #5

5. (a) (i) Describe a test to show that a semi-conductor diode is defective. **(2 marks)**

(ii) Sketch the I-V graph for a functioning semi-conductor diode. **(2 marks)**

(iii) Draw and complete a truth table for a 'NOT gate'. **(2 marks)**

(b) Figure 5 shows three resistors of values 2Ω, 6Ω and 12Ω in series.

(i) Calculate the equivalent resistance that one can use in series.

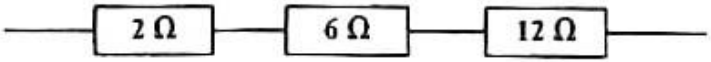


Figure 5

(2 marks)

(ii) In a second scenario, 2Ω, 6Ω and 12Ω resistors are placed in parallel as seen in Figure 6.

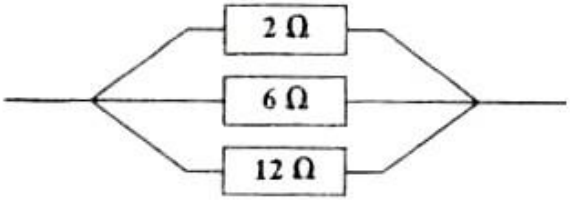


Figure 6

Calculate the equivalent resistance that one can use in parallel. **(4 marks)**

(c) Last year for Christmas, Paula had to put together a set of bulbs to light her family's Christmas tree. After much thought, she decided to put together strings of bulbs in series. Was that a wise decision? Justify your answer. **(3 marks)**

June 2013 #5

5. (a) Describe an experiment that can be used to determine the resistance of a metallic conductor. **(6 marks)**

(b) Figure 2 shows a 12 V battery of negligible internal resistance connected to an arrangement of resistors.

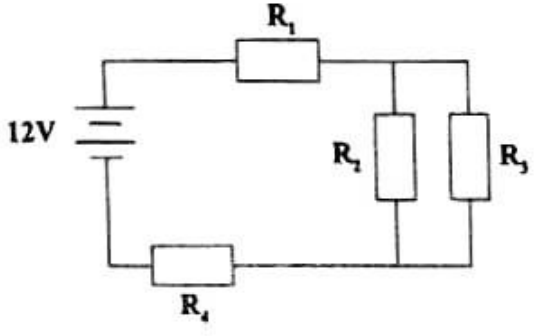


Figure 2

Given that resistors R_1 to R_4 each have a resistance of 3Ω, calculate

(i) the total resistance in the circuit **(3 marks)**

(ii) the current drawn from the 12V battery **(3 marks)**

(iii) the voltage across R_2. **(3 marks)**

Jan 2014 #5

5. (a) With the aid of a diagram, describe an experiment that may be used to investigate the relationship between current, I, and potential difference, V, for a filament lamp. Sketch your expected result. **(6 marks)**

(b) The power supply shown for the circuit in Figure 4 provides a current of 1 mA to the rest of the circuit.

(i) Assuming negligible losses in the connecting wires, calculate the required potential difference of the supply. **(5 marks)**

(ii) Calculate the current in the 5 kΩ resistor. **(3 marks)**

(iii) If the 2 kΩ resistor burns out, what current now flows in the 5 kΩ resistor? **(1 mark)**

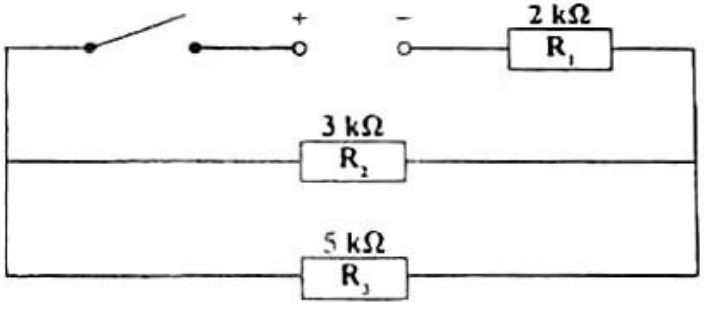


Figure 4

Jan 2015 #5

5. (a) (i) State the formula that relates the potential difference across a metallic conductor at constant temperature to the current through it. **(1 mark)**

(ii) State the formula that expresses the total resistance, R_T, of two resistors, R_1 and R_2 in parallel. **(1 mark)**

Write your answer to Question 5 (a) here.

(a) (i) .....

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(ii) .....

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(b) The brightness of the incandescent bulb in Figure 4 may be increased by varying the rheostat between 0 Ω and 100 Ω. When lit, the bulb operates at 0.30 A and 3.0 V.

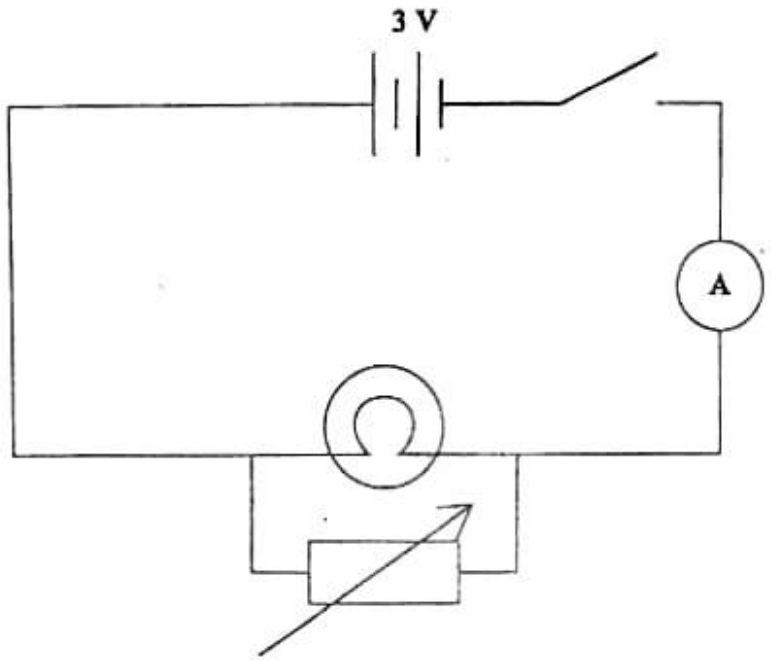

Figure 4

(i) What is the resistance of the bulb? **(2 marks)**

(ii) Assuming the resistance of the bulb remains constant once lit, calculate the ammeter reading if the rheostat is set to 100 Ω. **(4 marks)**

(iii) Is there a danger in reducing the rheostat resistance too much? Explain. **(3 marks)**

(iv) The assumption made in (b) (ii) is incorrect. With the aid of an I–V graph, indicate how the bulb's resistance actually varies with current. **(4 marks)**

June 2015 #3

3. (a) (i) Explain what is meant by the term 'electrical resistance'.

.....

.....

(1 mark)

(ii) Complete Table 2 to provide information regarding electrical meters.

TABLE 2

Meter	How Connected in a Circuit (Series or Parallel)	Resistance (High or Low)	Reason for Size of Resistance
Ammeter			....
Voltmeter			....

(6 marks)

(b) Calculate the reading on EACH of the meters shown in the circuit in Figure 2 when the switch is closed.

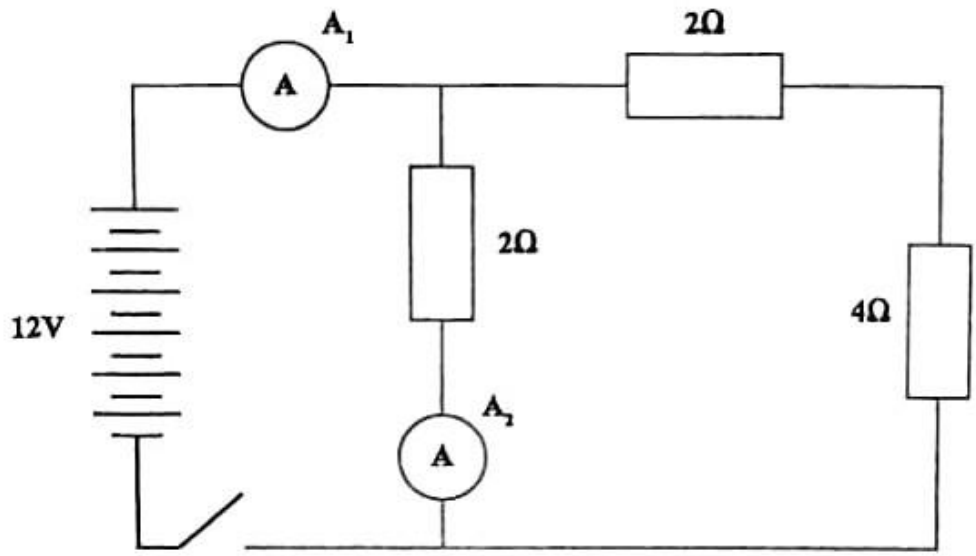

Figure 2

(i) Reading on A_1

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(6 marks)

(ii) Reading on A_2

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(2 marks)

Jan 2016 #6

6. (a) **Scientists use symbols when dealing with circuit diagrams in electricity. An electric circuit is displayed in Figure 7.**

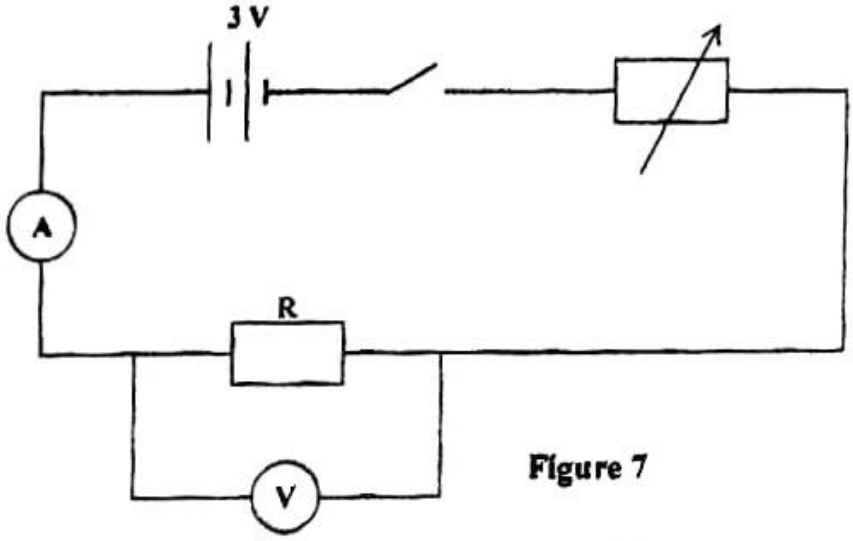

Figure 7

Write a description of the circuit in the space provided. **(6 marks)**

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..... **10 lines** .....

(b) **A Physics class was given a circuit diagram as shown in Figure 8. Use Figure 8 to answer the three questions posed to the class.**

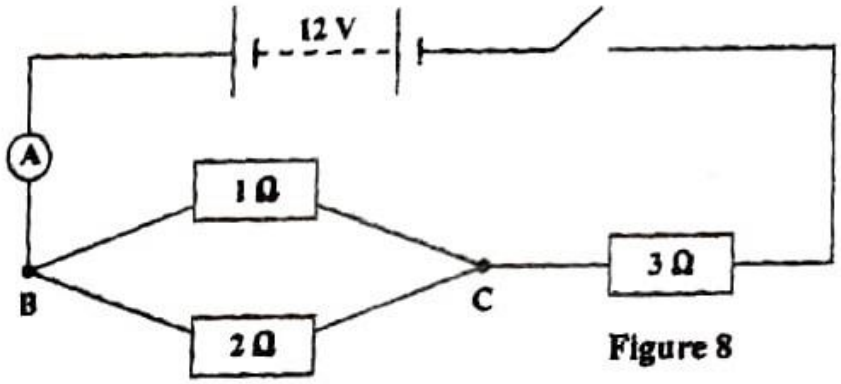

Figure 8

(i) **Given that the formula for the equivalent resistance of two resistors R_1 and R_2 in parallel is $R = \frac{R_1R_2}{R_1+R_2}$, calculate the equivalent resistance across BC.** **(2 marks)**

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..... **4 lines** .....

(ii) **Calculate the current flowing in the closed circuit.** **(4 marks)**

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..... **4 lines** .....

(iii) **When the current in (b)(ii) flows, what is the power dissipated in the 3 Ω resistor?** **(3 marks)**

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..... **4 lines** .....

Total 15 marks

Jan 2017 #2 a) – b)

2. (a) Figure 1 shows a cross section of a zinc–carbon cell.

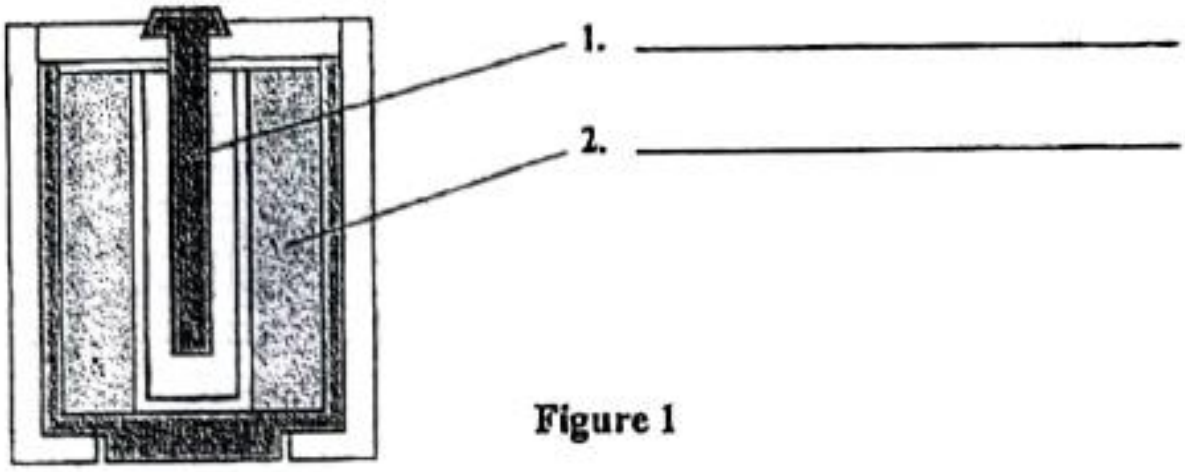

Figure 1

Label the parts of the cell indicated in Figure 1. **(2 marks)**

(b) The zinc–carbon cell is a primary cell. The lead–acid cell is a secondary cell.
State THREE differences between these cells. **(3 marks)**

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Jan 2019 #5

5. House wiring circuits contain fuses and earth wires. Appliances are connected to these circuits in parallel.

(a) (i) What is the purpose of the fuse in a circuit? **(2 marks)**

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.....

(ii) What is the purpose of the earth wire in a circuit? **(2 marks)**

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(iii) State TWO reasons why appliances are connected to the circuit in parallel. **(2 marks)**

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5.(b) Figure 5 shows a circuit diagram.

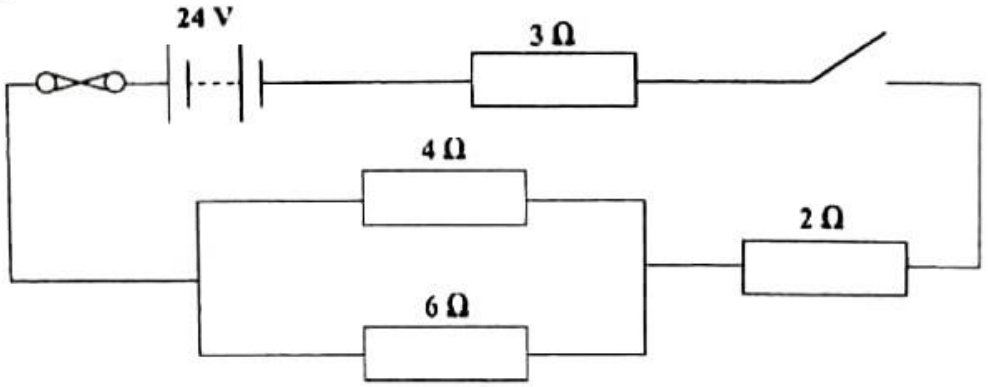

Figure 5. Circuit diagram

Use the circuit diagram in Figure 5 to determine

(i) the TOTAL resistance in the circuit. **(6 marks)**

(ii) the TOTAL current in the circuit. **(2 marks)**

(iii) Which fuse, a 2A fuse, a 3A fuse or a 4A fuse, is the most suitable to use in the circuit shown in figure 5? **(1 mark)**

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June 2019 #5

5.(a) A semi-conductor diode is used in a half-wave rectification. Using the axes on Figure 6, sketch the **I–V** graph for the semi-conductor diode. **(2 marks)**

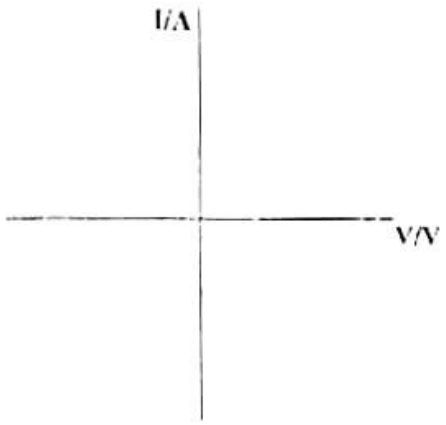


Figure 6. I–V graph for a semi-conductor diode

(b) Complete the truth table shown in Table 3 for a **NAND gate.** **(4 marks)**

TABLE 3. NAND GATE

Input		Output
A	B	C
0	0	
0	1	
1	0	
1	1	

(c) Figure 7 shows three resistors in series of values **2Ω, 5Ω** and **10Ω.**

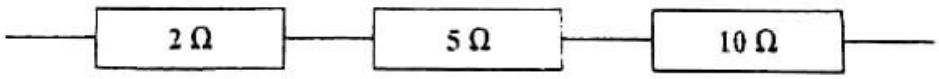


Figure 7. Resistors in series

(i) Calculate the equivalent resistance of the resistors shown in Figure 7. **(2 marks)**

5.(c) (ii) The resistors are placed in parallel as shown in Figure 8.

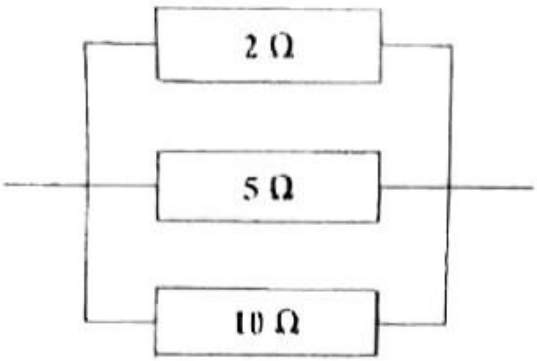


Figure 8. Resistors in parallel

Calculate the equivalent resistance of the resistors in Figure 8. **(4 marks)**

(iii) The resistors in Figure 8 were connected in a circuit to a **6 V** power supply. Calculate the total current flowing through the circuit. **(3 marks)**

ELECTRONICS

June 2010 #3

3. **(a)** A student connects the circuit in Figure 1 below to investigate rectification using a single diode.

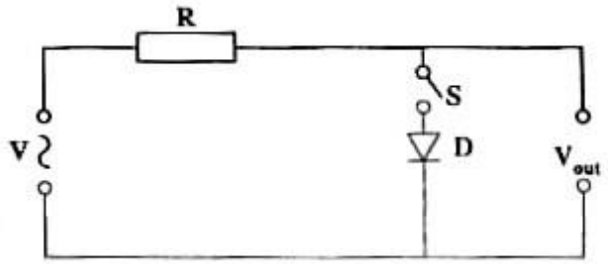


Figure 1

(i) Sketch the V_{out} – t graph when switch S is open.

(1 mark)

(ii) Sketch the V_{out} – t graph across diode D when switch S is closed.

(1 mark)

(iii) Sketch the V – t graph across a battery power source.

(1 mark)

(iv) What is the similarity in the voltage between (ii) and (iii)?

_____

_____

_____

(1 mark)

(v) How can you use the circuit in Figure 1 to determine whether or not a semiconductor diode is defective?

_____

_____

_____

(2 marks)

(b) (i) The truth table of a logic gate is shown below for inputs A and B and output C.

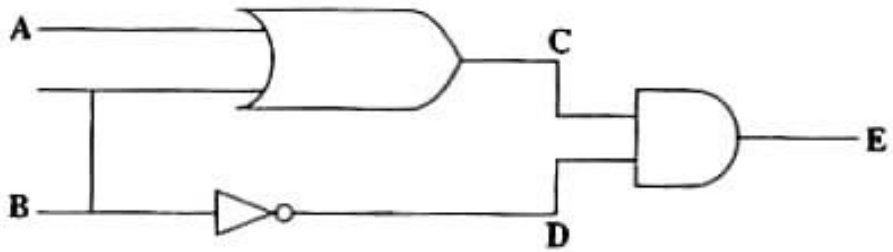
A	B	C
0	0	1
0	1	1
1	0	1
1	1	0

State the type of logic gate.

_____

(1 mark)

(ii) Complete the truth table for the following logic circuit.



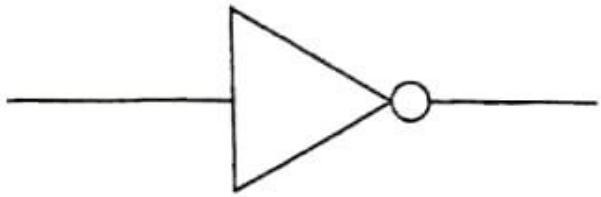
A	B	C	D	E
0	0	0	1	0
0	1			
1	0			
1	1		0	

(8 marks)

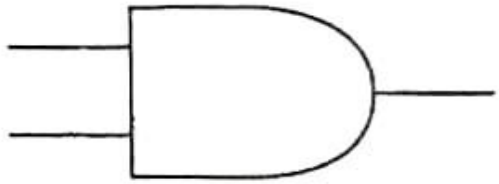
Total 15 marks

Jan 2017 #5

5. (a) State the name of EACH logic gate represented below.

(i)  .....

(1 mark)

(ii)  .....

(1 mark)

(iii)  .....

(1 mark)

(b) Complete the truth tables for the NOT and NOR gates.

(1 mark)

(i) NOT Gate

TABLE 3

INPUT	OUTPUT
0	
	0

(2 marks)

(ii) NOR Gate

TABLE 4

INPUT		OUTPUT
0	0	
0	1	
1	0	
1	1	

(c) Figure 5 shows a basic home security system that provides protection for two windows and front and back doors. The use of OR gates facilitates the system with all inputs on Low (0). If a disturbance occurs the input turns to High (1). The alarm will sound only if a High (1) output is received.

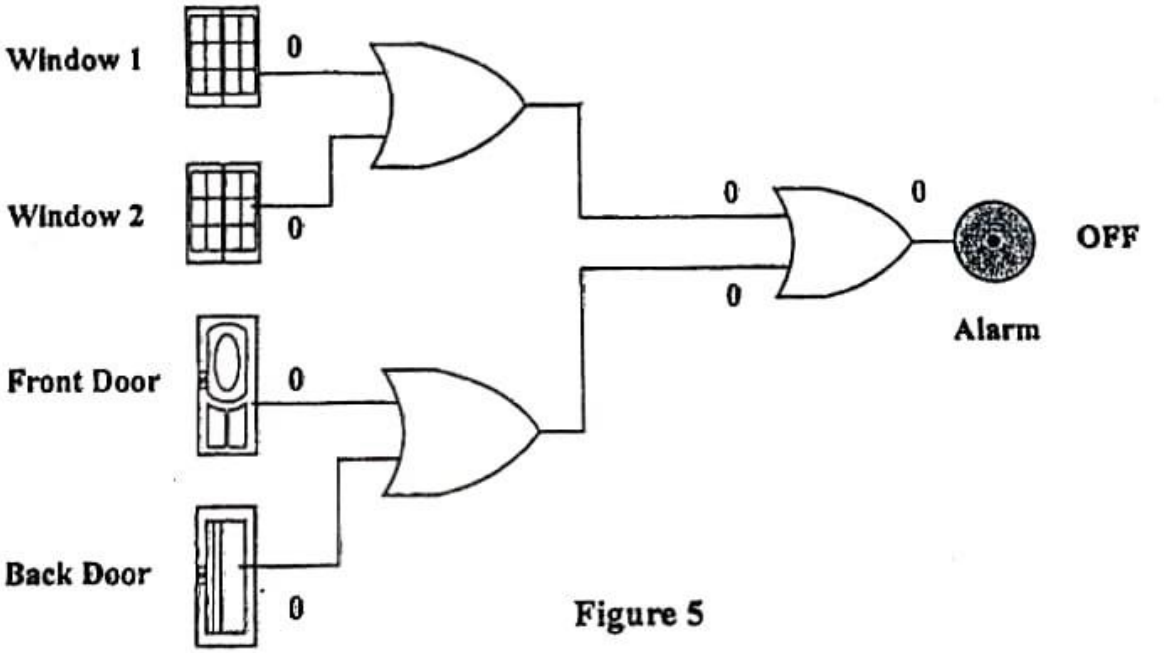


Figure 5

Figure 6 shows an intruder at Window 2 causing its input to change to High (1).

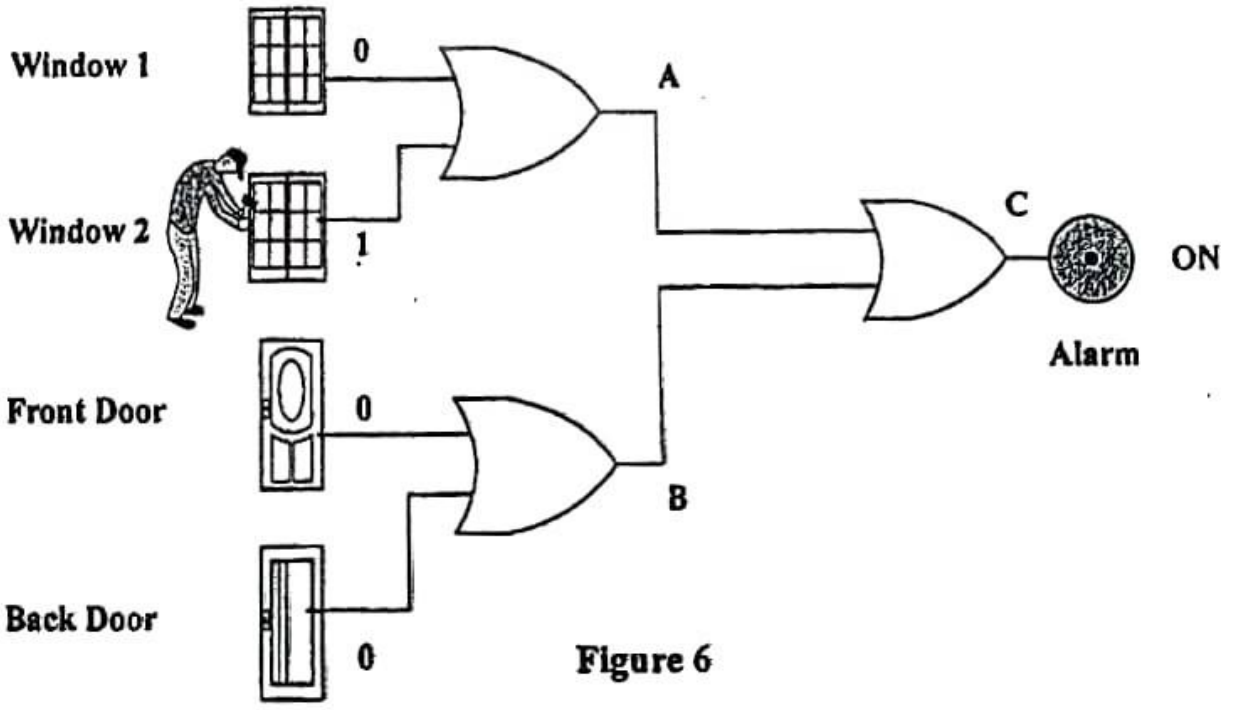


Figure 6

(i) Find the logic combination that causes the alarm to sound by determining the outputs at A, B and C in Figure 6. **(3 marks)**

A = ...

B = ...

C = ...

(ii) If a simultaneous disturbance is triggered at the back door and at Window 2, show on Figure 7, the logic output at A, B and C. **(3 marks)**

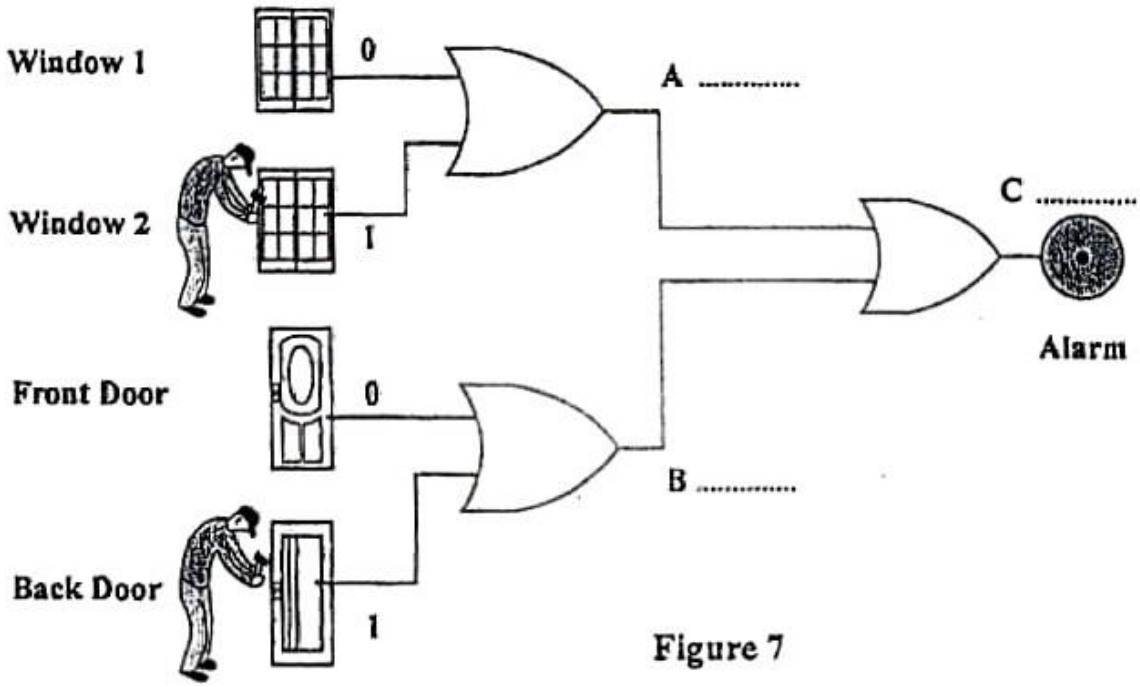


Figure 7

(d) State THREE ways in which advances in electronics, such as the introduction of logic gates, have made a positive impact on society. **(3 marks)**

(i) .....

.....

(ii) .....

.....

(iii) .....

.....

June 2019 #5 b)

(b) Complete the truth table shown in Table 3 for a **NAND gate.** **(4 marks)**

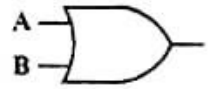
TABLE 3. NAND GATE

Input		Output
A	B	C
0	0	
0	1	
1	0	
1	1	

Jan 2020 #5

5.(a) Complete Table 2 by inserting the missing logic gates, symbols and functions. **(6 marks)**

TABLE 2: LOGIC GATES, SYMBOLS AND FUNCTIONS

Logic Gate	Symbol	Function
		Changes logic 0 to logic 1
AND		
OR		
NAND		Produces a logic 1 only when A and B are logic 0

(b) (i) With the aid of a circuit diagram, describe how an alternating current (a.c.) can be half-wave rectified to produce a direct current across a resistor (load). **(5 marks)**

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5.(b) (ii) Sketch the voltage-time graph to show the expected output across the load in **(b) (i)**. **(1 mark)**

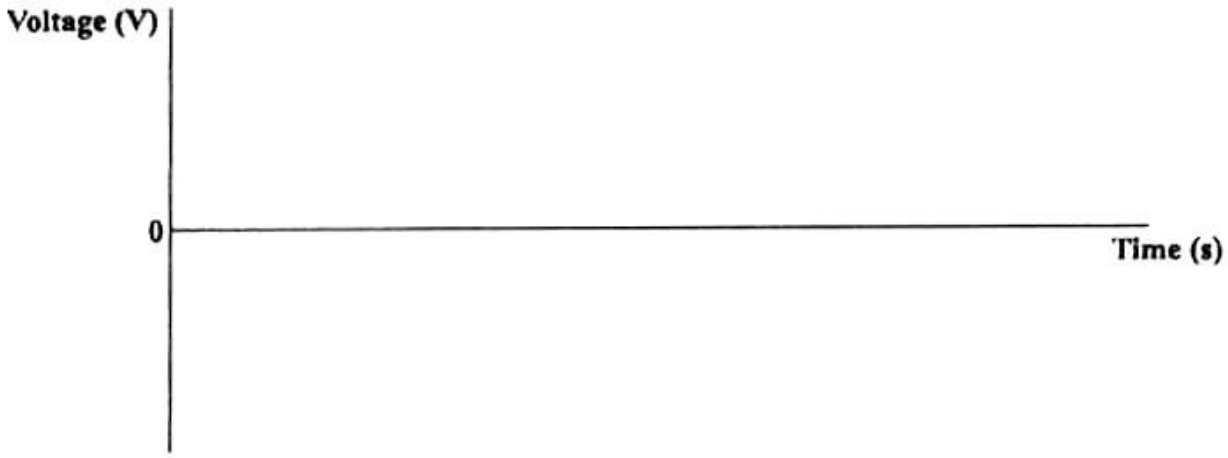


Figure 3. Voltage–time graph to show the expected output across the load

(c) Draw a voltage-time graph showing an a.c. source with a frequency of **5 Hz** and a peak voltage of **12 V**. **(3 marks)**

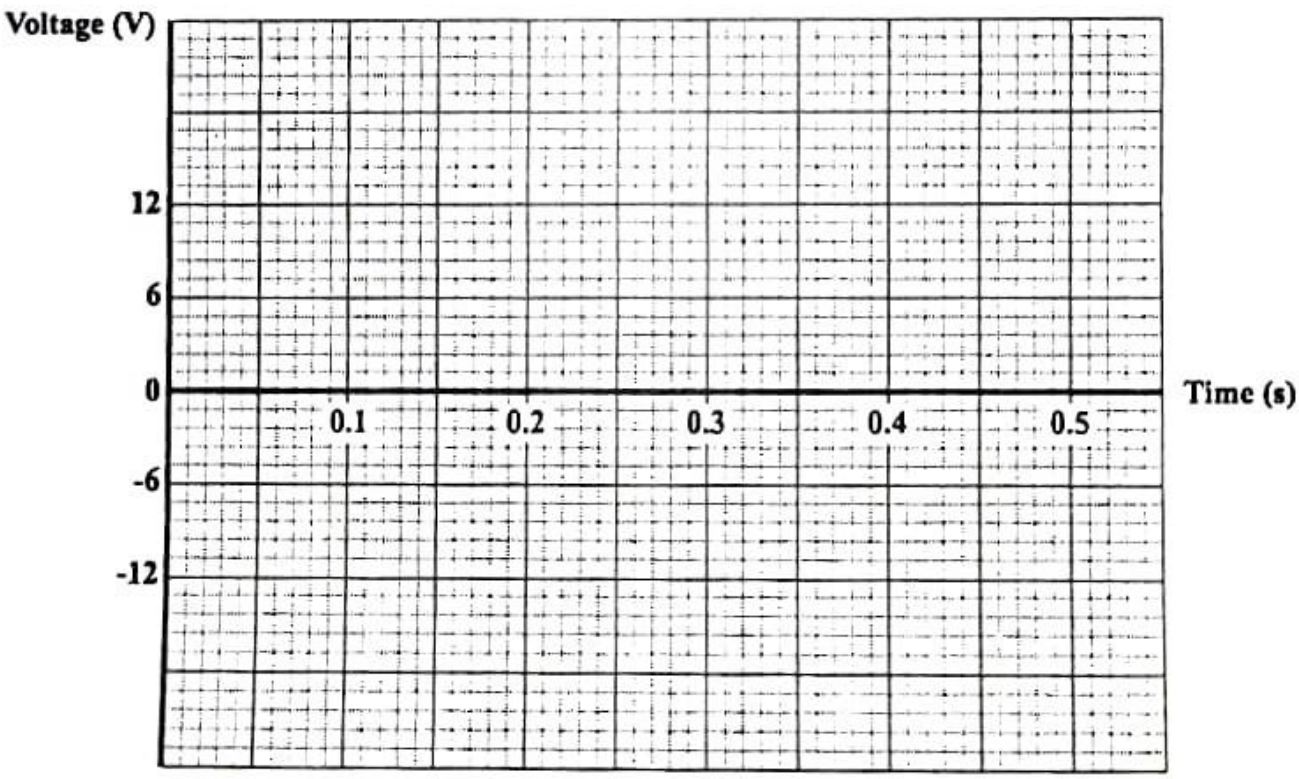


Figure 4. Voltage–time graph showing an a.c. source

ELECTROMAGNETISM

June 2010 #4

SECTION B

Answer ALL questions.

You MUST write your answers in the space provided after each question.

4. (a) With reference to the diagram of a simple d.c. motor shown in Figure 2

(i) explain how this motor works **(5 marks)**

(ii) give the purpose of the commutator. **(1 mark)**

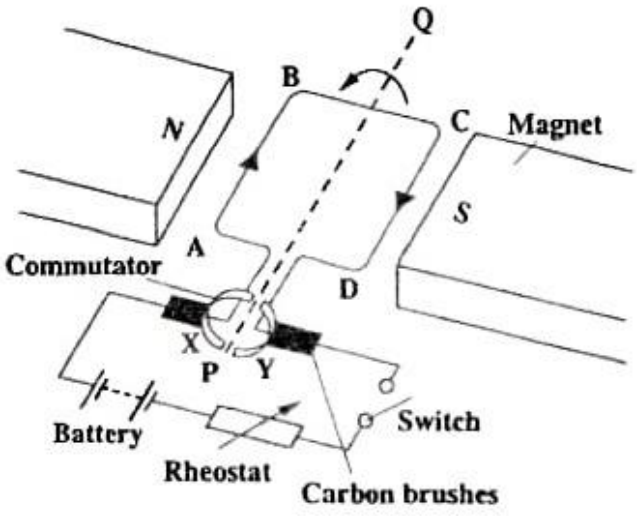


Figure 2. D.C. Motor

(b) A 24 V d.c. motor was used to lift a small appliance of mass 25 kg from the ground to the second floor of a multi-storey carpark. The floor is 30 m above the ground. The motor, operating at 100% efficiency, works at a steady rate and takes 5 s to complete the activity.

(i) Calculate the power provided by the motor. **(4 marks)**

(ii) Calculate the current drawn from the d.c. supply. **(4 marks)**

(iii) If the power required to lift the appliance was greater, what effect would this have on the value of the current? **(1 mark)**

Assume the voltage rating remains constant.

[g = 10 N Kg^{-1}]

Total 15 marks

Jan 2011 #5

5. (a) With the aid of at least one diagram, describe how the magnitude of the electromotive force (e.m.f.) induced in a conductor depends on the rate of change of magnetic flux that the conductor experiences. (6 marks)

(b) To make electric cars more efficient, they will need to be charged regularly using a magnetic field below the road surface. One solution is to designate one lane of the highway for recharging batteries.

(i) In the charging lane cars are required to keep moving. Why should this be so? (3 marks)

(ii) Assuming the magnetic field is constant, state with reason, how the speed of the car will affect the charging of the batteries. (3 marks)

(iii) In a certain section of road, 200 KW of power is expended to charge 100 cars. If each car converts 600 Watts of power to charging the battery, calculate the conversion efficiency. (3 marks)

Total 15 marks

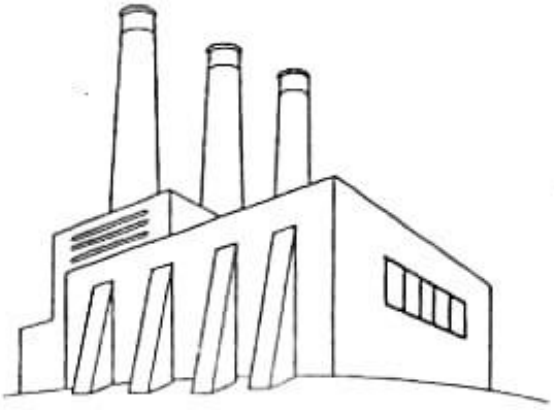
June 2011 #5

5. Many modern electrical appliances have been designed to operate with a.c. power rather than d.c. power because electrical power is transmitted as a.c. rather than d.c.

(a) (i) State TWO advantages of using a.c. to transmit electrical power. **(2 marks)**

(ii) Draw a diagram of a simple transformer indicating the features which enhance efficiency. **(4 marks)**

(b)



Electrical power produced by Powergen in Trinidad is stepped up from 11 000 V at 8 000 A to 110 000 V for transmission to Tobago.

(i) If the number of turns in the secondary coil is 900, calculate the number of turns in the primary coil for an ideal transformer. **(3 marks)**

(ii) Calculate the transmission current for the ideal transformer referred to at (b) (i). **(3 marks)**

(iii) Calculate the transmission power if the transformer is 70% efficient. **(3 marks)**

Total 15 marks

Jan 2012 #4

SECTION B

Attempt ALL questions.

You MUST write your answers in the spaces provided after each question.

4. (a) Figure 3 shows the diagram of a simple d.c. motor connected in a circuit.

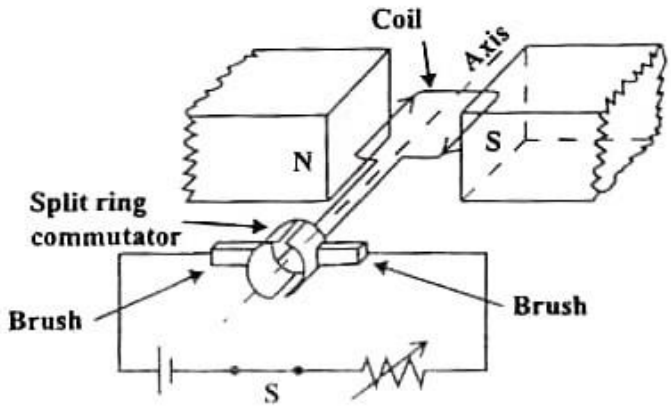


Figure 3. D.C. motor

With reference to the d.c. motor shown in Figure 3, explain how the coil is able to rotate continuously. **(6 marks)**

(b) The waveform shown in Figure 4 depicts the current through a resistor connected in an a.c. circuit.

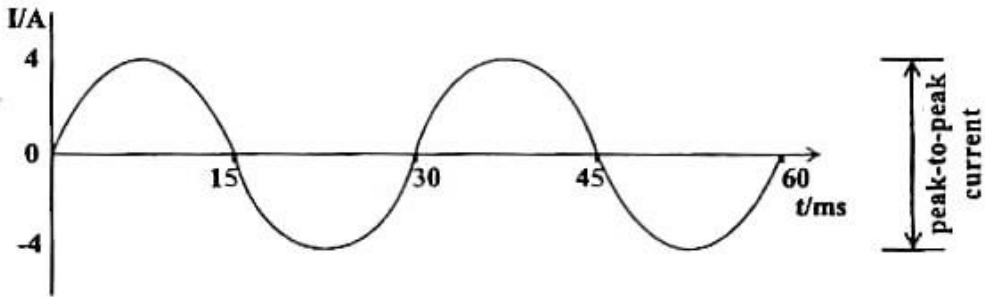


Figure 4. A.C. waveform

(i) Calculate the period and frequency of the alternating supply. **(3 marks)**

(ii) If the resistor is 45Ω, determine the peak-to-peak voltage across the resistor. **(3 marks)**

(iii) Calculate the maximum power dissipated in the resistor. **(3 marks)**

Total 15 marks

Jan 2013 #1

SECTION A

Attempt ALL questions.

You MUST write your answers in this answer booklet.

1. The data in Table 1 showing V_s and V_p were obtained when testing a transformer.

TABLE 1

V_p/V	V_s/V
2.4	21.1
3.5	32.3
4.4	40.5
6.1	54.6
7.7	69.9

(a) On page 3, plot a graph of V_s against V_p. **(7 marks)**

(b) Determine the gradient, S, of the graph.

(4 marks)

(c) Use the gradient, S, to calculate

(i) the number of turns in the primary, N_p, given that the number of turns in the secondary, $N_s = 750$

(4 marks)

(ii) the current in the secondary winding, if the primary current is 1.6 A.

(3 marks)

(d) (i) If the current in the secondary winding is actually 0.15 A, calculate the efficiency of this transformer.

(3 marks)

(ii) How would you know if this was 'an ideal transformer'?

(1 mark)

(e) State THREE features of the transformer that enable it to operate efficiently.

(3 marks)

June 2016 #4

SECTION B

Answer ALL questions.

4.(a) List THREE types of electromagnetic waves in order of increasing wavelength. Identify a use of EACH type of wave. **(6 marks)**

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(b) Humans can 'see' electromagnetic radiation only between the wavelengths of about 4×10^{-7} m and 7×10^{-7} m.
This is called the visible part of the spectrum.

A rattlesnake can detect e.m. radiation of frequency 3.5×10^{14} Hz and a honeybee can detect e.m. radiation of 1×10^{15} Hz.

Calculate the wavelengths corresponding to EACH frequency. **(5 marks)**

(c) Thunder is heard 2.3 seconds after a flash of lightning is seen. If the lightning strike is 750 m away, calculate the speed for this event. **(4 marks)**

[Speed of light, $c = 3 \times 10^8$ ms^{-1}] **Total 15 marks**

June 2017 #1

SECTION A

Answer ALL questions.

1. An experiment in which a magnet was allowed to fall through a coil was conducted to test the concept of induced e.m.f. The voltages were recorded at different time intervals.

Table 1 shows the results of the experiment.

TABLE 1

Time (ms)	Induced e.m.f. (V)
0	0.00
5	0.25
10	1.00
15	2.00
20	2.50
25	1.00
30	–0.75
35	–2.00
40	–1.00

(a) Using a scale of 2 cm to 5 ms on the horizontal axis and 2 cm to 0.5 V on the vertical axis, plot the graph of induced e.m.f., V, versus time, ms, on the grid provided on **page 5.** **(8 marks)**

(b) Use your graph to determine

(i) the induced e.m.f. after 12.5 milliseconds

.....

.....

(1 mark)

(ii) the time, in milliseconds, other than at the beginning of the experiment when the induced e.m.f. was 0 volts.

.....

.....

(1 mark)

(c) Kevin, a Physics student, conducted an experiment to determine the effects of electromagnetic induction. He used the following apparatus:

- A coil made of fine wires
- A sensitive galvanometer
- Connecting wires
- A bar magnet

Figure 1 shows the setup of the apparatus used by Kevin.

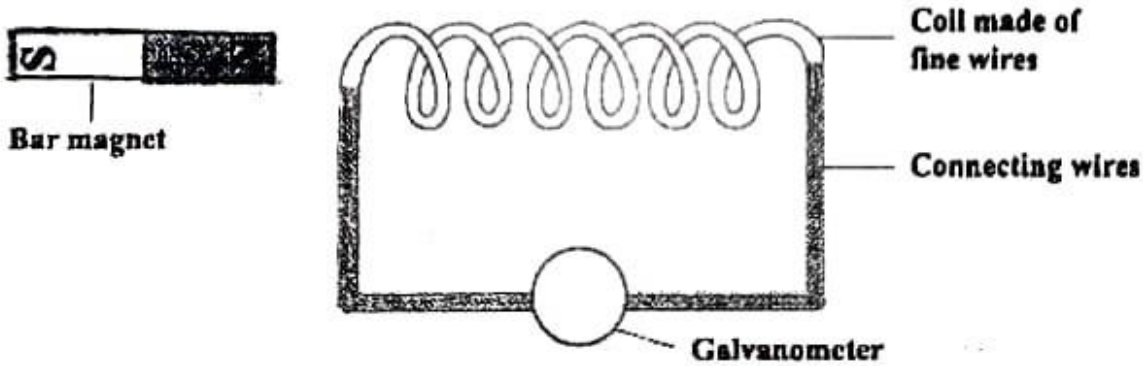

Figure 1

The magnet is pushed into the coil with the north pole entering first.

(i) Draw on Figure 1 the direction of the induced current and the direction of the arrow on the galvanometer as a result of this motion. **(2 marks)**

(ii) Explain why an induced current is produced. **(2 marks)**

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(iii) Why is it necessary to use a sensitive galvanometer? **(1 mark)**

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(iv) The magnet is then pulled out of the coil. Show on Figure 2 the direction of the induced current as a result of this motion . **(1 mark)**

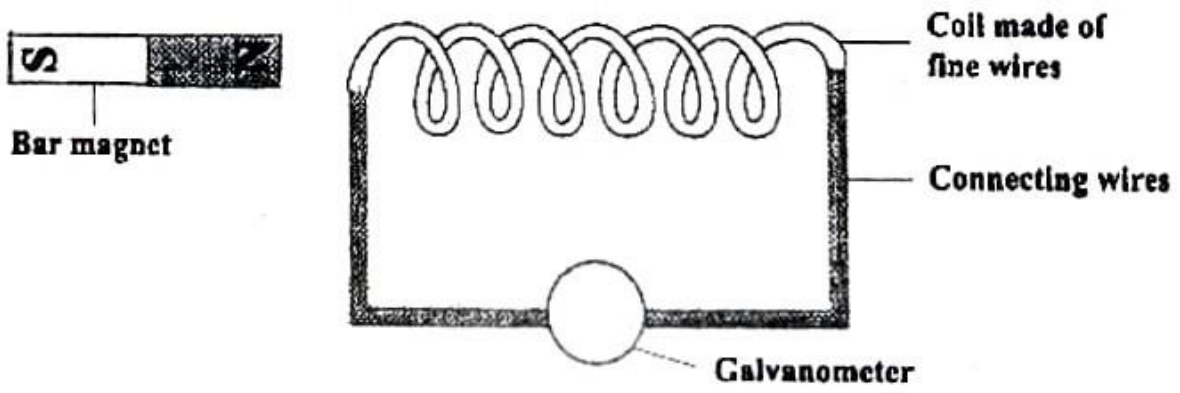

Figure 2

(v) State THREE changes or adjustments that Kevin could make in this experiment to increase the induced e.m.f. **(3 marks)**

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(vi) Describe what will happen if the magnet remains stationary in the coil. **(1 mark)**

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(d) Figure 3 shows a simple layout of an a.c. generator. A coil PQRS is connected to other components of the circuit which allow the coil to rotate in the direction indicated by the arrow.

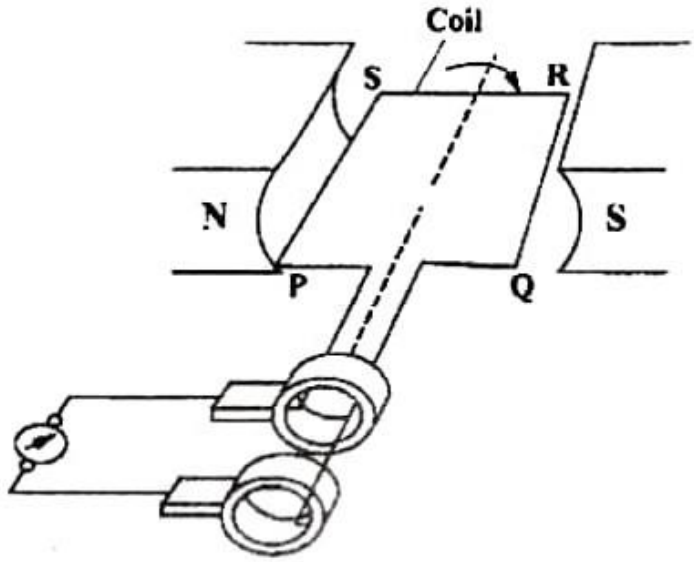

Figure 3

(i) Draw on Figure 3 the direction of the induced current if the coil rotates in a clockwise direction. **(1 mark)**

(ii) If the period of rotation of the coil is 0.02 s, calculate its frequency.

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(2 marks)

(iii) If the speed and direction of rotation of the coil are constant, sketch a graph of voltage (V) against time (s) to show the output for the generator for one complete cycle, given that it starts rotating from its current position.

(2 marks)

Jan 2018 #6

6. (a) Figure 6 shows the magnetic field between the poles of a strong magnet.

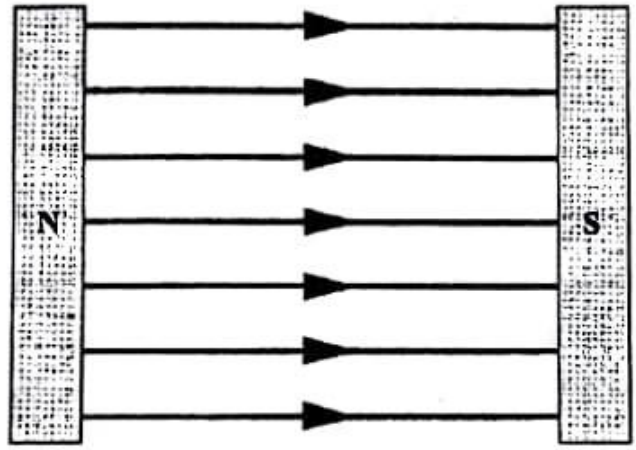

Figure 6. Magnetic field between the poles of a strong magnet

Complete the following diagrams to show

(i) the magnetic field due to a current carrying conductor where the current is directed into the plane of the paper **(2 marks)**

(ii) the resulting magnetic field when the current carrying conductor in (a) (i) is placed between the poles of the magnet, as shown in Figure 6. **(3 marks)**

(b) Figure 7 shows the end view of a simple d.c. motor.

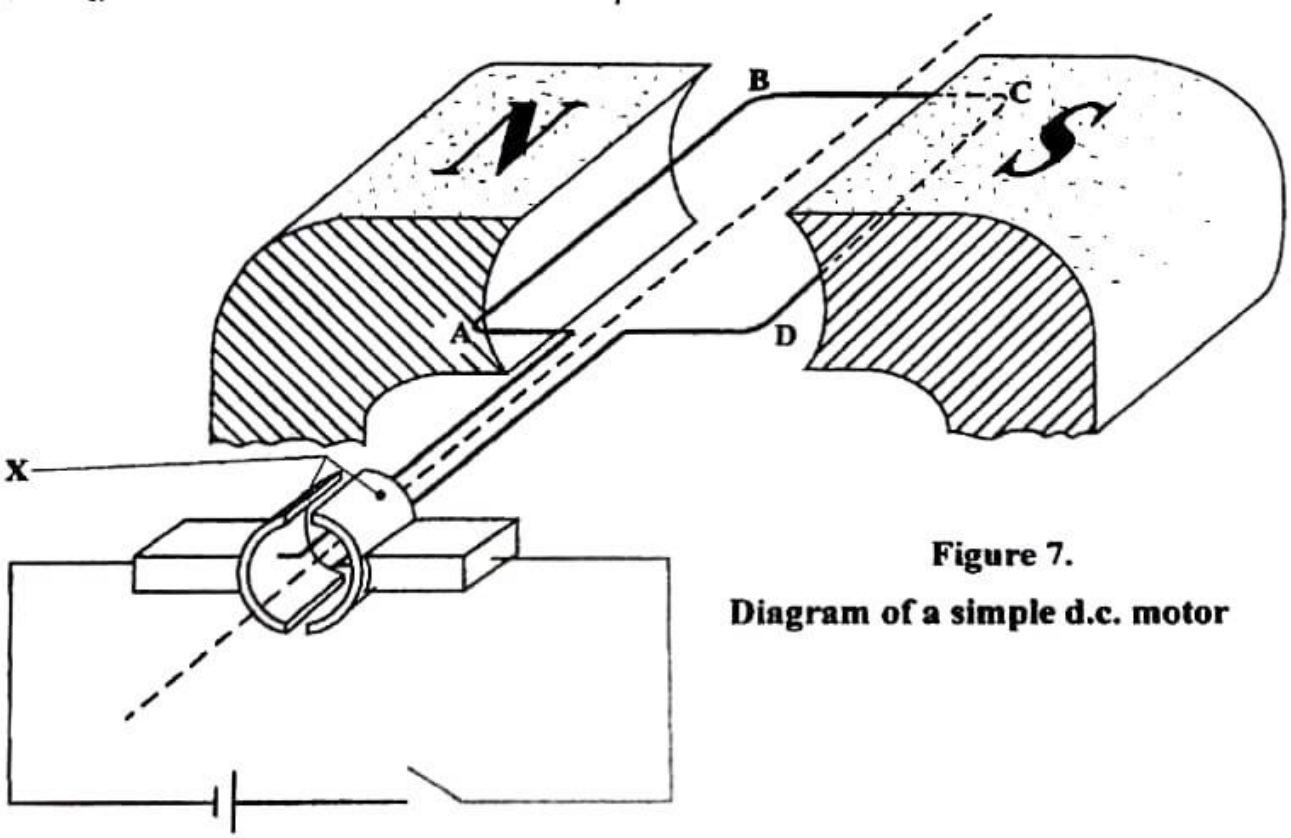

Figure 7.

Diagram of a simple d.c. motor

(i) Name the part labelled X ..... **(1 mark)**

(ii) Explain what happens when the switch is closed. Your answer should include the direction of the current, the forces acting, any rules applied, the direction of rotation and how continuous rotation is achieved. **(9 marks)**

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June 2018 #6

6. (a) A transformer is a commonplace technological tool used in our daily lives. Figure 6 shows one type of transformer used in electricity distribution.

(i) State the name of the parts labeled A, B, C and D in Figure 6 **(4 marks)**

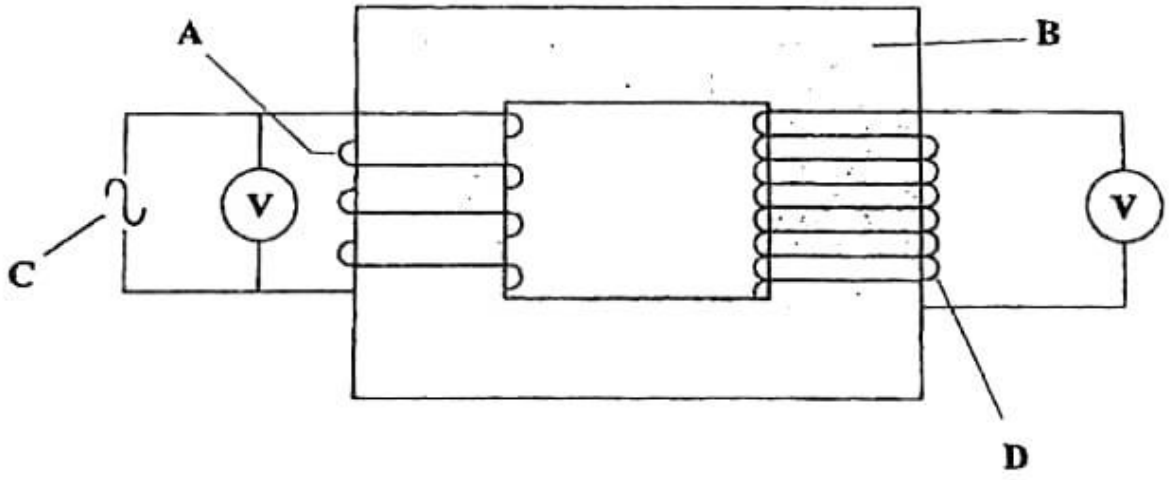

Figure 6. A transformer

A .....

B .....

C .....

D .....

(ii) Identify the type of transformer shown in Figure 6. **(1 mark)**

.....

.....

(iii) State the formula that relates voltage, V, to the number of turns, n, in a transformer. **(1 mark)**

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.....

(b) A transformer has 5000 turns in its secondary coil and 50 turns in its primary coil. The voltage supplied to its primary coil is 12.0 V a.c. and a current of 6.0 A flows in its primary coil.

Calculate

(i) the input power of the transformer **(4 marks)**

(ii) the voltage across the secondary coil **(2 marks)**

(iii) The maximum secondary current if the transformer is 100% efficient. **(3 marks)**

June 2019 #1

SECTION A

Answer ALL questions.

1.(a) Figure 1 is a diagram of a transformer. Name the parts labelled **X, Y** and **Z**. **(3 marks)**

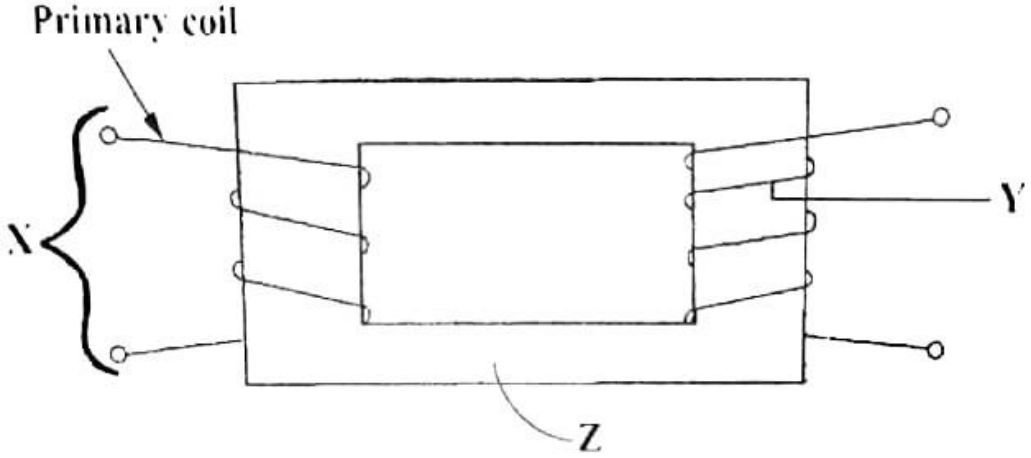

Figure 1. Transformer

X .....

Y .....

Z .....

The transformer shown in Figure 1 was tested and the values for the primary voltage, V_p, and the secondary voltage, V_s, were obtained. The data is shown in Table 1 below.

TABLE 1: VALUES FOR PRIMARY AND SECONDARY VOLTAGE

Primary Voltage, V_p/V	Secondary Voltage, V_s/V
1.5	14
3.0	26
5.0	45
6.0	53
7.5	67
8.0	72

(b) Using the grid **on page** 7, plot a graph of V_s against V_p. **(8 marks)**

(c) Determine the gradient, S. of the graph.. **(4 marks)**

(d) Use the gradient, S, to calculate

(i) the number of turns in the secondary coil, N_s , given that the number of turns in the primary coil. $N_p = 85$ **(4 marks)**

(ii) the current in the secondary coil, I_s , if the current in the primary coil. $I_p = 1.8$ A **(3 marks)**

(iii) the power output, .P_{out} of the transformer, given that the voltage in the secondary coil. $V_s = 55$ V **(3 marks)**

.....

SECTION E : THE PHYSICS OF THE ATOM

TABLE OF CONTENTS

TOPIC *Page Number*

MODEL AND STRUCTURE OF THE ATOM

Jan 2011 #6 a) – b)

6. (a) Some great scientists contributed to the modern-day view of the model of the atom. Two of these were J. J. Thompson and Ernest Rutherford.

For EACH of these scientists, describe briefly TWO main ideas they put forward concerning the nature of the atom, including the name of EACH of their models.

(6 marks)

(b) In final revision for your CSEC Physics examinations, your teacher gave you the following data on some unknown elements:

$$^{40}_{19}P;\quad ^{235}_{92}Q;\quad ^{40}_{18}R;\quad ^{238}_{92}X;\quad ^{39}_{19}Y$$

You are required to determine:

(i) which nuclides have the identical mass number

(ii) how many neutrons are in the heaviest nuclide

(iii) which nuclides are isotopes.

(5 marks)

June 2012 #4 a)

SECTION B

Answer ALL questions.

You MUST write your answers in the space provided after each question.

4. **(a)** Experiments into the fundamental nature of matter are being carried out at particle accelerator facilities. A hundred years ago, Geiger and Marsden performed the now famous gold – foil experiment at the suggestion of Rutherford.

Describe this experiment and explain how it established the nuclear structure of the atom.

(6 marks)

Jan 2014 #6 b) – d)

(b) Explain why an atom is normally neutral and stable. **(4 marks)**

(c) What are 'isotopes'? **(2 marks)**

(d) Figure 5 shows the structure of the atom of an element X:

n: neutrons p: protons e: electrons

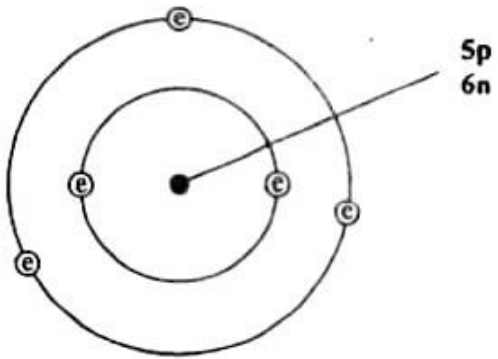

Figure 5

(i) State the mass number, atomic number and the charge on the nucleus of this atom.

(ii) Write the symbol for another possible isotope of X. **(4 marks)**

Jan 2017 #6 a) – b)

6.(a) Figure 8 shows a typical layout of Rutherford's experiment used to determine the composition of the atom.

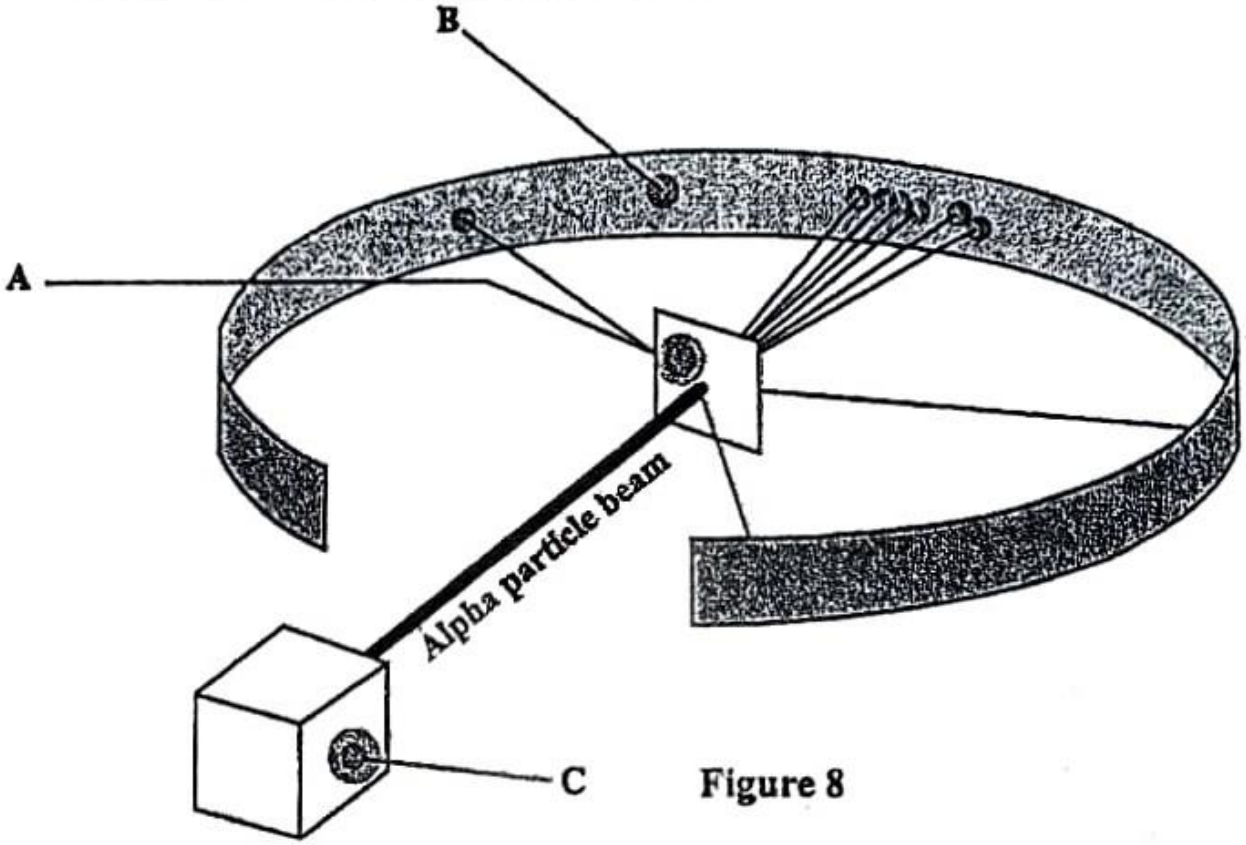

Figure 8

(i) State the names of the components labelled A, B and C. (3 marks)

A .....

B .....

C .....

(ii) Using your knowledge from Rutherford's experiment, explain why it was critically important for him to use the substance or element for the component labelled A. (2 marks)

.....

.....

.....

.....

(iii) State TWO conclusions from Rutherford's experiment about the model of the atom. **(2 marks)**

.....

.....

.....

.....

(b) The symbol $^{28}_{14}Si$ represents an atom of the metal silicon.

(i) Determine the number of neutrons found in ONE atom of silicon. **(1 mark)**

.....

(ii) Using the same standard notation, state a possible isotope of $^{28}_{14}Si$. **(1 mark)**

.....

June 2018 #2 a)

2. (a) (i) An atom consists of three types of particles: protons, neutrons and electrons. Complete the following table to show the charge of EACH particle. **(3 marks)**

TABLE 2. CHARGE OF PARTICLES IN AN ATOM

Particle	Charge
Proton	_____
Neutron	_____
Electron	_____

(ii) For the element $^{226}_{88}Ra$, determine the number of EACH of the three particles referred to in (a) (i). **(4 marks)**

Protons .....
.....

Neutrons .....
.....

Electrons .....
.....

(iii) State ONE similarity and ONE difference between the isotopes of an element. **(2 marks)**

Similarity .....
.....

Difference .....
.....

June 2019 #6 a)

6.(a) Lithium –7 is an isotope of lithium. The **mass number is 7** and the **atomic number is 3**.

(i) Use the information given above to determine the number of protons and neutrons present in an atom of lithium –7. **(2 marks)**

Protons .....

Neutrons .....

(ii) Draw a clearly labelled diagram of the structure of the lithium –7 atom. **(4 marks)**

RADIOACTIVITY

Jan 2010 #6

6. (a) It is suspected that a certain radioactive source emits alpha, beta and gamma radiations. With the aid of a diagram, describe how the presence of any TWO of the three types of radiation in such sample could be confirmed. **(6 marks)**

(b) Radioactive carbon $\left({}^{14}_{6}\mathrm{C}\right)$ loses a beta particle to become Nitrogen (N).

Write a nuclear equation to represent this nuclear reaction. **(3 marks)**

(c) Calculate the energy released in the solar fusion of deuterium represented by

$$ {}^{2}_{1}\mathrm{H} + {}^{2}_{1}\mathrm{H} \rightarrow {}^{4}_{2}\mathrm{He} + \text{energy} $$

Assume $u = 1.66 \times 10^{-27}$ kg

${}^{2}_{1}\mathrm{H}$ has an atomic mass of 2.0140 u

${}^{4}_{2}\mathrm{He}$ has an atomic mass of 4.0026 u

(6 marks)

June 2010 #6

6. (a) You were asked to present to your class, a comparison of alpha (α) with gamma (γ) radiation. Compare these two types of radiation in terms of their

(i) range in air

(ii) behaviour in an electric field

(iii) type of track in a cloud chamber. **(6 marks)**

(b) A nuclear scientist proposed the following nuclear reaction based on an artificial radioactive decay process to produce energy.

$$^{1}_{0}n + {}^{235}_{92}U \rightarrow {}^{143}_{54}Xe + {}^{90}_{38}Sr + 3({}^{1}_{0}n) + \text{Energy}$$

Table 2 below gives the atomic mass for each nuclide. ($u = 1.66 \times 10^{-27}$ Kg.)

Table 2

Nuclide	Atomic Mass /u
$^{1}_{0}n$	1.00867
$^{235}_{92}U$	235.04393
$^{143}_{54}Xe$	142.93489
$^{90}_{38}Sr$	89.90730

(i) Calculate the number of neutrons in Xenon (Xe). **(2 marks)**

(ii) Determine the energy released in the proposed nuclear reaction. **(4 marks)**

(iii) If the energy released in an alternative, natural decay reaction is 9.98×10^{-13}J, which would be the preferred method for the production of a nuclear power station? Justify your choice. **(2 marks)**

(iv) Give the reason for your decision in (iii). **(1 mark)**

[$c = 3.0 \times 10^{8}$ ms^{-1}]

Total 15 marks

Complete the table to answer 6 (a)

	(i) Range in air	(ii) Behaviour in an electric field	(iii) Track in a cloud chamber
Alpha α			
Gamma γ			

Jan 2011 #6 c)

(c) In a half-life experiment, the data shown in Table 4 were obtained.

TABLE 4

Count rate / minute	Time / second
4000	0.0
1000	55.0
500	80.0

Use the data to determine:

(i) TWO different values of the half-life of the element

(ii) The average half-life of the element **(4 marks)**

June 2011 #6

6. (a) (i) Outline THREE uses of radioisotopes in medicine. (3 marks

(ii) State THREE safety precautions to be taken when using radioactive substances. (3 marks

(b) (i) A gram of living plant material with Carbon –14, decays at a rate of about 1(disintegrations per minute. When the plant dies, the Carbon –14 decays, witl a half-life of 5 600 years. A gram of the dead plant is found to decay at abou 1 disintegration per minute. Calculate the probable age of the plant. (4 marks

(ii) The mass of the sun is lost at the rate of 2.0×10^9 kg s^{-1}. If the speed of light i a vacuum is 3.0×10^8 m s^{-1}, calculate the power output of the sun in kilowatts (5 marks

Total 15 marks

Jan 2012 #3

3. (a) (i) Albert Einstein put forward a theory that if the energy of a body changes, then its mass also changes. State the equation which relates these changes, clearly identifying the symbols or letters used in the equation.

_____

_____

_____

_____

(3 marks)

(ii) State TWO arguments EACH **for** and **against** the utilization of nuclear energy.

For: 1. _____

_____

2. _____

_____

Against: 1. _____

_____

2. _____

_____

(4 marks)

(b) Nuclear fission is a nuclear reaction in which a moving neutron strikes the nucleus of an atom splitting it into lighter nuclei, often producing free neutrons and photons in the form of gamma rays. One such reaction is given below.

$$ {}^{1}_{0}\text{n} + {}^{235}_{92}\text{Uranium} \rightarrow {}^{A}_{56}\text{Barium} + {}^{90}_{Z}\text{Krypton} + 3\left({}^{1}_{0}\text{n}\right) + \text{energy} $$

(i) Calculate the values of A and Z.

(2 marks)

(ii) The energy released in the given reaction is 1.8×10^{-12} J. Calculate the excess mass (mass change) in this reaction.

(3 marks)

(c) Fusion is the joining together of two nuclei. One possible fusion reaction is

$$ {}^{2}_{1}\text{Deuterium} + {}^{3}_{1}\text{Tritium} \rightarrow {}^{P}_{Q}\text{X} + {}^{1}_{0}\text{neutron} + \text{energy.} $$

By calculating P and Q, identify the nucleus X.

[$c = 3.0 \times 10^{8}$ ms^{-1}] **(3 marks)**

June 2012 #4 b)

(b) One type of reaction in a nuclear reactor involves the bombarding of an Uranium atom ($^{235}_{92}U$) with a neutron. In the process, Krypton (Kr) and Barium (Ba) are created along with the release of 2 neutrons and energy. The incomplete equation for this reaction is:

$$^{235}_{92}U + {}^{1}_{0}n \rightarrow {}_{36}Kr + {}^{144}Ba + 2\ {}^{1}_{0}n + \text{energy}$$

(i) Rewrite and complete the nuclear equation for this process.

_____

_____

_____

_____

(2 marks)

(ii) Table 3 below gives atomic mass data for nuclides.

TABLE 3

Nuclide	Atomic Mass / u
$^{235}_{92}U$	235.118
$^{}_{36}Kr$	89.947
^{114}Ba	143.881
$^{1}_{0}n$	1.009

where $u = 1.66 \times 10^{-27}$ kg

Calculate the energy released in the nuclear reaction in 4 (b)(i). State your answer in Joules.

[$c = 3.0 \times 10^{8}$ m s^{-1}]

(7 marks)

June 2013 #6

6. (a) Describe an experiment to compare the ranges of β and γ emissions in aluminium.

(6 marks)

(b) A liquid fluoride thorium reactor is said to be the new 'green' nuclear reactor.

(i) Rewrite the nuclear sequence to show how thorium-232 becomes uranium-233, a nuclear fuel, by calculating the numerical values of x, y, u, v, and z.

$$^{1}_{0}n + {}^{232}_{90}Th \longrightarrow {}^{x}_{y}Th$$

$${}^{x}_{y}Th \longrightarrow {}^{0}_{-1}e + {}^{u}_{v}Pa$$

$${}^{u}_{v}Pa \longrightarrow {}^{0}_{-1}e + {}^{233}_{z}U$$

(5 marks)

(ii) The equation representing the fission of U- 233 is

$$^{233}_{92}U + {}^{1}_{0}n \longrightarrow {}^{133}_{51}Sb + {}^{98}_{41}Nb + 3\,{}^{1}_{0}n + \text{energy}\ .$$

Table 4 provides the data for these nuclides where u = 1.66×10^{-27} kg.

TABLE 4

Nuclide	Atomic Mass/u
$^{233}_{92}U$	233.03964
$^{133}_{51}Sb$	132.91525
$^{98}_{41}Nb$	97.91033
$^{1}_{0}n$	1.00867

Calculate the energy released in the fission of $^{233}_{92}U$.

$c = 3.0 \times 10^{8}$ m s^{-1}

(4 marks)

6. (a) A nucleus of a radioactive isotope radium $^{226}_{86}$Ra emits an α-particle (alpha-particle) when it decays to a nucleus of the element radon, Rn.

(i) Write the equation representing this decay process. **(3 marks)**

(ii) How many neutrons are in the $^{226}_{86}$Ra nucleus? **(2 marks)**

6. (a) In 20 days, the activity of a sample of Bismuth decreases to one-sixteenth of its original activity.

(i) Define the term 'half-life'. **(2 marks)**

(ii) Calculate the half-life of Bismuth. **(4 marks)**

(b) Radioisotopes have many useful applications, but overexposure is a health hazard.

State TWO useful applications of radioisotopes and TWO precautions to be taken when handling radioisotopes. **(4 marks)**

(c) During the fission of 1 kg of Uranium –235, 6.7×10^{10} J of energy is released and there is a change in its mass.

Calculate the new mass. **(5 marks)**

Total 15 marks

Jan 2015 #6

6. **(a)** In order to separate the emissions from a radioactive source, they are subjected to a uniform electric field, E, perpendicular to their path as shown in Figure 5.

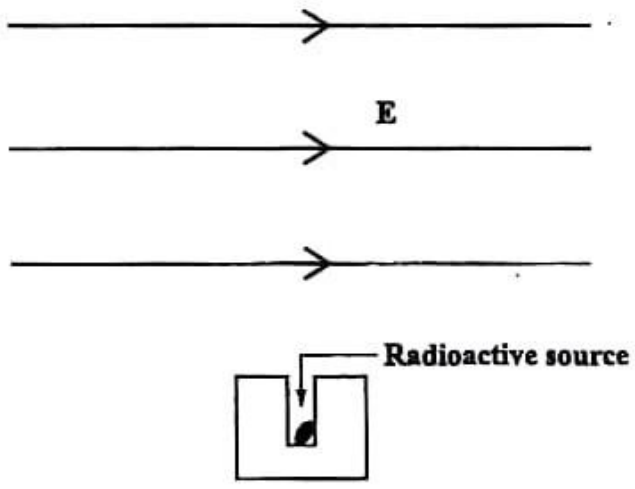

Figure 5

(i) Describe the path of each of the three emissions (α, β and γ) when subjected to a uniform electric field from left if the emissions are projected up towards the top of your page. **(3 marks)**

(ii) If the electric field is replaced by a uniform magnetic field into the page, predict the path of the emissions. **(3 marks)**

(b) One isotope of lead $^{210}_{82}Pb$, is not stable but can undergo exactly three distinct decays o an alpha or beta particle to become stable lead.

With reference to the information in Table 5, write a possible sequence of three nuclea equations that can result in $^{206}_{82}Pb$ (stable lead) from $^{210}_{82}Pb$.

TABLE 5

Element	Atomic Number
Bi	83
Po	84

(6 marks

(c) Calculate the energy given off in a nuclear reaction if the change in mass is 0.2014 u. **(3 marks)**

($u = 1.66 \times 10^{-27}$ kg; $c = 3.0 \times 10^{8}$ ms^{-1}).

June 2015 #1

SECTION A

Answer ALL questions.

1. The activity of a radioactive sample was measured over a 24-day period. The results are recorded in Table 1.

TABLE 1

Time (*t*) days	Activity (*A*) Disintegrations per second
0	40.0
4	29.5
8	20.0
12	14.0
16	10.0
20	6.5
24	5.0

(a) Plot a graph, **on page 3**, of Activity (*A*) versus Time (*t*). **(8 marks)**

(b) Using your graph, calculate the **average** half-life of the sample, determined from the average of two or three values.

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(12 marks)

(c) Use the graph to determine the activity of the sample after 25 days.

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(2 marks)

(d) (i) State TWO types of radioactive emissions.

(1) .....

(2) .....

(2 marks)

(ii) Which type of radioactive emission is the **most** dangerous to human tissue?

.....

(1 mark)

June 2016 #1

SECTION A

Answer ALL questions.

1. The activity of a radioactive sample was measured over a six-hour period. The results are recorded in Table 1.

TABLE 1

Time (*t*) in hours	Activity (*A*) Disintegrations per second
0	80.0
1	50.0
2	34.5
3	20.0
4	13.0
5	7.5
6	5.0

(a) Using the grid on **page 5**, plot a graph of Activity (*A*) versus Time (*t*).

(8 marks)

(b) (i) From your graph, determine the half-life of the sample. **(5 marks)**

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(ii) Using your graph, determine a more accurate value of the half-life of the sample. **(6 marks)**

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(c) From your graph, and using dotted lines, determine how long it takes for the activity of the sample to be reduced to 10 disintegrations per second, from its original activity level. **(2 marks)**

.....

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.....

(d) State ONE reason why a line drawn through all the points would not form a perfectly smooth curve. **(1 mark)**

.....

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.....

(e) All elements including radioactive substances have an 'atomic number' and 'mass number'. Explain what the two terms mean. **(2 marks)**

Atomic number: .....

.....

Mass number: .....

.....

(f) In medicine, Iodine–123, $\left[{}^{123}_{53}\mathrm{I}\right]$ is used to check a patient's thyroid function.

What does '123' represent? **(1 mark)**

.....

.....

.....

Jan 2017 #6 c)

(c) A radioactive element X undergoes a decay process which results in the formation of a new element Y, as shown in the following equation.

$$^{222}_{76}X \rightarrow {}^{p}_{q}Y + {}^{4}_{2}He$$

(i) State the type of decay process that occurred. **(1 mark)**

.....

(ii) Determine the values of p and q. **(2 marks)**

(iii) If element Y then undergoes a beta decay and forms an element Z, write the reaction equation. **(2 marks)**

(iv) How does radioactive decay affect a particle's mass? **(1 mark)**

June 2017 #3

3. (a) Elements with unstable nuclei are susceptible to decay.

(i) What is meant by the term 'nuclear fission'?

.....

.....

(1 mark)

(ii) State TWO advantages of utilizing nuclear energy.

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.....

(2 marks)

(b) Workers in nuclear power plants need to be extra careful on the job.

(i) State ONE precaution that workers in nuclear power plants need to take.

.....

.....

(1 mark)

(ii) Give TWO disadvantages of using nuclear reactors to generate energy.

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(2 marks)

(c) Uranium isotope U-238 undergoes nuclear fussion when struck by a neutron. Barium-139 and krypton-97 nuclei are emitted along with three neutrons as shown in the following equation.

$$^{238}_{92}U + ^{1}_{0}n \longrightarrow ^{139}_{\rho}Ba + ^{97}_{36}Kr + 3\ ^{1}_{0}n$$

Uranium -238	398.350×10^{-27} kg
Barium -139	232.560×10^{-27} kg
Krypton -97	152.620×10^{-27} kg
Neutron	1.670×10^{-27} kg
c	3.0×10^{8} ms^{-1}

(i) State the value of ρ. **(1 mark)**

.....

(ii) State the meaning of 'c' in Einstein's equation $\Delta E = \Delta mc^2$ **(1 mark)**

.....

(iii) Calculate the **total** mass of the elements formed after the reaction. **(2 marks)**

(iv) Calculate the energy released in the reaction.

(4 marks)

(v) State ONE use of the energy released from the reaction.

.....

.....

(1 mark)

Total 15 marks

SECTION B

Answer ALL questions.

You MUST write your answers in this answer booklet.

4. (a) The 2011 Fukushima nuclear disaster raised questions about the wisdom of utilizing nuclear power. State TWO arguments for and TWO arguments against the use of nuclear fission reactors. **(4 marks)**

Arguments for

1. .....

.....

2. .....

.....

Arguments against

1. .....

.....

2. .....

.....

(b) Nuclear fusion is seen as the great energy hope of the future. State TWO advantages of nuclear fusion over nuclear fission. **(2 marks)**

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(c) Correctly complete the following nuclear fusion reaction. **(3 marks)**

$$^{2}_{1}H + {}^{2}_{1}H \rightarrow \_\_\_\_\_ + {}^{1}_{1}H$$

.....

.....

.....

(d) A commonly used fusion reaction is

$$^{2}_{1}H + {}^{3}_{1}H \longrightarrow {}^{4}_{2}He + {}^{1}_{0}n.$$

The mass of the reactants and products for this reaction are recorded in Table 4 below.

TABLE 4

Nuclide	Mass/u
$^{2}_{1}H$	2.01410178
$^{3}_{1}H$	3.01604927
$^{4}_{2}He$	4.00260325
$^{1}_{0}n$	1.00866492

$u = 1.66 \times 10^{-27}$ kg $\quad$ $c = 3.0 \times 10^{8}$ m s^{-1}

Using the information in Table 4, calculate the energy released in this reaction.

(6 marks)

Total 15 marks

June 2018 #2 b)

(b)(i) Define the term 'half-life' of a radioactive substance. **(2 marks)**

.....

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.....

(ii) The element thorium (Th) has a half-life of 24 days and undergoes beta-decay. Calculate the time it would take for 10 grams of thorium to decay to 1.25 grams. **(4 marks)**

6.(a) Complete Table 3 below to show the properties of the THREE types of radioactive emissions. **(6 marks)**

TABLE 3: PROPERTIES OF RADIOACTIVE EMISSIONS

Type of Radioactive Emission	Charge	Ionizing Ability
Alpha /α		
Beta / β		
Gamma / γ		

(b) Complete the following nuclear equations. **(4 marks)**

(i) $^{14}_{6}C \dashrightarrow {}^{14}_{7}N + \square$

(ii) $^{226}_{88}Ra \dashrightarrow {}^{222}_{86}Rn + \square$

(c) A radioactive sample had an initial count of **1000** as measured on a Geiger–Müller counter.

After 15 hours, the count rate was **250**.
Calculate the half-life of the sample. **(5 marks)**

Total 15 marks

June 2019 #6

6.(a) Lithium –7 is an isotope of lithium. The **mass number is 7** and the **atomic number is 3**.

(i) Use the information given above to determine the number of protons and neutrons present in an atom of lithium –7. **(2 marks)**

Protons .....

Neutrons .....

(ii) Draw a clearly labelled diagram of the structure of the lithium –7 atom. **(4 marks)**

(b) In four days, the activity of a sample of lithium decreases to one-sixteenth of its original activity.

(i) Define the term 'half-life'. **(2 marks)**

.....

.....

.....

.....

6.(b) (ii) Calculate the half-life of lithium.. **(3 marks)**

(c) Calculate the energy given off in a nuclear reac ion if the change in mass is **0.2014 u.** **(4 marks)**

($u = 1.66 \times 10^{-27}$ kg , $c = 3.0 \times 10^{8}$ ms^{-2})

Total 15 marks

Jan 2020 #6

6.(a) Three emissions, α, β, γ, from a radioactive source are subjected to a uniform magnetic field perpendicular to their path, as shown in Figure 5.

(i) Draw the three rays to represent the path of EACH of the three emissions, α, β, γ, on Figure 5, as they pass through the magnetic field. **(3 marks)**

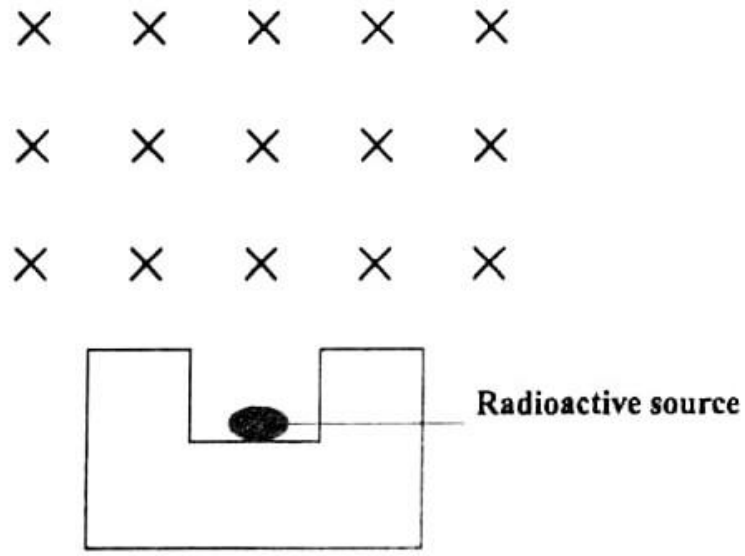

Figure 5. Radioactive source in a uniform magnetic field

(ii) The magnetic field is replaced by an electric field as shown in Figure 6. Draw the three rays to represent the path of EACH of the three emissions, α, β, γ, on Figure 6, as they pass through the electric field. **(5 marks)**

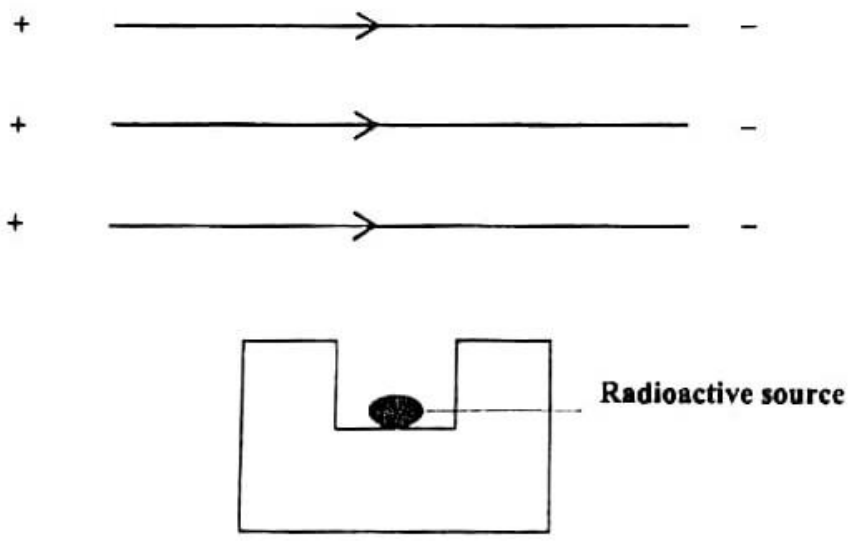

Figure 6. Radioactive source in an electric field

(b) An unstable isotope of lead, $^{210}_{82}Pb$, undergoes exactly two sequential beta particle decays followed by an alpha particle decay to become stable lead, $^{206}_{82}Pb$.

With reference to the information in Table 3, write the nuclear equations that will result in the formation of stable lead, $^{206}_{82}Pb$ from $^{210}_{82}Pb$. **(6 marks)**

TABLE 3: ELEMENTS AND ATOMIC NUMBERS

Element	Atomic Number
Bi	83
Po	84

First beta decay equation .....

Second beta decay equation .....

Alpha decay equation .....

(c) Calculate the energy given off in a nuclear reaction if the change in mass is **0.3018 u**.

($u = 1.66 \times 10^{-27}$ kg, $c = 3 \times 10^{8}$ ms^{-1}) **(3 marks)**

Total 15 marks