Name:	Index Number:	Class:

HUA YI SECONDARY SCHOOL

4E Preliminary Examination 2015 **4E**

PHYSICS **5059/01**

Paper 1 Multiple Choice 14 September 2015

1 hour

Candidates answer on the Multiple Choice Answer Sheet
Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your Name, Index Number and Class on the Answer Sheet in the spaces provided.

Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid.

There are **forty** questions on this paper. 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 choice 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 booklet.

For Examiner's Use	
Paper 1	

This document consists of **15** printed pages including the cover page.

[Turn Over

Setter: Mr Chong ML Chris

1 Keith uses a micrometer screw gauge to measure the thickness of a pipe.

Diagram 1 shows the reading when it is closed without the pipe.
Diagram 2 shows the reading when it is closed with the pipe.

Diagram 1

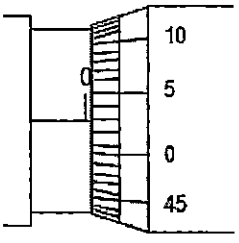
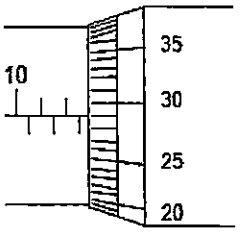


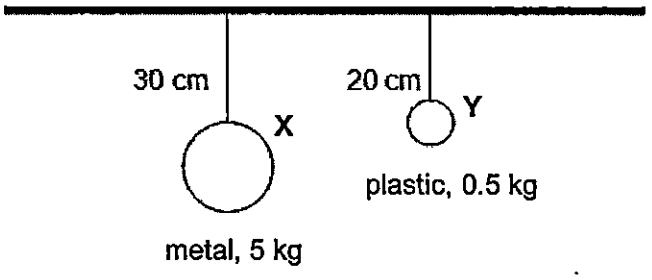
Diagram 2



What is the thickness of the pipe?

A 10.51 mm
B 10.57 mm
C 12.76 mm
D 12.82 mm

2 In the diagram, **X** and **Y** are two pendulums of different lengths, masses, sizes and materials.



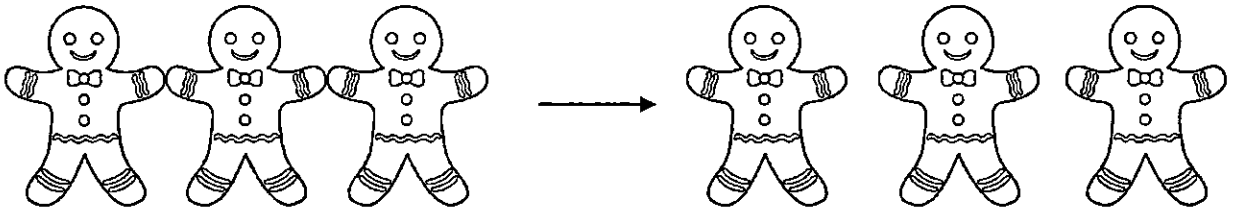
Which of the following statements is true?

A Y will swing faster as it is shorter.
B X will swing faster as it is larger in size.
C Y will swing faster as it has a smaller mass.
D X will swing faster as it is longer.

3 An object weighs 200 N on the Earth and 12 N on an asteroid.
What is the acceleration due to gravity on the asteroid?

A 0.6 m/s^2
B 1 2 m/s^2
C 10 m/s^2
D 12 m/s^2

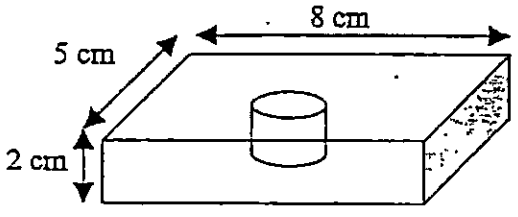
4 A piece of biscuit made of three ginger bread men has a density of 3.0 kg/m^3.
It has been broken into three identical pieces.



What is the density of each piece?

A 0 kg/m^3
B 1.0 kg/m^3
C 3.0 kg/m^3
D 9.0 kg/m^3

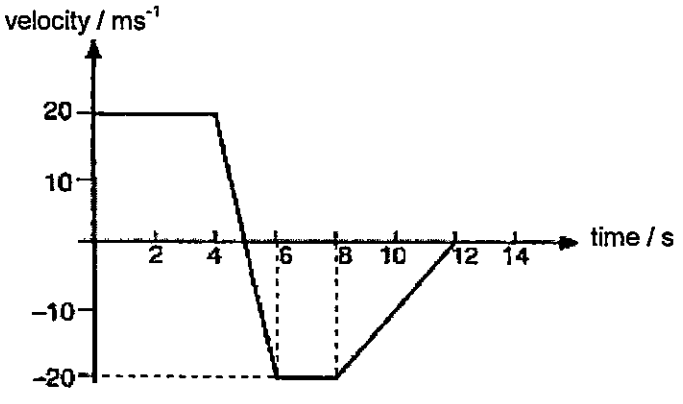
5 A rectangular block of steel has a cylindrical hole bored through it as shown.
The density of steel is 8 g/cm^3 and the mass of the block with the hole is 560 g.



What is the cross-sectional area of the hole?

A 5.0 cm^2
B 10 cm^2
C 35 cm^2
D 40 cm^2

6 The velocity-time graph below represents the motion of a particle along a straight line.

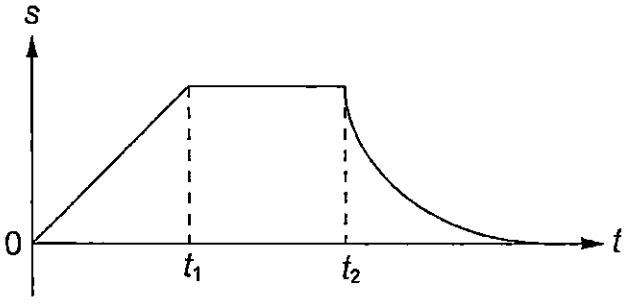


Which of the following statements are true?

I The particle's velocity is momentarily zero at t = 5 s.
II The particle comes back to its starting point in 12 s.
III The particle is furthest away from the starting point at t = 12 s.
IV The particle travels in the opposite direction between t = 5 s and t = 12 s.

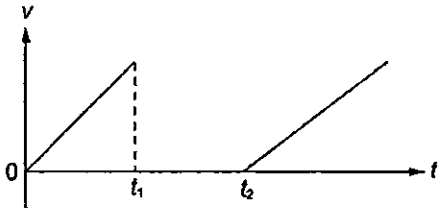
A I and III only
B I and IV only
C I, II and IV only
D I, III and IV only

7 A displacement-time graph of an object is as shown.

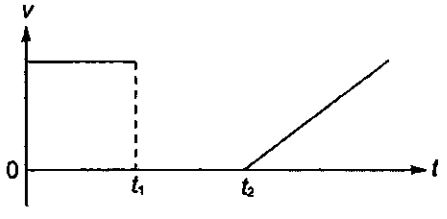


Which of the following graphs is its corresponding velocity-time graph?

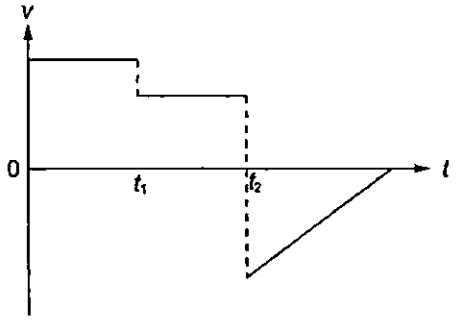
A



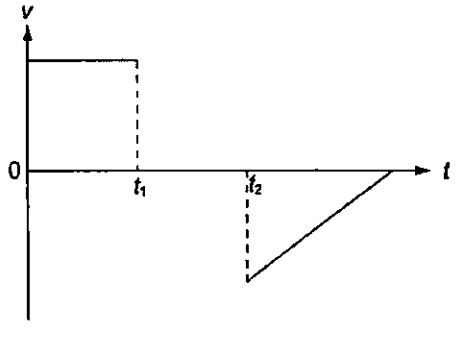
B



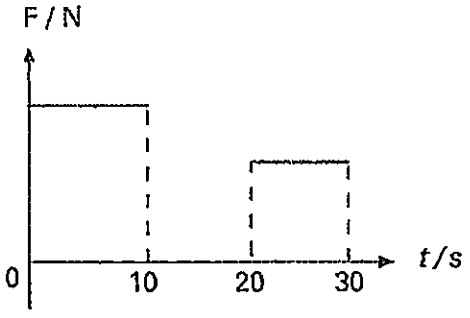
C



D

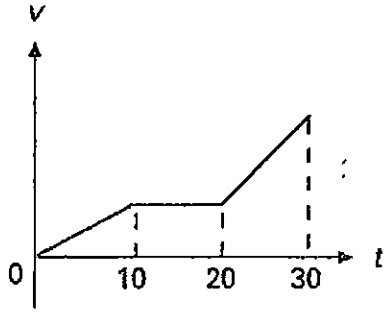


8 An object at rest experiences a force as shown in the resultant force against time graph.

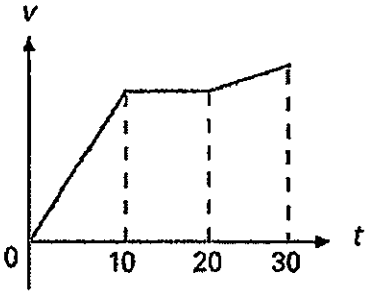


Which of the following velocity-time graphs is correct?

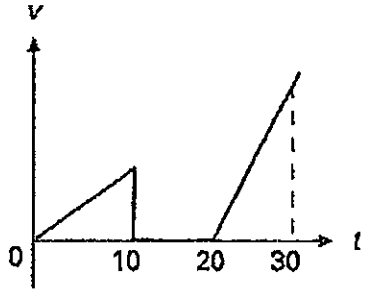
A



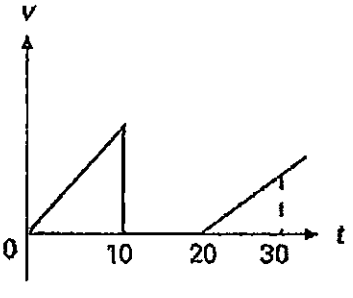
B



C



D

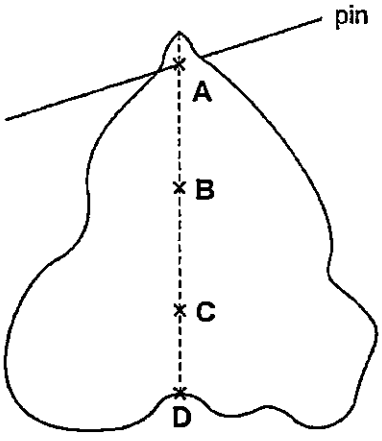


9 A box of mass 2 kg moves horizontally with a constant speed of 0.5 m/s when a force of 7 N is applied.

What force should be applied to the box for it to have an acceleration of 4.0 m/s^2?

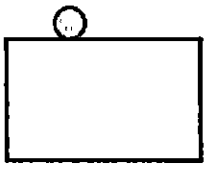
A 1.0 N
B 7.0 N
C 8.0 N
D 15.0 N

10 A piece of card of uniform thickness is suspended freely from a horizontal pin. Which of the points shown is its centre of gravity?



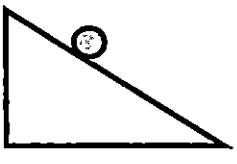
11 Which of the following shows a sphere in stable equilibrium?

A



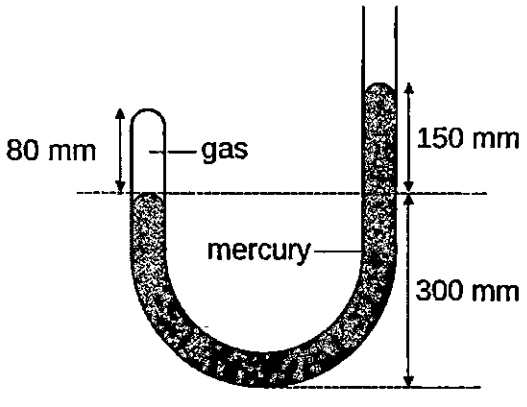
B

C



D

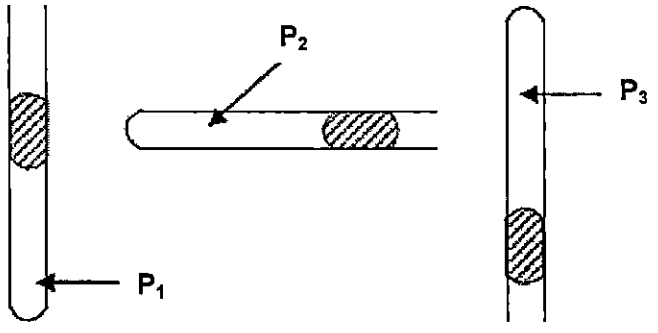
12 The diagram shows gas trapped in the left arm of a manometer containing mercury.



If the atmospheric pressure is 760 mmHg, what is the pressure of the trapped gas?

A 80 mmHg
B 150 mmHg
C 680 mmHg
D 910 mmHg

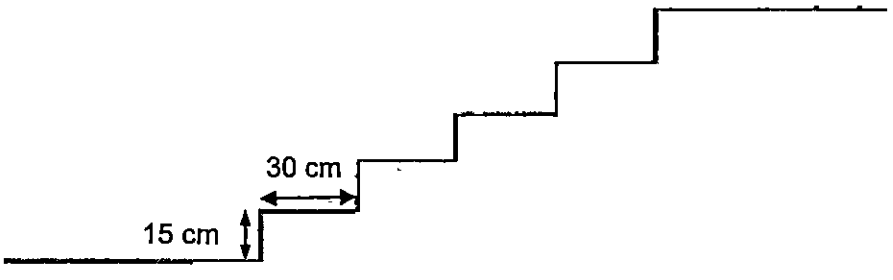
13 A column of dry air is trapped by a pellet of mercury in a capillary tube. The capillary tube is held in different positions as shown.



Which of the following correctly represents the pressures P_1, P_2 and P_3 of the enclosed air in the capillary tube?

A $P_1 = P_2 = P_3$
B $P_1 > P_2 > P_3$
C $P_1 > P_3 > P_2$
D $P_3 > P_2 > P_1$

14 The diagram shows a set of five steps. A student, of mass 50 kg, runs up the steps.



What is the work done by the student?

A 112.5 J
B 375 J
C 750 J
D 11 250 J

15 A person exerts a horizontal force of 700 N on a box that also experiences a friction force of 300 N.

If it takes 4.0 seconds to move the box 3.0 m, what is the power exerted by the person?

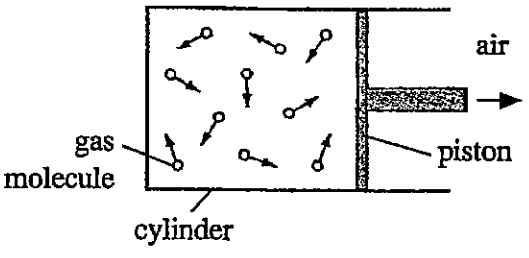
A 225 W
B 300 W
C 525 W
D 750 W

16 On a spray can containing insecticide, there is a warning label stating that it is dangerous to throw the can, even if empty, into a fire.

Why is it dangerous to throw an empty spray can into a fire?

A When the can is heated, the gas molecules inside the empty can will become very hot and explode.
B When the can is heated, the gas molecules inside the empty can will expand and the pressure within the container will build up until the can explodes.
C When the can is heated, the gas molecules inside the empty can will move faster and the pressure within the container will build up until the can explodes.
D When the can is heated, the can will melt and the gas inside it will explode.

17 Gas inside a cylinder is heated slowly to a higher temperature. The pressure inside the cylinder remains constant as the piston moves outwards.



How do the speed of the gas molecules and their rate of collision with the piston compare with their initial values at the lower temperature?

	speed of molecules	rate of collision
A	greater	greater
B	greater	reduced
C	greater	same
D	same	greater

18 A resistance thermometer was used to measure the temperature of a water bath. The readings on the resistance thermometer are:

960 Ω when the junction is in pure melting ice (at standard atmospheric pressure).
1200 Ω when the junction is in steam above boiling water (at standard atmospheric pressure).
1056 Ω when the junction is in a water bath.

What is the temperature of the water bath?

A 12 °C
B 25 °C
C 40 °C
D 50 °C

19 When you stand with one foot on a cement floor and the other foot on a carpet in a cold room, the cement floor feels colder than the carpet.

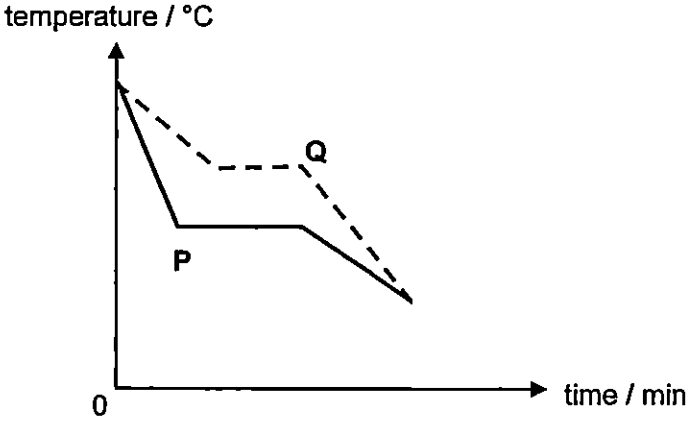
Which is the most likely explanation?

A Air is unable to circulate through the carpet fibres.
B The cement floor is at a lower temperature than the carpet
C There is a higher rate of heat transfer from the carpet to your foot than from the cement floor to your foot.
D There is a higher rate of heat transfer from your foot to the cement floor than from your foot to the carpet.

20 Which of the following statements describes why cooling always accompanies evaporation?

A The air molecules cool the liquid.
B The more energetic molecules leave the liquid.
C There are fewer liquid particles left in the liquid.
D The molecules in the liquid absorb energy from the air.

21 Two liquids, **P** and **Q**, of the same masses are placed in a room for cooling. Their cooling curves are as shown.



Which statement is correct?

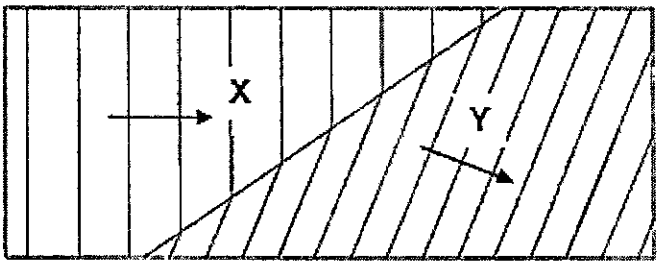
A Both liquid **P** and liquid **Q** have the same freezing point.
B Liquid **P** has a higher specific heat capacity than liquid **Q**.
C Liquid **P** has a lower specific latent heat of fusion than liquid **Q**.
D Solid **P** has a higher specific heat capacity than solid **Q**.

22 A piece of aluminium of mass 2 kg at 700 °C is placed into 2 kg of water at 20 °C until it reaches thermal equilibrium. (specific heat capacity of aluminum = 900 J kg^{-1} $°C^{-1}$, specific heat capacity of water = 4200 J kg^{-1} $°C^{-1}$, specific latent heat of vaporisation of water = 2.27 x 10^6 J kg^{-1})

What is the mass of water which will be vaporised at 100 °C?

A 0.09 kg
B 0.18 kg
C 0.27 kg
D 0.36 kg

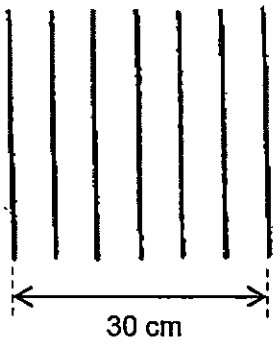
23 The diagram shows water waves travelling from section **X** to section **Y** in a ripple tank.



Which statement is correct?

A The water is shallower in section **Y**.
B The water is deeper in section **Y**.
C The frequency is lower in section **Y**.
D The waves move faster in section **Y**.

24 In a ripple tank experiment, plane water waves are projected onto a screen as shown. The vibrator vibrates at 50 times per second.



What is the wavelength and speed of the wave?

	wavelength	speed
A	4.0 cm	2.0 m/s
B	4.0 cm	12.5 m/s
C	5.0 cm	2.5 m/s
D	5.0 cm	10 m/s

25 Waves **P** and **Q** are components of the electromagnetic spectrum. **P** has a longer wavelength than **Q**.

Which statement about **P** and **Q** is likely to be true?

A **P** can travel faster in vacuum than **Q**.
B **P** is radio wave and **Q** is infra-red radiation.
C **Q** has a lower frequency than **P**.
D **Q** is ultra-violet radiation and **P** is X-ray.

26 The frequencies of two musical notes **X** and **Y** are 256 Hz and 512 Hz respectively. If **X** and **Y** have the same amplitude, which of the following statements is/are true?

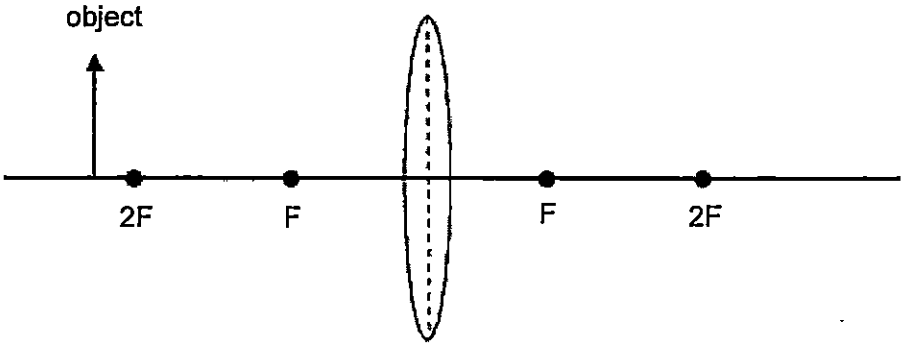
I Y has a higher pitch than **X**.
II The loudness of **X** is larger than that of **Y**.
III The wavelength of **Y** is longer than that of **X**.

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

27 The diagram shows an observer looking at an object through a pipe with a mirror installed at its corner.

Which of the following shows the image seen by the observer?

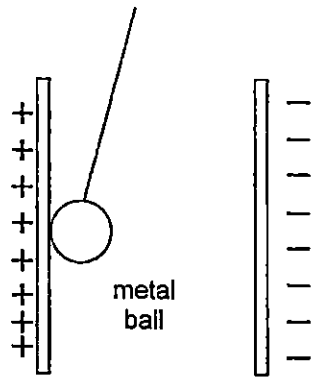
28 An object is placed in front of a thin converging lens as shown.



Which of the following has the above set-up?

A camera
B magnifying glass
C photocopier
D projector

29 A neutral metal ball of negligible weight, suspended between two conducting charged plates, touches the positively charged plate as shown.



What will be the subsequent motion of the metal ball between the positively charged conducting plate and the negatively charged conducting plate?

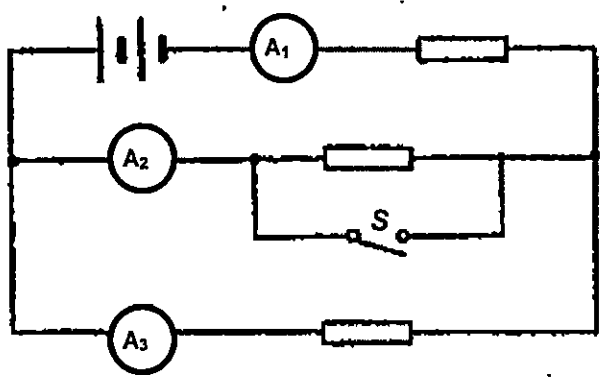
A The metal ball will remain attracted to the positive plate.
B The metal ball will be attracted to the negative plate.
C The metal ball will oscillate to and fro between the conducting plates.
D The metal ball will stay at the centre of the two conducting plates.

30 A resistor with resistance R is made from a length L of resistance wire with a cross-sectional area A. A second resistor with resistance $2R$ is made from a wire of the same material with a cross-sectional area of $\frac{1}{4}A$.

What length of wire is needed for the second resistor?

A $\frac{1}{2}L$ B L
C $2L$ D $8L$

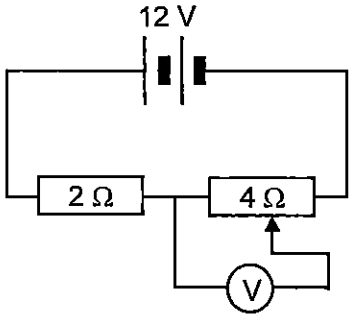
31 A circuit with three ammeters and three resistors is shown.



What will happen to the readings of the three ammeters when switch S is closed?

	A_1	A_2	A_3
A	increases	increases	increases
B	increases	becomes zero	remains unchanged
C	decreases	increases	becomes zero
D	increases	increases	becomes zero

32 A potential divider is connected in series with a fixed resistor as shown in the circuit.



By adjusting the potential divider, what are the minimum and maximum readings on the voltmeter?

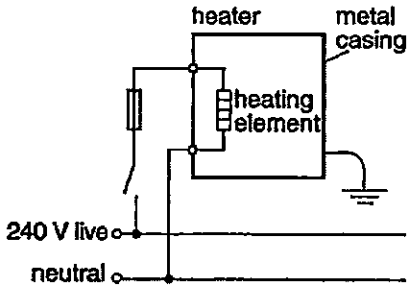
	minimum reading / V	maximum reading / V
A	0.00	4.00
B	0.00	8.00
C	0.00	9.00
D	4.00	12.00

33 Why can birds stand on an overhead high voltage transmission line without getting electrocuted?

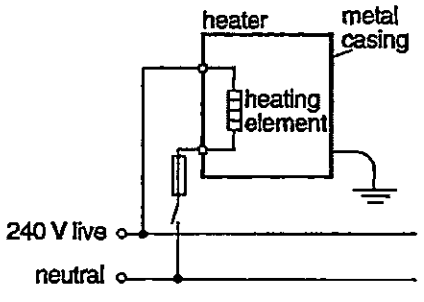
A They are not connected to Earth.
B Their feet are very good insulators.
C Their bodies have very high resistance.
D The air spaces between their feathers act as insulators.

34 Which of the following correctly shows how a water heater should be connected to the mains?

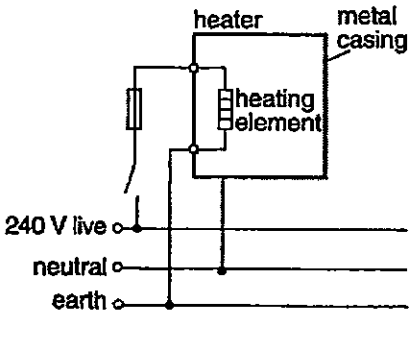
A



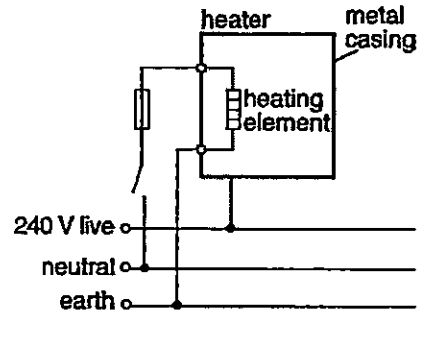
B



C



D

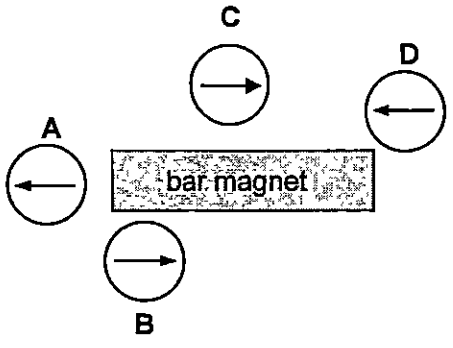


35 When one end of an iron rod is placed near a compass,

A any pole of the compass may point towards it.
B it is always the N-pole of the compass that points towards it
C it is always the S-pole of the compass that points towards it.
D the compass needle will not be affected by the rod.

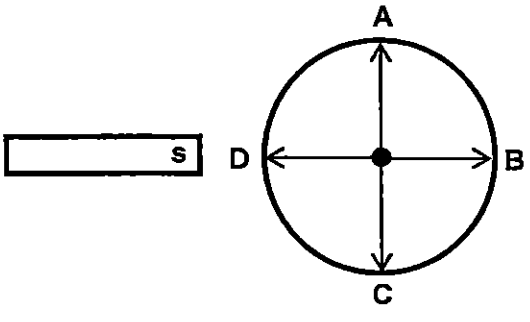
36 Four magnetic compasses are placed near a bar magnet as shown.

Which compass is faulty?

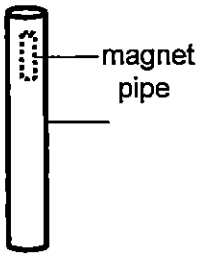


37 The diagram shows the screen of an electron gun. A beam of electron hits the center of the screen initially when going into the screen.

When the south pole of a magnet is placed at the position as shown, what direction will the beam deflect?



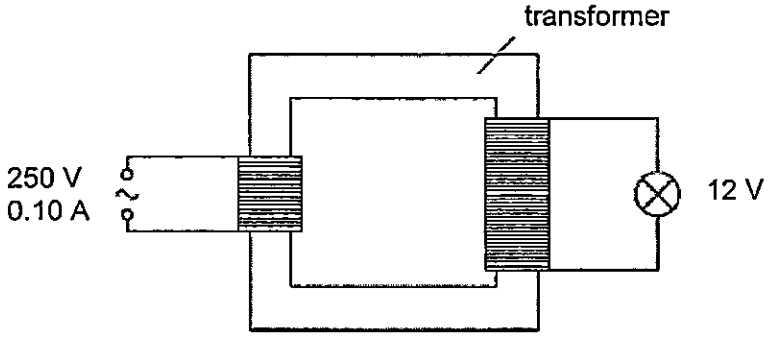
38 A cylindrical shaped magnet is dropped into an aluminium pipe as shown. The magnet falls through the pipe at a slow speed.



As the magnet falls,

A the air resistance increases and it opposes the motion of the magnet.
B similar polarity is induced in the bottom half of the pipe and like poles repel.
C it induces a current in the pipe and the pipe heats up, therefore there is resistance against motion of the magnet.
D it induces a current in the pipe which creates a magnetic field that opposes the motion of the magnet.

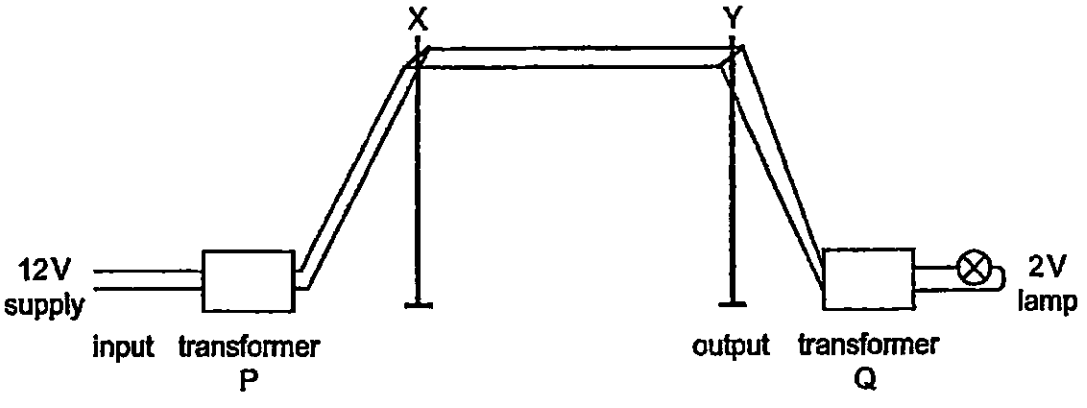
39 A transformer is used to operate a 12 V lamp from a 250 V mains supply. The mains current is 0.10 A and the efficiency of the transformer is 75 %.



What is the current in the lamp?

A 1.56 A
B 2.08 A
C 2.78 A
D 3.12 A

40 The diagram represents a model power line experiment set up in a school laboratory.



Which statement is **not** true?

A Transformer **P** is a step-up transformer.
B The current decreases along the power line **XY**.
C The voltage across the power line at **X** is greater than the voltage across the line at **Y**.
D The lamp lights up if the power supply is a.c. but not if it is d.c.

End of Paper

Name:	Index Number:	Class:

HUA YI SECONDARY SCHOOL

4E Preliminary Examination 2015 **4E**

PHYSICS **5059/2**

Paper 2

26 August 2015
1 hour 45 minutes

Candidates answer on the Question Paper
Additional Materials: NIL

READ THESE INSTRUCTIONS FIRST

Write your Name, Index Number and Class at the top of this page.
Write in dark blue or black pen.
You may use a pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

Section B
Answer **all** the questions. Question 12 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 workings 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	
10	
11	
12	
TOTAL	

This document consists of **19** printed pages including the cover page.

[Turn Over

Setter: Mr Chong ML Chris

Section A [50 marks]
Answer **all** the questions in this section.

1 Fig. 1.1 shows a ship-to-ship cable, **ABC**, used by the navy to transfer people and goods from one ship to another in dangerous conditions. Initially, the angle of declination from each ship is 20° when a 1200 N object is suspended at the mid-point.

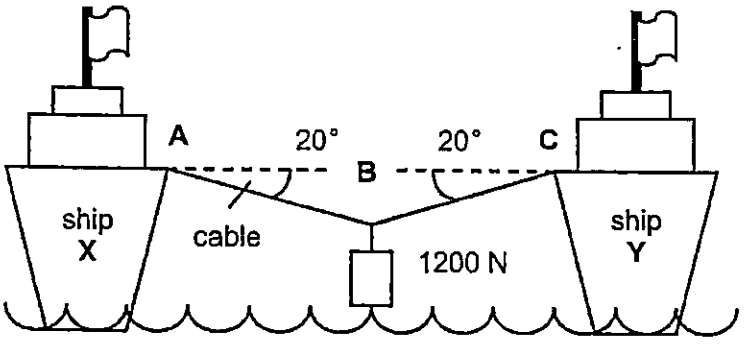


Fig. 1.1

(a) The tension in the cables **AB** and **CD** are the same. By using a suitable scale drawing, determine the tension in the cable **AB**.

tension = ... [3]

(b) In very stormy weather, the sailors are always worried when they see the cable becoming horizontal because they know from experience that this can cause the cable to break. Such a broken cable often whips incredibly fast back to the decks of the ships causing severe injury or death.

Explain why an almost horizontal cable is very likely to break.

.....

..... [1]

[Total: 4]

2 Fig. 2.1 shows a method of lifting water from a river. The bucket and its contents weigh 60 N and is suspended from **Q**, 0.80 m from the pivot. The lever is uniform and has a weight 10 N. A man pushes down on the lever with a vertical force ***F*** at point **P**, 1.2 m from the pivot.

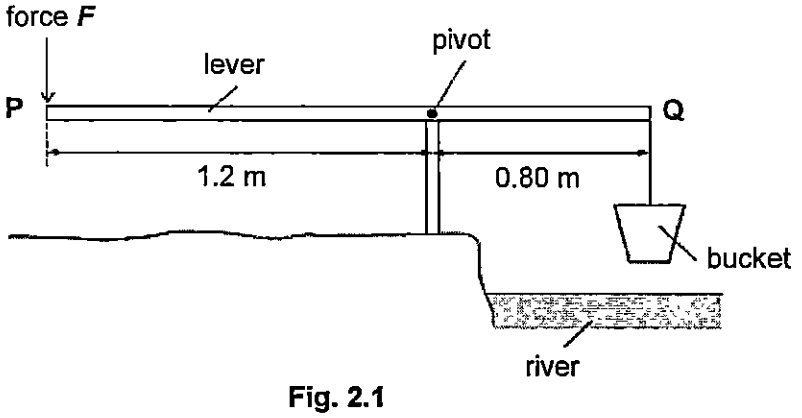


Fig. 2.1

(a) Indicate the weight of the lever with its centre of gravity **G** on Fig. 2.1. [1]

(b) Calculate the force ***F*** that the man exerts at point **P** to keep the lever balanced.

force = ... [2]

(c) The bucket is lifted by a vertical height of 5 m at a constant speed of 3 m/s. The gravitational field strength is 10 N/kg.

Calculate the power exerted by the man in lifting the bucket and water.

power = ... [2]

[Total: 5]

3 Fig. 3.1 shows a solar heating system. A 3000 W boiler serves as a back-up system in the event that the solar heating system could not provide sufficient heat.

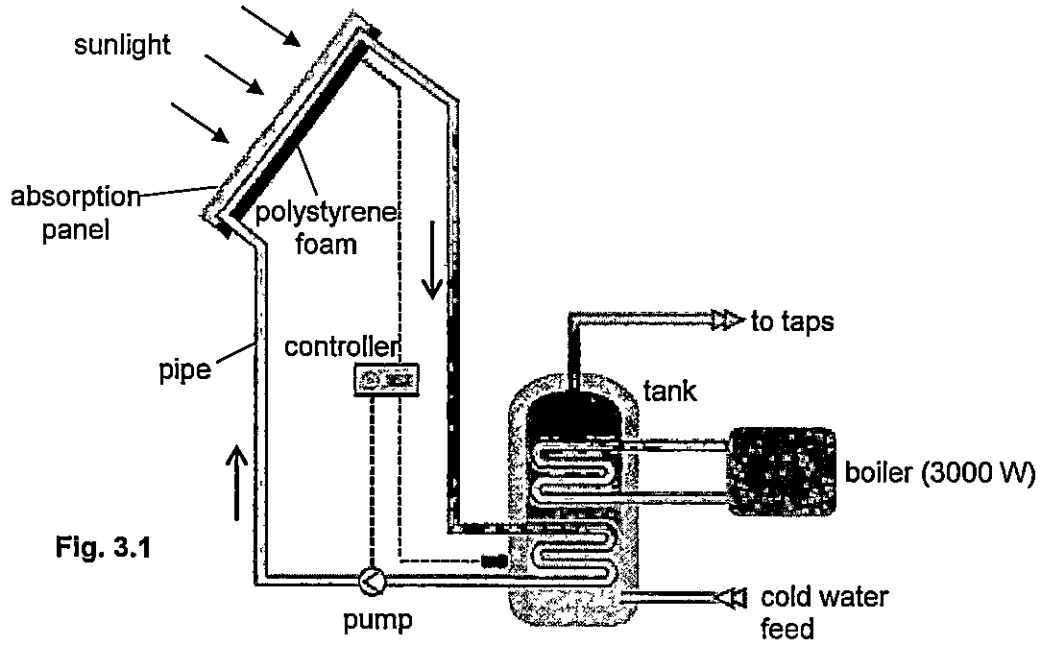


Fig. 3.1

(a) State the process by which energy is transferred

(i) from the sun to the absorption panel,

..... [1]

(ii) from the pipe to the water inside it.

..... [1]

(b) Explain why polystyrene foam is used as the backing board of the absorption panel.

.....

.....

..... [2]

(c) State a feature of the pipe in the water tank that allows the water to be heated up faster.

..... [1]

(d) The boiler was switched on for 96 minutes to provide more heat to the water. Calculate the cost of using the boiler at a cost of 25 cents per kWh.

cost = ... [2]

[Total: 7]

4 Fig. 4.1 shows the heating curve of a substance **X**. The amount of **X** used in the experiment was 400 g. The heater used was rated at 200 W.

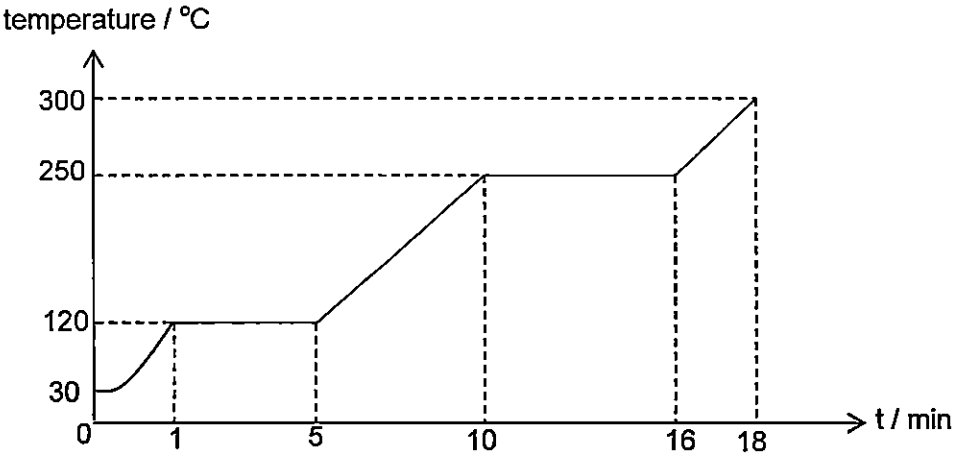


Fig. 4.1

(a) Using the kinetic theory of matter, explain why the temperature remains constant from t = 10 min to t = 16 min.

.....

.....

..... [2]

(b) Calculate

(i) the amount of energy required for melting substance **X**,

energy = ... [2]

(ii) the specific latent heat of vaporisation for substance **X**.

specific latent heat of vaporisation = ... [2]

[Total: 6]

5 When moving from position **G** to **L**, a ship sends pulses of ultrasonic waves at a frequency of 45 000 GHz continuously to the bottom of the sea. The variation of the time interval, t, between the emission of a pulse and the reception of its reflection is shown in Fig. 5.1. The speed of sound in water is 1350 m/s.

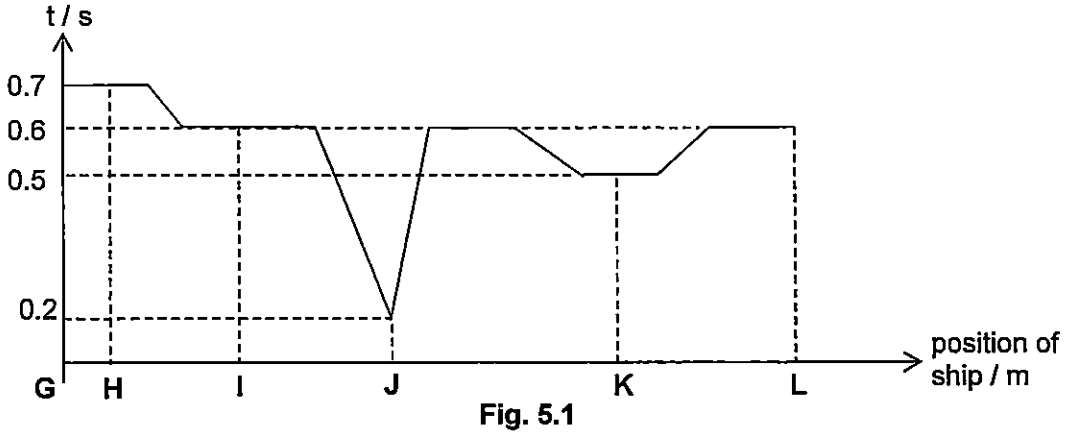


Fig. 5.1

(a) Calculate the depth difference between position **J** and **L**.

depth difference = ... [2]

(b) Calculate the wavelength of the ultrasound waves in water.

wavelength = ... [2]

(c) State one reason why the depth of the seabed changes abruptly within a few metres from **I** to **J**.

..... [1]

(d) State one other application of ultrasound.

..... [1]

[Total: 6]

6 Fig. 6.1 shows a regular hexagonal glass piece of refractive index 1.42. The ray of light entering the glass piece is parallel to its top surface.

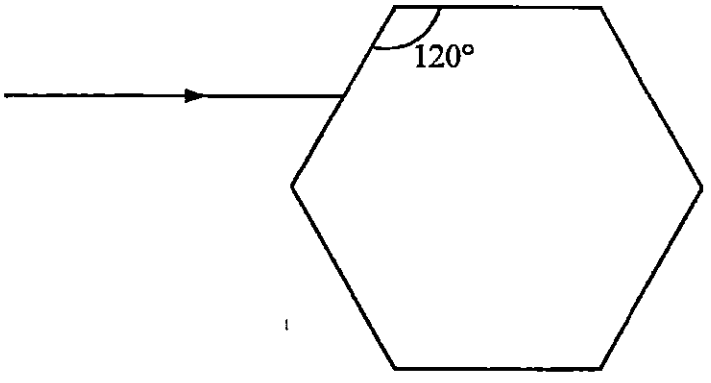


Fig. 6.1

(a) Calculate the critical angle of the glass.

critical angle = ... [1]

(b) Determine the angle of refraction of the light ray when it enters the glass piece.

angle of refraction = ... [2]

(c) Complete Fig. 6.1 to show how the light ray continues after it meets the glass piece.
Mark all the angles of incidence and angles of refraction clearly.
Show relevant working clearly in the space below. [4]

[Total: 7]

7 Fig. 7.1 shows two conducting spheres. Sphere **B** is connected to earth through a sensitive ammeter. Sphere **B** is initially uncharged. Sphere **A** has a very large positive charge on it. When sphere **B** is brought near to sphere **A**, a spark jumps between the two spheres and the ammeter needle moves rapidly up the scale and then back to zero.

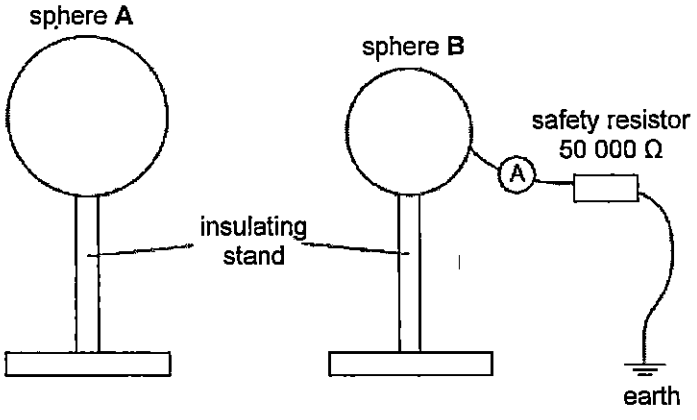


Fig. 7.1

(a) On Fig. 7.1, draw how the charges distribute itself on sphere **B** when it is brought near to sphere **A**. [1]

(b) Explain why the ammeter needle moves and returns to zero.

.....

.....

..... [2]

(c) The current through the ammeter is 0.0012 mA.
Calculate the potential difference across the safety resistor.

potential difference = ... [1]

[Total: 4]

8 Fig. 8.1 shows a circuit with 11.0 V direct current supply, three resistors and four voltmeters.

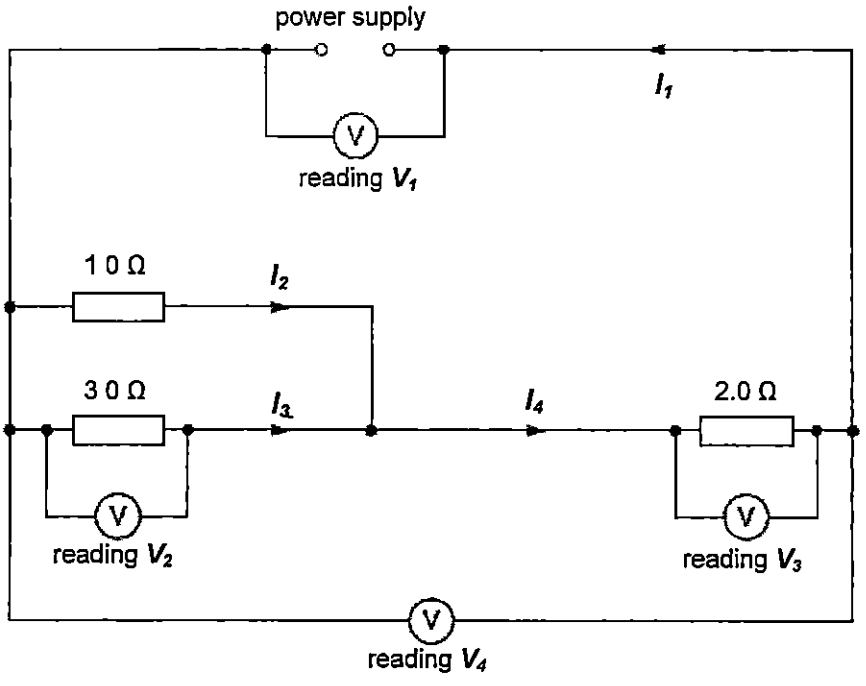


Fig. 8.1

The reading of voltmeter V_2 is 3.0 V.

(a) State the readings of

(i) V_4,

V_4 = ... [1]

(ii) V_3.

V_3 = ... [1]

(b) Calculate the currents I_2 and I_3.

I_2 = ... [1]

I_3 = ... [1]

(c) Calculate the current I_1.

I_1 = ... [1]

[Total: 5]

9 Fig. 9.1 shows a circuit breaker with the contacts closed.

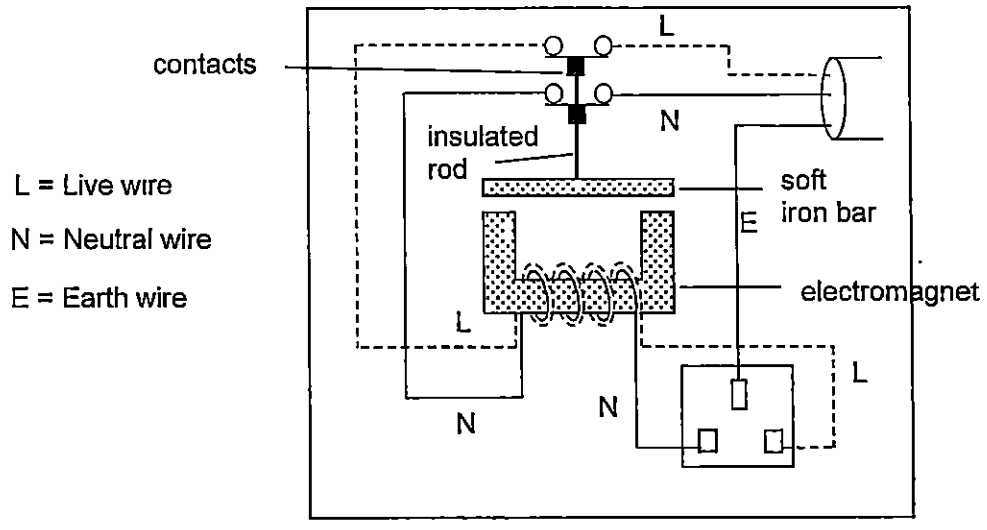


Fig. 9.1

(a) State a hazard which happens in the household circuit which causes this device to be triggered.

..... [1]

(b) Explain how this device helps to switch off the mains supply whenever the hazard stated in **(a)** occurs.

.....

.....

.....

..... [3]

(c) State two ways of making the circuit breaker more sensitive.

.....

..... [2]

[Total: 6]

Section B [30 marks]
Answer **all** the questions in this section.
Answer only **one** of the **two** alternative questions in Question 12.

10 Fig. 10.1 shows a rigid rectangular card which has a rectangular hole cut out in the centre. Fig. 10.2 shows the setup used to measure the acceleration of the card as it falls freely to the ground. A torchlight which is directed towards the **LDR** is turned on. A computer is used to measure the potential difference across **RS**.

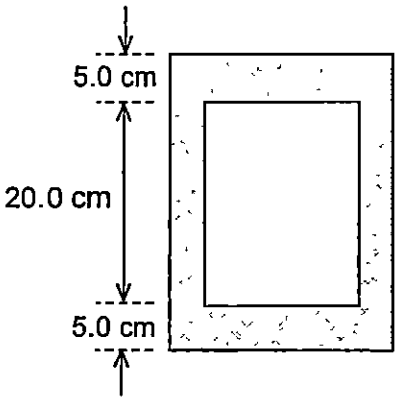


Fig. 10.1

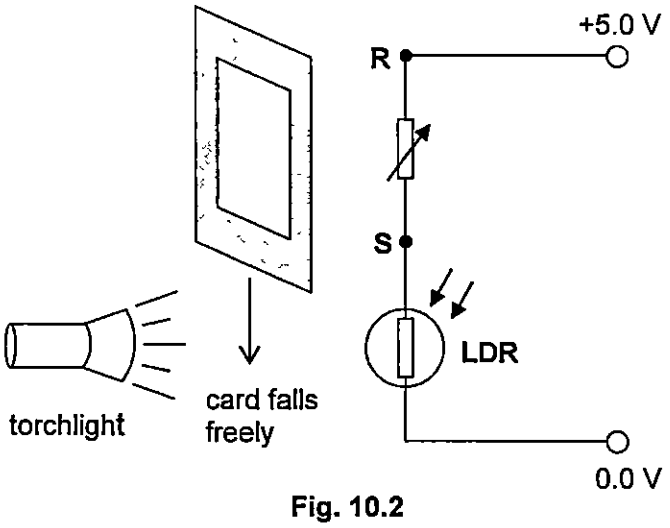


Fig. 10.2

Fig. 10.3 shows the graph of potential difference across **RS** against time.

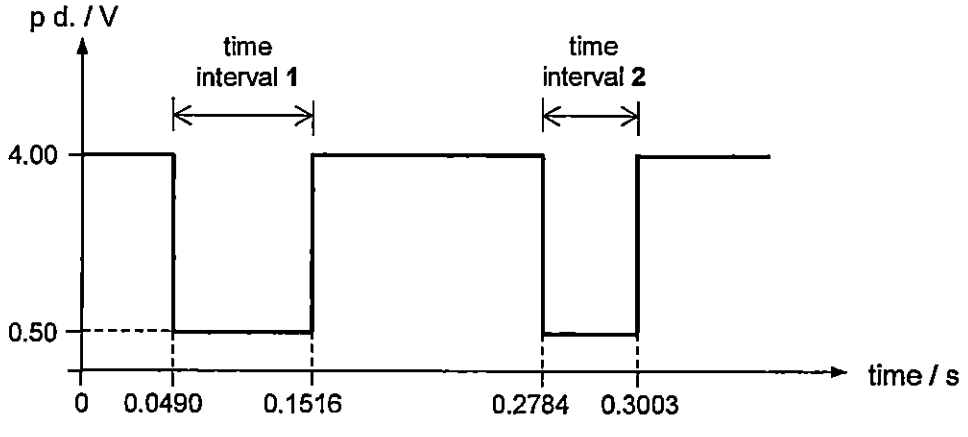


Fig. 10.3

(a) State what happens to the resistance of the **LDR** as the card falls.

.....

.....

..... [2]

(b) Explain why the p.d. across the variable resistor drops to 0.50 V.

.....

.....

.....

..... [3]

(c) Explain why time interval **1** is longer than time interval **2** (as shown in Fig. 10.3) when the rigid card falls.

.....

.....

..... [2]

(d) Calculate the average acceleration of the card in cm/s^2.

average acceleration = ... [3]

[Total: 10]

11 Fig. 11.1 shows a skydiver of mass 70 kg falling towards the Earth after jumping from an aeroplane.

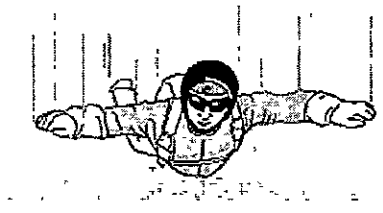


Fig. 11.1

At time t = 0 s, he jumps from the aeroplane. He opens his parachute 12 seconds later. Fig. 11.2 shows the speed-time graph for the skydiver.

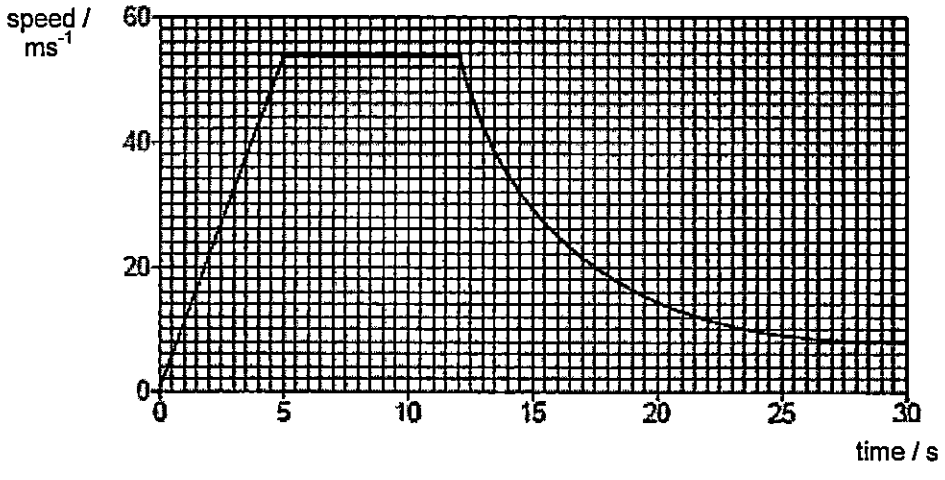


Fig. 11.2

(a) Determine the resultant force of the diver at t = 3 s.

resultant force = ... [3]

(b) State the terminal velocity of the skydiver before he opens his parachute.

terminal velocity = ... [1]

(c) Determine the distance travelled by the skydiver when his weight is equal to the air resistance.

distance = ... [2]

(d) Describe the motion of the skydiver for the period between t = 12 and t = 30 s.

.....

.....

..... [2]

(e) Explain your answer in **(d)** in terms of forces acting on the skydiver.

.....

.....

..... [2]

[Total: 10]

12 Either

Fig. 12.1 shows an experimental trolley which uses pressure to propel it forward. The trolley has an enclosed rectangular rigid tank filled with water and the air inside the tank is pressurised. There is a nozzle at the bottom of the tank which allows the water to rush out when the stopper is removed.

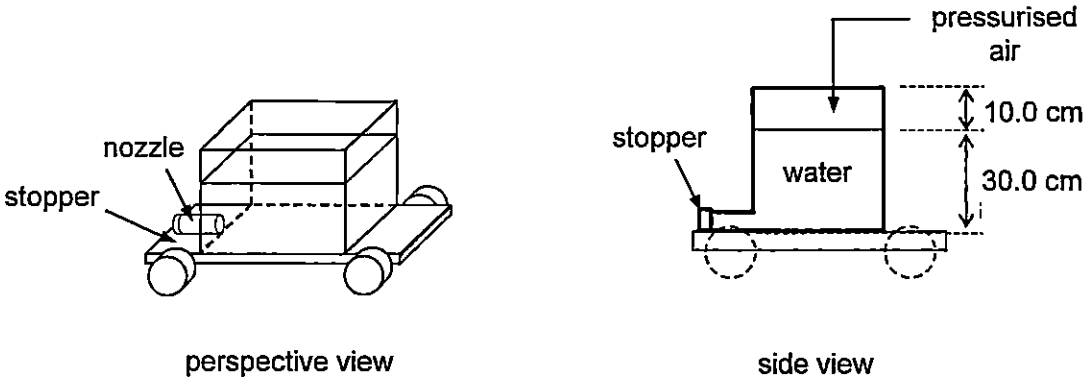


Fig. 12.1

The following information is provided.

initial height of the water in the tank	30.0 cm
initial height of the air in the tank	10.0 cm
initial air pressure in the tank	2.50×10^5 Pa
cross-sectional area of the nozzle	4.00×10^{-4} m^2
atmospheric pressure	1.00×10^5 Pa
density of water in the tank	1000 kg/m^3

(a) Calculate the total pressure exerted on the stopper due to the air and water inside the tank.

total pressure = ... [2]

(b) The calculated pressure in **(a)** is larger than the atmospheric pressure.
Explain why the stopper is **not** forced out of the nozzle.

....

..... [1]

(c) When the stopper is removed, the water would push out of the nozzle, which causes a forward force and propels the trolley to move forward.

Calculate the maximum forward force due to this propulsion.

forward force = ... [2]

(d) After a short period of time, the height of the water drops to 15.0 cm.
Explain the pressure changes of the air inside the tank using kinetic model of matter.

.....

.....

.....

..... [3]

(e) The cross-sectional area of the nozzle is enlarged.
State two changes that will occur with reference to the trolley.

.....

.....

..... [2]

[Total:10]

12 Or

A coil of wire wound round a soft iron core is connected to a switch and batteries in series. A permanent magnet is suspended with its North pole near one end of the core as shown in Fig.12.2.

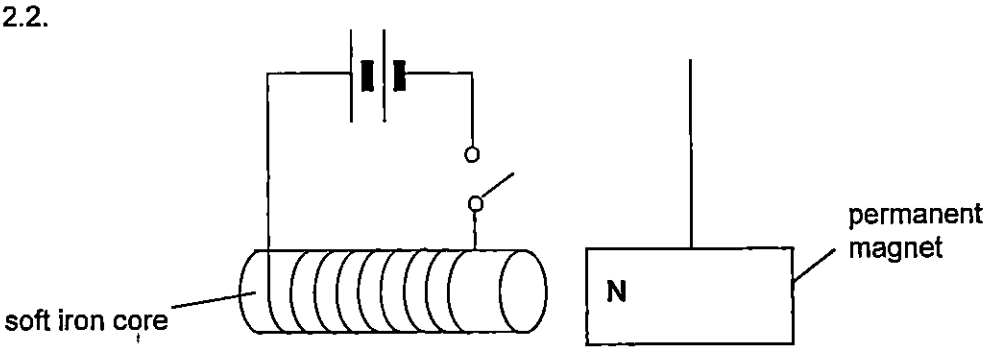


Fig. 12.2

(a) Describe and explain what will happen to the magnet when the switch is closed.

.....

.....

..... [2]

(b) The switch and batteries connected to the coil are now removed and replaced by a sensitive voltmeter. Small permanent magnets, attached to a conveyor belt, are moved under the coil which act as a detecting device as shown in Fig.12.3.

The voltmeter records voltage pulses as the conveyor belt moves along positions **A**, **B**, **C** and **D** at constant speed.

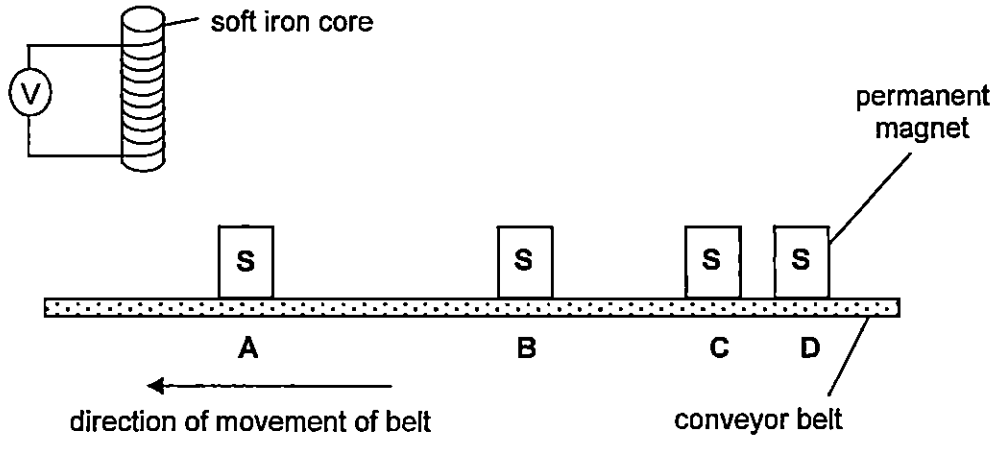


Fig. 12.3

Fig. 12.4 shows the graph of voltmeter reading against time, with the letters **A**, **B**, **C** and **D** corresponding to the positions of the belt as each magnet passes under the coil.

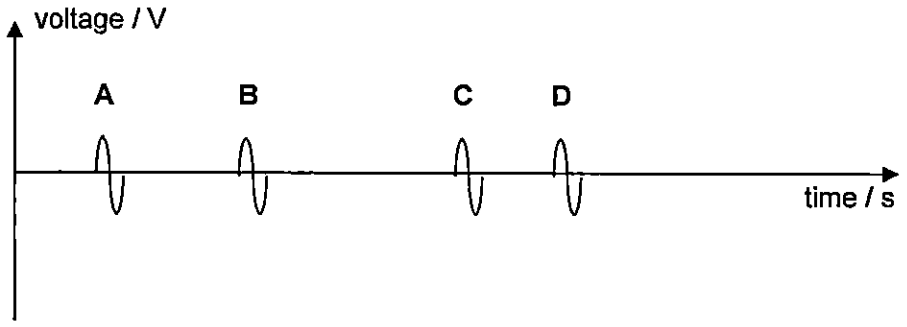


Fig. 12.4

(i) Explain why the voltage pulses occur.

.....

..... [1]

(ii) Explain why the pulse produced by each magnet has a positive and a negative value as it passes the coil.

.....

.....

..... [2]

(iii) State one way to produce a voltage pulse of greater amplitude.

.....

..... [1]

(c) A rectangular coil can be balanced in a horizontal position when current flows through it as shown in Fig. 12.5. The coil is pivoted at two fulcrums and connected to a d.c. power supply. A weighing pan of 100 g mass is hung at side **WX**, while side **YZ** is placed inside a magnetic field.

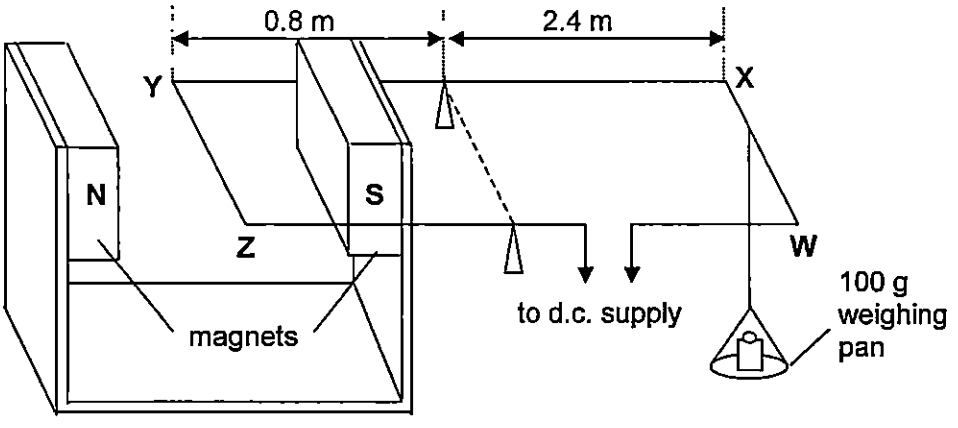


Fig. 12.5

(i) Calculate the moment produced by the weighing pan about the pivot and state the direction of this moment.

moment = ... [1]

direction = ... [1]

(ii) Hence, state the direction of the current flowing in **YZ** and explain how you derived your answer.

.....

.....

..... [2]

[Total: 10]

End of paper

HUA YI SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2015
SECONDARY FOUR EXPRESS
PHYSICS
ANSWER SCHEME

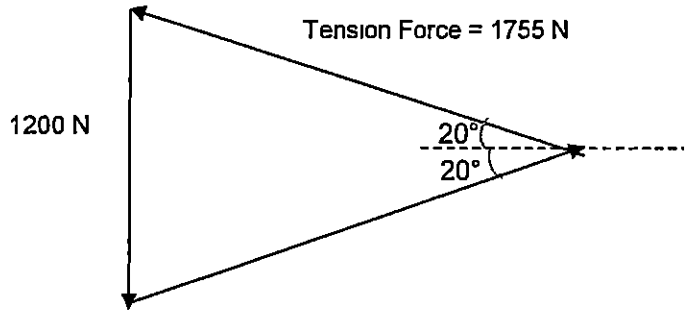
Paper 1 (40 marks)

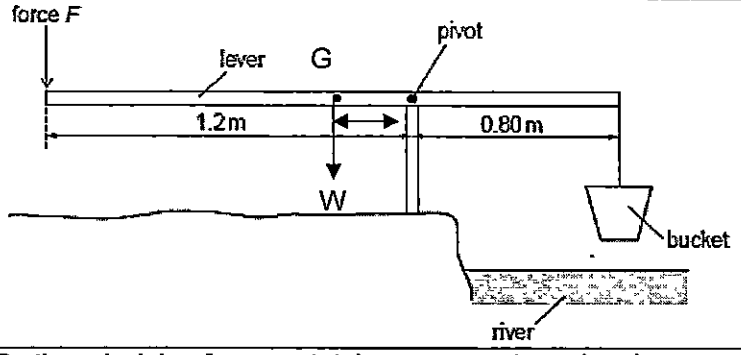
Qns	Ans	Solution
1	C	zero error = +0.03 mm thickness = 12.79 – (+0.03) = 12.76 mm
2	A	Period of pendulum is affected by length of pendulum. But independent of mass. The shorter the length, the shorter the period, the faster the swing.
3	A	M = W / g = 200N / 10 Nkg^{-1} = 20 kg F = ma, a = F / m = 12 N / 20 kg = 0.60 m/s^2
4	C	Density depends on material. The density of a material will be same no matter how many pieces it is divided into.
5	A	Density = mass / vol Vol of block with hole = mass / density = 560 / 8 = 70 cm^3 Vol of block w/o hole = 8 × 5 × 2 = 80 cm^3 Vol of hole = 80 – 70 = 10 cm^3 Cross-sectional area of hole = 10 / 2 = 5.0 cm^2
6	C	
7	D	Gradient of s-t graph gives the value of v Gradient was constant, then 0, then negative and decreasing, so v is also constant, then 0, then decreasing from a negative value to 0.
8	B	Constant resultant force gives a constant acceleration due to F = ma Acceleration has a constant high value, followed by 0 acceleration (constant speed), then a lower constant acceleration. The gradient of a v-t graph gives the value of acceleration. *note: Ans is not D. when acceleration is 0, it is at constant speed instead of at rest. Reason being to be at rest from a moving motion, object needs to slow down first. To slow down, F must be –ve, but F was never –ve in the graph.
9	D	Friction = 7 N since resultant force = 0 N when at constant speed F = ma = 2 × 4 = 8 N Applied force = 8 + 7 = 15 N
10	C	C.G. will shift towards the part of the object with more mass.
11	B	An object is considered to be at stable equilibrium if it can return to its original position after being shifted.
12	D	Pressure of gas = atmospheric pressure + 150 mm Hg = 760 mm Hg + 150 mm Hg = 910 mm Hg
13	B	
14	B	Work done = f × d Direction of d must be same as f which is weight in this case, so we only consider vertical distance travelled. Distance d should be in m. Work done = [(50 × 10) × (15 ×5)] / 100 = 375 J

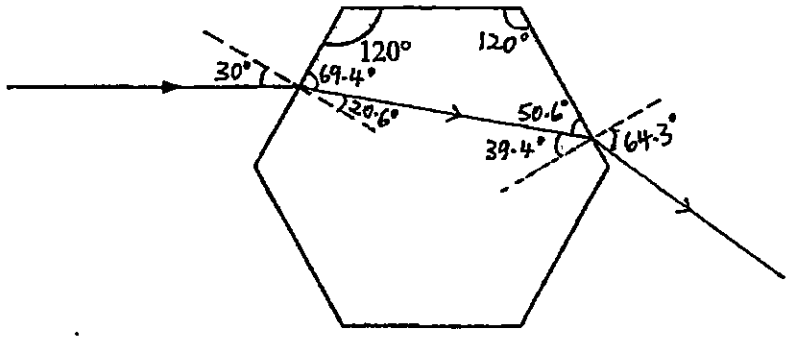
15	C	Work done = applied force × d Common mistake: many often use resultant force × d Disregarding friction which is a distractor, P = E/t = (700 × 3) / 4 = 525 W *note: if qns asks for **useful** power, then we subtract friction to get resultant force and calculate energy from there, in which the answer would be 300 W, as 225 W of power is wasted through friction.
16	C	
17	B	When molecules are heated, temp increase and K.E. increases, thus speed increases. When the piston goes outwards, volume increases but no. of molecules stays the same. Since no. of molecules per unit volume decreases, rate of collision decreases. However, when speed of molecules increases, there is also an increase in rate of collision, which we are not sure if it makes up for the decrease in rate of collision due to larger volume. However, bearing in mind overall pressure did not change, and that pressure due to the faster molecules hitting the walls harder increase. The rate of collision with the walls must then decrease.
18	C	1200 Ω - 960 Ω = 240 Ω → represents a difference of 100 °C 1056 Ω - 960 Ω = 96 Ω Temp of water bath = 100 / 240 ×96 = 40 °C
19	D	Cement is a better conductor of heat than carpet, thus it conducts heat faster away from the feet.
20	B	Energetic surface molecules escape, leaving less energetic molecules behind in the liquid. Having less K.E. means having a lower temp which shows that cooling happened.
21	D	Having a higher specific heat capacity means more energy is required to change temp of object per kg, meaning more time is needed for to change temperature.
22	B	Final temp = 100 °C Energy loss by aluminium = energy gained by water $mc\Delta T = mc\Delta T + m l_f$ $(2 \times 900 \times 600) = (2 \times 4200 \times 80) + (m \times 2.27 \times 10^6)$ $m = 408\,000 / 2.27 \times 10^6 = 0.18$ kg
23	A	Wavelength is shorter in Y. Frequency will never change once wave is created, thus speed $v = f\lambda$ is slower in Y. Speed of wave is slower in shallow regions so Y is shallower than X.
24	C	Frequency = 50 Hz Wavelength = 30 / 6 = 5.0 cm Speed $v = f\lambda = 50 \times 5 = 250$ cm/s = 2.5 m/s
25	B	All EM waves travel at the same speed in vacuum. $v = f\lambda$, with a constant v, if P has a longer λ, then it will have a lower frequency than Q. radiowaves have longer wavelength and lower frequency than infra-red radiation.
26	A	
27	D	
28	A	The object distance is more than 2f, thus a real and diminished image will be produced. A camera is an application than gives such an image.
29	C	After making contact with each plate, the sphere will either give away electrons (to the positive plate) or gain electrons (from negative plate), until it has like charges with the plates and will repel. The process

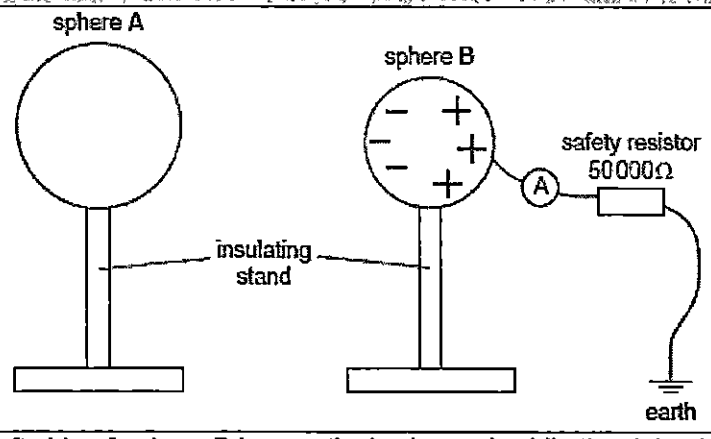
		repeats continuously, making the sphere oscillate.
30	**A**	$R_1 = \rho L_1 / A_1$. $L_1 = (R_1 \times A_1) / \rho$ $L_2 = (2R_1 \times \frac{1}{4} A_1) / \rho = \frac{1}{2} L_1$
31	**D**	All the current will flow through A_2 (and no current flows through A_3). The circuit becomes a series circuit and total resistance of circuit decreases, thus current in A_1 decreases. A_2 will be the same as A_1.
32	**B**	
33	**A**	
34	**A**	The fuse and switch should be on the live wire and the earth wire should be connected to the metal casing.
35	**A**	The compass is a permanent magnet, so any pole of the compass would be attracted to iron, a magnetic material.
36	**D**	
37	**C**	Magnetic field direction is towards the S pole. Current direction is out of paper since it is opposite to electron direction. Using Fleming LH rule, electron will deflect downwards.
38	**D**	
39	**A**	$P_p = V_p I_p = 250\ V \times 0.10\ A = 25\ W$ $P_s = 0.75 \times 25\ W = 18.75\ W$ $I_s = 18.75 / 12 = 1.56\ A$
40	**B**	

Paper 2
Section A (50 marks)

Question No.		Solution	Marks
1	**(a)**	Appropriate scale [B1] (can only award if there is something drawn, not only scale written) Diagram drawn accurately with arrows and labels [M1] $T_{AB} = T_{BC} = 1755\ N$ [A1]  	3
	(b)	When the cable becomes horizontal, the **tension force in them is much greater** [B1] in order to balance with the weight of the object. This results in the cable breaking.	1
		[Total : 4]	

2	(a)			1
	(b)	By the principle of moment, take moment about the pivot: (10 N x 0.2 m) + (F x 1.2 m) = 60 N x 0.8 m [M1] F = 38.3 N (to 3 sf) [A1]		2
	(c)	Power = force x speed = 60 N x 3 m/s [M1] = 180 W [A1]		2
			[Total: 5]	
3	(a)	(i)	Radiation [B1]	1
		(ii)	Conduction [B1]	1
	(b)	Polystyrene foam is a **poor conductor of heat** [B1 with its trapped air], thus it **reduces heat loss from the panel to the surroundings through conduction** [B1].		2
	(c)	The pipe is **long**, making it have a **larger surface area** [B1]. Alternative answer: the pipe is **located at the bottom of the water tank** [B1], making convection more effective.		1
	(d)	Cost of using the boiler = 3 kW x 1.6 x 25 [M1] = 120 cents [A1] (give M1 even if there are conversion errors)		2
			[Total: 7]	
4	(a)	During boiling, **energy is absorbed to weaken the intermolecular forces** [B1], thus **internal potential energy increases and kinetic energy remains constant** [B1]. Since K.E. is constant, temperature is also constant.		2
	(b)	(i)	energy = P x t = 200 W x (4 x 60)s [M1] = 48 000 J [A1]	2
		(ii)	200 x (6 x 60) = 0.4 x l_f [M1] l_f = 72000/0.4 = 180 000 J/kg [A1]	2
			[Total: 6]	

5	(a)	time difference = 0.6 – 0.2 = 0.4 s 2d = v × t 2d = 1350 x 0.4 [M1] d = 540/2 = 270 m [A1]	2
	(b)	v = fλ 1350 = 4500 x 10^9 x λ [M1] λ = 3.00 x 10^{-11} m [A1]	2
	(c)	There might be a **school of fishes** [B1] swimming through at that time. Alternative: Debris	1
	(d)	Checking of cracks in structures [B1] Alternatives: Prenatal scanning / obtain images of fetuses	1
		[Total: 6]	
6	(a)	sin c = 1/n = 1/1.42 c = 44.8° (3 sf) [A1]	1
	(b)	i = $120^0 - 90^0 = 30^0$ [B1] n = sin i / sin r 1.42 = sin 30^0 / sin r sin r = sin 30^0 / 1.42 r = 20.6^0 (3 sf) [A1]	2
	(c)	 Working : i = $90^0 - 50.6^0 = 39.4^0$ [B1] since i < c , refraction occurs (ecf allowed) n = sin r / sin i 1.42 = sin r / sin 39.4^0 sin r = 1.42 sin 39.4^0 r = 64.3^0 (3 sf) [B1] refracted ray [B1] emergent ray [B1] lack of arrows for both rays or failure to label relevant angles: -1	4
		[Total: 7]	

7	(a)		1
	(b)	Left side of sphere B is negatively charged, while the right side is earthed means that **electrons move from the earth to neutralise the positive charges on the right side of B** [B1]. The **movement of electrons through the ammeter caused the needle to deflect. Once the right side of B is neutralised, there is no deflection** [B1] as no electron is needed to move through B.	2
	(c)	V = IR = 0.0012 x 10^{-3} A x 50 000 Ω = 0.060 V (2 s.f.) [A1]	1
		[Total: 4]	
8	(a)	(i) 11.0 V [A1]	1
		(ii) 11.0 V – 3.0 V = 8.0 V (2 s.f.) [A1]	1
	(b)	$I_3 = \frac{V_2}{3.0\,\Omega} = \frac{3.0\,V}{3.0\,\Omega} = 1.0$ A [A1] $I_2 = \frac{V_2}{1.0\,\Omega} = \frac{3.0\,V}{1.0\,\Omega} = 3.0$ A [A1]	2
	(c)	$I_1 = I_4 = I_2 + I_3$ = 1.0 + 3.0 A = 4.0 A [A1, ecf allowed]	1
		[Total: 5]	
9	(a)	**Short circuit** [B1] Alternative: **Overloading**	1
	(b)	The **large current causes the solenoid to become a stronger electromagnet** [B1] that can **attract the soft iron bar** [B1] downwards. This causes the **circuit to become open** [B1] and current no longer flows through it.	3
	(c)	Increase the number of turns of coil in the electromagnet [B1] Decrease the distance between the electromagnet and the soft iron bar. [B1] Not accepted: Use soft iron core, increase current through circuit.	2
		[Total: 6]	

Section B (30 marks)

10	(a)	When **light** from torchlight is **blocked by the card**, the **resistance of the LDR increases** [B1]. When the **light** is not blocked by the card and **reaches the LDR**, the **resistance of the LDR decreases** [B1].	2
	(b)	When light is blocked by the card, the **brightness around the LDR is low**, hence the **resistance of the LDR increases.** [B1] When **resistance of LDR increases**, the **potential difference across the LDR also increases**. [B1] Since the variable resistor is in series with the LDR, when **p.d. of LDR increases**, the **p.d. across the variable resistor will decrease**. [B1]	3
	(c)	The **time interval 1 is caused by the bottom of the card** which **reaches the LDR level first** OR **time interval 2 is caused by the top of the card** which it reaches the LDR level. [B1] (Mark can be given if student somewhat makes the correct link between the time intervals and the part of the card) When the **top of the card reaches the LDR level**, the **speed of the card is faster** [B1] due to acceleration caused by gravity, hence the shorter time in interval 2.	2
	(d)	Initial speed = 5.0 / (0.1516 – 0.0490) = 48.733 cm/s Final speed = 5.0 / (0.3003 – 0.2784) = 228.311 cm/s [M1 for both correct speeds] Time interval = (0.3003 + 0.2784) / 2 - (0.1516 + 0.0490) / 2 = 0.18905 s [M1] Average acceleration = (v-u) / t = (228.311 – 48.733) / 0.18905 = 950 cm/s^2 (to 3 s.f.) [A1, ecf allowed]	3
		[Total: 10]	
11	(a)	Acceleration at 3 s = acceleration between 0 and 5 s = (54 – 0) / 5 [M1] = 10.8 m/s^2 [B1] F = ma = 70 kg × 10.8 m/s^2 = 756 N [A1, ecf allowed]	3
	(b)	54 m/s [A1]	1
	(c)	When weight = air resistance, resultant force = 0 N and speed is constant Distance travelled = area under graph = 54 x 7 [M1] = 387 m [A1]	2

	(d)	The skydiver is undergoing **decreasing deceleration** [B1] from t = 12 s up to around t = 28 s, where he is moving at **constant speed** [B1] thereafter.	2
	(e)	As the parachute was opened, the **air resistance increased to be more than the weight** [B1] due to increase in surface area. The skydiver then slows down due to resultant force being negative. As he **slows down, the air resistance decreases, thus rate of deceleration decreases** [B1]. The air resistance will decrease until it is equal to weight, making resultant force = 0 N and he then moves at constant speed.	2
		[Total: 10]	
12 E	**(a)**	P = hpg = 0.30 x 1000 x 10 = 3000 Pa [M1] total pressure = 3 000 + 250 000 = 253 000 Pa (3 s.f.) [A1]	2
	(b)	The **friction between the stopper and the nozzle** prevents the stopper from coming off. [B1]	1
	(c)	F = P A = (253 000 – 100 000) x (4.00×10^{-4}) [M1] = 61.2 N (to 3 s.f.) [A1]	2
	(d)	As the water level decreases, the volume of air in the tank increases. This causes the **no. of molecules per unit volume to decrease** [B1]. The **frequency of collision between the air molecules and the walls of the tank decreases** [B1]. This reduces the force per unit area exerted on the walls, thus **reducing pressure of the air** in the tank [B1].	3
	(e)	The **forward force** on the trolley is **increased.** [B1] The trolley will **be in motion for a shorter duration.** [B1] Alternative: acceleration of the trolley increases / attain a higher speed in a shorter time	2
		[Total: 10]	
12 Or	**(a)**	When switch is closed and current flows in the coil, the **end of the coil facing the magnet becomes a North pole** [B1] Hence the magnet **repels** from the coil as like poles repel. [B1]	2
	(b)	**(i)** As the magnet moves with the conveyor belt, the coil experiences a **changing magnetic flux**, thus **inducing an emf in the coil.** [B1]	1
		(ii) As the magnets **approach** the coil, the coil experiences a **changing magnetic** flux that induces an **emf in one direction to try to repel the magnet.** [B1] As the magnets **move away** from the coil, the coil **experiences a changing magnetic flux, producing an emf in the opposite direction to try to attract the magnet.** [B1]	2

		(iii)	Increase the speed of the conveyor belt [B1] Alternatives: increase the number of turns of coil around the iron core / use stronger permanent magnets with stronger magnetic field strength.	1
	(c)	(i)	Moment = f x perpendicular d from pivot = 1N x 2.4 m = 2 4 Nm [A1] Direction: clockwise [B1]	2
		(ii)	**Force on YZ needs to be downwards to produce an anticlockwise moment** as balance the moment of the pan. [B1] **Using Fleming's Left Hand Rule, the current should flow from Z to Y** to produce a downward force. [B1]	2
			[Total: 10]	

End of Paper