# AHMAD IBRAHIM SECONDARY SCHOOL
# GCE O-LEVEL PRELIMINARY EXAMINATION 2017

## PHYSICS 5059/ 01

Secondary Four Express

Date : 18 August 2017
Duration : 1 hour

**INSTRUCTIONS TO CANDIDATES**

**Do not open this booklet until you are told to do so.**
Write your name and register number on the answer sheet in the spaces provided.

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

**Read very carefully the instructions on the answer sheet.**

**INFORMATION FOR CANDIDATES**

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 booklet.

Answer **ALL** the questions in this section.

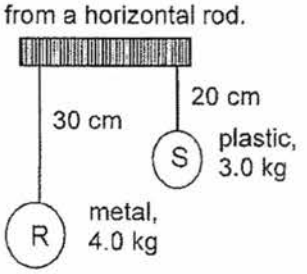
1 What is the correct order of magnitude for the diameter of an atom and for the diameter of the Earth?

| | diameter of atom | diameter of Earth |
|---|---|---|
| A | 0.1 nm | 10 Mm |
| B | 0.1 nm | 10 Gm |
| C | 0.1 μm | 10 Mm |
| D | 0.1 μm | 10 Gm |

2 A student measures the diameter of a pen with a ruler.
How could he increase the accuracy of the measurement?

**A** take the average value of several measurements of the diameter along different parts of the pen using the ruler
**B** take the average value of several measurements of the diameter along different parts of the pen using vernier calipers with zero error
**C** take the average value of several measurements of the diameter along different parts of the pen using vernier calipers without zero error
**D** use a micrometer with zero error and take one value of the diameter

3 The diagram shows two different pendulums R and S hung from a horizontal rod.
Which of the following statements is **true**?




**A** R has a shorter period as it has a greater density.
**B** R has a shorter period as it is larger in size.
**C** S has a shorter period as it has a smaller mass.
**D** S has a shorter period as it is shorter.

4 Two forces act at a point.

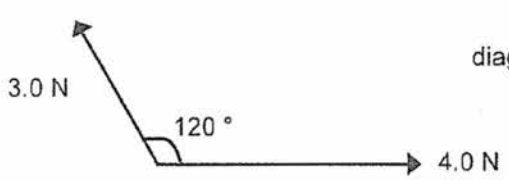


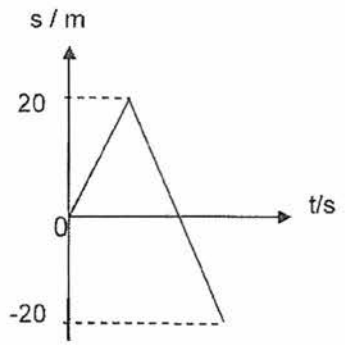

diagram not drawn to scale

What is the resultant of the two forces?

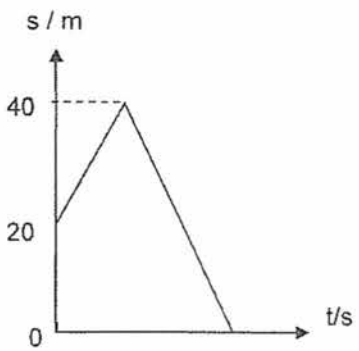
**A** 1.0 N **B** 3.6 N **C** 5.0 N **D** 7.0 N

5 A ball is thrown vertically up from the top of a building 20 m high with an initial velocity of 20 m $s^{-1}$. The displacement of the balls is measured from the point of projection of the ball. Which of the following graphs best represents the displacement of the ball with time t?

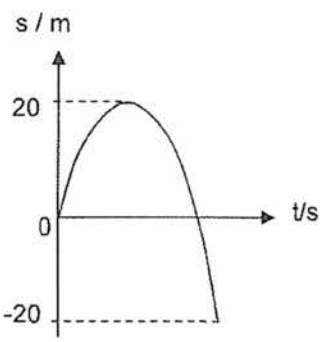
A



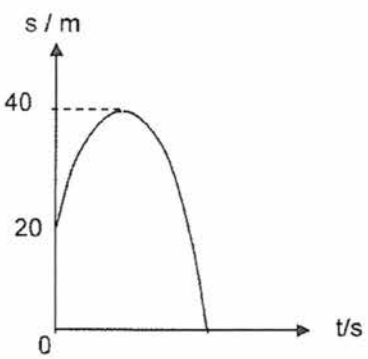

B



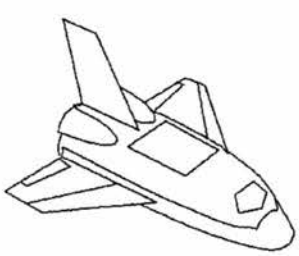

C




D

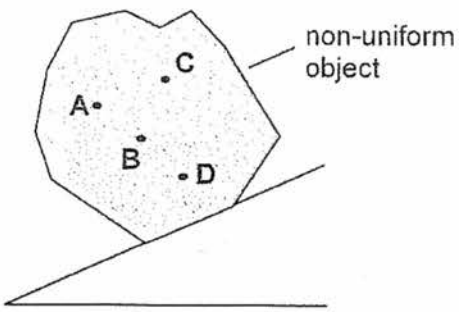



6 If the engine of a space craft travelling in empty space is turned off, the space craft will

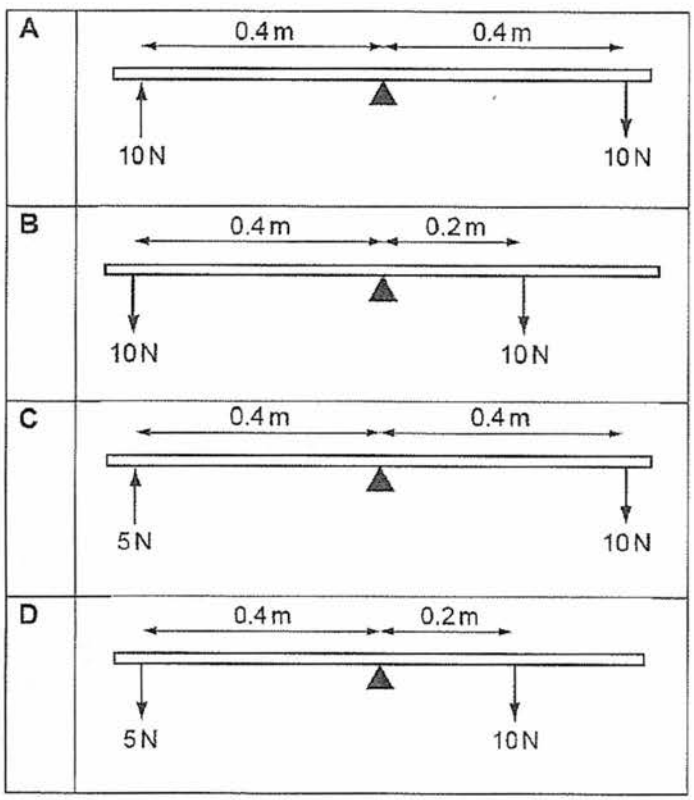


A continue to move with constant acceleration.
B continue to move with constant deceleration.
C continue to move with constant velocity.
D stop moving.

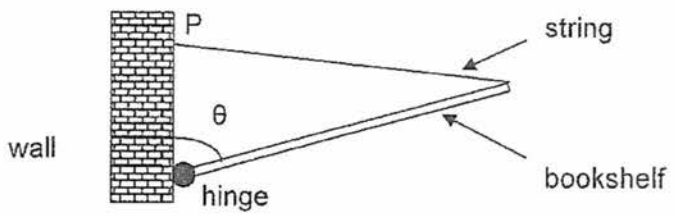
7 A non-uniform object is placed on an inclined plane as shown below. If the object is just about to topple, which position will be its centre of gravity?




8 Forces are applied to a uniform beam pivoted at its centre.
Which beam is balanced?



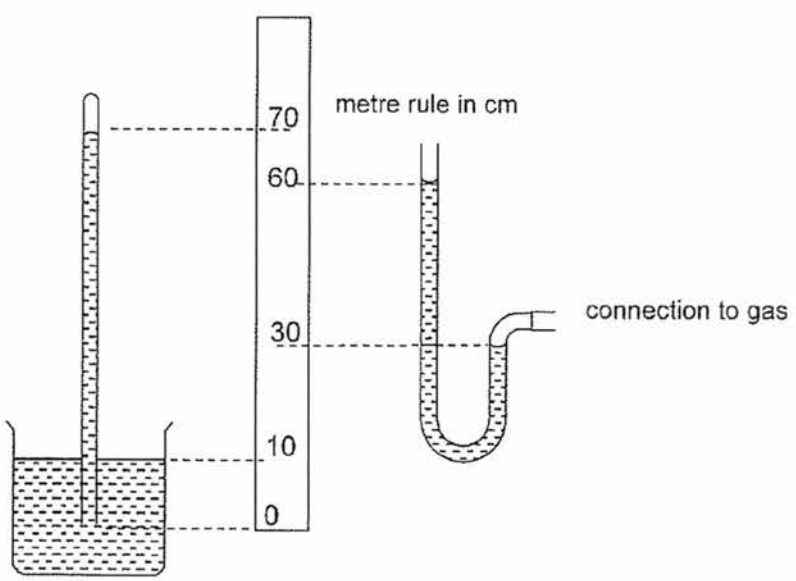
9 A string is tied to the wall at a fixed point P to help to secure a bookshelf.




Which of the following will help to minimise the tension in the string in order to help it last longer?

A a smaller θ
B have a longer bookshelf
C less friction at hinge
D use steel bookshelf instead of light wooden one

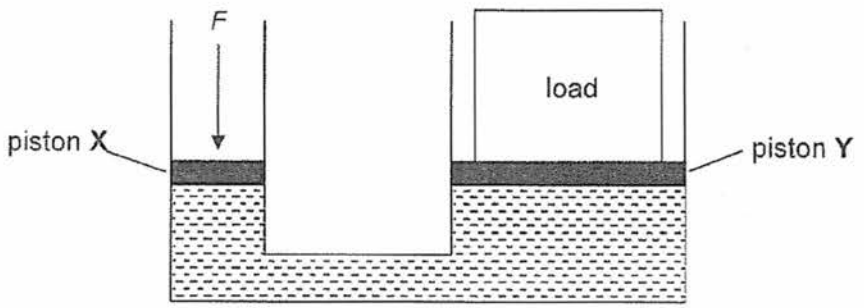
10 A mercury barometer and a mercury manometer are placed in the same room which is on a hill top. The manometer is connected to a gas container.




What is the pressure of the gas?

A 15 cm Hg B 40 cm Hg C 75 cm Hg D 90 cm Hg

11 A hydraulic press which consists of two circular pistons is shown. The diameter of piston **Y** is twice the diameter of piston **X**. A downward force of *F* is applied to piston **X**.




What is the size of the upward force on the load?

**A** 0.5*F* **B** 1.0*F* **C** 2.0*F* **D** 4.0*F*

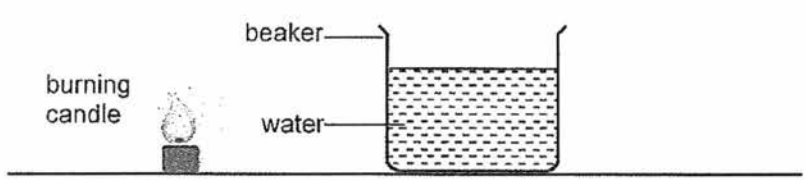
12 A student, Peter, observes Brownian motion of smoke particles in air with a microscope. He sees moving points of light. Where do these points of light come from?

**A** air particles moving randomly
**B** air particles vibrating
**C** air and smoke particles moving randomly
**D** smoke particles moving randomly

13 A gas is heated in a sealed metal container. Which one of the following quantities will not increase?

**A** average force of collision of the particles on the container walls
**B** average kinetic energy of the particles
**C** frequency of the collision between particles
**D** intermolecular distance between particles

14 The diagram shows a beaker of water placed near a burning candle.



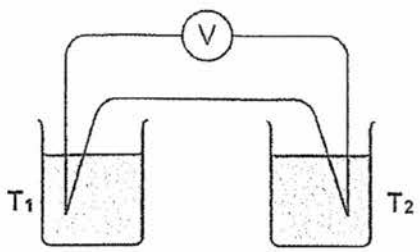

How does thermal energy from the candle reach the water in the beaker?

**A** conduction → convection
**B** radiation → conduction
**C** convection → conduction
**D** radiation → convection

15 Which one of the following physical properties does not vary with temperature?

A mass of a liquid at a constant volume
B pressure of a fixed mass of gas at a constant volume
C resistance of an electrical conductor
D volume of a fixed mass of liquid

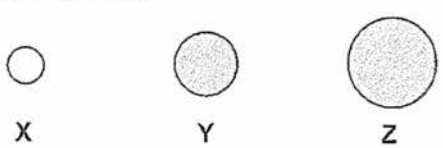
16 A thermocouple thermometer uses a voltmeter to measure the electromotive force (e.m.f.) generated between two junctions. The junctions are at temperatures $T_1$ and $T_2$.




Which pair of values of $T_1$ and $T_2$ will not produce any voltmeter reading?

| | $T_1$ / °C | $T_2$ / °C |
|---|---|---|
| A | - 10 | - 20 |
| B | - 5 | 0 |
| C | 10 | 10 |
| D | 0 | 100 |

17 The diagram shows three spheres **X**, **Y** and **Z** of different sizes. Spheres **X** and **Y** are in thermal equilibrium. Spheres **Y** and **Z** are made from the same material while sphere **X** is made from a different material.



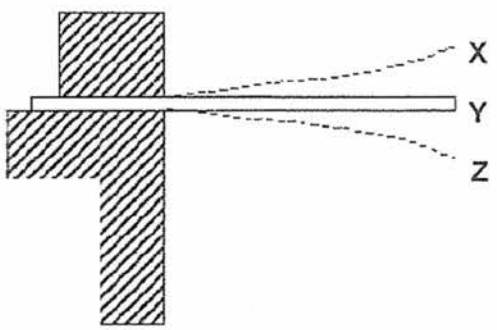

Which of the following statements is true?

A **X** and **Y** have the same specific heat capacity.
B **Y** has a lower heat capacity than **Z**.
C The temperature of **Y** is higher than that of **X**.
D There is a net transfer of thermal energy if **X** is placed in contact with **Y**.

18 The energy required to change liquid water into water vapour at the same temperature is called the latent heat of vaporisation. What does this energy do?

A increases the average separation of the water molecules
B increases the average speed of the water molecules
C raises the temperature of the air near the water
D splits the water molecules into their separate atoms

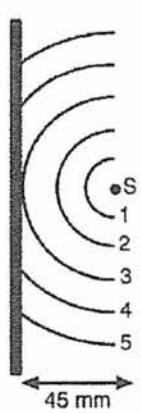
19 The diagram shows a ruler clamped at the end of a bench, with a length of the ruler projecting to position **Y**. The end of the ruler was pushed down to **Z** and then released. The ruler vibrated for a while between **Z** and **X**, emitting a sound wave of frequency 50 Hz.




How long did it take for the end of the ruler to move from **Z** to **X**?

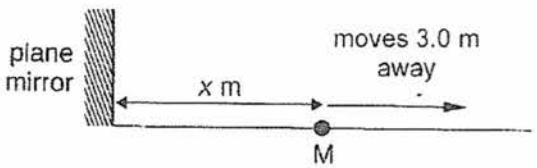
A 0.010 s
B 0.020 s
C 25 s
D 50 s

20 A vibrating source S produces circular water waves near a straight reflector. If the speed is 60 mm/s, find the wavelength and frequency of the waves.




| | Wavelength/ mm | Frequency/ Hz |
|---|---|---|
| A | 15.0 | 4.0 |
| B | 15.0 | 40 |
| C | 22.5 | 2.6 |
| D | 22.5 | 26 |

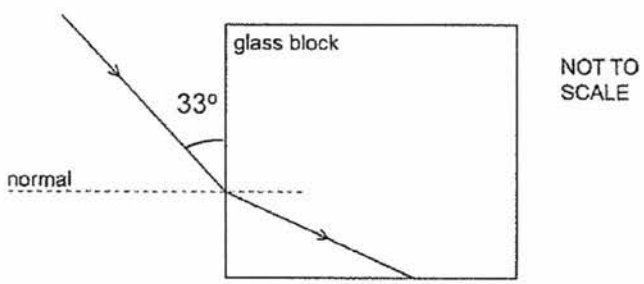
21 The diagram shows a man standing at a position M in front of a plane mirror, a distance of $x$ m from the mirror.




When the man moves 3.0 m away from the mirror, the new distance between the man and his image becomes 12 m. What is the value of $x$?

A 1.0 m
B 2.0 m
C 3.0 m
D 4.0 m

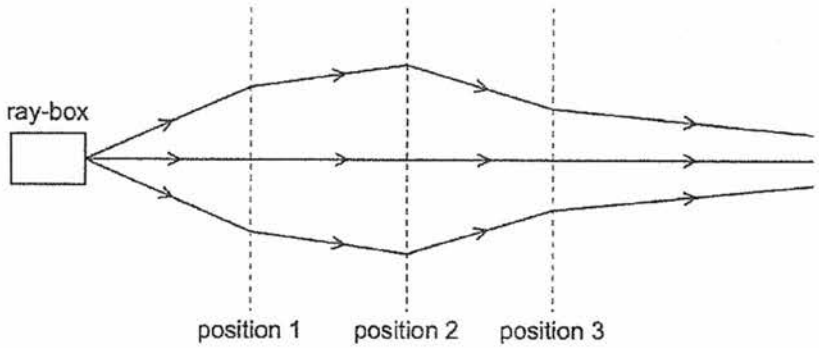
22 Light passes from air into a glass block of refractive index 1.5, as shown.




What is the angle of refraction in the glass and what is the critical angle?

| | angle refraction | critical angle |
|---|---|---|
| A | 34° | 42° |
| B | 34° | 60° |
| C | 38° | 42° |
| D | 38° | 60° |

23 The rays of light from a ray-box pass through three lenses placed at positions 1, 2 and 3.



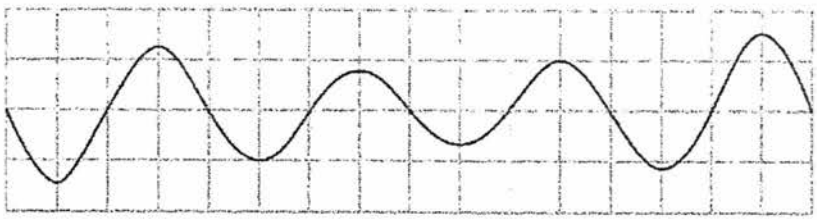

What type of lens is used at each position?

| | position 1 | position 2 | position 3 |
|---|---|---|---|
| A | converging | converging | converging |
| B | converging | converging | diverging |
| C | diverging | converging | diverging |
| D | diverging | diverging | converging |

24 Which line in the table summaries the change in wave characteristics on going from infra-red to ultraviolet in the electromagnetic spectrum?

| | frequency | speed in a vacuum |
|---|---|---|
| A | decreases | decreases |
| B | decreases | remains constant |
| C | increases | remains constant |
| D | increases | increases |

25 The waveform of a sound appears on an oscilloscope as shown.



Which of the following correctly describes the changes in the sound?

| | pitch | loudness |
|---|---|---|
| A | increases and then decreases | decreases and then increases |
| B | decreases and then increases | remains the same |
| C | increases and then decreases | remains the same |
| D | remains the same | decreases and then increases |

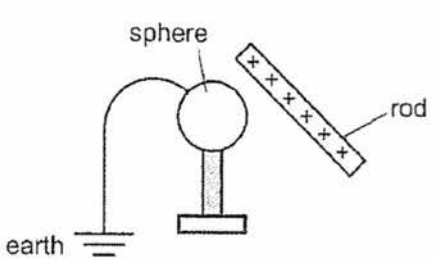
26 A sonic 'tape measure' is used to measure the distance of a place. In measuring a place of distance 1280 m away, it transmits a sound pulse and received the echo 8.0 s later. What is the speed of sound measured?

A 160 m/s
B 250 m/s
C 320 m/s
D 400 m/s

27 Which of the following is equivalent to one coulomb?

A one ampere per volt
B one ampere second
C one volt ampere
D one volt per ampere

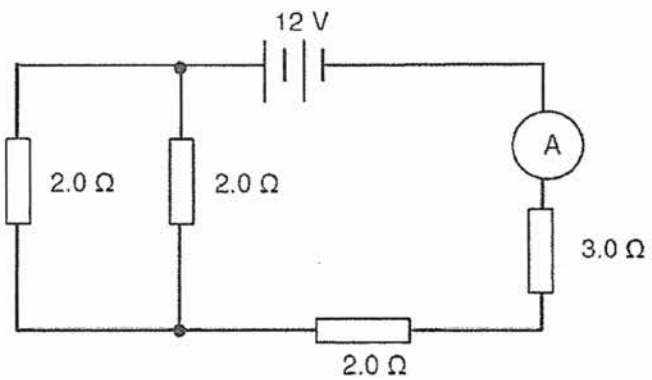
28 A positively charged rod is held close to an earthed metal sphere.




Which of the following describes the charge on the metal sphere?

A It is negative because electrons are attracted towards the rod.
B It is neutral because electrons are attracted towards the rod and protons are repelled.
C It is neutral because it is earthed.
D It is positive because protons are repelled by the rod.

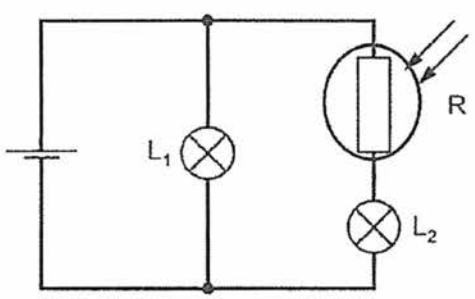
**29** A circuit is set up in the diagram below.




What is the ammeter reading in the circuit?

**A** 0.50 A **B** 0.67 A **C** 1.5 A **D** 2.0 A

**30** In the circuit shown, R is a light-dependent resistor.




The light intensity on R increases.
What happens to the brightness of the two lamps $L_1$ and $L_2$?

| | $L_1$ | $L_2$ |
|---|---|---|
| **A** | decreases | decreases |
| **B** | decreases | increases |
| **C** | stays the same | decreases |
| **D** | stays the same | increases |

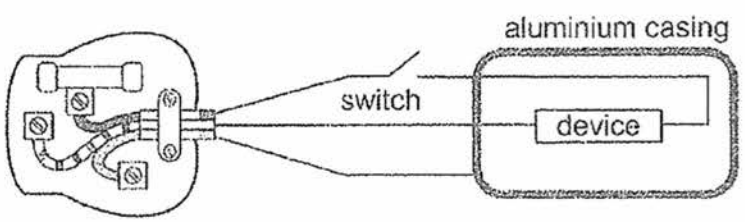
31 The diagram shows the label on an electric iron.

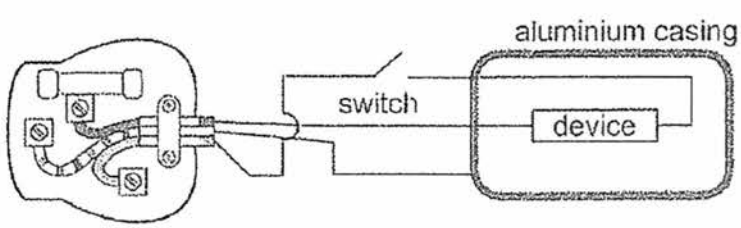
| ELECTRIC IRON | |
|---|---|
| Operating Voltage | 240 V |
| Power | 2.8 kW |
| Fuse Rating | 13 A |

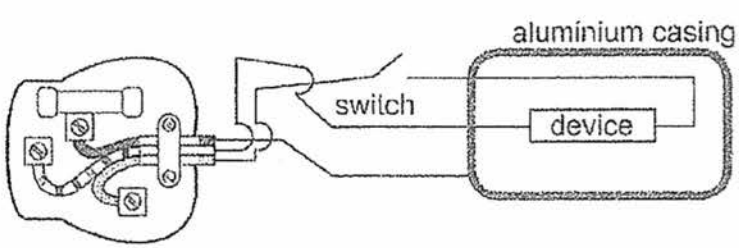
This iron is used for 12 hours every month. The cost of 1 kWh of electrical energy is 25 cents. Which of these statements is true about the electric iron?

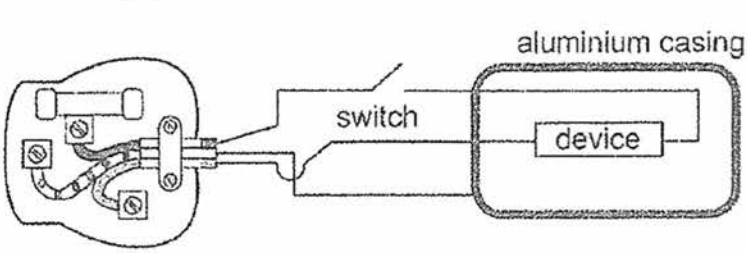
A The fuse will blow because the fuse rating is too low.
B The energy dissipated in the iron every month is 120 kJ.
C The iron is 90% efficient.
D It costs $8.40 every month to use the iron.

32 Which one of the following electrical appliances is correctly wired to a three-pin plug?

A



B


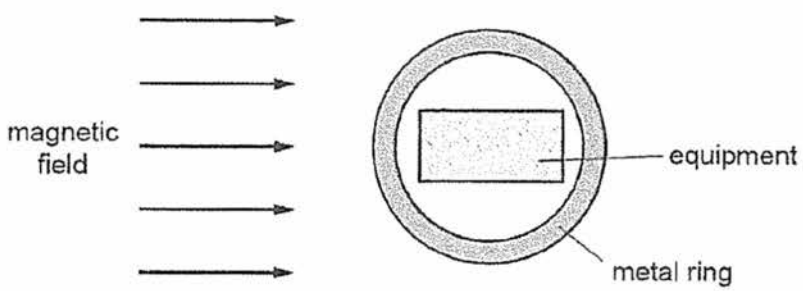

C



D


33 The bulb in a lamp is rated 2 V, 1 W, while the bulb in an oven is rated 220 V, 10 W. What will happen when both the lamp and oven are connected in series across a 220 V operating supply?

A The bulb in the lamp will blow immediately, and no current will flow in the circuit.
B The bulb in the lamp will appear to operate normally, while the bulb in the oven will emit a weak light.
C The bulb in the lamp will emit very little light, while the bulb in the oven will appear to operate normally.
D Both bulbs will operate at normal brightness.

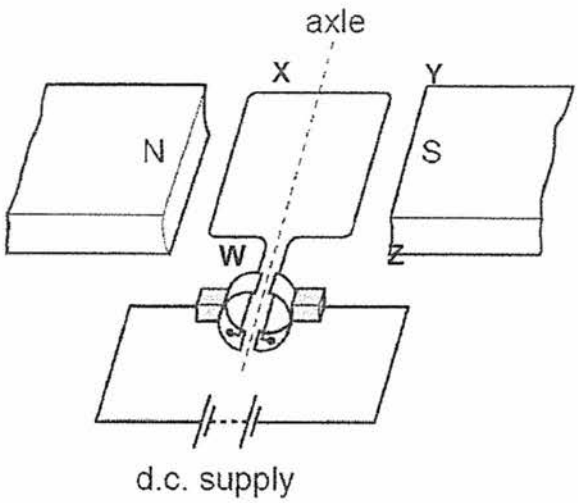
34 A metal ring screens a piece of equipment from a magnetic field.




Which metal should be used for the ring, and why?

| | metal | explanation |
|---|---|---|
| A | copper | the metal carries the field lines around the equipment |
| B | copper | the metal is non-magnetic |
| C | iron | the metal carries the field lines around the equipment |
| D | iron | the metal is non-magnetic |

**35** The diagram below shows a simple d.c. motor.

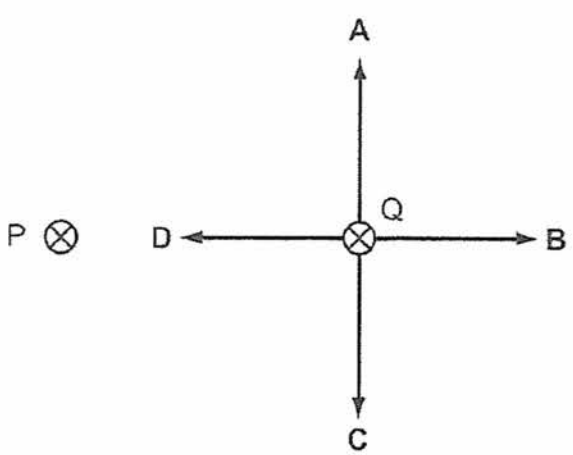



When the switch is closed, which of the following statements is/are correct?

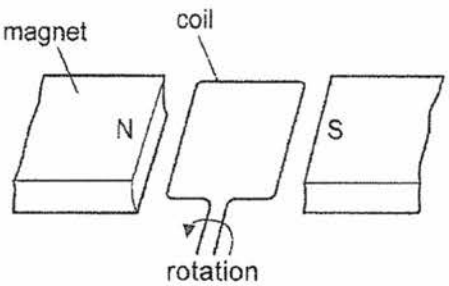
I A current will flow round the coil in the direction **WXYZ**.
II The coil will rotate in a clockwise direction about the axle.
III The split-ring commutator will reverse the direction of the current every 360°.

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

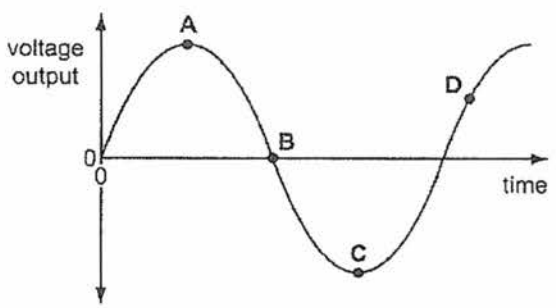
**36** P and Q represent two, parallel, straight wires carrying currents into the plane of the paper. P and Q exert a force on each other.
Which arrow shows the force on Q?



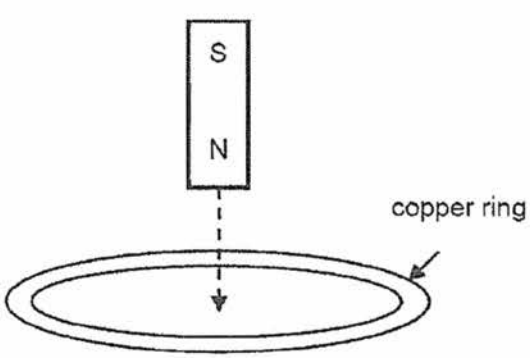
**37** The diagram shows part of an a.c. generator when its coil is in a horizontal position.




The graph below shows the voltage output plotted against time.
Which point on the graph shows the coil in a vertical position?



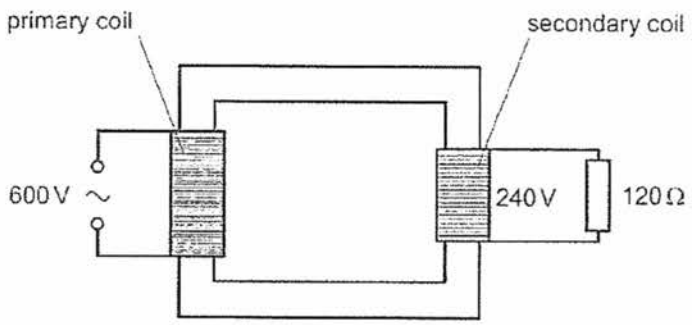

**38** A magnet is dropped vertically through a copper ring.




Which of the following statements is **incorrect**?

**A** A current flows in the ring just before the magnet passes through the ring.
**B** A current flows in the ring just after the magnet passes through the ring.
**C** The magnet's acceleration decreases just before it passes through the ring.
**D** The magnet decelerates just after it passes through the ring.

39 An ideal transformer has a primary voltage of 600 V and a secondary voltage of 240 V. The secondary coil is attached to a resistor of resistance 120 Ω.



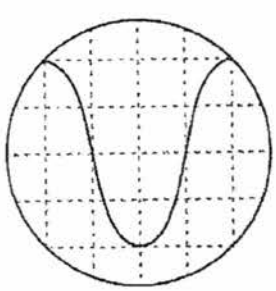

What is the power dissipated in the resistor and the current in the primary coil?

| | power / W | current / A |
|---|---|---|
| A | 120 | 0.20 |
| B | 120 | 5.0 |
| C | 480 | 0.80 |
| D | 480 | 1.3 |

40 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 / V | frequency / Hz |
|---|---|---|
| A | 4.0 | 83.3 |
| B | 4.0 | 125 |
| C | 8.0 | 83.3 |
| D | 8.0 | 125 |



-- End of Paper –
Setter: Mdm Ilysa Saari

# AHMAD IBRAHIM SECONDARY SCHOOL
# GCE O-LEVEL PRELIMINARY EXAMINATION 2017

## PHYSICS 5059/02

Secondary 4 Express

Date: 14 August 2017
Duration: 1 h 45 min

Name: ..... ( ) Class: .....

**READ THESE INSTRUCTIONS FIRST**

**Do not open this booklet until you are told to do so.**
Write your name, class and register number in the spaces at the top of this page and on any writing papers used.
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

**Section A**
Answer **all** questions.

**Section B**
Answer **all** questions. Question 11 has a choice of parts to answer.

Candidates are reminded that **all** quantitative answers should include appropriate units.
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.

The number of marks is given in brackets [ ] at the end of each question or part question.

| For Examiner's Use | |
|---|---|
| P1 MCQ | / 40 |
| P2 Section A | / 50 |
| P2 Section B | / 30 |
| TOTAL | / 120 |

## Section A

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

1 Fig. 1.1 shows a 58 g ball being thrown vertically upwards from the top of a building with an initial velocity of 20 m/s. It reaches the highest point and begins to fall. It lands on the ground in the 6th second. The velocity-time graph is shown in Fig. 1.2.

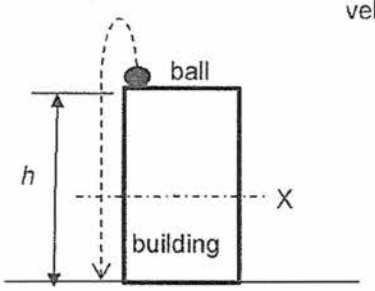



Fig. 1.1

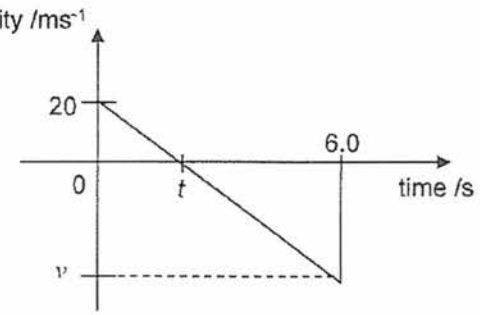



Fig. 1.2

**(a)** The acceleration due to gravity is 10 m/s². Calculate

**(i)** the time *t* for the ball to reach its highest point,

time = ..... [2]

**(ii)** the velocity *v* of the ball just before it touches the ground.

velocity = ..... [1]

**(b)** Determine the height *h* of the building.

height = ..... [2]

(c) Explain how Fig. 1.2 shows that the stone is moving in opposite direction after a period of time.

.....

..... [1]

(d) State the assumption made in order to obtain the straight line graph in Fig. 1.2.

.....

..... [1]

2 Fig. 2.1 shows a student doing a push-up. A total force $F$ acts upwards on his hands. There is also a force $R$ upwards on his toes.

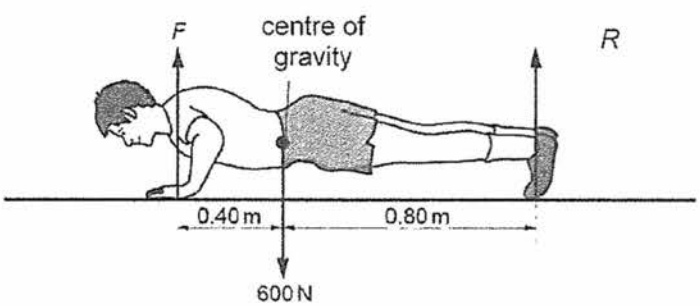



**Fig. 2.1**

The weight of the student is 600 N and this force acts downwards from his centre of gravity.

(a) Describe how work is done on his body as it rises from the ground.

.....

..... [1]

(b) At the position shown in Fig. 2.1, the student is stationary. The weight of the student causes a moment about his toes. Calculate

(i) the moment of the weight of the student about his toes,

moment = ..... [1]

(ii) the value of the forces $F$ and $R$.

$F$ = .....

$R$ = ..... [2]

(c) Describe the other force that forms a Newton's Third Law action-reaction pair with $F$, and state the body on which it acts.

.....

.....

..... [2]

3 Fig. 3.1 shows a diver salvaging items from a plane wreck below the surface of a lake. The density of the water in the lake is 1000 kg/m$^3$, the atmospheric pressure at the surface is 1.0 x 10$^5$ Pa and the gravitational field strength is 10 N / kg. The diver inflates a balloon with air at a depth of 15 m and attaches the balloon to a tray of object.

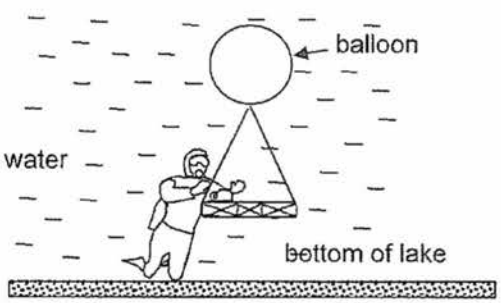



**Fig. 3.1**

(a) Calculate

(i) the pressure due to 15 m of water in Pa,

pressure = ..... [2]

(ii) the total pressure at 15 m below the surface of the lake.

pressure = ..... [1]

(b) The pressure of the air inside the balloon is lower at the surface of the lake than at a depth of 15 m. Explain, in terms of the air molecules inside the balloon, why the pressure is lower. State any assumption(s) made.

.....

.....

..... [2]

(c) State one difference between the arrangement of the molecules of water in the lake and the molecules of air in the balloon.

.....

..... [1]

4 Electronics components are easily overheated and damaged. They are thus usually attached to heat sinks which will transfer thermal energy from the electronic components to the surroundings. Fig. 4.1 shows a heat sink attached to an electronic component in a computer.

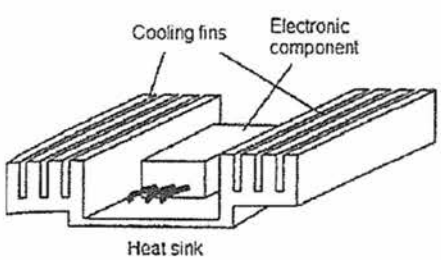



Fig. 4.1

(a) (i) Suggest a material for the heat sink and explain why.

.....

.....

..... [2]

(ii) Suggest a colour for the heat sink and explain why.

.....

.....

..... [2]

(b) Heat sinks are characterised by their *thermal resistances*. The heat sink shown in Fig. 4.1 has a thermal resistance of 2 °CW$^{-1}$. This means its temperature will rise by 2 °C when the electronic component dissipates 1 J of thermal energy per second.

(i) Find the temperature rise of the heat sink when the electronic component dissipates a thermal power of 10 W.

temperature = ..... [1]

(ii) The electronic component continues to dissipate heat. Suggest a reason why the temperature of the heat sink will be constant after some time.

.....

..... [1]

5 The boiling point of nitrogen is –196 °C.

(a) State what is meant by *boiling point* of nitrogen is –196 °C.

.....

..... [1]

(b) The energy of liquid nitrogen changes as it turns into a solid at the melting point. State and explain how the energy changes, using ideas about molecules.

.....

.....

..... [2]

(c) The liquid nitrogen reaches –196 °C, its boiling point. A small piece of metal at 20 °C is lowered slowly into the liquid nitrogen. The small piece of metal has a mass of 50 g. When it is lowered into the liquid nitrogen, the metal cools to –196°C.
The specific heat capacity of the metal is 390 J/(kg°C).
The specific latent heat of vaporisation of nitrogen is 200 J/g.
Calculate the mass of nitrogen that boils away when the metal is placed in it.

mass = ..... [3]

6 A collector views a postage stamp of height 1.5 cm through a lens. The lens is 2.0 cm from the stamp and the ratio of height of image to height of object is 3.0.

(a) In Fig. 6.1, complete the full scale ray diagram to determine the image of the stamp. [3]

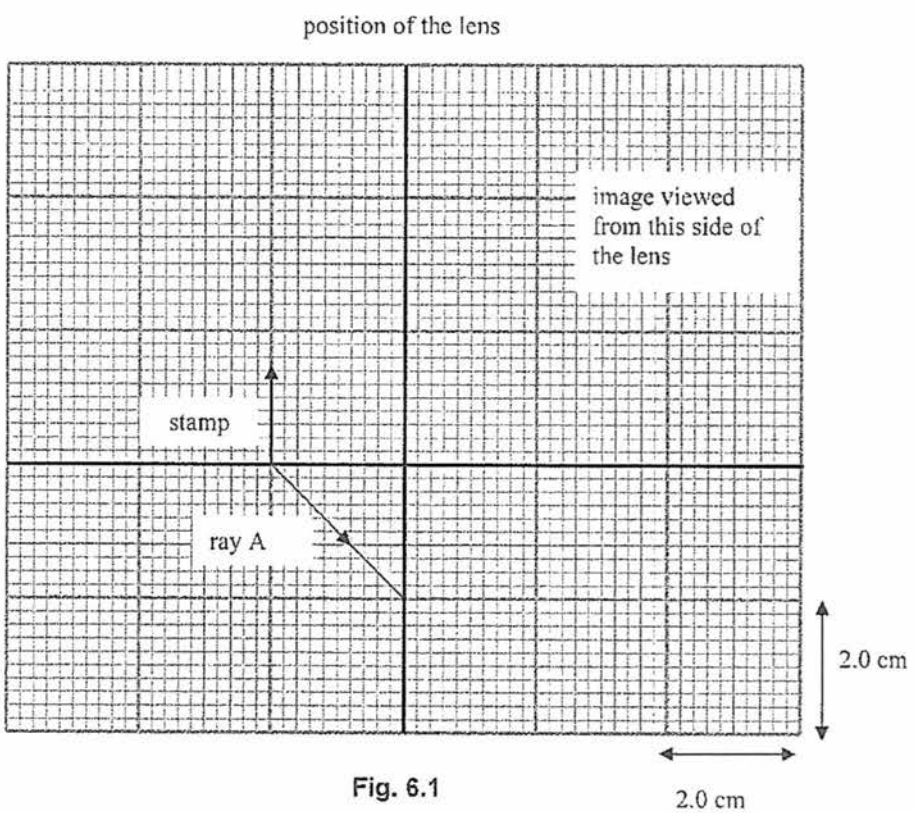



Fig. 6.1

**(b)** State what is meant by a virtual image.

.....

..... [1]

**(c)** Use your drawing to determine the focal length of the lens.

focal length = ..... [1]

**(d)** On Fig. 6.1, complete the path of ray A after passing through the lens. [1]

**7** Ultrasound may be used to measure distances. Fig. 7.1 shows a setup consisting of a cathode-ray oscilloscope (CRO) connected to a microphone, a pulse generator and a reflecting wall.

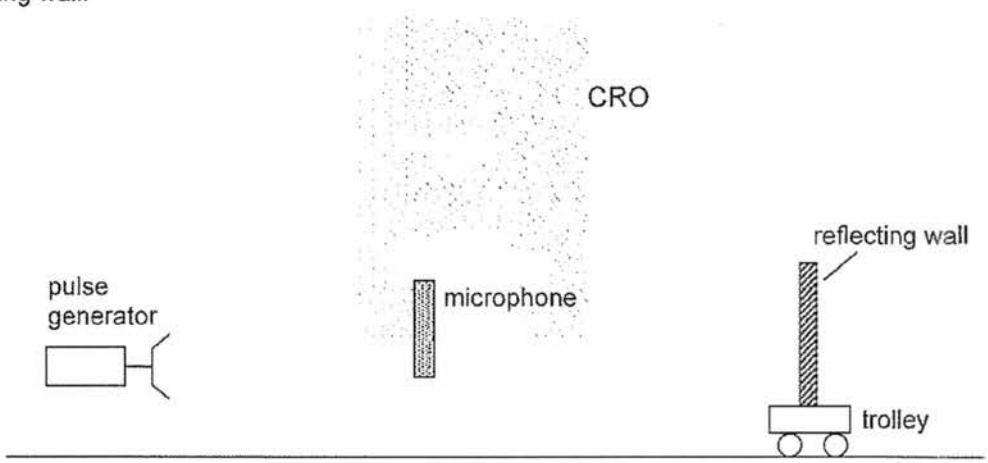



**Fig. 7.1**

An ultrasonic pulse is generated by the pulse generator. The CRO is turned on at the same time and a trace consisting of two pulses is obtained on the CRO as shown in Fig. 7.2. The time-base of the CRO is set at 10 ms/division.

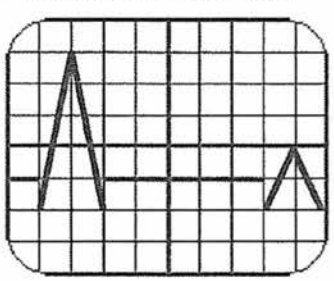


**Fig. 7.2**

(a) Ultrasound is a longitudinal wave. Explain what is meant by this statement.

.....

..... [1]

(b) If the speed of sound is 330 m/s, determine the distance between the microphone and the reflecting wall.

distance = ..... [2]

(c) The reflecting wall is now moved closer to the microphone.

(i) Describe two changes that would occur to the trace on the CRO.

.....

.....

.....

..... [2]

(ii) Suggest why the setup could not be used if the distance between the microphone and the wall is less than 1 m.

.....

..... [1]

8 Fig. 8.1 shows a simple experimental set-up to study the motion of a motor. **AB** and **CD** are solenoids connected to a battery. **F** and **G** are connected to an external d.c. voltage supply.

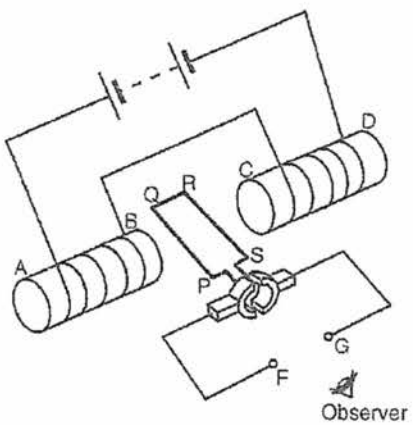



**Fig. 8.1**

**(a)** State the polarity of the solenoids

**(i)** at B,

..... [1]

**(ii)** at C.

..... [1]

**(b)** If the direction of rotation of the coil **PQRS** as seen by the observer is in the **clockwise direction**, state whether **F** or **G** is connected to a positive terminal.

..... [1]

**(c)** Suggest two ways that can be done to have the coil PQRS turn in the anti-clockwise direction.

1. .....

.....

2. .....

..... [2]

(d) The coil rotates continuously when the split-ring commutator is used. Explain why.

.....

.....

..... [2]

## Section B

Answer **all** the questions in this section.
Answer only one of the two alternative questions in **Question 11.**

**9** A student decided to build a temperature probe using a thermistor. He sets up the circuit as shown in Fig. 9.1. The 9.0 V battery has negligible internal resistance.

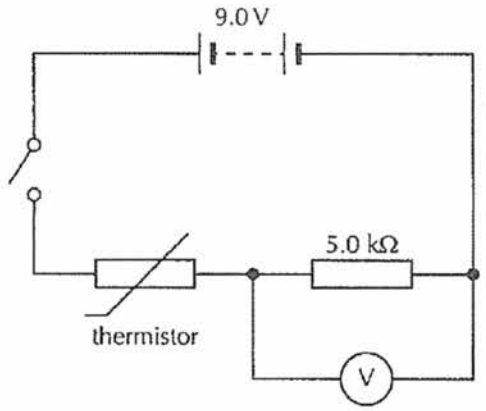



**Fig. 9.1**

The voltmeter connected in parallel to the 5.0 kΩ resistor has infinite resistance. The thermistor is immersed into a water bath, which is then heated. The calibration curve for the thermistor is shown in Fig. 9.2.

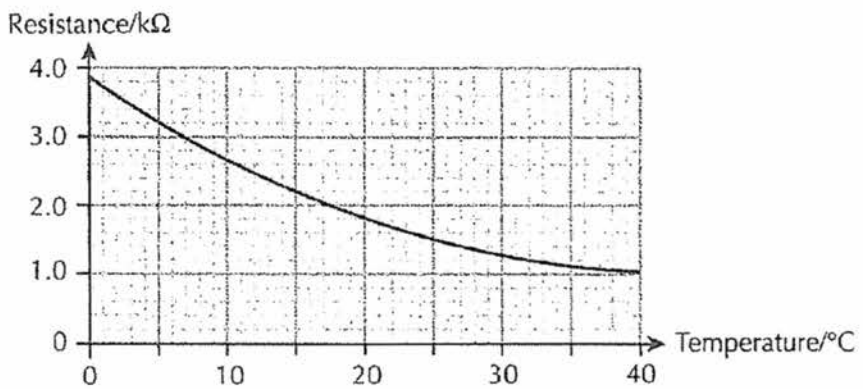



**Fig. 9.2**

**(a)** Explain why it is necessary to include a fixed resistor in the circuit as shown in Fig. 9.1.

.....

.....

..... [2]

**(b)** The probe is to be used to measure temperatures in the range of 0 °C to 35 °C.

**(i)** Use Fig. 9.2 to determine the resistance of the thermistor when the probe is at a temperature of 35 °C.

..... [1]

**(ii)** Hence, calculate the reading on the voltmeter when the temperature is 35 °C.

voltmeter reading = ..... [2]

**(iii)** The 5.0 kΩ resistor is replaced by a light bulb. When the switch is closed, the student observes that the brightness of the light bulb increases gradually. Explain this observation.

.....

.....

.....

..... [2]

**(c)** The student decides to use an ammeter and a 100 Ω resistor to replace the voltmeter and the 5 kΩ resistor as shown in Fig. 9.3.

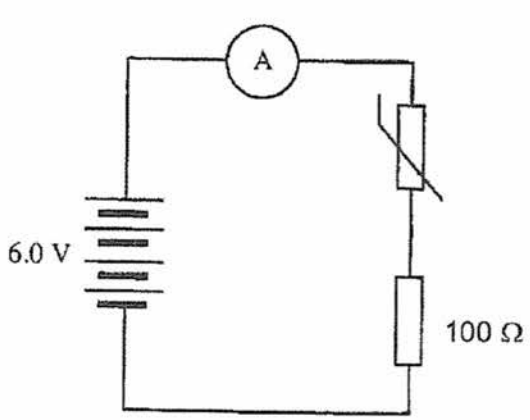



**Fig. 9.3**

The ammeter reading was measured across a range of temperatures and the results were plotted in a graph shown in Fig. 9.4.

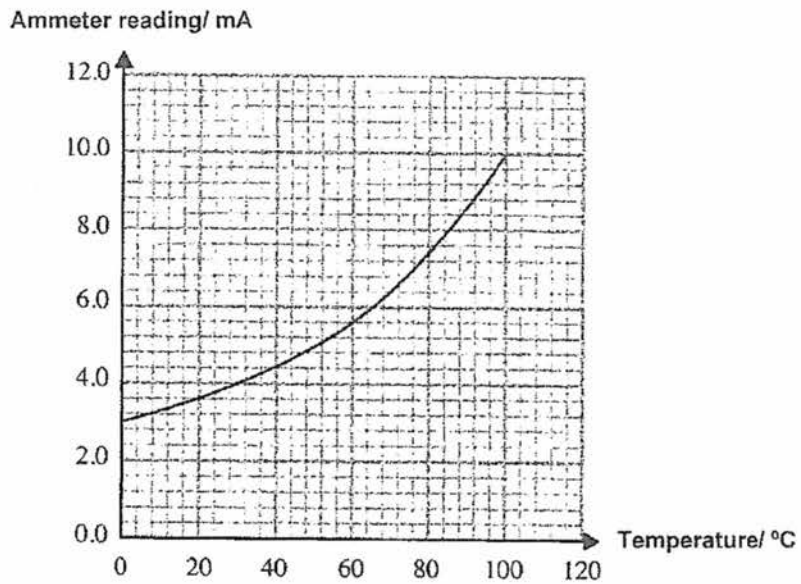



**Fig. 9.4**

**(i)** Describe how the ammeter's reading changes with temperature.

..... [1]

**(ii)** Calculate the thermistor's resistance at 100 °C.

resistance = ..... [2]

10 Two coils, A and B, are placed one on top of the other, as shown in Fig. 10.1. Coil A is connected in series with a battery and a switch. A millivoltmeter is connected across the terminals of coil B.

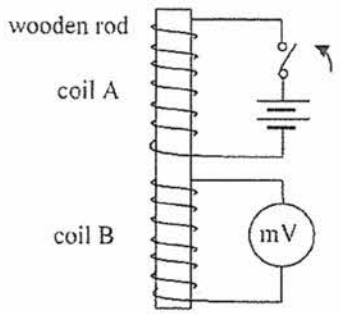



Fig. 10.1

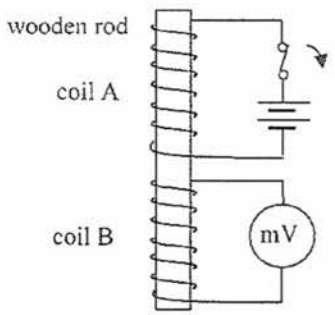



Fig. 10.2

(a) Explain why, when the current in coil A in Fig 10.1 is switched on, the millivoltmeter indicates an induced e.m.f. for a short period of time and then reduces to zero rapidly.

.....

.....

..... [2]

(b) (i) On Fig. 10.2, draw an arrow on coil B to show the direction of the induced current in coil B when the switch was just opened. [1]

(ii) Explain the direction drawn in **(b)(i)**.

.....

.....

.....

..... [2]

**Fig. 10.3** shows two coils of insulated wire wound on an iron core to make a transformer. One coil is connected to a 16 V a.c. supply. The other coil is connected to a lamp, which is rated 12 V, 24 W.

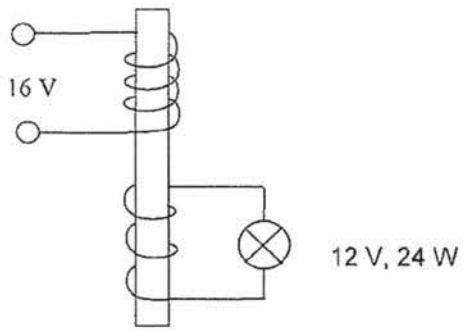



**Fig. 10.3**

**(c)** The lamp is operating at its correct rating.
Calculate the minimum current drawn from the 16 V supply.

current = ..... [2]

**(d)** The current drawn from the supply is found to be 1.7 A instead. Caculate

**(i)** the input power to the transformer,

power = ..... [1]

**(ii)** the energy lost by the transformer each second.

energy = ..... [1]

**(e)** Explain why the thermal energy lost in the wire is lower if the wire is thicker.

.....

..... [1]

11 EITHER

**Fig. 11.1** shows the circuit diagram of a hairdryer. A motor-driven fan and a heating element are used to generate warm air. The hairdryer is connected to a 240 V a.c. supply.
Switch S can be connected to either contact X or Y.

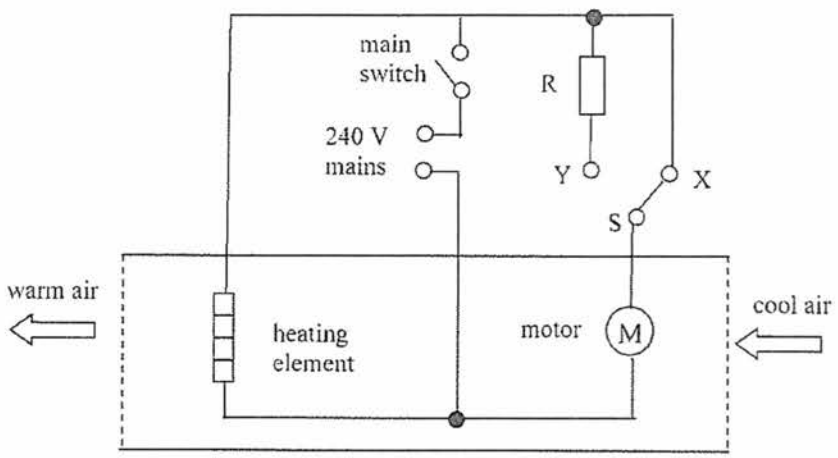



**Fig. 11.1**

**(a)** The hairdryer is used to dry wet hair. Explain, using kinetic model of particles, how the hairdryer can increase the rate of evaporation of water from the wet hair.

.....

.....

.....

..... [3]

**(b)** During quality control tests of the hairdryer in the factory, switch S is first connected to contact X. Some measurements are made to obtain the data shown in **Fig. 11.2**.

| | |
|---|---|
| resistance of the heating element | 30 Ω |
| resistance of resistor R | 20 Ω |
| temperature of air entering the hairdryer | 25 °C |
| rate of air flow through the hairdryer | 0.055 kg/s |
| specific heat capacity of air | 1 000 J/kg°C |

**Fig. 11.2**

(i) Estimate the temperature of the air flowing out of the hairdryer.

temperature = ..... [2]

(ii) State one assumption in your calculation.

.....

..... [1]

(c) Switch S is then connected to contact Y. State and explain how this change will affect the speed of the motor-driven fan.

.....

.....

..... [2]

(d) Calculate the cost of using the hair dryer for 10 minutes if the hair dryer is set to the lower heating setting and the cost of electricity is 20 cents per kWh.

cost = ..... [2]

OR

Fig. 11.3 shows part of the mains electrical circuit in a house. The mains supply is 240 V.

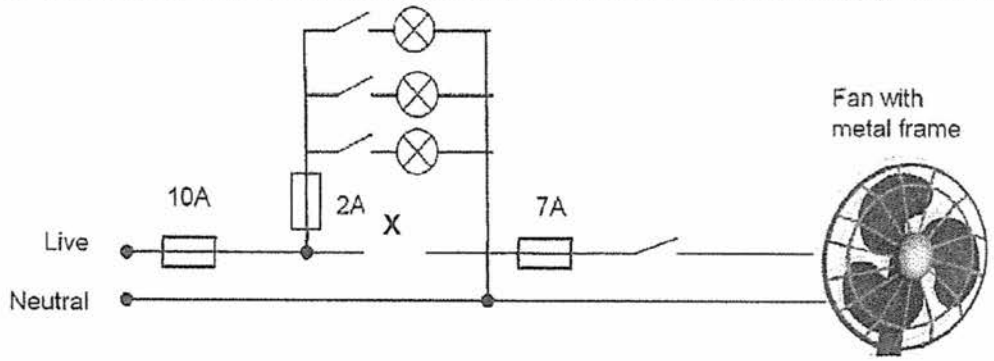



**Fig. 11.3**

Three identical lamps are connected to the live wire through a fuse labelled **X**.
An electrical fan is connected to the live wire through a 7 A fuse.
There is a 10 A fuse to protect the whole circuit.

**(a)** Explain what is meant by

**(i)** *live wire*,

.....

..... [1]

**(ii)** *neutral wire*.

.....

..... [1]

**(b)** Each of the lamps is rated 100 W, 240 V.

**(i)** Calculate the amount of current drawn by each lamp.

current = ..... [1]

(ii) Suggest a suitable fuse rating for X.
Support your answer with appropriate calculations.

fuse rating = ..... [2]

(c) The electrical fan is not connected to an earth wire. Explain how this will affect the safety of the user.

.....

.....

..... [2]

(d) If the live wire touches the neutral wire inside the fan, state and explain what will happen to the fan, the lamps and the fuses.

.....

.....

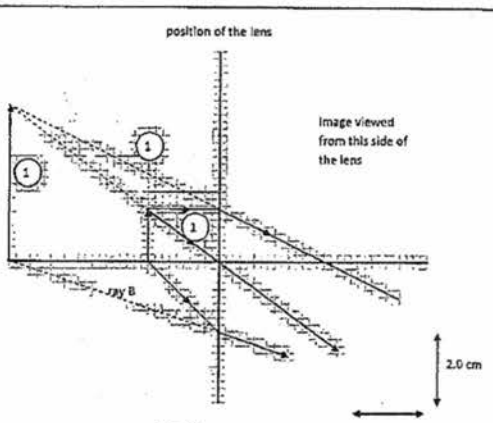
.....

..... [3]

**End of Paper**
**Setter: Mdm Ilysa Saari**

## Answers to 4E Preliminary Examinations 2017

| No | | Answers |
|---|---|---|
| 1 | ai | a = (v – u) / t<br>-10 = (0-20) / t [M1]<br>t = 2.0 s [A1] |
| | aii | -10 = (v-0) / (6.0-2.0)<br>-10 = v / 4.0<br>v = - 40 m/s [A1] (2 sig.fig. & allow for e.c.f.) |
| | b | height = area under the graph from 4.0s to 6.0s<br>= ½ x (6.0 – 4.0) x (20 + 40) [M1]<br>= 60 m [A1] (allow for ecf) |
| | d | After 2.0 s, the velocity changes from positive to negative. [B1] |
| | e | No air resistance acting on the ball throughout the motion. [B1] |
| 2 | a | When he pushes the floor, his body rises and moves through a distance in the same direction as the force F, hence work is done. [B1] |
| | bi | Moment = F x d<br>= 600 x 0.80<br>= 480 Nm [A1] |
| | bii | By Principle of Moments,<br>F x 1.2 = 480<br>F = 400 N [A1] (ecf awarded)<br><br>∑ upward forces = ∑ downward forces<br>F + R = 600<br>R = 200 N [A1] |
| | c | The other force that forms an action-reaction pair with *F* is the force exerted by the boy's hand on the floor. [B1]<br>It has an equal magnitude but acting in the opposite direction to *F*. [B1] |
| 3 | ai | P=hρg = 15 x 1000 x 10 [M1]<br>= 150 000 Pa [A1] |
| | aii | Total P = 100 000 + 150 000 = 250 000 Pa or 2.5 x $10^5$ Pa [A1] |
| | b | Assume temperature remains the same when it is near the surface or at depth of 15 m. [B1]<br>At depth of 15 m, pressure is higher than at the surface. the volume is smaller so the air molecules are moving a shorter distance before it impacts on the balloon walls or the **frequency of collisions is higher although its speed of impact and KE is the same.** [B1] |
| | c | Air molecules are spaced further apart than water molecules [B1] |
| 4 | ai | Material: Any type of metal [A1] |

| | | |
|---|---|---|
| | | Explanation: Metals are better conductors of thermal energy than non-metals so it allows higher rate of heat transfer to be conducted from the component to the heat sink. [A1] |
| | aii | Colour: Any dark colour [A1]<br>Explanation: Dark colours are better emitters of radiation than light colours so it increases the rate of emission of thermal energy to the surroundings so that it can cool faster. [A1] |
| | bi | Temperature rise = (2)(10) = 20 °C [A1] |
| | bii | Rate of conduction of thermal energy from electronic component = rate of emission of thermal energy to surroundings. [A1] |
| 5 | a | Nitrogen hanges from liquid to vapour/ gaseous state at a **constant** temperature of –196 °C [B1] |
| | b | Energy of nitrogen decreases. [B1]<br>Energy is released as intermolecular bonds are formed (or to strengthen forces of attraction between molecules) when liquid solidifies to form a solid. [B1] |
| | c | Energy given out by the metal = $mc\Delta\theta$<br>Energy given out by the metal = (50/1000)(390)(20 – (-196)) [M1]<br>Energy given out by the metal = 4212 J [M1]<br>Mass of nitrogen = 4212/200 = 21.06 = 21 g [A1] |
| 6 | a | correct position (6 cm)<br>or height for image (4.5cm) [A1]<br><br>drawing of ray passing through centre of lens and extending backwards to meet image. [A1]<br><br>correct drawing of second ray [A1]<br><br>  <br><br>Fig. 6.1 |
| | b | A virtual image is an image that cannot be formed on a screen [B1] |
| | c | f = 3.0 cm [B1] |
| | d | correct drawing using concept ray from bottom of object originate from bottom of image [B1] |
| 7 | a | Ultrasound travels in a direction parallel to the direction of vibration of the medium particles. [B1] |

| | | |
|---|---|---|
| | b | Time taken for sound to travel from microphone to wall and back = 7 x 0.01<br>= 0.07 s [M1]<br>2d / 0.07 = 330<br>d = 11.6 m [A1] |
| | ci | The second pulse on the CRO will be positioned nearer to the first pulse [B1] and has a larger amplitude. [B1] |
| | cii | The two pulses on the CRO will overlap each other / cannot be distinguished from each other. [A1] |
| 8 | ai | B is north pole. [A1] |
| | aii | C is south pole. [A1] |
| | b | G is connected to the positive terminal. [A1] |
| | c | 1. reverse polarity of E,<br>2. wind the solenoids differently from the given to give a S pole on the left and N pole on the right<br>3. reverse the polarity at F or G<br><br>Any correct 2 ways – [A1] mark each |
| | d | The split-ring allows the current direction in the coil to be reversed for every half rotation. [A1]<br>By Fleming's Left Hand Rule, an upward force always acts on the left side and a downward force always acts on the right side of the coil since the current direction is the same on each side. [B1]<br>This allows the coil to rotate continuously in one direction. |
| 9 | a | With the fixed resistor, the total resistance of the circuit will be higher. [B1]<br>Hence, a smaller range of current/ smaller maximum current will be present in the circuit. [B1] |
| | bi | 1.1 kΩ [A1] |
| | bii | V = (5/(5+1.1)) x 9.0 [B1]<br>V = 7.4 V [B1] |
| | biii | Temperature of water bath increases, the temperature of the thermistor increases and its resistance decreases. [B1]<br>Current passing through the light bulb (or potential difference across the light bulb) increases. [B1] |
| | ci | The increase in current per unit temperature is increasing. [A1] |
| | cii | Current at 100 °C = 10 mA<br>p.d across the resistor = $(10 \times 10^{-3})$ (100) = 1.0 V [B1]<br>p.d across thermistor = 6 – 1 = 5.0 V |

| | | |
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| | | resistance = V/I = 5/(10x10$^{-3}$) = 500 Ω [B1] |
| 10 | a | The induced e.m.f in coil B is due to a change in the magnetic flux linkage created by coil A on coil B when current flows in coil A making it an electromagnet. [B1]<br>When the current is steady, there is no change in magnetic flux linkage between the two coils although there is magnetic flux linkage between the 2 coils. Zero change results in no emf induced according to Faraday's law of electromagnetic induction. [B1] |
| | bi | Direction of current in the outer coil of B is to the right [B1] |
| | bii | By Lenz's Law, the induced current must be in such a direction as to oppose the change in magnetic flux in coil B. [B1]<br>The induced current thus produces a North pole at the end of coil B that is facing coil A to oppose the weakening or moving away south pole at the bottom of coil A. [B1] |
| | c | P=VI, I=P/V = $I_S$ = 24/12 = 2.0 A [B1]<br>$I_P/I_S = V_S/V_P$<br>$I_P$ =(12/16) x 2.0 = 1.5 A [B1] |
| | di | Input Power = IV = 1.7 x 16 = 27.2 W [B1] |
| | dii | Lost power = 27.2 – 24 = 3.2 W [B1] |
| | e | As resistance is inversely related to the cross-sectional area, thicker wires will result in a decrease of resistance. Since P = $I^2R$, [A1] thus power loss in the cables decreases as resistance of cable decreases. |
| 11E | a | Hair dryer causes fast moving air molecules to collide with the water molecules on the hair and transfer energy to them. [B1]<br><br>**More** water molecules increase in KE and they move more vigorously. [B1]<br>Overcome forces of attraction between the remaining molecules and doing work to overcome atmospheric pressure. [B1]<br><br>OR<br><br>The water molecules once evaporated from the hair are removed away by the movement of the air molecules from the motor [B1] thus freeing up the space for the remaining water molecules to escape [B1].<br><br>OR<br><br>The water molecules can evaporate at a greater rate at a lower humidity level [B1] as the hot air from the motor reduces the moisture level in the air [B1]. |
| | bi | Heat lost by heater in 1 s = heat gained by air in 1 s<br>$V^2/R=mc(\Delta\theta)$ or 2402/30 = 0.055 x 1000 x $\Delta\theta$ [B1]<br>$\Delta\theta$ = 34.9 [B1]<br>Temperature of air flowing out = 34.9 + 25 = 59.9 °C or 60 °C [A1] |

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| | bii | Assume room temperature is constant or<br>Assume no heat is lost by the heating circuit to other parts of the circuit or<br>All the heat energy is transferred to the cold air and not lost to the surrounding eg by radiation Or<br>Assume resistance of motor is zero ohm.<br><br>Any one – [B1] |
| | c | Speed of rotation of the motor decreases and produces moving cool air at a slower rate. [A1]<br>When switch is connected to Y, the addition of resistor R only reduces current flow to the motor. [A1] |
| | d | Total Power of heating element and motor<br>= $240^2/30 + 240^2/20$ = 1920 + 2880 = 4,800 W [B1]<br>Cost = (4,800/1000) x (10/60) x 20 = 16.6 cents [A1] |
| 11O | ai | The live wire is connected to a high potential and delivers current to the appliance. [B1] |
| | aii | The neutral wire is connected to zero potential and provides a return path for the current back to the supply. [B1] |
| | bi | Current drawn = P / V<br>= 100 / 240<br>= 0.42 A (2 s.f.) [A1] |
| | bii | Total current drawn by 3 lamps<br>= 0.416 x 3<br>= 1.25 A [B1]<br><br>Hence fuse rating = 2 A [A1]<br><br>Max [1] ecf if current drawn in (i) is wrongly calculated. |
| | c | If the live wire touches the metal frame of the fan, the fan will become live/be at a high voltage/potential. [B1]<br>The user will get an electric shock if he touches the fan. [B1] |
| | d | The fan will not work as it will be short-circuited. [B1]<br>The 7 A and 10 A fuses will blow due to the large current. Fuse X (2A fuse) will not blow because it is in a parallel connection. [B1]<br>The lamps will not light up because the 10 A fuse has blown, hence the circuit becomes an open circuit/electrical supply is cut off. [B1] |