Name: .....( ) Class: Sec 4A

Queenstown Secondary School

Secondary Four Express
Preliminary Examination 2016

Physics 5059 Paper 1

20-09-2016
Tuesday

Time: 1130 - 1230 hrs
Duration: 1 hour

READ THESE INSTRUCTIONS FIRST

Do not open this sheet until you are told to do so.

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name and index number on the Answer Sheet in the spaces provided unless this has been done for you.
DO **NOT** WRITE IN ANY BARCODES.

There are **forty** questions in this section. Answer **all** questions. For each question, there are four possible answers, **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your answer in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this section.
The use of an approved scientific calculator is expected, where appropriate.

Multiple Choice Questions (40 marks)
Answer all questions on the separate answer sheet provided.

1. A pendulum swings from X to Z and back to X. M is the horizontal distance of the centre of the bob, Y, from the vertical axis. Diagram 2 shows the graph of the horizontal distance M against time.

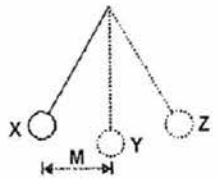


Diagram 1

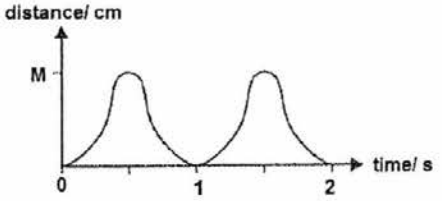
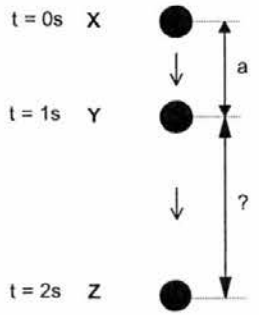


Diagram 2

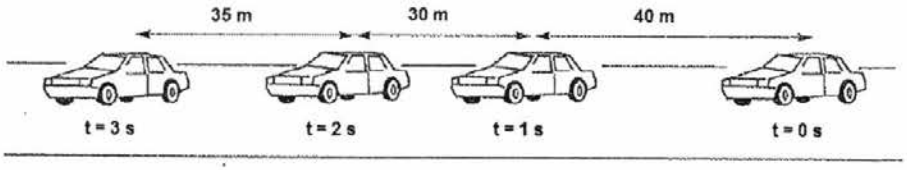
Determine the frequency of the pendulum.
A. 0.5 Hz B. 1.0 Hz C. 1.5 Hz D. 2.0 Hz

2. An object falls freely from rest (point X) to the ground (point Z). Express the distance between Y and Z in terms of a.

A. a
B. 2a
C. 10 - a
D. 20 - a

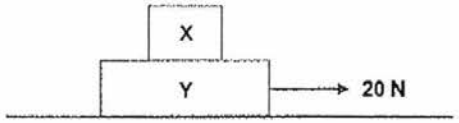


3. A car travels along a straight road. Which of the following statements is correct about the car?



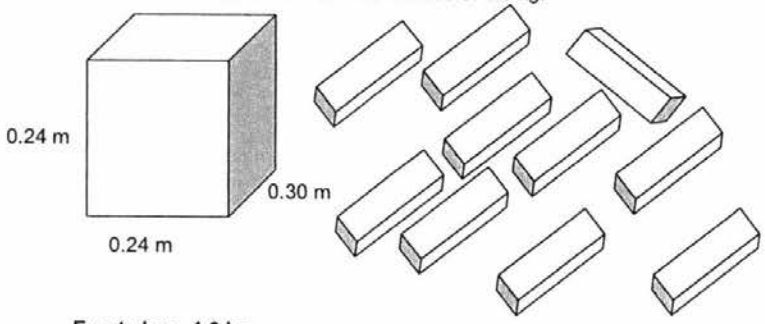
A. The car increases its acceleration from 0 s to 3 s.
B. The car travels at a constant speed throughout the journey.
C. The average speed of the car is 35 m/s.
D. The car shows a constant deceleration throughout its journey.

4. Block X with a mass of 2 kg is placed on top of Block Y which has twice its mass. Assume that all the contact surfaces are frictionless, what is the acceleration of X when Y is pulled by a force of 20 N?



A. 0 ms^{-2} B. 3.3 ms^{-2} C. 4 ms^{-2} D. 10 ms^{-2}

5. Ten aluminum bars, each of a mass 5.2 kg, fill an empty aluminum box. The box measures 0.30 m x 0.24 m x 0.24 m and has a mass of 1.0 kg.



Empty box, 1.0 kg

10 X 5.2 kg aluminum bars

What is the average density of the box packed with ten bars of aluminum in kg/m^3?

A. 52.0 ÷ (0.3 X 0.24)
B. 53.0 ÷ (0.3 X 0.24)
C. 52.0 ÷ (0.3 X 0.24 X 0.24)
D. 53.0 ÷ (0.3 X 0.24 X 0.24)

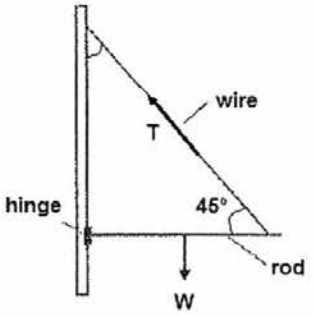
6. Two balls of the same mass are dropped on Earth and again on the Moon in a separate experiment. One ball is solid, the other is hollow. The gravitational field strength on Earth is 10 N/kg and 1.6N/kg on the Moon. Choose the most appropriate statement.

A. The solid ball has the largest force acting on it on Earth.
B. The solid ball has the largest force acting on it on the Moon.
C. The force acting on the balls is independent of where the balls are dropped.
D. Both balls experience equal force when dropped on the Moon but the force is smaller than when dropped on Earth.

7. If a nut and bolt are difficult to undo, it may be easier to turn the nut by using a longer spanner because a longer spanner gives.

A. a larger turning force.
B. a larger turning moment.
C. a larger work done.
D. a larger inertia.

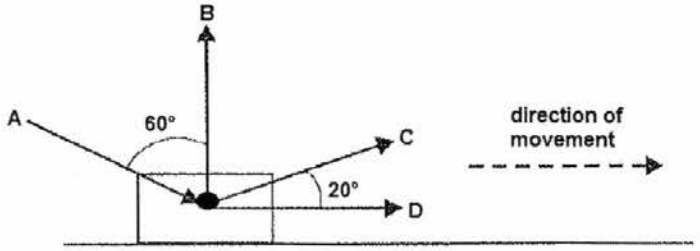
8. A uniform horizontal rod is held in position by a wire as shown in the diagram below. The rod is 0.6 m long and has a mass of 1600 g.



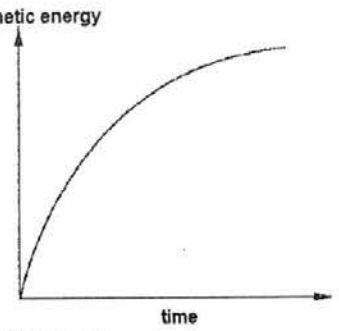
What is the value of force T?

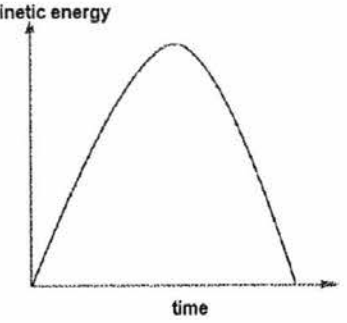
A. 2.3 N B. 4.8 N C. 8.0 N D. 11.3 N

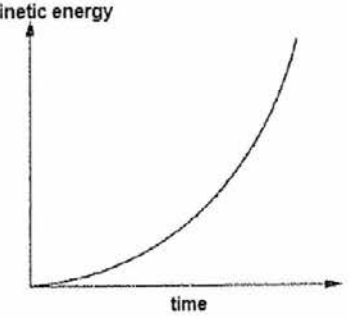
9. Four forces of equal magnitude act on a stationary object at the same point. Which of the forces does the ***most*** work?

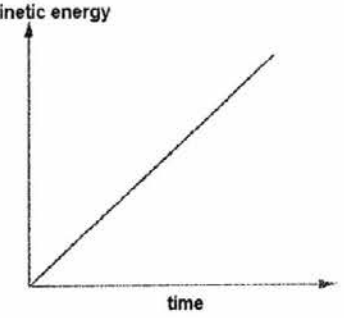


10. Which of the following graphs correctly describes the variation of kinetic energy with time for a block over time when it slides down a smooth inclined plane from rest?

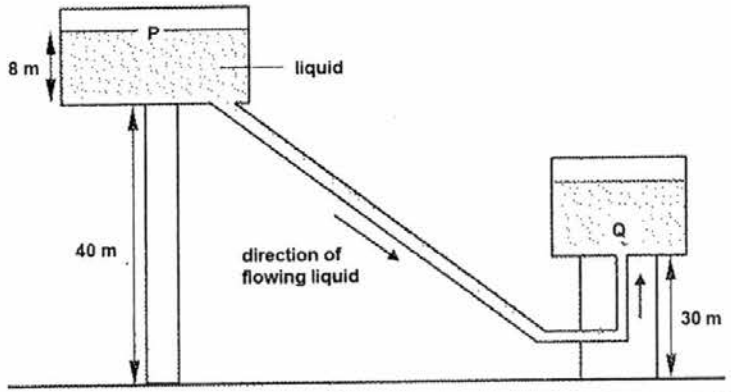
A.


B.


C.


D.


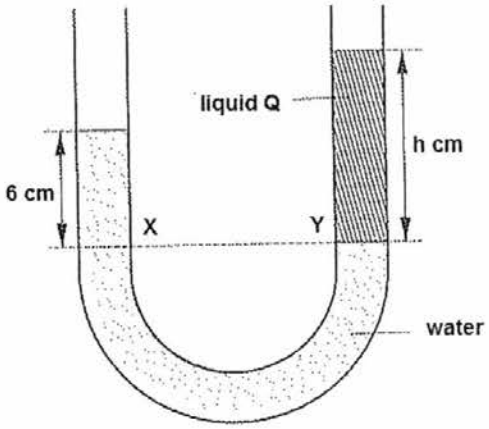
11. Liquid is stalled in tank P and allowed to flow into another tank at Q.



If the density of the liquid is 1400 kgm^{-3}, what is the pressure at the bottom of tank Q?

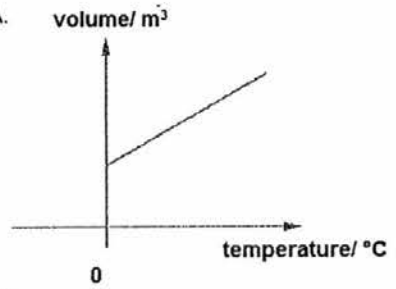
A. 1.1 x 10^5 Nm^{-2} B. 2.5 x 10^5 Nm^{-2} C. 4.2 x 10^5 Nm^{-2} D. 5.6 x 10^5 Nm^{-2}

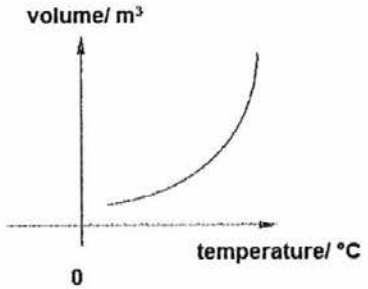
12. A U-tube is used to determine the density of liquid Q. When liquid Q is poured into one arm of the tube, the water level rises on the other arm. If densities of water and liquid Q are 1000 kgm^{-3} and 750 kgm^{-3} respectively, what is the value of **h**?

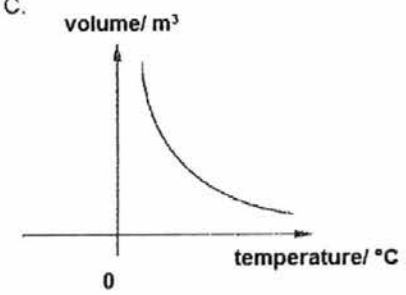


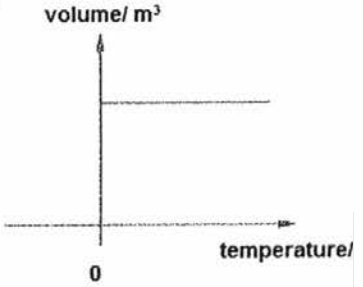
A. 8 cm B. 10 cm C. 12 cm D. 14 cm

13. Which of the following graphs correctly shows the relationship between volume and temperature of a gas when the mass and pressure of the gas remain constant?

A.


B.


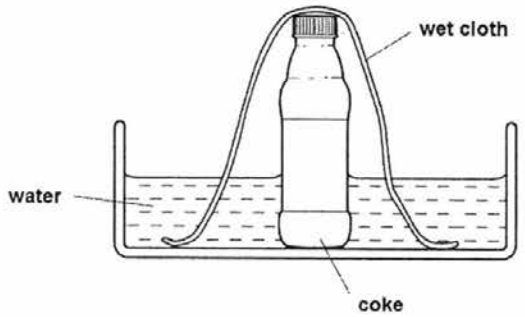
C.


D.


14. Food is cooked faster in water when placed in a pressure cooker compared to a metal pot. Which of the following statements best explains the reason?

A. Surface area of water increases in a pressure cooker.
B. Surface area of food particles increases in a pressure cooker.
C. The pressure in the pressure cooker increases the boiling point of water.
D. The boiling pint of food substances is lowered.

15. On a hot day, a bottle of coke can be kept cool by standing it in a bowl of water and placing a wet cloth over it.



Why is the bottle of coke kept cool?

A. Hot air cannot escape from the bottle.
B. The cloth conducts heat from the bottle into the water.
C. The drink cannot evaporate from the bottle.
D. Water evaporating from the cloth cools the drink.

16. Householders are being urged to reduce heat loss from roofs by laying a matting of fibre glass, which consists of very large number of inter-wined fine glass fibres, on the floor or the roof space. Which of the following statement best explains why fibre glass is effective as a heat insulator?

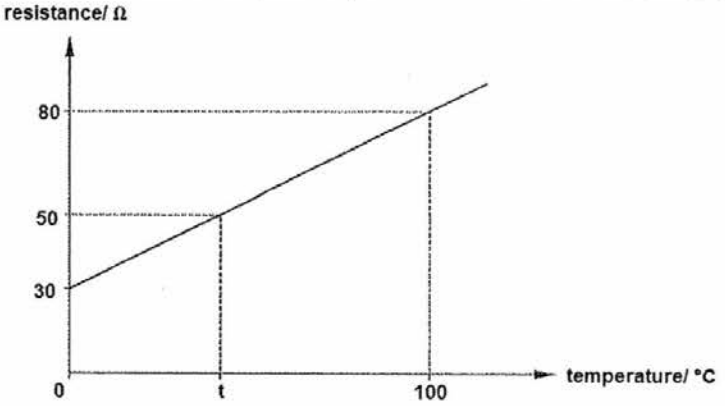
A. The glass fibre will not absorb much heat and this low thermal capacity results in good insulation.
B. The fibre glass prevents the faster-moving air molecules escaping into the roof from the room below.
C. The fibre glass reduces air movements within the fibre glass matting and stationary air is a very good insulator.
D. The thermal conductivity of glass is very low and therefore is transmitted.

[Turn over

17. The temperature of an alcohol-in-glass thermometer decreases when placed in a glass of ice cubes. Which of the following remains constant?

A. density of the alcohol
B. mass of the alcohol
C. volume of the alcohol
D. internal energy of the alcohol

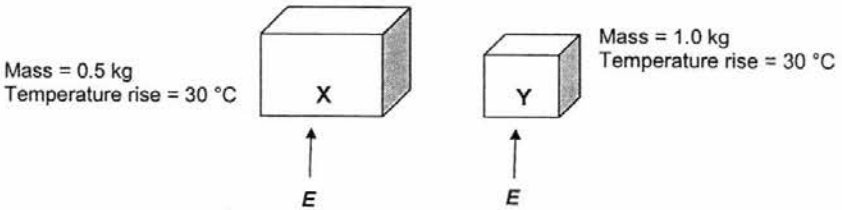
18. The variation of resistance against temperature of a thermometer is shown below.



Determine the value of temperature t.

A. 30 °C B. 40 °C C. 50 °C D. 60 °C

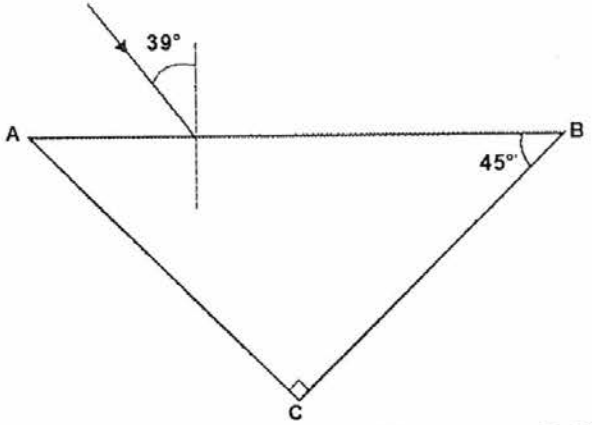
19. Two metal blocks X and Y of the same initial temperature are being heated up by the same heat source for the same duration. The amount of heat received by each block is represented by ***E***.



Which of the following statement about the metal blocks is correct?

A. The ratio of heat capacity of X to Y is 1 : 2.
B. The ratio of heat capacity of X to Y is 2 : 1.
C. The ratio of specific heat capacity of X to Y is 1 : 2.
D. The ratio of specific heat capacity of X to Y is 2 : 1.

20. A ray of light is incident on a triangular glass prism of refractive index 1.49. Determine the angle of incidence at BC.



A. 31° B. 42° C. 50° D. 72°

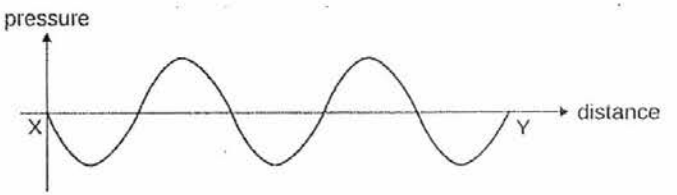
21. A device makes use of a converging lens that produces an image at the back of the lens. What are the characteristics of the image produced when the device is used to view a distant object?

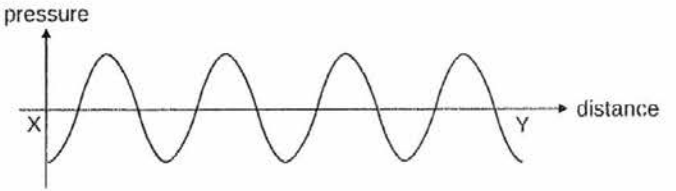
A. real, inverted, diminished
B. real, upright, same size
C. virtual, inverted, magnified
D. virtual, inverted, diminished

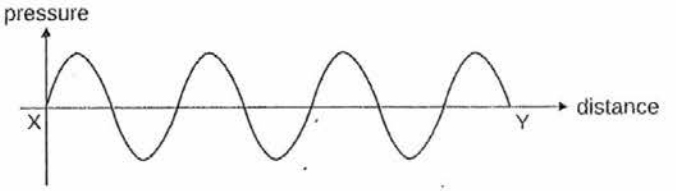
[Turn over

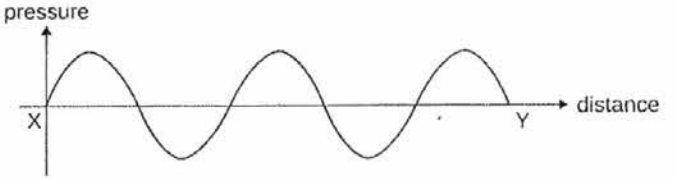
22. In a particular instance of a sound wave, the positions of the air particles is represented by straight lines as shown below.

Which of the following graphs correctly shows the pressure variation with respect to distance?

A.


B.


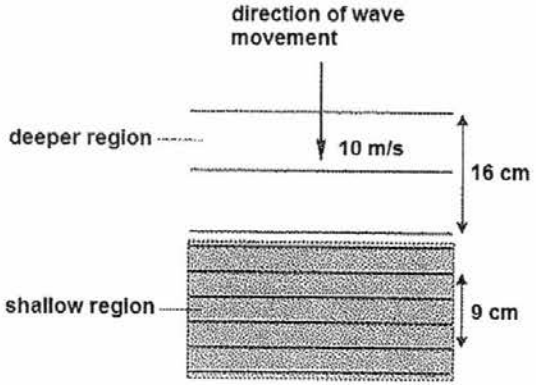
C.


D.


23. Which of the following electromagnetic waves is utilised for daily satellite imaging of the weather?

A. gamma rays B. radio waves C. ultraviolet D. infra-red

24. Plane waves travel at a speed of 10 m/s from a deeper region of water to a shallow region.

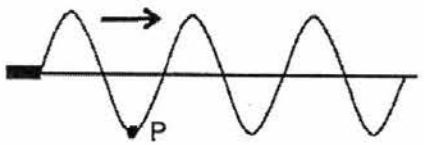


Which of the following about frequency and speed at the shallow region is correct?

	Frequency / Hz	Speed / ms^{-1}
A.	100	3.75
B.	125	3.75
C.	100	10
D.	125	10

25. The transverse wave shown below was moving from left to right. At one instant, a student observed that particle **P** of the wave was 5.0 cm away from the source and at the trough of the wave.

wave.

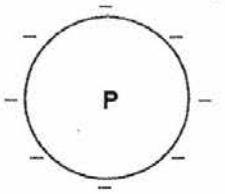


After a time lapse of one and half periods, the position of particle **P** would be at

A. the crest of the wave vertically upward.
B. the original position as seen by the student.
C. one and half wavelength horizontally to the left.
D. one and half wavelength horizontally to the right.

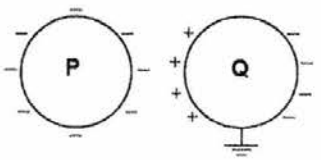
[Turn over

26. The diagram shows an isolated sphere P with its charge distribution.

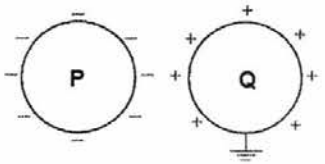


Another similar earthed sphere Q is brought near to sphere P. Which of the following diagrams shows the final charge distribution on both spheres?

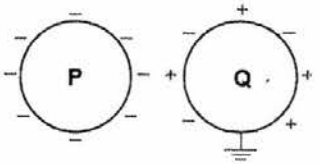
A.



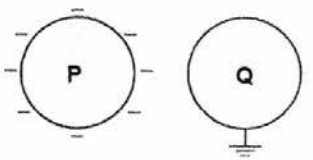
B.



C.

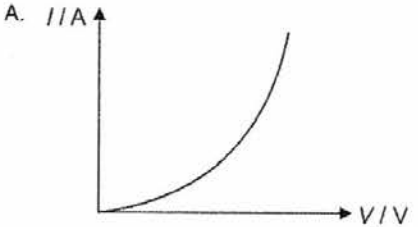


D.

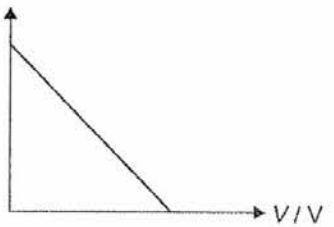


27. Which of the following *I-V* graph represents a thermistor?

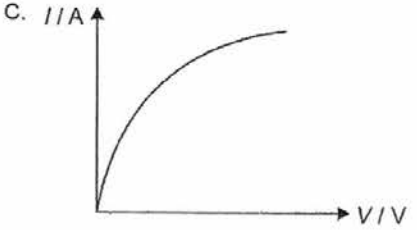
A.



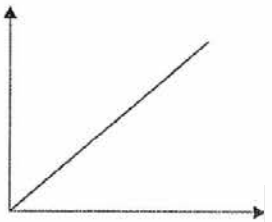
B.



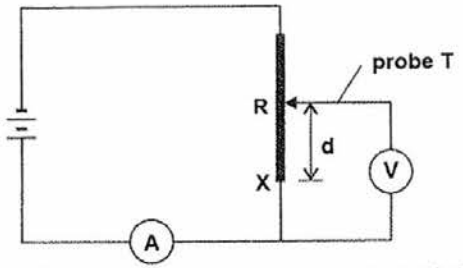
C.



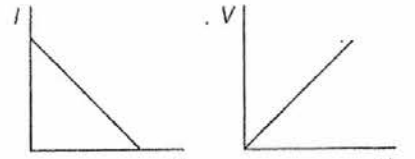
D.

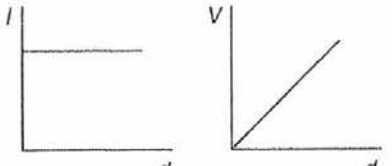


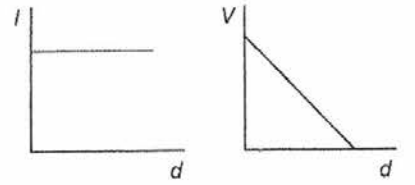
28. An electrical circuit is set up as shown below. The resistor R is a resistance wire and the probe T is able to slide along the wire. The variable distance d of the probe T is measured from point X of R.

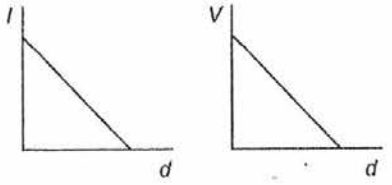


Readings from the voltmeter V and the ammeter A are taken and plotted against distance d. Which pair of graphs for current and voltage is correct?

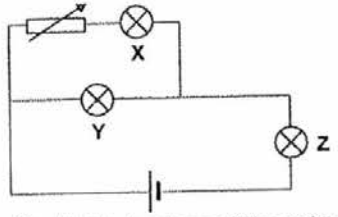
A.


B.


C.


D.


29. Three identical light bulbs X, Y and Z are connected in a circuit with a rheostat.

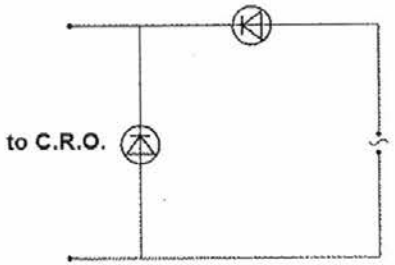


How will the brightness of the light bulbs change if the resistance of the rheostat is increased?

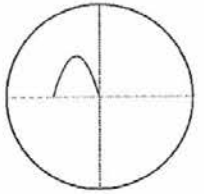
	X	Y	Z
A.	dimmer	dimmer	brighter
B.	dimmer	brighter	brighter
C.	dimmer	brighter	dimmer
D.	dimmer	unchanged	dimmer

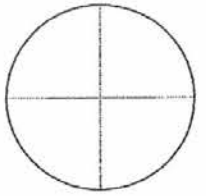
[Turn over

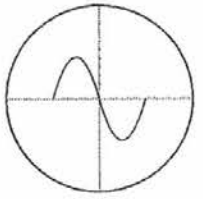
30. Two diodes are connected to an a.c. supply and a cathode ray oscilloscope (C.R.O.).

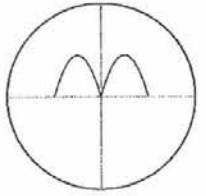


Which of the following shows the correct display on the C.R.O. screen?

A.


B.


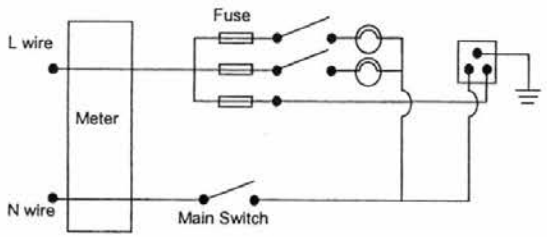
C.


D.


31. What will happen to the current flowing through a lamp if its 120 W light bulb is replaced with a 60 W light bulb?

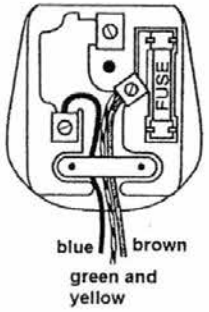
A. Current does not change.
B. Current is half as much.
C. Current is twice as much.
D. Current is quarter as much.

32. What is the mistake in the household circuit shown below?



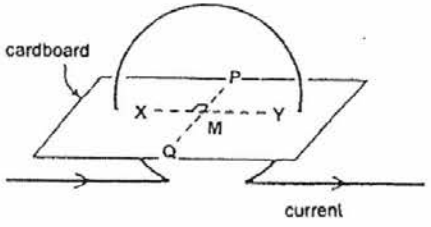
A. There should be an earth wire connected to the bulbs.
B. The neutral and the live wire in the socket should be interchanged.
C. The position of the earth wire in the socket is wrong.
D. The main switch should be installed at the live wire.

33. The diagram below shows the plug of an old electric iron wired wrongly. What effect would there be?



A. The metal case becomes live.
B. The electric iron catches fire.
C. The electric iron does not work.
D. The fuse in the plug blows.

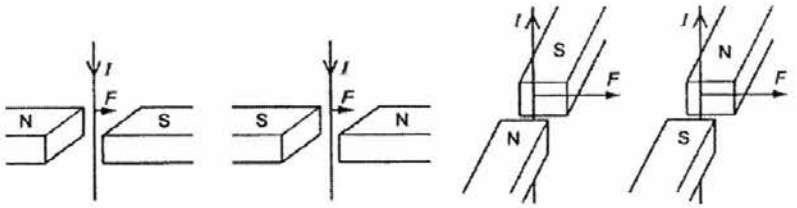
34. When a compass is placed at point P on the cardboard shown below, where will the north pole of the compass needle point towards?



A. X B. Y C. P D. Q

35. Which diagram shows the direction of the force F that is produced by a current I in a magnetic field?

A. B. C. D.



36. The diagram shows a beam of electrons entering a magnetic field. The direction of the field is into the page.

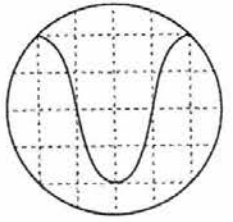
What will be the initial direction of the deflection of the electrons as the beam passes through the field?

A. out of the page
B. into the page
C. towards the top of the page
D. towards the bottom of the page

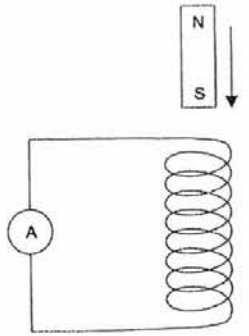
37. The diagram shows the trace obtained on the screen of an oscilloscope when a given signal is applied to the input terminals. The time-base is set at 2.0 ms / div and the voltage sensitivity is set at 2.0 V / div.

Which of the following correctly represents the peak voltage and frequency of the signal?

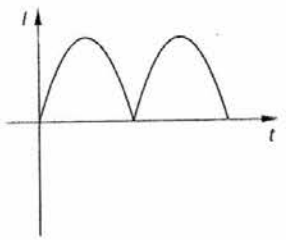
	Peak voltage	Frequency
A.	4 V	83.3 Hz
B.	4 V	125 Hz
C.	8 V	83.3 Hz
D.	8 V	125 Hz

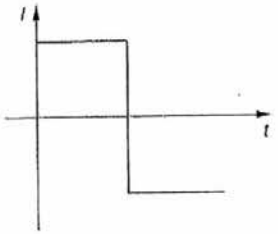


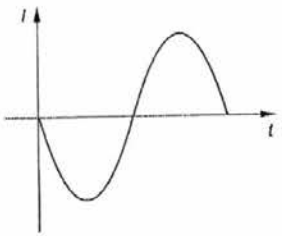
38. A bar magnet falls through a coil of wire. The coil of wire is connected to a galvanometer.

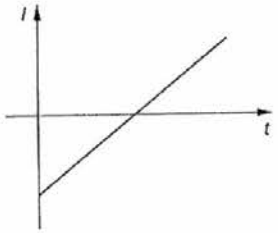


If the bar magnet falls through the coil at a constant speed, which of the following graphs correctly shows the change of current flowing in the solenoid against time?

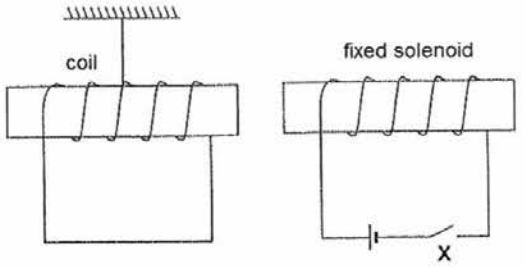
A.


B.


C.


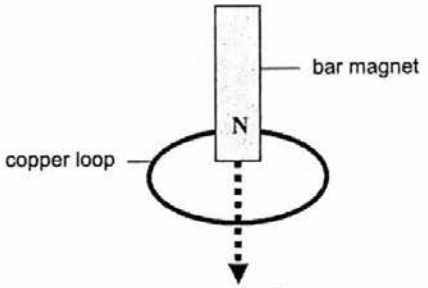
D.


39. A fixed solenoid is placed near a freely suspended coil. What happens to the coil when switch X is closed?



A. It remains at rest.
B. It swings back and forth.
C. It attracts the fixed solenoid and then swings to rest.
D. It repels away from the fixed solenoid and then swings to rest.

40. A bar magnet is dropped through a loop of copper wire as shown.



Which of the following statement(s) is/are correct?

1. When the magnet approaches the copper loop, a current is induced in the loop that flows in a clockwise direction as seen by the observer from the top of the loop.

2. When the magnet moves through the copper loop, the current induced in the copper loop sets up a magnetic field that always repel the magnet.

3. Heat is produced in the copper loop.

4. The magnet falls through the copper loop with an acceleration that is lower than the acceleration of free fall due to gravity.

A. 2 only B. 1 and 2 only C. 2 and 3 only D. 3 and 4 only

Name: .....( ) Class: Sec 4A

Queenstown Secondary School

Secondary Four Express
Preliminary Examination 2016

Physics 5059 Paper 2

15-09-2016
Thursday

Time: 1100 - 1245 hrs
Duration: 1 hour 45 minutes

READ THESE INSTRUCTIONS FIRST

Do not open this sheet until you are told to do so.

Write your name and index number in the spaces at the top of this page and on all the work you hand in.
Write in dark blue or black ink.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Section A
Answer **all** questions.

Sections B
Answer **all** questions. Question 13 has a choice of parts to answer.

Candidates are reminded that **all** quantitative answers should include appropriate units. The use of an approved scientific calculator is expected, where appropriate. 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.

At the end of the examination, fasten all your work securely together. The number of marks is given in brackets [ ] at the end of each question or part question.

FOR EXAMINER'S USE	
Section A	
Section B	
TOTAL	

Section A

Answer **all** questions in this section in the spaces provided.
The total mark for this section is 50.

1. In parascending, a person is attached to a parachute and towed over the sea by a rope attached to a motorboat as shown in Figure 1.1.

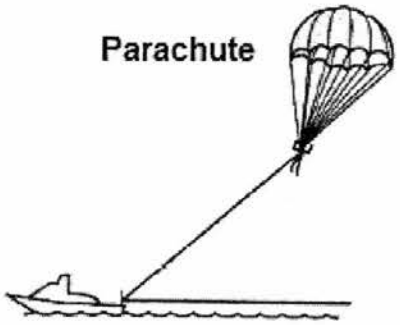


Figure 1.1

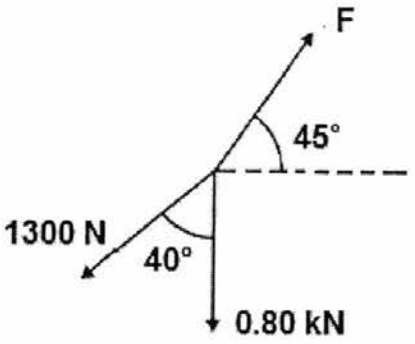


Figure 1.2

Figure 1.2 shows the directions of the forces acting on the person with a weight of 0.80 kN when being towed horizontally at a constant speed of 8.5 ms^{-1}. The tension force on the tow rope is 1300 N and the drag force is labelled **F**.

(a) State the resultant force acting on the person. Explain your answer. [1]

_____

_____

(b) Using a vector diagram, determine the value of the drag force, **F**. State an appropriate scale that you use. [4]

2. A box of 12 kg is initially at rest on a rough horizontal surface when a horizontal force is applied to it. The force varies with time as shown in Figure 2.

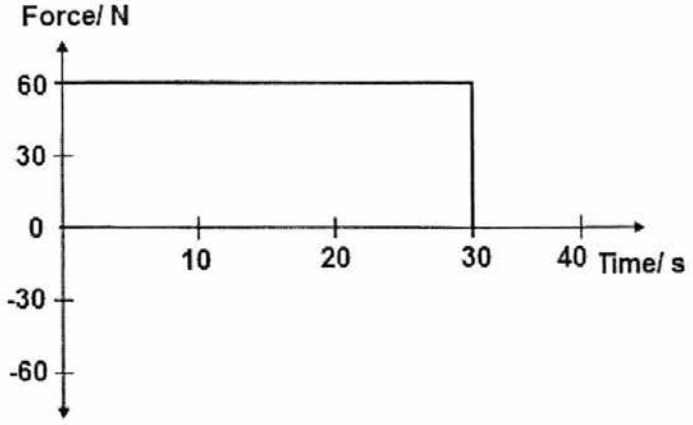


Figure 2

(a) If the box moves with an acceleration of 4 ms^{-2} in the first 30 s, what is the frictional force between the surfaces? [2]

(b) With the help of calculations, describe how does the velocity change from t = 30 s to t = 40 s? [3]

[Turn over

3. A boy of mass 60 kg uses a bridge to cross a river on his way to school every day. The bridge is supported symmetrically by two rollers. F_R and F_T represent the reaction forces by the two rollers **X** and **Z** respectively.

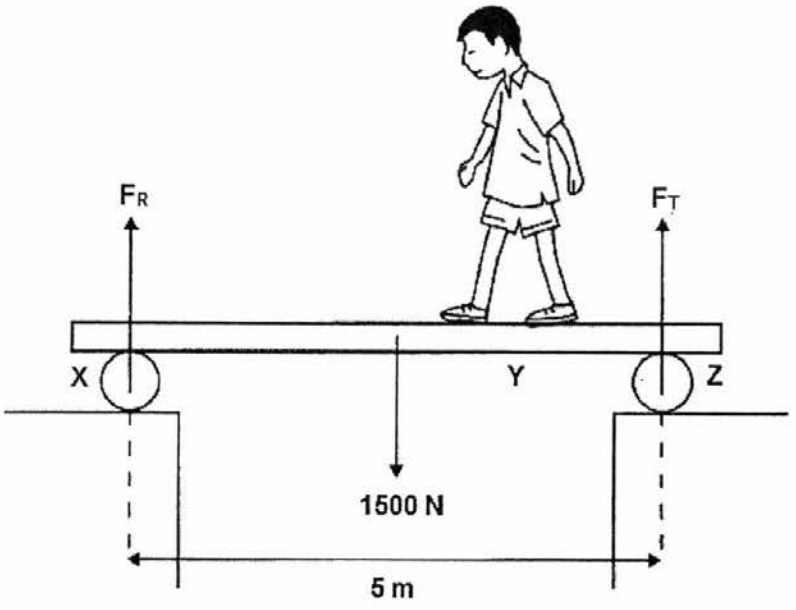


Figure 3

If the boy is at a distance of 2.0 m from the roller at **Z**, determine the reaction forces F_R and F_T. [4]

4. Hot-air balloons have a heater underneath the small opening of the balloon. When the heater is turned on, an upward force pushes the balloon upwards into the sky.

Figure 4

(a) Explain briefly how the balloon lifts off the ground and rises up into the sky. [3]

(b) Would it be easier for the balloon to lift off the ground if the opening of the hot-air balloon is made wider? Explain your answer. [3]

[Turn over

5. A metal block **X** of mass 500 g is heated in boiling water of 100°C for 20 minutes. The block is then transferred immediately to a polystyrene cup containing water at 28°C as shown in Figure 5.1 below. Readings are taken at intervals of 20 s for the temperature rise as soon as the block is lowered into the water. The mass of water in the polystyrene cup is 250 g. The graph as shown in Figure 5.2 below shows the variation of the temperature against time. Given that the specific heat capacity of water is 4200 J kg^{-1} $°C^{-1}$ and the specific latent heat of vaporisation of water is 2.26 x 10^3 $kJkg^{-1}$.

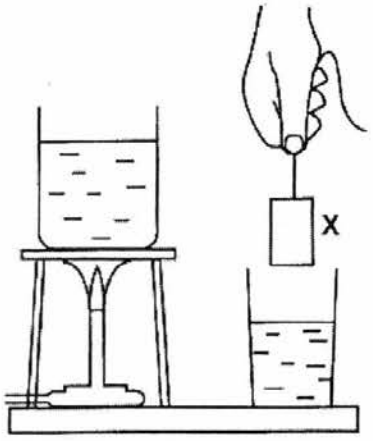


Figure 5.1

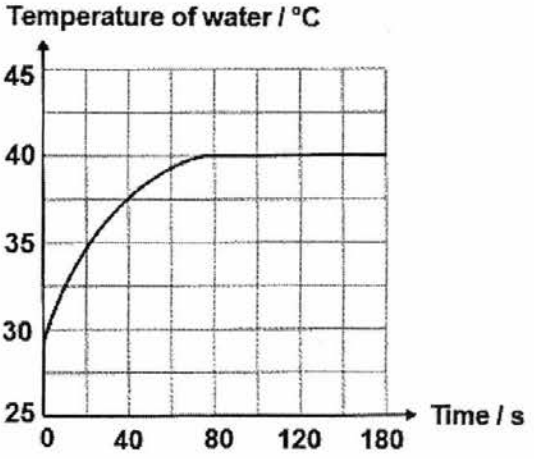


Figure 5.2

(a) Calculate the heat energy gained by water in the polystyrene cup when it is at thermal equilibrium. [2]

(b) Calculate the specific heat capacity of the metal block **X**. [2]

(c) State an assumption made to determine your answer in (b). [1]

_____

_____

6. A simple mercury barometer is set up in a school laboratory. The surrounding atmospheric pressure is 100 kPa and the height of the mercury column is represented by ***h***.

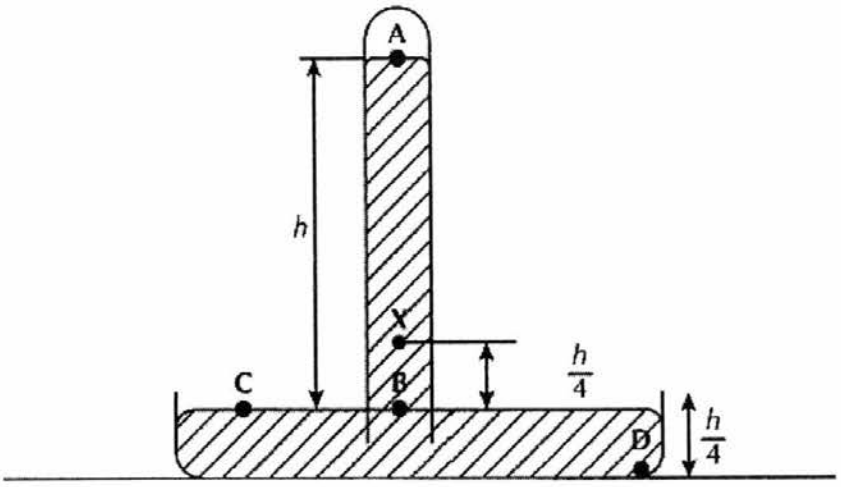


Figure 6

(a) Compare and explain the pressure at points **B** and **C**. [2]

(b) Which of the points **A**, **B**, **C**, **D** or **X** has the highest pressure? Explain your answer. [2]

(c) Determine the pressure at point **X**. [2]

[Turn over

7. Johnny was rowing a boat on a quiet stream. He noticed water waves passing under his boat with a quarter-second pause between each crest. Three waves take 1.5 seconds to sweep straight down the length of his 5.0 m boat.

Figure 7

Determine

(a) the velocity of the water waves, [2]

(b) the period of the water waves, [1]

(c) the wavelength of the water waves. [2]

3. A ship travels above a seabed from positions A to F as shown in Figure 8.1 below. At each point, the ship transmits sound pulses to the seabed to determine its depth. The speed of sound is 1500 ms^{-1}.

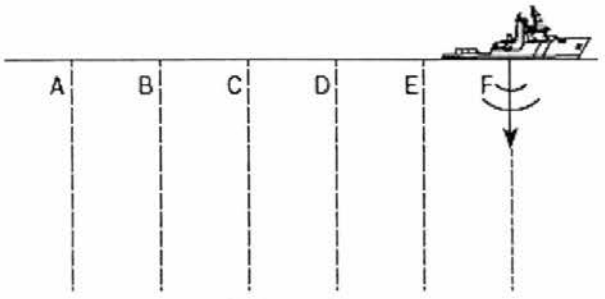


Figure 8.1

The time interval between each transmitted pulse and the reflected pulse received by the ship is recorded in the Intensity-time graph as shown in Figure 8.2 below. The thick lines represent the transmitted pulse while the thin lines represent the reflected pulse.

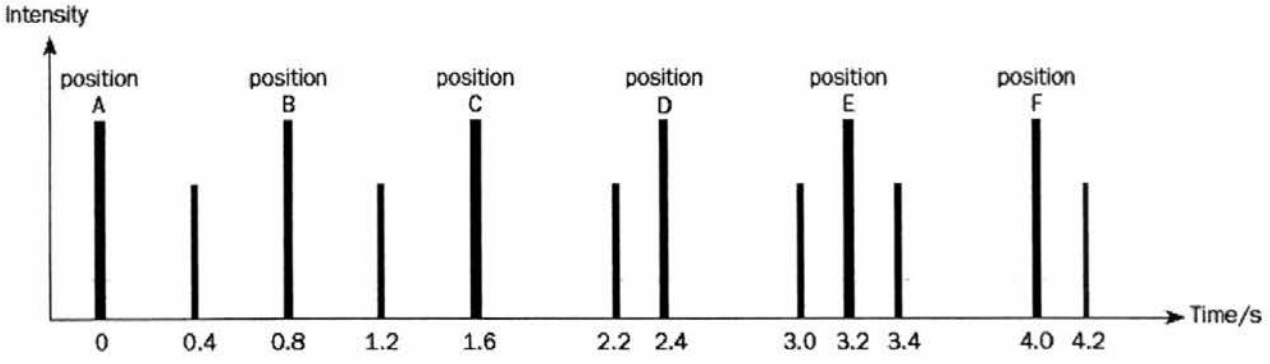


Figure 8.2

(a) Why is there a difference between the amplitude of the transmitted pulse and the received pulse? [1]

(b) Using the information given, determine which position(s) of the seabed is/are the deepest. Show your working clearly. [3]

[Turn over

9. Five resistors C, D, E, F and G each have different resistance values. The p.d. of resistor G is given as 15 V.

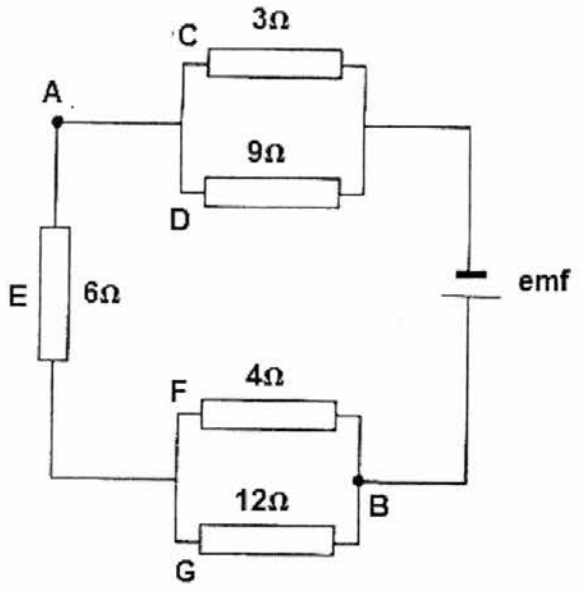


Figure 9

(a) Calculate the p.d. between A and B. [3]

(b) State and explain whether the e.m.f. of the circuit would be different if the resistor D is removed?

[2]

10. A very light loosely coiled spring is fixed to a horizontal ceiling at one end as shown in Figure 10 below. Each loop in the spring has a diameter of 10.0 cm and the separation of the individual loops is 3.0 cm.
Electrical connections are made to both ends of the spring. When the switch is closed, current flows in the spring and a small change in the length of the spring is observed.

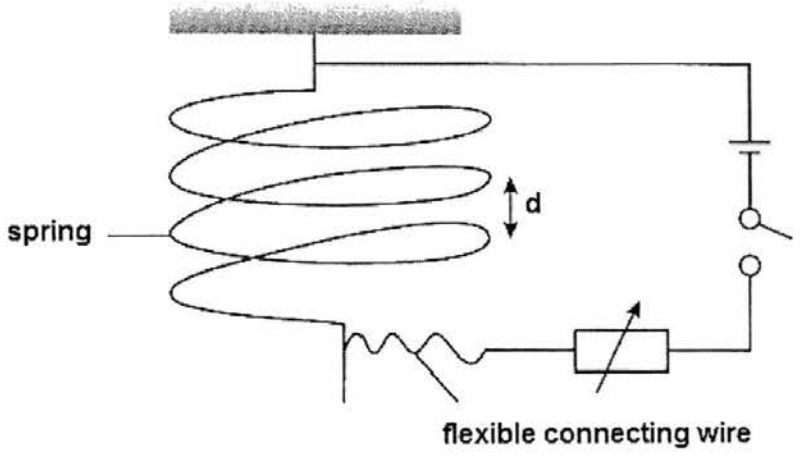


Figure 10

(a) On the diagram above, mark the direction of current in the individual loops of the spring when the switch is closed. [1]

(b) State and explain why the distance between the loops changes when current flows in the coil. [2]

(c) Suggest what would be observed if the terminals of the battery are reversed? Explain your answer. [2]

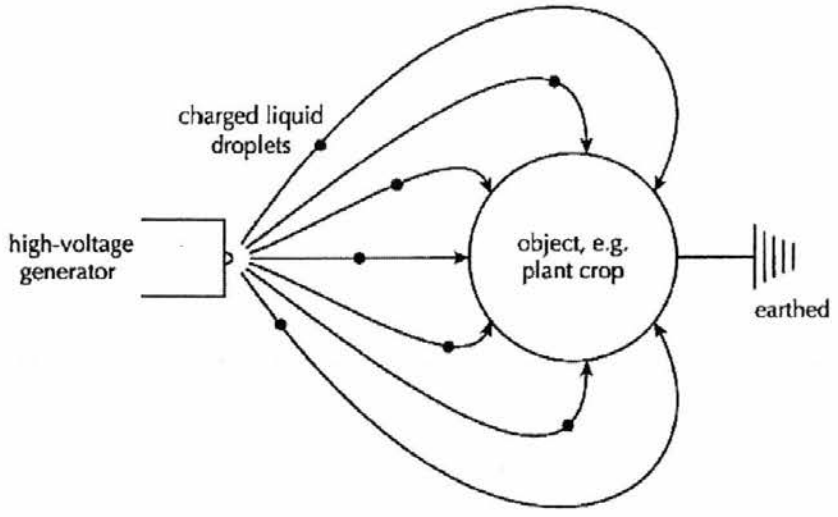
Section B

Answer all **three** questions in this section.

The last question is in the form of an EITHER/ OR and only one of the alternatives should be attempted.

11. To protect crops against insects, diseases and weed pests, farmers use chemicals such as insecticides, fungicides and herbicides. One way to apply these chemicals is through electrostatic crop spraying.

The principle of electrostatic crop spraying involves spraying a charged cloud of liquid droplets (e.g. insecticides, fungicides and herbicides) onto an object connected to the ground (e.g. plant crops). Although there are many different methods of electrostatic spraying, the simplest model is shown below.



A portable high-voltage generator gives the drops of liquid a charge. This makes the liquid break up into smaller droplets and causes the spray to become finer and more spread out.

Since the plant crops are connected to the ground and are conductive, they become slightly charged when the charged liquid droplets approach them. The charged plant crops attract the liquid droplets which allow a thorough and more uniform coating of the liquid across all uneven surfaces of the plants.

(a) Using information provided, deduce the type of charge on the liquid droplets and plant crops. [2]

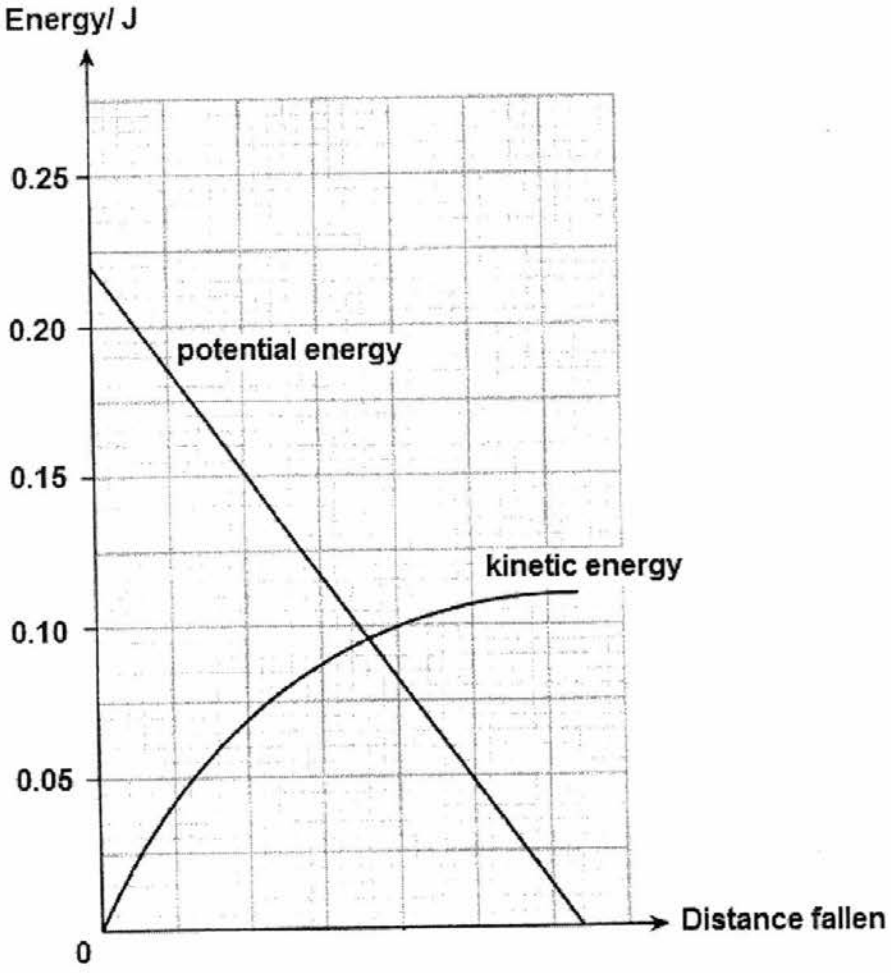
(b) Explain why the charges on the liquid droplets cause the spray to be uniformly spread on the crops. [1]

(c) Discuss why the plants become slightly charged when the charged liquid droplets approach them. [3]

(d) State two advantages of using very small charged droplets during electrostatic crop spraying of chemicals. [2]

(e) The high-voltage generator with a resistance of 5 kΩ is connected to a 230 V supply. If it is turned on for 20 minutes every day, calculate the energy consumption in kWh in a year. [2]

12. A ball is released from rest and falls to the floor. Air resistance causes the ball to reach terminal velocity before it reaches the floor. The figure below shows the graphs of the potential and kinetic energies of the ball against the distance fallen. Only the energy axis has been given a scale. The mass of the ball is 8.80×10^{-3} kg.



(a) Using the figure above, calculate the height from which the ball is dropped. Take the floor level to be zero potential energy. [2]

(b) Show that the terminal velocity of the ball is about 5.0 m/s. [3]

(c) Calculate the air resistance when the ball is falling with terminal velocity. [2]

(d) Calculate the energy loss per second as the ball falls at terminal velocity. [2]

(e) Predict how the energy loss per second would be different if the mass of the ball is twice now. [1]

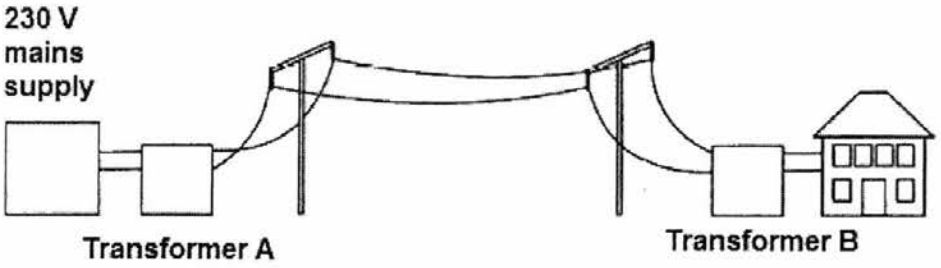
[Turn over

EITHER

13. A farmer connects his house to the mains electricity. The house is far away from the nearest 230 V mains electricity supply.

The diagram below shows the mains supply connected to the house.

The farmer uses 230 V lamps in the house but they do not light up at the full brightness. He then decides to add transformers, as shown in the diagram below.

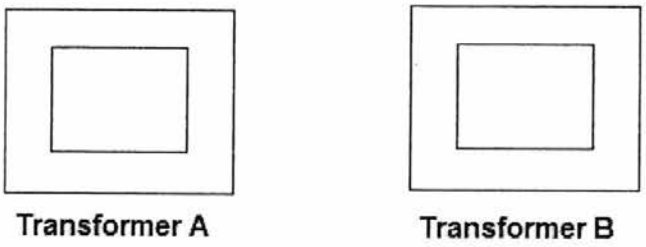


The lamps are brighter now after the transformers are added.

(a) Explain the difference in the brightness of the lamps. [3]

(b)(i) The 230 V mains supply provides 690 W of power to transformer A. If the energy loss per second has to be kept below 10% and the resistance of the cables between the transformers is 3 kΩ, calculate the minimum ratio of the number of turns in the secondary coil to the number of turns in the primary coil for transformer A. [3]

(ii) The diagram below shows a solid iron transformer core.

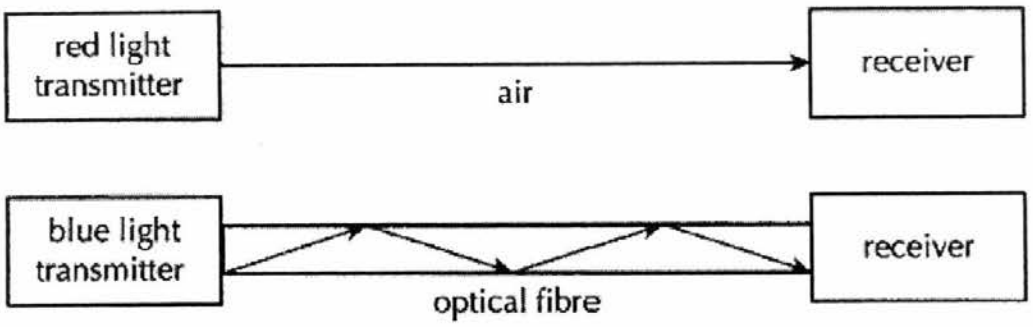


Draw two diagrams showing the possible construction for transformers A and B. Indicate clearly the possible number of turns you would use on the primary and secondary coils for each transformer. [2]

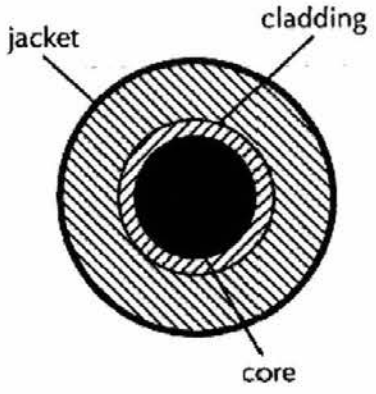
(c) Explain one possible advantage of alternating current (a.c.) over direct current (d.c.) in transmitting electrical power. [2]

OR

(a) Two light signals, red light and blue light, are sent from a transmitter to a receiver by two different methods as shown below.



The structural composition of the optical fibre through which the blue light travels is as shown below. The core, cladding and jacket of the optical fibre are usually made of materials like silicon dioxide (glass) and polymers or a mixture of both.

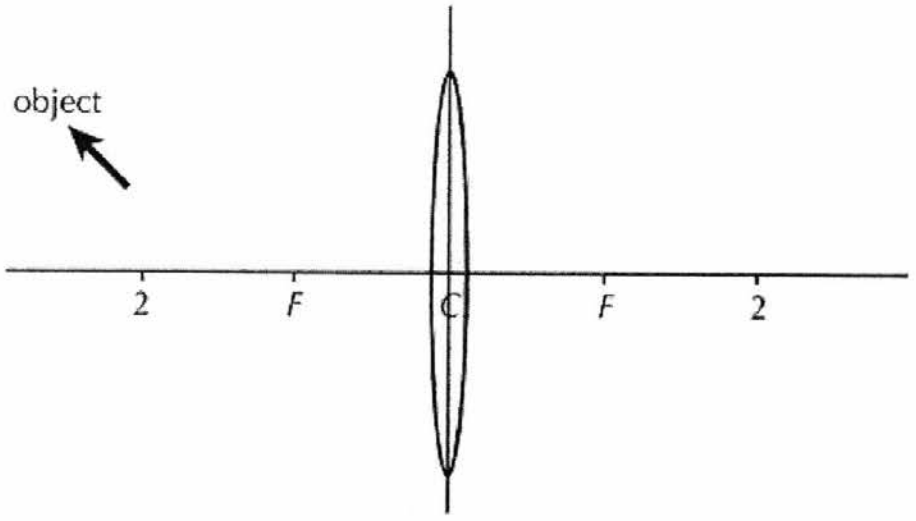


(i) Name the phenomenon which prevents the blue signal from escaping from the optical fibre. [1]

(ii) Deduce, whether the core or the cladding has a lower refractive index. Explain your answer. [2]

(iii) Compared to the red light signal, the blue light signal takes a longer time to arrive to the receiver. Suggest a possible reason for this. [2]

(b) An object is placed a distance away from a thin converging lens. F and C represent the principal focus and optical centre of the lens respectively.



(i) **On the same diagram above**, include four light rays from the object to locate the position of the image. Draw the image clearly and label it as ***I***. [3]

(ii) Suggest a simple way to test that the image formed is real. [2]

Answer Scheme for Secondary 4 Express Pure Physics Prelim 2016

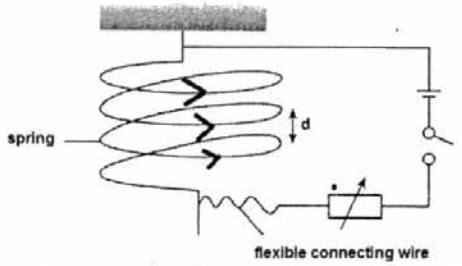
Paper 1 (40 marks)

1	A	**11**	B	**21**	A	**31**	B
2	A	**12**	A	**22**	B	**32**	C
3	C	**13**	A	**23**	D	**33**	D
4	A	**14**	C	**24**	B	**34**	C
5	D	**15**	D	**25**	A	**35**	D
6	C	**16**	C	**26**	B	**36**	D
7	A	**17**	B	**27**	A	**37**	B
8	D	**18**	B	**28**	B	**38**	C
9	D	**19**	D	**29**	C	**39**	D
10	C	**20**	A	**30**	A	**40**	A

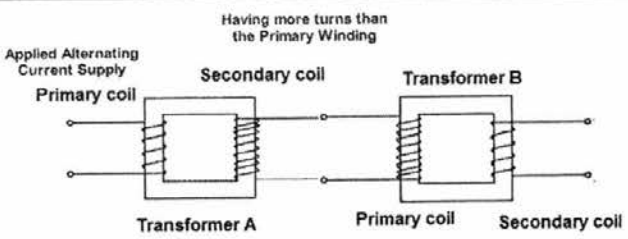
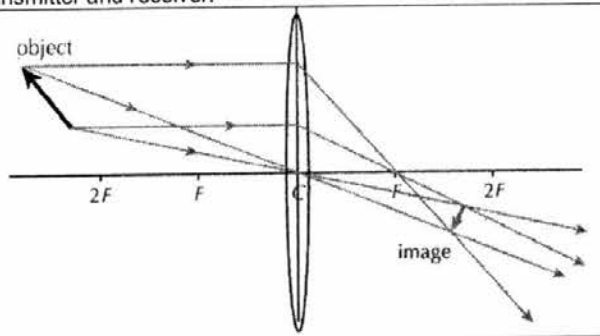
Paper 2

Qns	Scoring Points	Marks
	SECTION A (50 marks)	
1(a)	The **resultant force is zero** since the person is being towed at **constant speed**.	1m
1(b)	Vector diagram	4m
2(a)	Use F = ma, Resultant force = 12 x 4 = 48 N [1] Applied force = 60 N Frictional force = 60 – 48 = 12 N [1]	2m
2(b)	Since applied force is 0 N for the next 10 s, the resultant force = frictional force (which is unchanged) = **- 12 N.** [1] -12 = 12 (a) a = -1.0 m/s^2 At **t = 30s**, find velocity. [1] 4 = (v – 0)/ 30 **v = 120 m/s** At **t = 40s**, find velocity. [1] -1 = (v – 120) / 10 **v = 110 m/s.** Therefore, the velocity of the box changes from v = 120 m/s at t = 30 s to v = 110 m/s at t = 40 s.	3m
3	Taking moments about X, find F_T. Clockwise moments = Anticlockwise moments (2.5 x 1500) + (600 x 2) = F_T x 5 [3] F_T = 990 N To find F_R, Total upward force = Total downward force 990 + F_R = 1500 + 600 F_R = 1110 N [1]	4m

4(a)	When the heater is turned on, the air inside the hot-air balloon is heated, **becomes less dense and rises** [1]. The amount of hot air inside the balloon increases and **creates an upward force** [1] on the balloon. When the **upward force becomes larger than the weight of the balloon, a resultant upward force** [1] causes it to rise into the sky.	3m
4(b)	When the opening of the balloon is made wider, the less dense **warm air inside the balloon will escape out** and allows **denser surrounding air to enter**.[1] Hence, the **density of the air inside and outside of the balloon will equalize** [1] and there will be **no upward force** [1] to lift the balloon into the sky.	3m
5(a)	Use Q = mcΘ Q = 0.25 x 4200 x (40 – 28) Q = 12 600 J	2m
5(b)	Thermal energy gained by water = Thermal energy loss by X 12 600 = 0.5 x c x (100 – 40) c = 420 J kg^{-1} °C^{-1}	2m
5(c)	There is no energy loss to the surroundings.	1m
6(a)	Pressure at points B and C are the **same** since both are at the **same height** or level.	2m
6(b)	**Point D** has the highest pressure since it is at the **greatest depth** in the mercury.	2m
6(c)	P = ¾ x 100 000 P = 75 000 Pa	1m
7(a)	v = d/t v = 5 / (1.5 ÷ 3) v = 10 m/s	2m
7(b)	T = ¼ = 0.25 s	1m
7(c)	v = λ/ T 10 = λ / 0.25 2.5 m = λ	2m
8(a)	As the transmitted pulse travels to and fro the seabed, some energy is dissipated to the seabed, hence the reflected pulse is weaker than the transmitted pulse.	1m
8(b)	Let the time interval between each transmitted pulse and the reflected pulse received by the ship be t, and the depth be d. $v = \frac{2d}{t} \Rightarrow d = \frac{vt}{2}$ At position A, $d = \frac{1500(0.4 - 0)}{2} = 300$ m At position B, $d = \frac{1500(1.2 - 0.8)}{2} = 300$ m At position C, $d = \frac{1500(2.2 - 1.6)}{2} = 450$ m At position D, $d = \frac{1500(3.0 - 2.4)}{2} = 450$ m At position E, $d = \frac{1500(3.4 - 3.2)}{2} = 150$ m At position F, $d = \frac{1500(4.2 - 4.0)}{2} = 150$ m Positions C and D are the deepest.	3m (clear working shown for the depth of each position and identifying which two positions are the deepest.)

9(a)	$15 \div (1/12 + 1/4)^{-1} = 15 \div 3 = 5$ A p.d. across AB = 5 x (6 + 3) = 45 V	3m
9(b)	The emf of the circuit **remains unchanged** since the emf of the circuit is dependent on the **number of batteries** instead of the number of resistors in the circuit.	2m
10(a)		1m
10(b)	As current flows through the spring, each loop carries current in the **same direction as its neighbouring loop**. This creates a **magnetic field** around the loops which results in an **attractive force** between the loops, hence the loops become closer.	2m
10(c)	The loops will still experience an **attractive force** towards each other since the **current** flowing in each loop is still in the **same direction relative to each other.**	2m
	SECTION B (30 marks)	
11a	Liquid droplets: Positively charged Plant crops: Negatively charged	2m
11b	The liquid droplets are **positively charged** by the high-voltage generator and **repel one another** upon being sprayed out since like charges repel.	1m
11c	As the positively charged liquid droplets approach the crops, the **free electrons from the ground move from the earth to the plants since unlike charges attract.** The crops have **more negative charges** compared to its original positive charges, hence the crops have an **overall negative charge.**	3m
11d	1. Smaller charged droplets ensure **thorough coating** of chemical on the crops, hence a small amount of chemical is required, **reducing cost**. 2. Smaller charged droplets ensure that **most chemical lands on the plants** instead of the ground. Hence, this **minimizes chemical pollution** to the environment.	2m
11e	$\mathbf{E = (V^2/R)\,t}$ $E = (230^2 / 5000) \times (1/3 \times 365) = 1287$ kWh	2m
12(a)	Loss in GPE = mgh 0.22 = 0.0088 x 10 x h h = 2.5 m Height is 2.5 m.	2m

12(b)	Maximum constant KE of the ball occurs when the ball reaches its maximum velocity (terminal velocity). $\frac{1}{2} mv^2 = 0.11$ [1] $\frac{1}{2} \times 0.088 \times v^2 = 0.11$ [1] v = 5.0 m/s [1] Terminal velocity is 5.0 m/s.	3m
12(c)	At terminal velocity, the acceleration of the ball is zero, hence its resultant force is zero, total upward force = total downward force. Air resistance = Weight of the falling ball Air resistance = mg = 0.0088 x 10 = 0.088 N	2m
12(d)	At terminal velocity, the ball is displaced downward by 5.0 m per second. Energy loss per second = mgh = mg x distance fallen every second = 0.088 x 5.0 = 0.44 J	2m
12(e)	The **energy loss per second increases** since the terminal velocity of the heavier ball would be higher and hence distance fallen every second is larger.	1m
13(a)	When electricity is delivered over long distances, some **electrical energy is lost** as heat due to resistance in the cable wires. [1] This power loss due to cable wires (as heat energy in every second) is calculated by $\mathbf{P = I^2R}$. [1] By using a transformer, electricity is stepped up to high voltages during transmission, hence **current is reduced and energy loss is also reduced**.[1/2] Thus, **lamps are brighter** in the second situation. [1/2]	3m
13(b)(i)	Energy loss per second = 10/100 x 690 = 69 W $\mathbf{P = I^2R}$ $69 = I^2 (3000)$ I = 0.152 A [1] Using Power in primary coil = Power in secondary coil $V_pI_p = V_sI_s$ $V_s/V_p = N_s/N_p$ $N_s/N_p = I_p/I_s$ Current in primary coil: Use P = VI 690 = I x 230 I = 3 A [1] $N_s/N_p = I_p/I_s$ = 3 / 0.152 = 19.73 ≈20 [1]	3m

13(b) (ii)	 **Transformer A: Primary coil: Secondary coil → 100: 2000** **Transformer B: Secondary coil: Primary coil → 2000: 100**	2m (1m – for correct drawing of both transformers indicating that one end of the transformer has more coils than the other. 1m – correct ratio given)
13(c)	Alternating current voltages can be **stepped up or down using transformers**. This **minimizes energy loss** during long distance transmission as high a.c. voltages can be stepped up using step up transformers and step down using step down transformers before it is safe for consumer use.	2m
14(a) (i)	Total internal reflection	1m
14(a) (ii)	For total internal reflection to occur in the core, light has to travel from a **denser to a less dense** medium. Hence, the **cladding has a lower refractive index**.	2m
14(a) (iii)	1. The **speed of light is slower in the optical fibre** than in the air since the **optical density of the optical fibre is higher** than that of air. 2. The **path of red light is shorter (straight path)** than that of **blue light (jagged path)** for the same distance between the transmitter and receiver.	2m (For either reason with explanation)
14(b) (i)		½ mark for each correct light ray. 1 mark for the correct image drawn. Total: 3m
14(b) (ii)	Place a screen at the position of the image. [1] If an image is formed on the screen, it is a real image. [1]	2m