NAME	CLASS	INDEX NO.

ST. PATRICK'S SCHOOL
PRELIMINARY EXAMINATIONS 2016

SUBJECT : PHYSICS 5059 (PAPER 1) DATE : 25 AUG 2016

LEVEL : SECONDARY 4 EXPRESS DURATION : 1 HOUR

INSTRUCTIONS TO CANDIDATES

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO.

1. Write your name, class and index number on the **Question Paper** and the **Optical Answer Sheet** in the spaces provided. **It is also required that you WRITE and SHADE your index number on the Optical Answer Sheet.**
2. Answer **ALL** questions on the **Optical Answer Sheet** provided.
3. Throughout the paper, the **acceleration due to gravity on Earth** is taken as 10 N/kg **unless stated otherwise.**
4. Calculators may be used where necessary. **Where numerical answers are not exact, give answers to THREE (3) significant figures.**
5. Submit the **Optical Answer Sheet** and the **Question Paper SEPARATELY** at the end of the examination.

This question paper consists of 16 *printed pages.*

Each question is provided with ***four*** *possible answers (**A**, **B**, **C** and **D**). Select the most appropriate answer and* ***shade*** *your choice on the* ***Optical Answer Sheet*** *provided.*

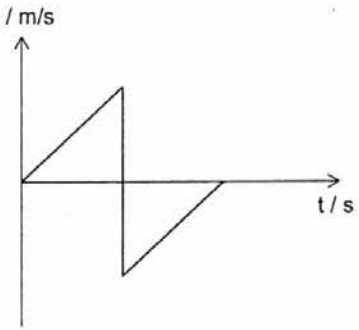
1 Which one of the following pairs are both vector quantities?

A Force and power
B Pressure and volume
C Acceleration and weight
D Density and kinetic energy

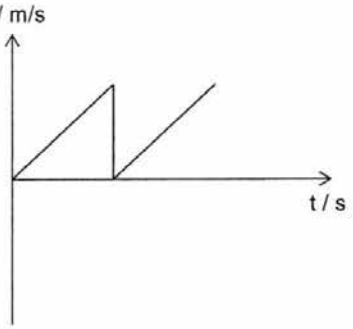
2 A ball is dropped from the top of a ladder. It falls vertically through air and rebounds in a vertical path upon hitting the ground.

Assuming that no energy is lost during its impact with the ground and negligible air resistance, which one of the following velocity-time graphs best describes the motion of the ball?

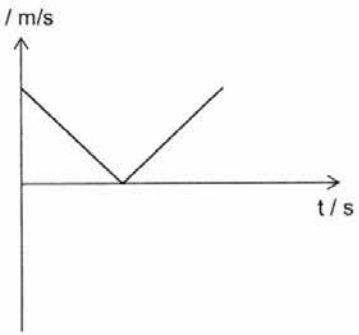
A



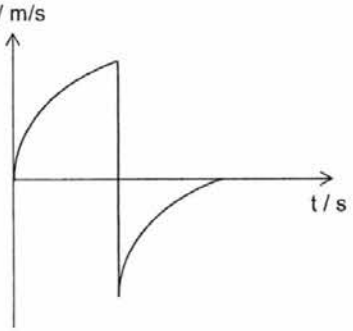
B



C



D

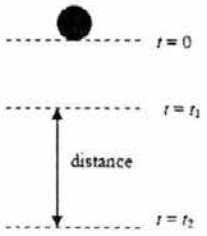


3 A road has lamp posts at every 80 m. When a car with uniform acceleration passes by one lamp post, it has a speed of 5 m/s, and when it passes the next lamp post, its speed is 20 m/s.

What is the acceleration of the car?

A $0.94\ m/s^2$
B $1.25\ m/s^2$
C $2.34\ m/s^2$
D $3.75\ m/s^2$

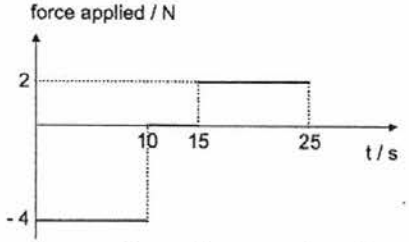
4 A ball is dropped vertically from rest at time **t** = 0 s and accelerates downwards with an acceleration **g** as shown in the diagram.



What distance does it cover between **t** = t_1 s and **t** = t_2 s?

A $\frac{1}{2}gt_2^2$
B $\frac{1}{2}g(t_1+t_2)$
C $\frac{1}{2}g(t_2-t_1)^2$
D $\frac{1}{2}g(t_2^2-t_1^2)$

5 A 10 kg mass is initially at rest on a rough horizontal surface. A horizontal force is then applied to it and the force applied varies according to the diagram shown.



Given that the frictional force acting on the mass when it is moving is 2 N, what is the acceleration of the mass between 15 s to 25 s?

A $0\ m/s^2$
B $0.2\ m/s^2$
C $0.4\ m/s^2$
D $0.6\ m/s^2$

6 Which of the following correctly describe(s) an action-reaction pair?

I Both forces act at the same time.
II Both forces act on the same body.
III Both forces act in different direction.
IV Both forces have the same magnitude.

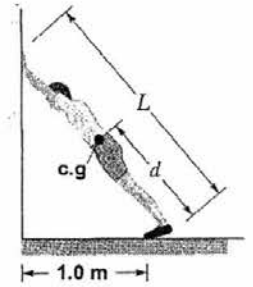
A I only
B II and III only
C I, III and IV only
D I, II, III and IV

7 Brass is an alloy formed by mixing two metals, copper and zinc. For a particular piece of brass, 20 % (by volume) consists of copper while 80 % (by volume) consists of zinc.

Given that the densities of copper and zinc are 8.9 g/cm^3 and 7.1 g/cm^3 respectively, what is the average density of this particular brass alloy?

A $7.46\ g/cm^3$
B $8.00\ g/cm^3$
C $53.0\ g/cm^3$
D $746\ g/cm^3$

8 The diagram shows an 80 kg man leaning out against a vertical ice wall that has negligible resistance.

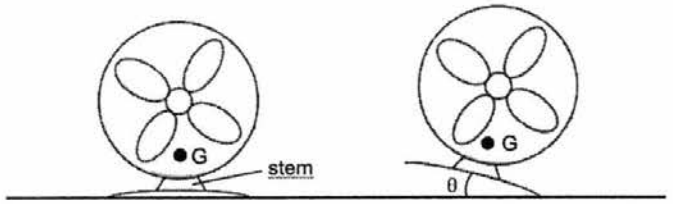


Distance **L** is 2.1 m and his centre of gravity (c.g.) is 1.1 m from his feet-ground contact point (or **d** = 1.1 m).

If he is on the verge of slipping, what is the friction force between his feet and ground?

A 227 N
B 237 N
C 270 N
D 273 N

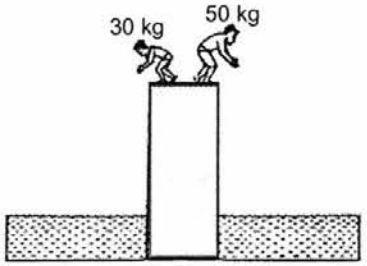
A standing fan can topple if tilted. The centre of gravity of the fan is marked **G** and the angle of tilt is marked θ.



Which one of the following statements is **true**?

A The fan will topple only when θ is more than 45°.
B The fan will topple only when θ is more than 90°.
C The fan will topple at a smaller angle θ if weights are added to its base.
D The fan will topple at a smaller angle θ if the stem of the fan is extended longer.

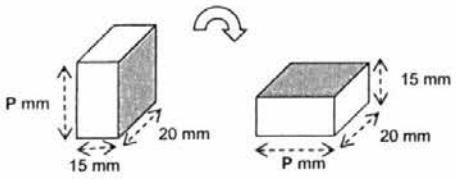
10 The figure shows two trainee divers diving from the same height into a pool.



Assuming that the air resistance is negligible, which one of the following physical quantity is different between the divers just before they hit the water?

A Velocity
B Acceleration
C Kinetic energy
D Distance travelled

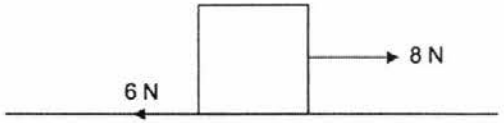
11 A block of metal is shown standing on the floor. It is then turned onto one of its longer faces.



If the pressure between the block and the floor is reduced by 4 times as a result, what is the length of **P**?

A 40 mm
B 60 mm
C 75 mm
D 80 mm

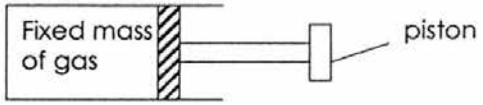
12 A box is pushed 10 m along a horizontal surface by a force of 8 N. The frictional force opposing the motion is 6 N as shown in the diagram.



How much of the work done is converted to thermal energy and kinetic energy of the box?

	Thermal energy / J	Kinetic energy of the box / J
A	20	60
B	60	20
C	60	80
D	80	60

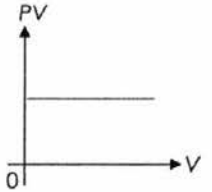
13 The diagram shows a cylinder with a piston containing a fixed mass of air.



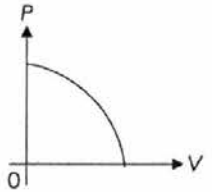
The temperature is kept constant and the piston is gradually pushed into the cylinder.

Which one of the following graphs does not show the variation of the volume **V** of the gas with its pressure **P**?

A



B



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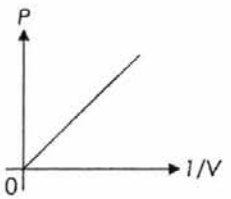

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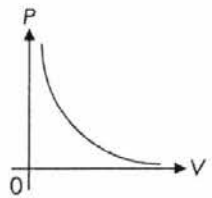
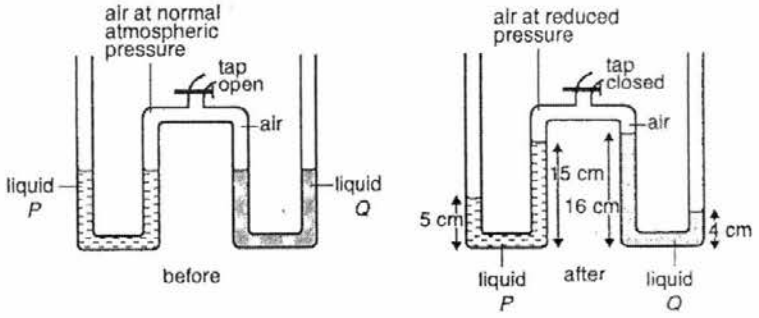


14 The diagram shows the situation before and after some air has been drawn out of the glass tube.



If the density of liquid **P** is 0.80 g/cm^3, find the density of liquid **Q**.

A 0.67 g/cm^3 **B** 0.75 g/cm^3
C 0.83 g/cm^3 **D** 1.20 g/cm^3

15 Stars form in space from huge clouds of hydrogen atoms that attract one another because of the force of gravity. As the atoms attract, the cloud gets smaller and the atoms move faster. What effect will this have on the temperature and pressure in the cloud?

	Temperature	Pressure
A	No change	Increases
B	Decreases	No change
C	Increases	Decreases
D	Increases	Increases

16 The resistance of a resistance thermometer is 3.21 Ω at 10 °C and 4.20 Ω at 100 °C. What is the temperature at which the resistance is 3.76 Ω?

A 40 °C **B** 50 °C
C 56 °C **D** 60 °C

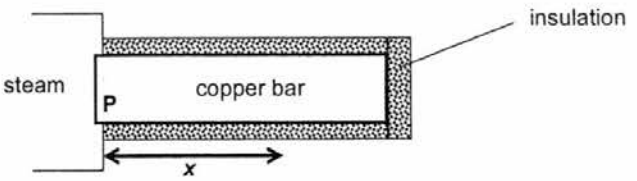
17 Which of the following is/are true when a substance undergoes a change of state from liquid to gas?

I Internal energy is increased.
II Potential energy is increased.
III Work is done to break the intermolecular bonds between its particles.

A I only **B** II only

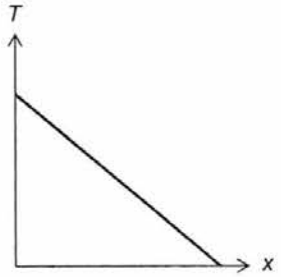
C II and III only **D** I, II and III

18 A cylindrical copper bar of length 0.50 m has one end P in contact with a continuous supply of steam. The sides and the other end of the bar are well-insulated as shown in the diagram.

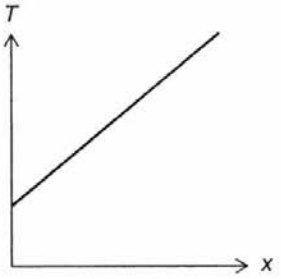


After several hours, how does temperature of the bar, ***T*** vary with the distance ***x***, from point **P**?

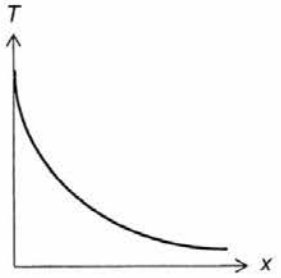
A



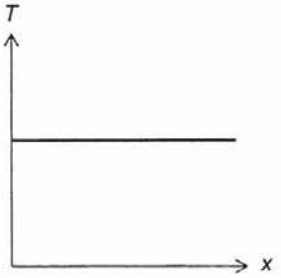
B



C

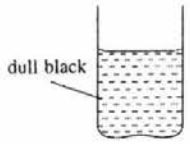


D

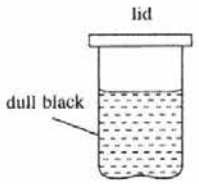


The diagram shows four similar containers. Each container contains the same volume of water initially at 30 °C. They are left exposed to the sun's rays for ten minutes. Which container contains the hottest water?

A



B



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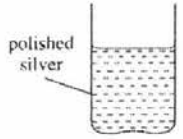
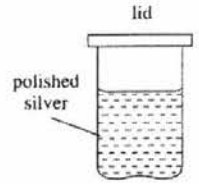
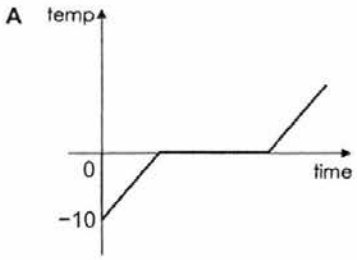


D

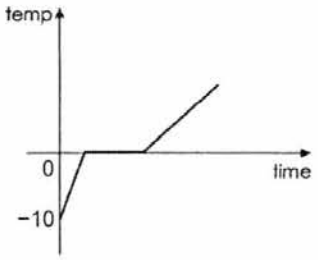


20 A block of ice at −10 °C was heated. Given that ice has a lower specific heat capacity as compared to water, which one of the following correctly illustrates the heating curve?

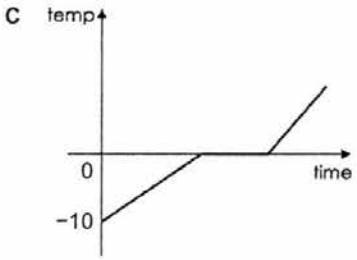
A



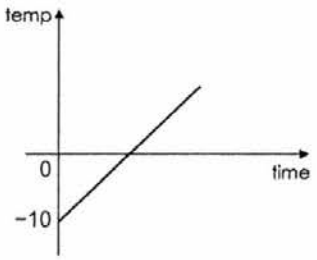
B



C



D



21 Which one of the following properties makes ice a good coolant for drinks?

A Low specific heat capacity
B Low specific latent heat of fusion
C High specific latent heat of fusion
D High specific latent heat of vaporization

22 Cooling water enters the heat exchanger in the turbine hall of a nuclear power station at 6.0 °C and leaves at 14.0 °C. What is the rate of water flow if the rate of heat removal by the water is 6.7×10^9 J per minute and the specific heat capacity of water is 4 200 J/kgK?

A $\dfrac{4200 \times 8}{6.7 \times 10^9 \times 60}$ kg/s

B $\dfrac{4200 \times 8 \times 60}{6.7 \times 10^9}$ kg/s

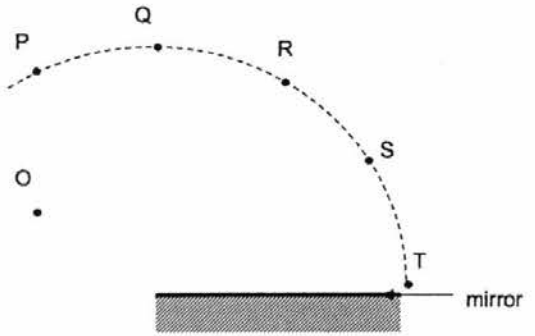
C $\dfrac{6.7 \times 10^9}{4200 \times 8 \times 60}$ kg/s

D $\dfrac{6.7 \times 10^9 \times 60}{4200 \times 8}$ kg/s

23 Which one of the following must be a property of a virtual image?

A It is laterally inverted.
B It is of the same size as the object.
C It cannot be picked up on a screen.
D It is as far behind the mirror as the object is in front of the mirror.

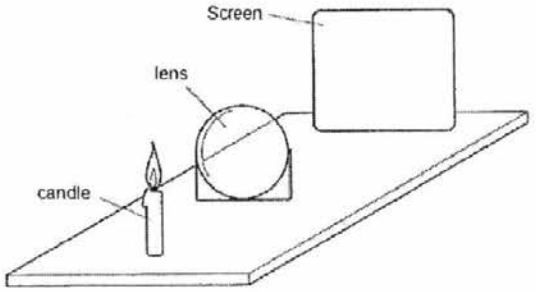
24 An object at **O** is placed in front of a mirror.



Where must the observer position himself such that he will be able to see the image of **O** in the mirror?

A At **P** only
B At **Q** only
C Between **R** and **S**
D Between **S** and **T**

25 A thin converging lens is used to produce a focused image of a candle on a screen.



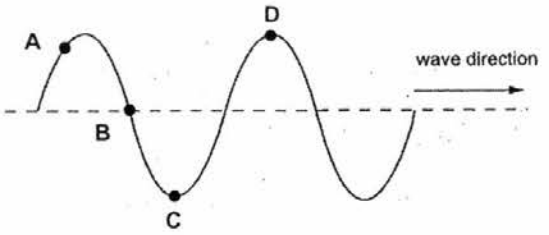
Various focused images are produced on the screen by moving the lens and the screen backwards and forwards.

Which one of the following statements is **always** correct?

A The image is inverted.
B The image is bigger than the object.
C The image is closer to the lens than the object is.

D The image is at the principal focus (focal point) of the lens.

26 The diagram shows a water wave moving in the direction shown.



At which point is the water moving upwards with maximum speed?

27 Which one of the following is not a correct use of the stated electromagnetic wave?

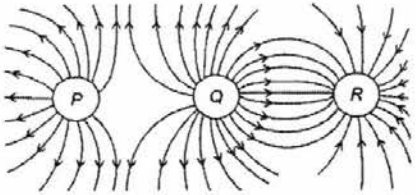
	Electromagnetic Wave	Use
A	X-rays	Detection of cracks in buildings
B	Radiowaves	Satellite television
C	Infra-red radiation	Intruder alarms
D	Ultraviolet radiation	Sterilisation

28 Which of the following decrease(s) the pitch of a note formed when a string of the harp is plucked?

I Plucking a longer string.
II Plucking a thicker string.
III Plucking the string harder.
IV Increasing the tension of the string.

A I only
B I and II only
C III and IV only
D I, II, III and IV

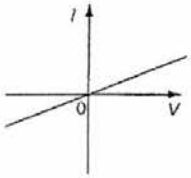
The figure shows the pattern of electric field produced by three charged spheres.



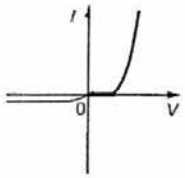
Which one of the following correctly shows the charge on each sphere?

	P	Q	R
A	Negative	Negative	Positive
B	Positive	Negative	Negative
C	Negative	Positive	Positive
D	Positive	Positive	Negative

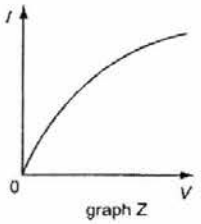
30 The three graphs **X**, **Y** and **Z** show the I/V characteristics for three different components.



graph X



graph Y

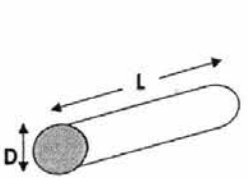


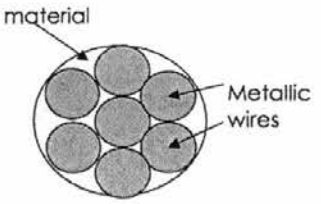
graph Z

To which components do these characteristics correspond?

	Graph X	Graph Y	Graph Z
A	Filament lamp	Metallic conductor	Semiconductor diode
B	Metallic conductor	Semiconductor diode	Filament lamp
C	Semiconductor diode	Metallic conductor	Filament lamp
D	Metallic conductor	Filament lamp	Semiconductor diode

31 A metallic wire of resistivity **ρ** has a length **L** and a diameter **D**. Seven strands of this wire is bundled together to create an electrical cable as shown in the diagram.



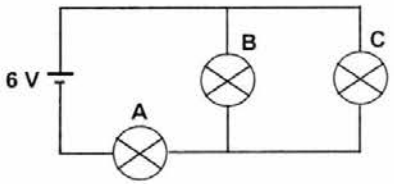


Cross section of the electrical cable

Which one of the following is true?

A The resistance of the cable is equivalent to a single wire of diameter 7D.
B The resistance of the cable is equivalent to a single wire with diameter 3D.
C The electrical cable's resistance is about seven times that of the original wire.
D The electrical cable's resistance about one-seventh times that of the original wire.

32 Three identical lamps **A**, **B** and **C** are connected as shown in the following circuit.

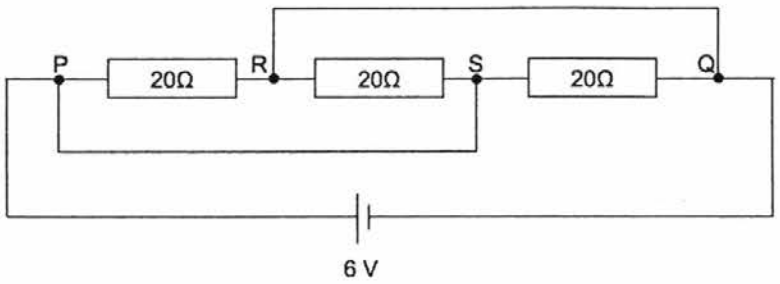


Which of the following is/are true about the circuit?

I Lamp **B** and lamp **C** are equally bright.
II All the current will pass through lamp **A**.
III Lamp **A** is brighter than lamp **B** and lamp **C**.
IV The potential difference across lamp **B** is 2 V.

A **I** and **III** only
B **II** and **IV** only
C **I**, **II** and **III** only
D **I**, **II**, **III** and **IV**

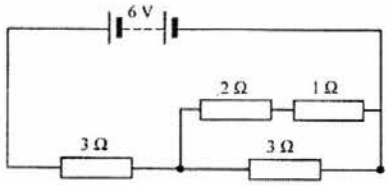
33 A 6 V e.m.f. is connected between terminals **P** and **Q** in the circuit as shown in the diagram.



What is the potential difference between **RS**?

A 2 V
B 4 V
C 6 V
D 8 V

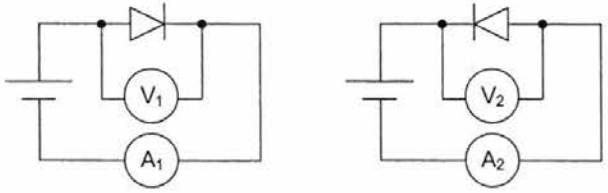
34 The diagram shows a circuit.



What is the potential difference across the 2 Ω resistor?

A 1.33 V
B 2.00 V
C 2.66 V
D 3.00 V

35 The following two circuits shown are connected with a diode, voltmeter and ammeter each.



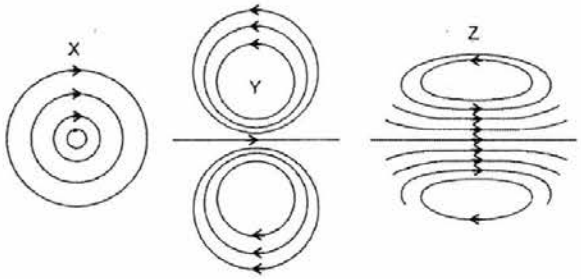
Which of the meters will show a reading?

A A_1 and V_1
B A_2 and V_2
C A_1 and V_2
D A_2 and V_1

36 The current in an electric heater, when it is working normally, is 5 A. How much current is in each of the three wires connecting the heater to the mains?

	Live	Neutral	Earth
A	0 A	0 A	5 A
B	5 A	5 A	0 A
C	5 A	0 A	5 A
D	0 A	5 A	0 A

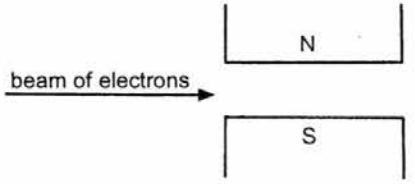
37 The diagrams show the magnetic fields obtained from a current flowing through a straight wire, a circular coil and a solenoid.



Which one of the following correctly lists the origins of the magnetic fields illustrated?

	Straight wire	Circular coil	Solenoid
A	X	Y	Z
B	X	Z	Y
C	Y	X	Z
D	Y	Z	X

38 A beam of electrons is projected into the space between two magnetic poles.



What will happen to the electrons?

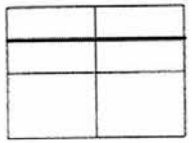
A They will be deflected into the plane of the paper.
B They will be deflected out of the plane of the paper.
C They will be deflected towards the north pole of the magnet.
D They will be deflected towards the south pole of the magnet.

Which part of a simple d.c. motor reverses the direction of current through the coil every half-cycle?

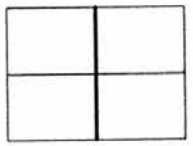
A The armature
B The brushes
C The commutator
D The slip rings

40 An alternating voltage is applied to the Y-plates of a CRO while the X-plates are turned off. What will be observed on the screen?

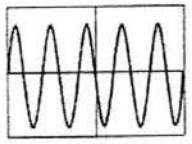
A



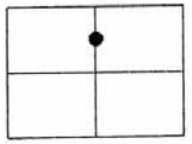
B



C



D



END OF PAPER

ME partnerinlearning	CLASS	INDEX NO.

ST. PATRICK'S SCHOOL
PRELIMINARY EXAMINATIONS 2016

SUBJECT : PHYSICS 5059 (PAPER 2) DATE : 23 AUG 2016

LEVEL : SECONDARY 4 EXPRESS DURATION : 1 H 45 MIN

INSTRUCTIONS TO CANDIDATES

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO.

1. Write your name, class and index number on the **Question Paper** in the spaces provided.
2. Answer **ALL** questions in **Section A** in the spaces provided.
3. Answer **ALL** questions in **Section B** in the spaces provided. Question **12** is an **EITHER / OR QUESTION**. **SELECT ONLY ONE PART OF THIS QUESTION**.
4. Throughout the paper, the **acceleration due to gravity on Earth** is taken as 10 N/kg **unless stated otherwise**.
5. Candidates are reminded that **all** quantitative answers should include appropriate units. The use of an approved scientific calculator is expected, where appropriate.
6. Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.
7. **DO NOT DETACH** any sections from this paper.
8. Submit this paper at the end of the examination.

For Examiner's Use Only

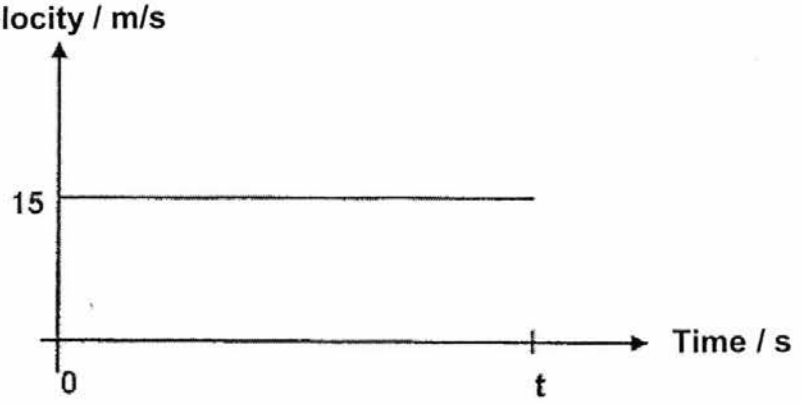
Section	A [50 m]	B [30 m]	P1 [40 m]	Total [120 m]	Grade	Target Grade
Score						

This question paper consists of **21** *printed pages.*

ECTION A : [50 marks]

nswer **ALL** *questions in this section. Show your working and write your answers in the ace provided.*

1 A car stops at a red light. As the light turns green, it accelerates forward at 2.5 m/s^2. At the same instant, a lorry passes by. The graph shows the motion of this lorry from this instant to **t** seconds later.



(a) In the graph, draw the velocity against time graph of the car as it accelerates at 2.5 m/s^2 in **t** seconds. **[1]**

(b) Determine the time taken for the car to catch up with the lorry.

[2]

(c) How far down the road will they meet?

[

Figure I shows a boy on a sledge travelling down a slope.

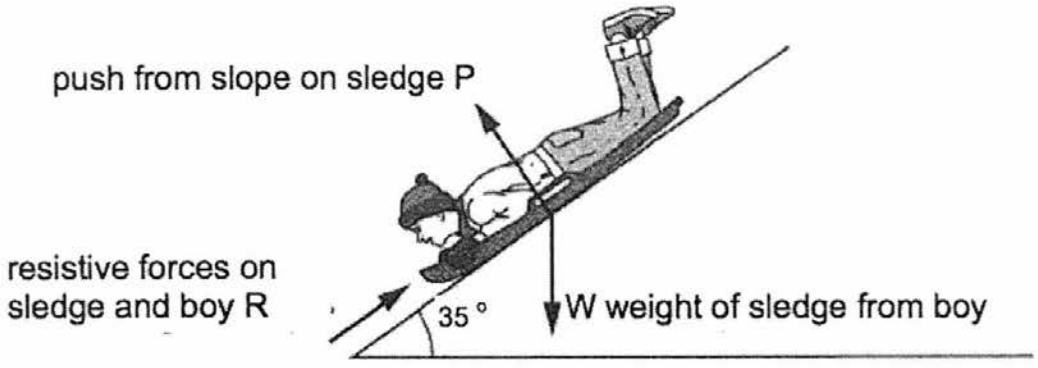


Figure I

The boy and the sledge have a total mass of 60 kg and are travelling at a constant speed. The angle of the slope to the horizontal is 35° and the resistive forces on the sledge and boy is **R**.

All the forces acting on the boy and the sledge are shown on **Figure I** and in a force diagram in **Figure II**. The gravitational field strength is 10 N/Kg.

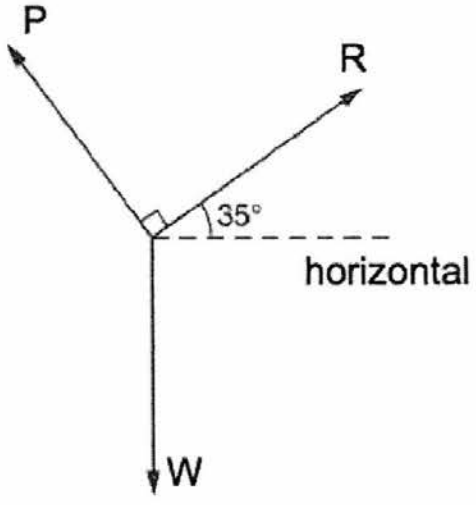


Figure II

(a) Calculate the magnitude of **W**, the total weight of the boy and the sledge.

(b) Use graphical method to determine the magnitude of the resistive force **R**. Use a scale of 1 cm to represent 100 N.

[3]

(c) Using your answer to part **(b)** or otherwise, find the magnitude of the push from the slope on the sledge, **P**.

.....

[1]

(d) Explain why the boy is travelling at constant speed even though he is moving down a slope.

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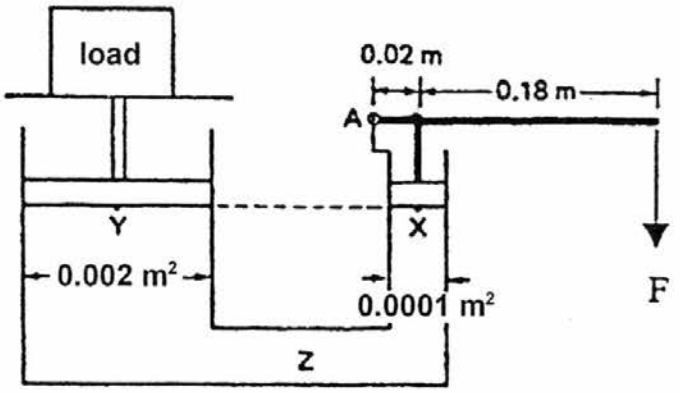
[

The diagram shows a hydraulic press that has perfectly fitting frictionless pistons of cross-sectional areas of 0.002 m^2 and 0.0001 m^2 respectively.



A small piston is fitted to a lever system pivoted at **A** and a force **F** is applied at the end of the lever as seen in the diagram. You may neglect the weights of the pistons and the lever.

(a) Calculate the force applied at **X**, given that the load is 800 N.

[2]

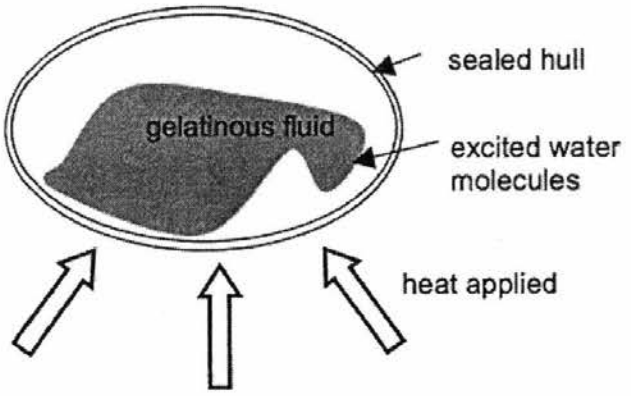
(b) Hence, calculate **F**.

[2]

(c) When the piston at **X** moves 0.050 m downwards, how far does the piston at **Y** move upwards?

[

Popcorn is prepared by supplying heat to the kernel which contains moisture inside its sealed hull. The diagram shows a kernel heated before popping.



The moisture is being excited and the starch inside turns into a bubbling gelatinous fluid. When the kernel pops, the gel-like starch is exposed to cold air and solidifies into the fluffy white characteristic that the popped popcorn has.

(a) Using the kinetic model of gas, explain how increasing the temperature inside the kernel enables it to pop. State any assumptions you have used.

.....

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.....

..... **[2]**

(b) A popcorn vendor discovers that he can get bigger popcorns by simply fitting a simple vacuum pump to the cooker in which he popped the corns. Explain why this happens.

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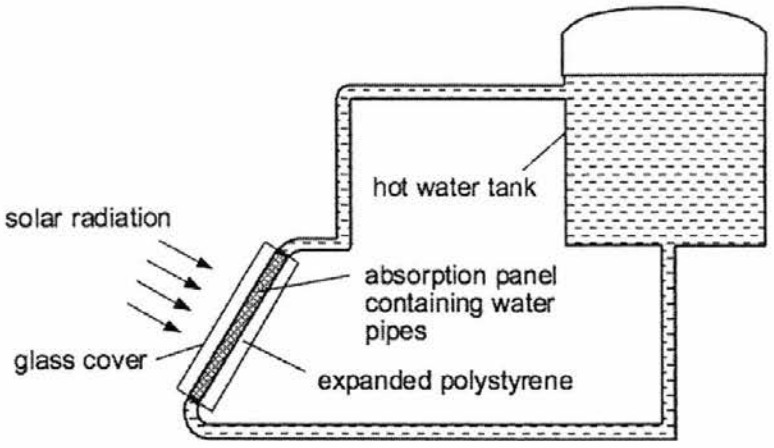
The diagram shows the structure of a solar heating system.



(a) State the methods by which heat gets

(i) from the sun to the outside of the pipe.

..... **[1]**

(ii) from the outside of the pipe to the water in the pipe.

..... **[1]**

(b) Explain why the system is more effective when

(i) the surface of the absorption panel is blackened.

.....

..... **[2]**

(ii) expanded polystyrene is used as the backing board.

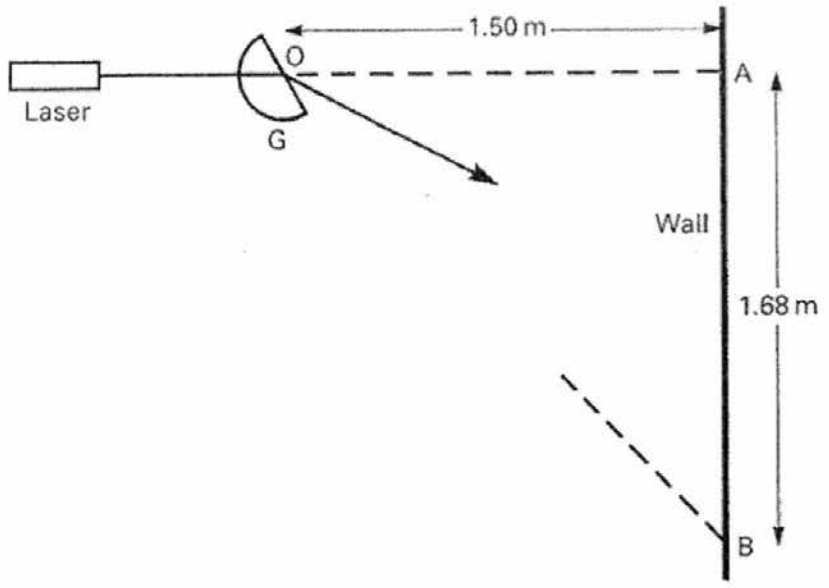
.....

..... **[2]**

(c) On a hot day, the amount of solar radiation falling on the panel is 120 W/m^2. If the total area of the panel is 5 m^2 and only 21% of the energy is absorbed by water, calculate the energy absorbed by the water in 6 hours.

[

The diagram shows a narrow laser beam directed towards a point **A** on a vertical wall. A semicircular glass block **G** is placed symmetrically across the path of the beam.



The glass block is rotated about the centre, **O**, and the bright spot where the beam strikes the wall moves down from **A** to **B** and then disappears.

(a) Account for the disappearance of the bright spot after **B**.

.....

..... **[1]**

(b) On the diagram, indicate with an arrow, the direction of rotation (clockwise or anticlockwise) of the glass block **G** in order to obtain the bright spot that moves down from **A** to **B**. **[1]**

(c) Given that **OA** = 1.50 m and **AB** = 1.68 m, determine

(i) the critical angle, and

[

(ii) the refractive index of the glass block.

[1]

(d) Explain whether **AB** would be longer or shorter if a material of higher refractive index is used for the glass block.

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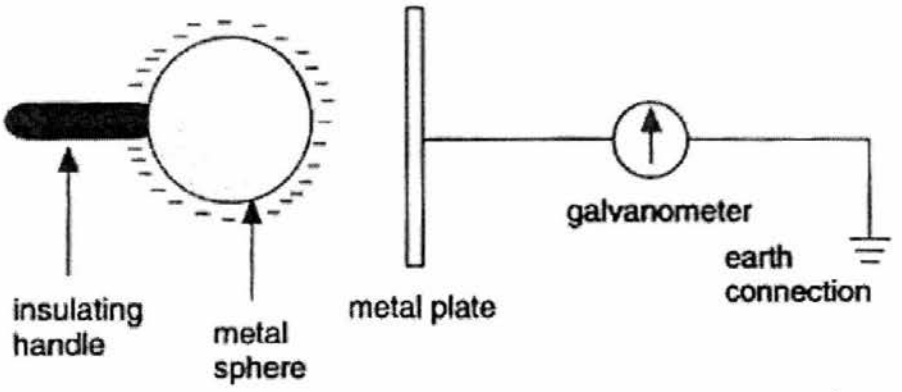
..... **[2]**

The diagram shows a negatively charged metal sphere held with an insulating handle. When the sphere is brought towards the metal plate, the sensitive galvanometer indicates a momentary current.



(a) Why is a momentary current produced?

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.....

..... [2]

(b) How could a deflection of the galvanometer pointer in the opposite direction be produced?

.....

..... [1]

(c) Explain why there is no deflection of the galvanometer pointer if the metal sphere is held in the hand and moved towards the metal plate.

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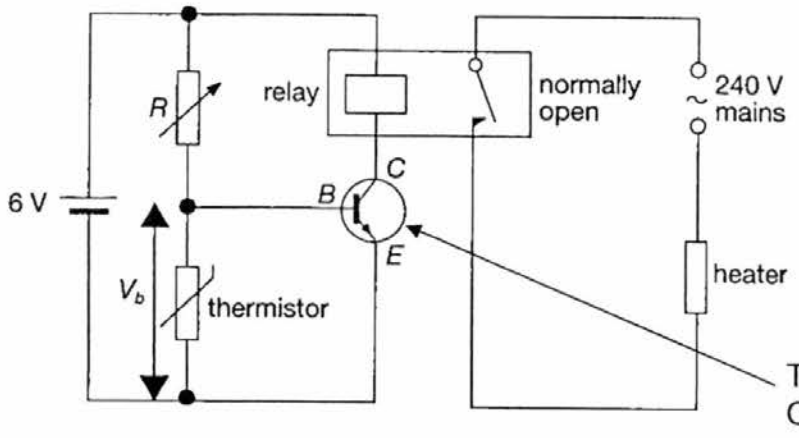
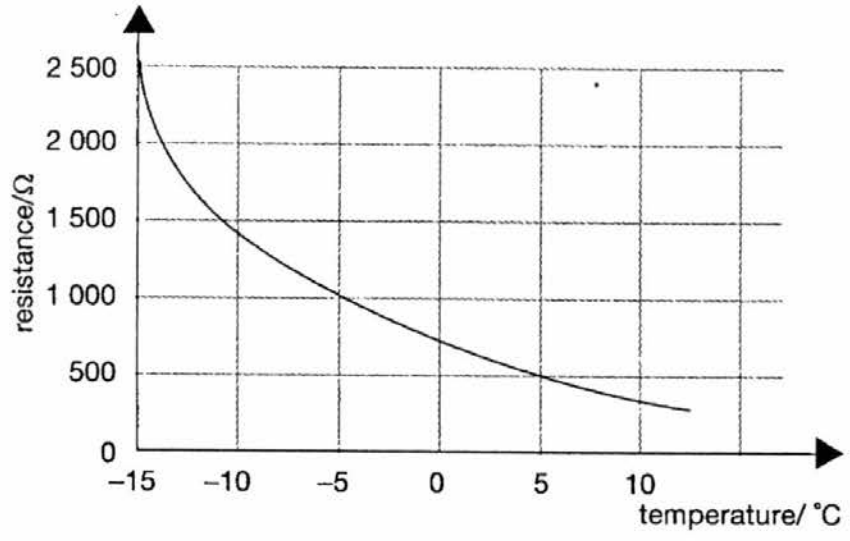
..... [1]

The circuit shows a **transistor switch** used to control the temperature in a greenhouse. **A transistor switch acts like a switch**. It will be switched ON when $\mathbf{V_b}$ is 0.7 V.



The relationship between the resistance of the thermistor and the temperature of the surroundings is shown in the following graph.



(a) From the graph, find the resistance of the thermistor at 5 °C.

.....

[1]

(b) **If $\mathbf{V_b}$ is 0.7 V, the transistor switch is switched ON.**

Calculate the potential difference across the rheostat, **R**.

[2

(c) Calculate the maximum resistance of the rheostat, **R**, so that the transistor switch can switch ON when the temperature drops below 5 °C.

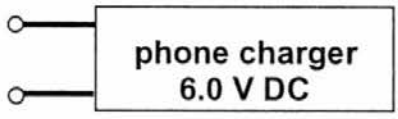
[2]

(d) Calculate the maximum resistance of the rheostat, **R**, so that the transistor switch can switch ON when the temperature drops below −5 °C.

[2]

A phone charger requires 6.0 V of direct current.

(a) Draw a labelled circuit diagram to show how this can be made possible from a 240 V a.c mains.



[2]

(b) State the purposes of the main electrical components you have included in the circuit.

.....

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.....

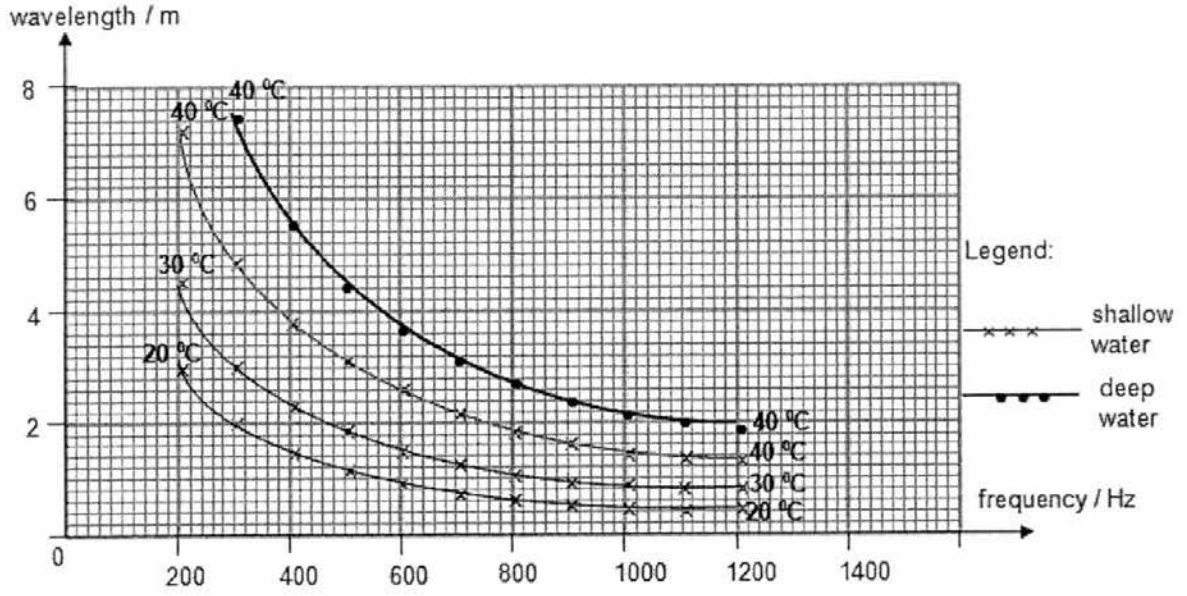
..... **[2]**

ECTION B : [30 marks]

ch question is worth **10 marks**. *Answer* **ALL** *questions in this section.* **Question 3** *is an* **THER / OR QUESTION**. ***SELECT ONLY ONE PART OF THIS QUESTION***. *Show your working and write your answers in the spaces provided.*

10 The relationship between the wavelength and frequency of sound waves in a river at three different temperatures 20 °C, 30 °C and 40 °C are monitored closely in shallow and deep water regions.

Selective data are collected at shallow and deep water regions and the results are plotted in the graphs shown.



(a) By referring to the graphs, calculate the speed of the sound waves with frequency 400 Hz at temperatures 20 °C and 40 °C in the shallow water region.

[3]

(b) State and explain the relationship between the speed of the sound waves of the same frequency and the temperature of water in which they travel.

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.....

.....

[

(c) Given that the temperature of water is kept constant at 40 °C and the frequency of the sound waves emmitted is 400 Hz.

(i) The sound wave travels from shallow water into deep water. State clearly the changes, if any, that could occur to the frequency, wavelength and speed of the sound wave.

.....

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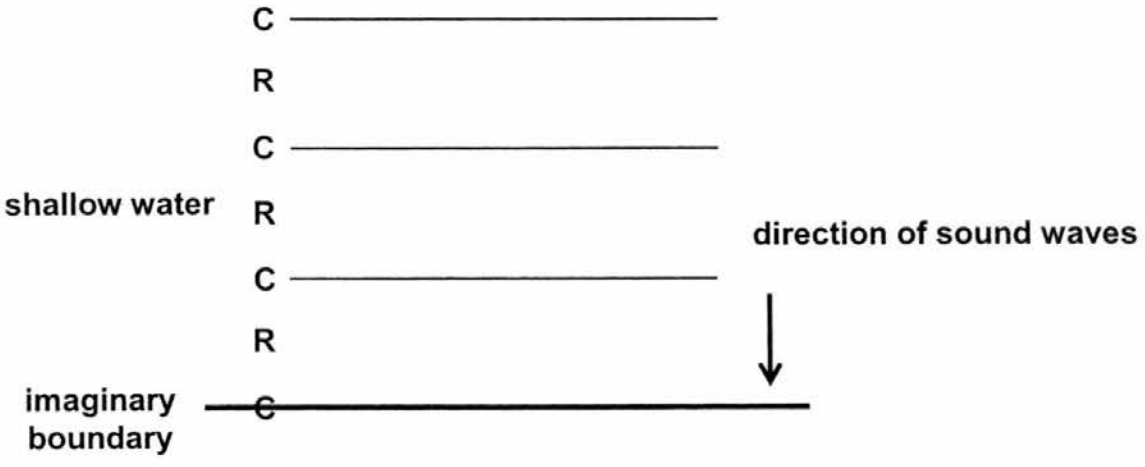
.....

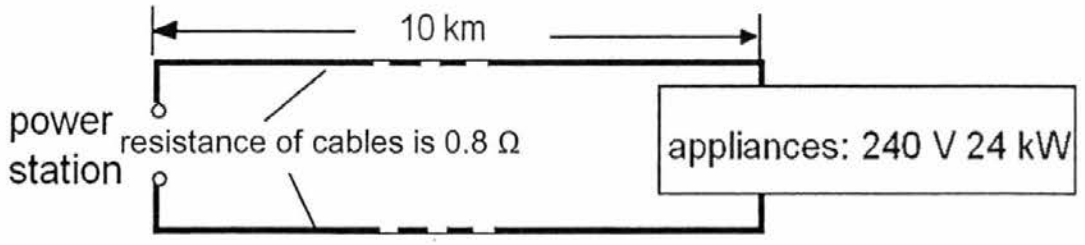
..... [3]

(ii) The diagram (**not drawn to scale**) shows the direction of sound waves travelling perpendicularly to the boundary from shallow water to deep water. Regions of compression are labelled as **C** while regions of rarefactions are labelled as **R**.



By referring to the graphs, complete the sound waves formed in deep water. Indicate in the diagram, the wavelengths of the sound waves in both regions. [

A power station supplies energy to a village 10 km away. The village needs 24 kW of power to all appliances which work with a voltage of 240 V across.



The resistance of cables is 0.8 Ω.

(a) Calculate

(i) the power dissipated by the current in the cables,

[3]

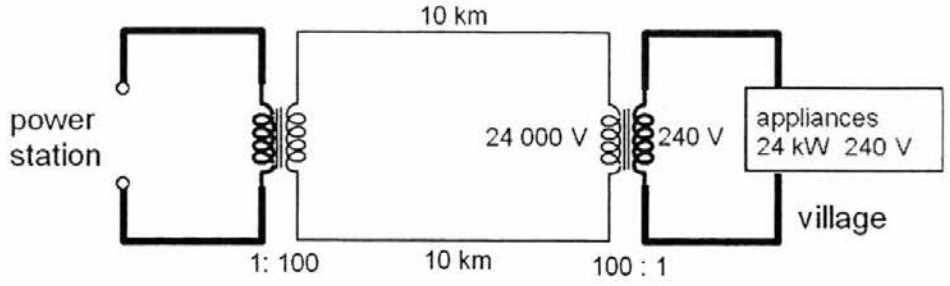
(ii) the voltage supplied by the power station,

[2]

(iii) the power developed by the generator.

[1]

(b) In order to reduce the loss of power during the transmission, we use transformer to step the voltage up 100 times at the power station end, and to step it down again at the village end as shown in the diagram.



(i) Calculate the new current flowing in the cables.

[1]

(ii) Find the power dissipated in the cables with the new current flowing.

[1]

(iii) From your answers in **(a)(i)** and **(b)(ii)**, explain how stepping up the voltage before transmission helps to reduce power loss.

.....

.....

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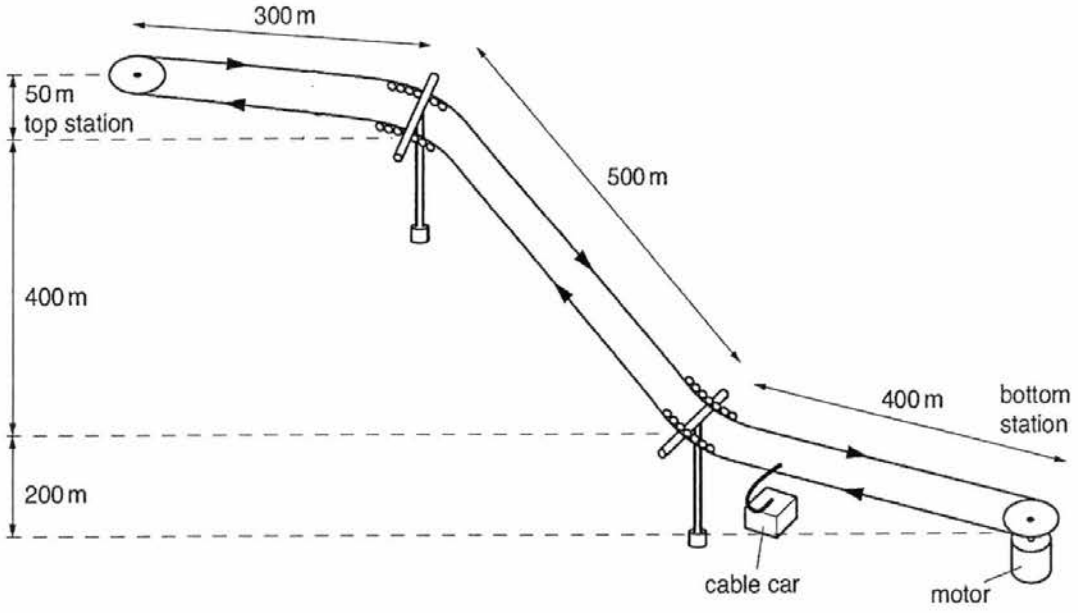
..... **[2]**

EITHER

A cable car in a mountain resort lifts passengers through a total height of 650 m. The total distance travelled is 1200 m, as shown in the diagram.



Each car of mass 1500 kg is capable of carrying a maximum additional load of 1300 kg. The cable is driven by an electric motor at the bottom station. The cable cars are already set into continuous motion and maintained at a constant speed throughout. Each cable car takes 480 s to travel from the bottom station to the top station.

(a) Calculate the contant speed maintained for the cable car.

[2]

(b) Calculate the kinetic energy of a fully loaded cable car at this speed.

[

(c) A fully loaded cable car starts from the bottom and reaches the top at the same speed.

Calculate the average power supplied by the motor to each fully loaded cable car.

[2]

(d) Assuming the speed of the cable car remains relatively constant, the power supplied by the motor must vary from time to time in each journey.

State and explain with reason, which part of the journey requires the highest power supply from the motor.

.....

.....

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..... **[2]**

(e) The actual power consumed must be a lot larger than the theoretical value calculated.

Suggest two reasons why this is so.

.....

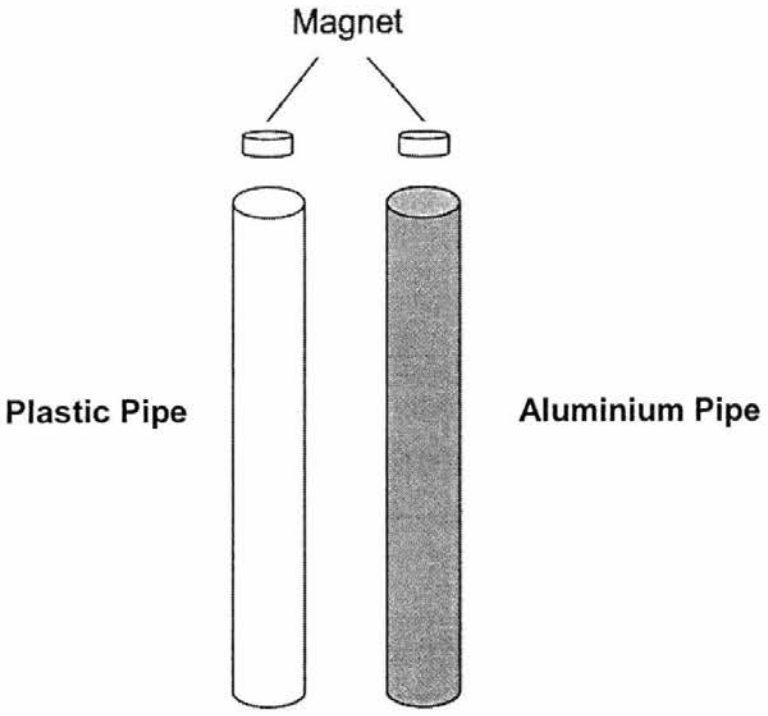
.....

.....

..... **[2]**

OR

A strong magnet is dropped into a plastic and an aluminium pipe respectively as shown in the diagram.



It was found that the magnet took a longer time to fall through the aluminium pipe.

(a) Explain why the speed of the magnet through the aluminium pipe is slower than the magnet through the plastic pipe.

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.....

..... **[3]**

(b) State and explain how the speed of the magnet can be further slowed.

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.....

..... **[2]**

(c) At a particular point in time, the magnet of mass 150 g has an acceleration of 3.1 m/s^2. Calculate the repulsive force that has been produced.

[4]

(d) Describe the motion of the magnet as it moves through the aluminium pipe in terms of the acceleration.

.....

..... **[1]**

END OF PAPER

ST. PATRICK'S SCHOOL
PRELIMINARY EXAMINATIONS 2016

SUBJECT : PHYSICS 5059 | DATE : 23 AUG 2016 (P2) 25 AUG 2016 (P1)

LEVEL : SECONDARY 4 EXPRESS | DURATION :

PAPER 1 [40 marks] (DURATION: 1 HOUR)

1	2	3	4	5	6	7	8	9	10
C	**A**	**C**	**D**	**A**	**C**	**A**	**A**	**D**	**C**

11	12	13	14	15	16	17	18	19	20
B	**B**	**B**	**A**	**D**	**D**	**D**	**D**	**B**	**B**

21	22	23	24	25	26	27	28	29	30
C	**C**	**C**	**D**	**A**	**B**	**B**	**B**	**D**	**B**

31	32	33	34	35	36	37	38	39	40
D	**D**	**C**	**A**	**C**	**B**	**A**	**B**	**C**	**B**

PAPER 2 (DURATION: 1 HOUR 45 MIN)

Section A [50 marks]

QN	Suggested Answers	Sub Ttl	Ttl
1a	Any straight line graph • starting from the origin **and** • ending at a point above the horizontal line at t s.	**1**	**4**
1b	15t = ½ × t × 2.5t [1] $1.25t^2 - 15t = 0$ t(1.25t – 15) = 0 t = 0 s or t = 15 ÷ 1.25 = 12 s [1]	**2**	
1c	Distance = 15 × 12 = 180 m [1]	**1**	

QN	Suggested Answers	Sub Ttl	Ttl
2a	W = mg W = 60 × 10 W = 600 N [1]	**1**	**6**
2b	**R** is 35° to horizontal and Resultant force drawn perpendicular to **P.** [1] Parallelogram/Triangular Law correctly applied [1] **R** = 340 N (±40 N) [1] **Deduct 1 m for missing labels or arrows on forces.** **No answer mark for wrong or missing unit.**	**3**	
2c	**P** = 500 N (±50 N) [1]	**1**	
2d	Either one of the following [1]: • There is no resultant force acting on the boy and sledge. • All forces are in equilibrium.	**1**	

QN	Suggested Answers	Sub Ttl	Ttl
3a	$P = P_x$ $\frac{F_Y}{A_Y} = \frac{F_X}{A_X}$ $\frac{800}{0.002} = \frac{F_X}{0.0001}$ [1] $F_X = 40$ N [1]	2	6
3b	Taking moments about the pivot, by POM, Total clockwise moments = total anti-clockwise moments $F \times 0.200 = 40 \times 0.02$ [1] $F = 4$ N [1]	2	
3c	Workdone at Y = Workdone at X $800 \times d = 40 \times 0.050$ [1] $d = 0.0025$ m [1]	2	

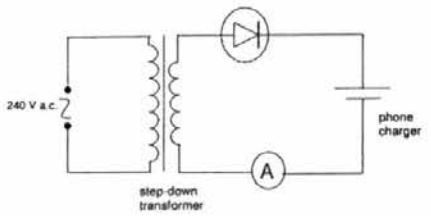
QN	Suggested Answers	Sub Ttl	Ttl
4a	Assumption: Volume remains constant [½] And any three of the points below: With the increase in temperature, the fluid particles will gain kinetic energy and vibrate more vigorously [½]. They collide more frequently [½] with the wall inside the kernel and the pressure inside the kernel increases. [½] As the pressure inside the kernel is greater than [½] the pressure outside, the kernel pops.	2	4
4b	With a vacuum pump fitted inside the cooker, the outside of the kernel will have a much smaller pressure [1]. There will be a greater pressure difference [1] inside and outside the kernel resulting in a greater force to pop the kernel.	2	

QN	Suggested Answers	Sub Ttl	Ttl
5ai	Radiation [1]	1	8
5aii	Conduction [1]	1	
5bi	Black is a good absorber [1] of radiant heat. Hence, heat is absorbed by the pipe at a faster rate [1].	2	
5bii	Expanded polystyrene is a poor conductor [1] of heat. Hence, the pipe will be hot and lose heat to the surrounding at a slower rate [1].	2	
5c	Rate at which energy is absorbed by the panel $= 120 \times 5 \times 0.21$ $= 126$ W [1] Energy absorbed by water $= 126 \times 6 \times 60 \times 60$ $= 2.72$ MJ [1]	2	

QN	Suggested Answers	Sub Ttl	Ttl
6a	The angle of incidence in the glass block at O exceeds the critical angle [½] and the laser beam is totally reflected internally [½].	1	7
6b	Anticlockwise. [1]	1	
6ci	When the spot is at B, $\tan\theta = \frac{1.68}{1.50}$ $\theta = 48.2°$ [1] Critical angle = 90° − 48.2° = 41.8° [1]	2	
6cii	$\eta = \frac{1}{\sin 41.8°} = 1.50$ [1]	1	
6d	A higher refractive index will result in a smaller critical angle [1]. This will result in shorter length of AB [1].	2	

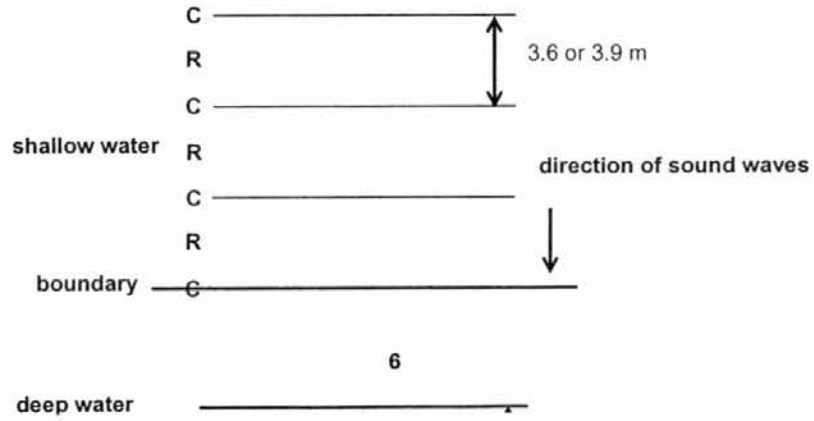
QN	Suggested Answers	Sub Ttl	Ttl
a	Electrons in the metal plate are repelled by the negatively charged particles to the ground [1]. The sudden rate of flow of electrons to the ground produced a current [1].	2	4
7b	Use a positively charged [1] metal sphere.	1	
7c	When the metal sphere is held in the hand, it will be discharged and become neutral [1]. The electrons in the metal plate will not be repelled.	1	

QN	Suggested Answers	Sub Ttl	Ttl
8a	500 Ω [1]	1	7
8b	Voltage across R = 6 – 0.7 [1] = 5.3 V [1]	2	
8c	V_t = (R_t / R_t + R_R) V 0.7 = (500 / 500 + R_R) 6 [1] R_R = 3785.7 Ω Max resistance of R = 3790 Ω [1]	2	
8d	V_t = (R_t / R_t + R_R) V 0.7 = (1000/ 1000 + R_R) 6 [1] R_R = 7571.4Ω Max resistance of R = 7570 Ω [1]	2	

QN	Suggested Answers	Sub Ttl	Ttl
9a	 Either half-wave rectifier or full-wave rectifier accepted. [1] Step-down transformer [1]	2	4
9b	A transformer to step down voltage [1]. A diode to convert ac to dc [1].	2	

Section B [30 marks]

QN	Suggested Answers	Sub Ttl	Ttl
10a	From the graph, when f = 400 Hz, λ = 1.4-1.6 m at temperature 20 °C, [½] v = f λ = 400 × (1.4~1.6) = 560-640 m/s [1] λ = 3.6-3.9 m at temperature 40 °C, [½] v = f λ = 400 × (3.6~3.9) = 1440~1560 m/s [1]	3	10
10b	The speed of sound increases [1] as the temperature increases. This is due to a larger wavelength [1] at higher temperature. OR The speed of sound increases [1] as the temperature increases. At higher temperature, the water molecules have more kinetic energy and vibrate more vigorously [1], making it easier for the series of compressions and rarefactions to pass through.	2	
10ci	At constant temperature, frequency remains constant [1]. Since the wavelength increases in deeper water [1], the speed increases in deeper water [1].	3	
10cii	Larger wavelength in deep water [1]. Indicate wavelengths [½ + ½].	2	



QN	Suggested Answers	Sub Ttl	Ttl
11ai	I = P / V = 24000 / 240 = 100 A [1] Power dissipated by cables = I^2R = $(100)^2 \times 0.8$ [1] = 8000 W [1]	**3**	**10**
11aii	Voltage drop due to resistance of cables = 100 × 0.8 Ω = 80 V [1] Voltage supplied by power station = 80 + 240 = 320 V [1]	**2**	
11aiii	P = 24000 + 8000 = 32000 W [1] OR P = VI = 320 × 100 = 32000 W [1]	**1**	
11bi	Current in cables = 100 × (1/100) = 1 A [1]	**1**	
11bii	Power dissipated by cables = I^2R = $(1)^2 \times 0.8$ = 0.8 W [1]	**1**	
11biii	By stepping up the voltage before transmission, the current flowing in the cables is greatly reduced [1] from 100 A to 1 A. Due to the square effect [1] of current in $P = I^2R$, the power loss due to cable reduced significantly from 8000 W to 0.8 W.	**2**	

Either

QN	Suggested Answers	Sub Ttl	Ttl
12a	Average speed = 1200 / 480 [1] = 2.50 m/s [1]	**2**	**10**
12b	Kinetic energy = ½ mv^2 = ½ × (1500 + 1300) × 2.50^2 [1] = 8750 J [1]	**2**	
12c	Gain in gravitational potential energy = mgh = (1500 + 1300) × 10 × 650 = 18.2×10^6 J [1] Average power = 18.2×10^6 / 480 = 37900 W [1]	**2**	
12d	The steepest part of the journey (the middle section) requires the highest power supply [1]. This is because the while the kinetic energy of the cable car remains constant throughout the journey, its gravitational potentially energy increases at the highest rate during this part of the journey [1].	**2**	
12e	Some energy is converted into thermal energy [1] due to friction in the system and resistance in wires [1] carrying electricity in the motor.	**2**	

Or

QN	Suggested Answers	Sub Ttl	Ttl
12a	As the magnet falls through the aluminium pipe, there is a rate of change of magnetic field lines linking the aluminium pipe [1]. An induced current is produced [1] in the aluminium pipe and by Lenz's Law, this induced current would produce a magnetic effect that opposes the movement of the magnet [1], thus slowing it down.	**3**	**10**
12b	Using a stronger magnet [1], this will produce a greater induced current [1] and thus a greater repulsive force.	**2**	
12c	$F_R = ma = (150/1000) \times 3.1 = 0.465$ N [1] W – Repulsive Force = 0.465 [1] Repulsive Force = (150/1000) × 10 – 0.465 [W = mg [1]] = 1.04 N (3sf) [1]	**4**	
12d	As the magnet falls through the aluminium pipe, it undergoes decreasing acceleration [1].	**1**	