Name: Register Number: Class:

PRELIMINARY THREE EXAMINATION 2016
SECONDARY FOUR EXPRESS

PHYSICS SPA **5059**

Paper 1 Multiple Choice **20 September 2016**
Tuesday

1 hour

READ THESE INSTRUCTIONS FIRST

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 correct and record your choice in **soft pencil** on the OTAS.

Read very carefully the instructions on the OTAS.

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.
Take the gravitational field strength on Earth, g to be 10 N/kg.

This question paper consists of **14** printed pages, including this cover page.

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

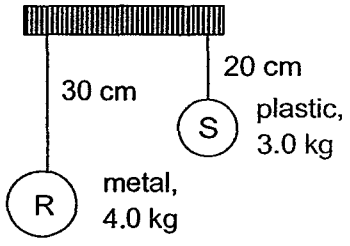
2 A student measures the diameter of a cylindrical wooden pencil with a ruler.
How could he increase the precision of the measurement?

A	take the average value of several measurements of the diameter along different parts of the pencil using the ruler
B	take the average value of several measurements of the diameter along different parts of the pencil using vernier calipers with zero error
C	take the average value of several measurements of the diameter along different parts of the pencil 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 will swing faster as it has a greater density.
B R will swing faster as it is larger in size.
C S will swing faster as it has a smaller mass.
D S will swing faster as it is shorter.



4 Two forces act at a point.

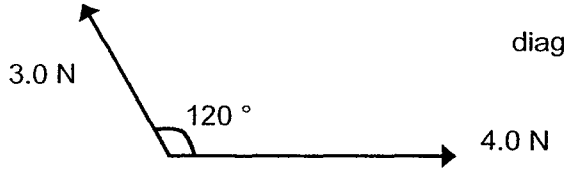


diagram not drawn to scale

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

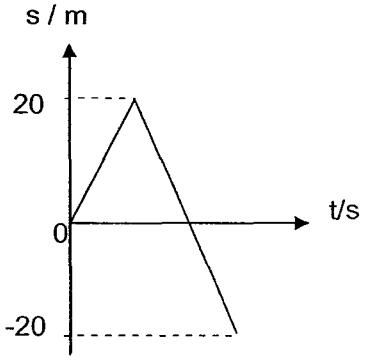
Once upon a time (300 B.C.) there was a very wealthy king, Hiero of Syracuse (Sicily) suspected that the goldsmith has cheated him by using a gold and silver mix instead of pure gold to make a crown. King Hiero asked Archimedes to determine the truth without destroying the crown. (In modern terms, he was to perform nondestructive testing).

Given that the mass of crown = 1000 g, volume of crown = 64.8 cm^3 and density of gold, silver and water are:19.3g/cm^3;10.49 g/cm^3 and 1g/cm^3 respectively, find the percentage of gold and silver.

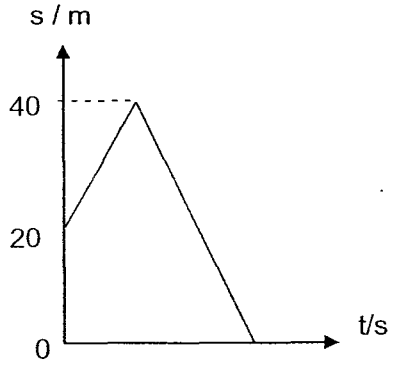
	% of Gold	% of Silver
A	29.8	70.2
B	35.2	64.8
C	64.8	35.2
D	70.2	29.8

6 A ball is thrown vertically up from the top of a building 20 m high with an initial velocity of 20 m s^{-1}. If 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?

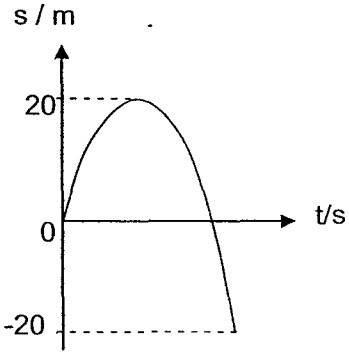
A



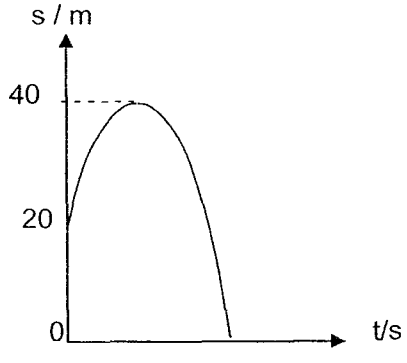
C



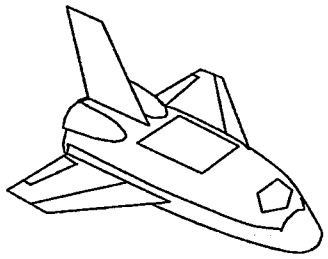
B



D



7 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.

8 A non-uniform object is placed on an inclined plane as shown in **Fig 8.1**. If the object is just about to topple, which position will be its centre of gravity?

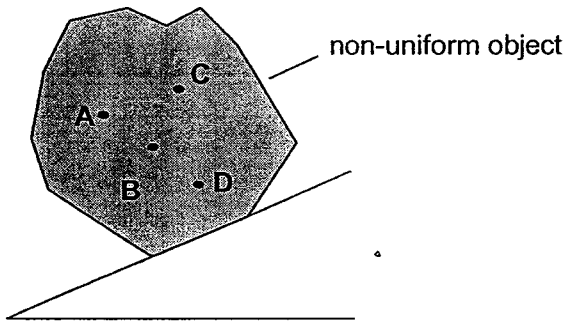
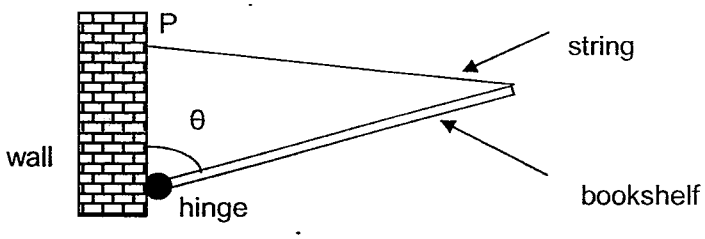


Fig 8.1

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

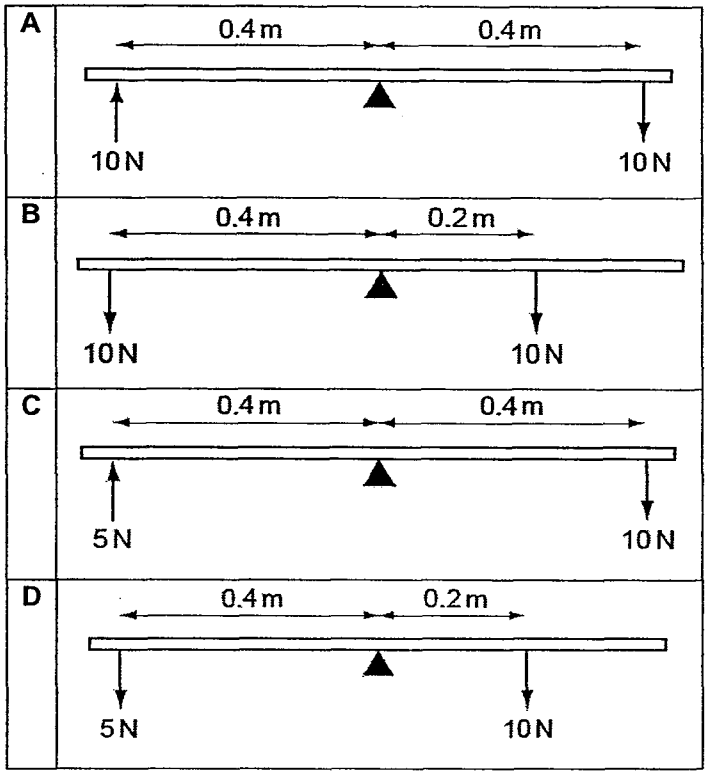


Which of the following will help to minimize the tension in the string in order to help it last longer?

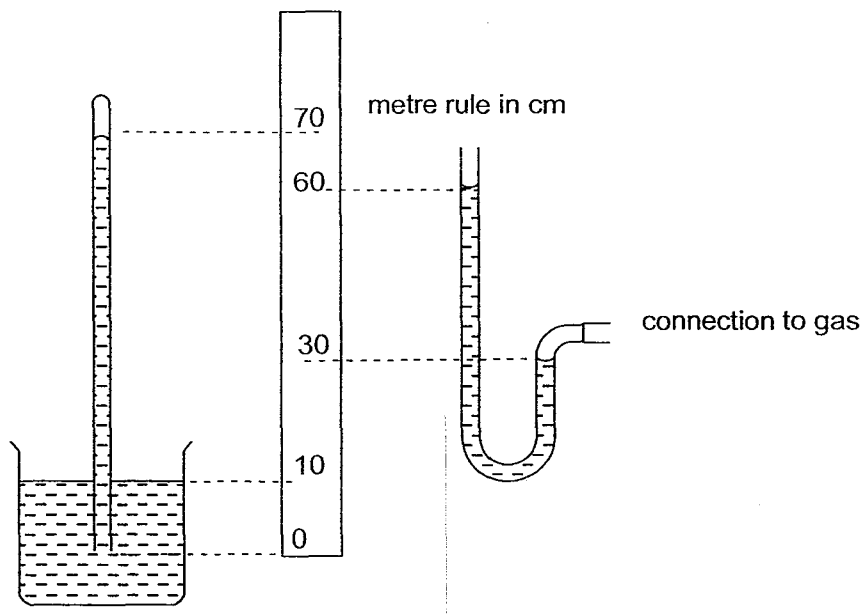
A a smaller θ
B have a longer bookshelf
C less friction at hinge
D use steel bookshelf instead of light wooden one

10 Forces are applied to a uniform beam pivoted at its centre.

Which beam is balanced?



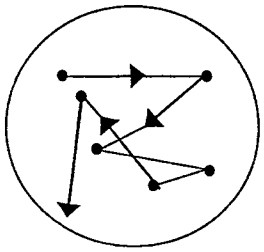
11 A mercury barometer and a mercury manometer are placed in the same room which is on a hill top. The manometer is connected to a gas container.



What is the pressure of the gas?

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

12 Smoke particles in a transparent box are observed using a microscope. A small point of light is seen to move around as shown.



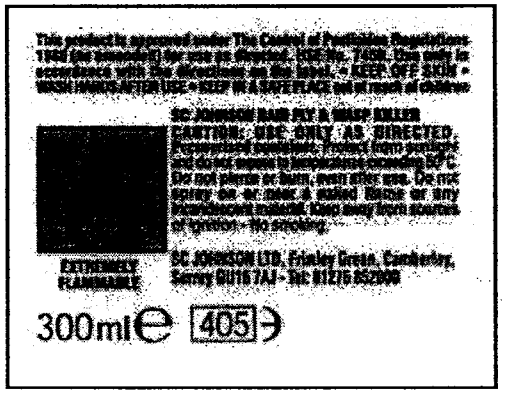
What does this experiment demonstrate about air molecules?

A They are in continuous random motion.
B They can be seen through a microscope.
C They move because of collisions with smoke particles.
D They move more slowly when they are heated.

13 When a solid is melting how do the potential energy and kinetic energy of the particles in the solid change?

	Potential Energy	Kinetic Energy
A	decreases	increases
B	increases	increases
C	increases	no change
D	no change	increases

14 On the spray containers of insecticide, there is a warning label stating that it is dangerous to dispose of the container, even when empty, in fire.



Why is it dangerous to throw empty insecticide containers into fire?

A	The can is not fire-proof and will catch fire easily.
B	When the can is heated, the gas molecules within the can will absorb the heat quickly from the fire and catch fire.
C	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.
D	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.

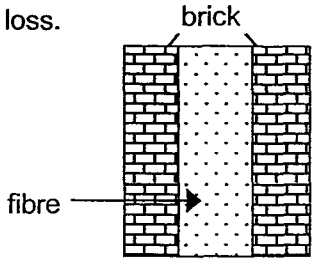
15 The resistance of a piece of platinum wire in melting ice and boiling water are 800 Ω and 910 Ω respectively. What is the temperature reading in Kelvin when the resistance has a value of 1000 Ω?

A 328 K B 383 K C 455 K D 495 K

16 A brick wall in a cold country is filled with fibre to prevent heat loss.

Heat cannot easily escape through the wall because the fibre

A heats up the wall.
B is tightly packed.
C is warm.
D traps air.



17 A liquid placed inside an insulated container is kept boiling by a heater immersed in it. When the power supplied to the coil is 84 W, the liquid boils away at a rate of 10^{-3} kg/min.

Calculate the specific latent heat of vaporization of the liquid in J/kg.

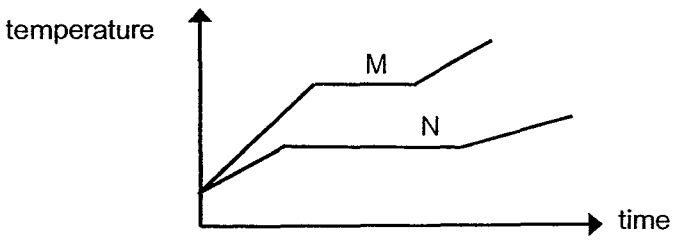
A 8.4×10^2 **B** 5.05×10^4 **C** 8.4×10^4 **D** 5.04×10^6

18 Two cars, one painted dull black and the other a shiny white, were left in the sun. When the two cars had reached the same temperature they were driven into the shade.

Which car will be heated up faster and which car will cool down faster?

	In the Sun	*In the shade*
A	Black car heats up faster	Black car cools down faster
B	Black car heats up faster	White car cools down faster
C	White car heats up faster	Black car cools down faster
D	White car heats up faster	White car cools down faster

19 Two solids M and N are heated separately by identical heaters under identical conditions. The changes in temperature with time for the two solids are shown below.



If M and N are of the same mass, which of these statements is/are correct?

1 Freezing point of N is lower than that of M.
2 Solid N has a higher specific heat capacity than solid M.
3 The specific latent heat of fusion of N is higher than that of M.

A 1 only **B** 1 and 2 only **C** 1 and 3 only **D** 1, 2 and 3

20 It is observed that the crest of a water wave takes 10 s to travel 20 cm. Given that the frequency of the wave is 5 Hz, calculate the wavelength of the water wave.

A 0.040 cm **B** 0.40 cm **C** 4.0 cm **D** 40 cm

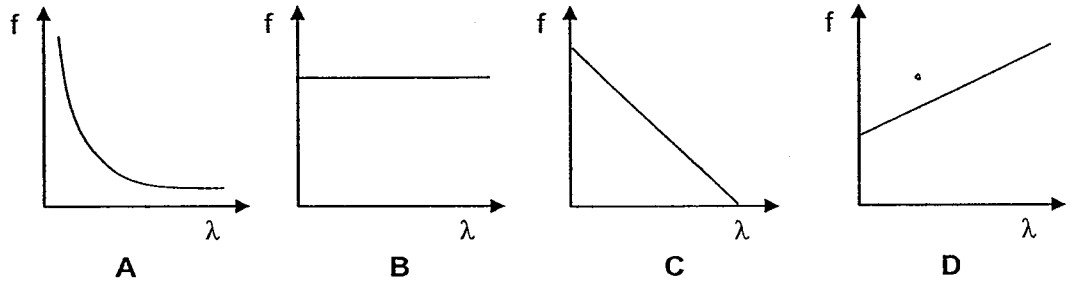
21 Which one of the following values can possibly be the wavelength of X-rays given that the wavelength of red light is 700 nm?

A 5×10^{-2} m **B** 5×10^{-5} m **C** 5×10^{-7} m **D** 5×10^{-10} m

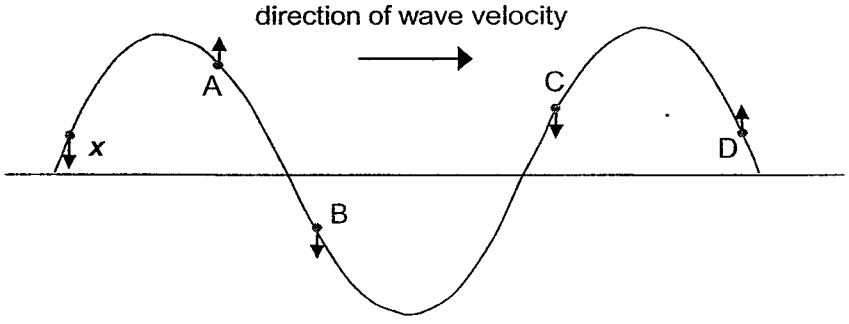
22 Which one of the following statements is **NOT** correct?

A	Gamma rays have wavelengths shorter than visible light and may be used to find faults in metal casting.
B	Infrared rays are given off by hot objects, and can pass through fog and glass.
C	Radiowaves have wavelengths longer than visible light and can be reflected by layers in the upper atmospheres.
D	Ultraviolet rays may produce sunburn, are absorbed by glass and can produce fluorescence.

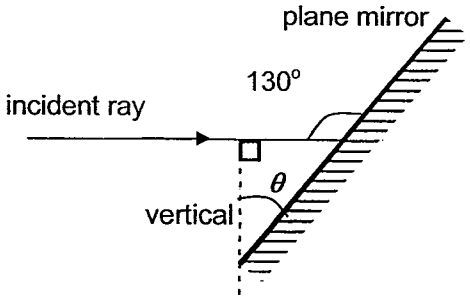
23 Which one of the following graphs shows the correct relationship between the frequency, f of an electromagnetic wave and its wavelength, λ?



24 The diagram shows a section of a wave motion. The particle at position ***x*** moves in the direction of the arrow shown. Which of the following particles at the labelled positions, **A**, **B**, **C** and **D** is ***incorrect***?



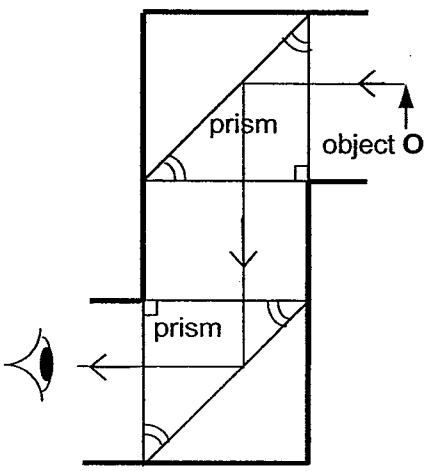
25 A plane mirror is tilted at an angle of θ to the vertical. When an incident ray of light strikes the mirror it makes an angle of 130° to the surface of the mirror as shown below.



Find the angle of reflection and the angle θ.

	angle of reflection / °	angle θ / °
A	40	40
B	40	50
C	50	40
D	65	50

26 A periscope is used to look over the top of obstacles. One type consists of two triangular prisms that are fitted at end of a tube as shown. Each prism has angles of 90° and 45°. A ray of light from the top of an object **O**, passes through the periscope. The image of the object is viewed by an eye **E**.

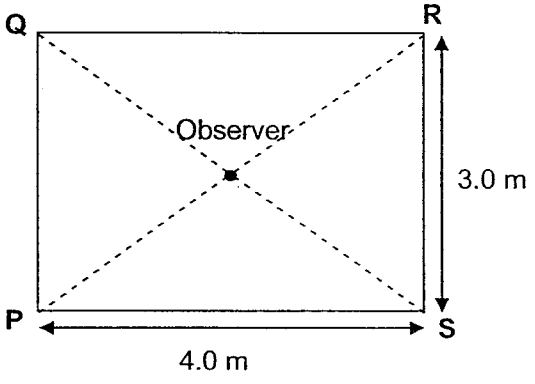


What type of image is formed is seen by the eye **E**?

A	inverted and same size as object
B	inverted and smaller size than the object
C	upright and same size as object
D	upright and smaller size than the object

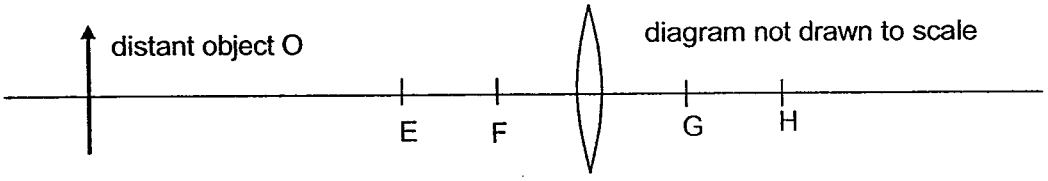
27 The diagram represents, the top view of a room **PQRS** which measures 3.0 m by 4.0 m. An observer stands at the centre of the room with his back to **PS**.

In order for the observer to see the full width of the wall **PS**, what is the minimum length of a plane mirror placed at eye level on the wall **QR**?



A	1.0 m
B	1.3 m
C	2.0 m
D	2.5 m

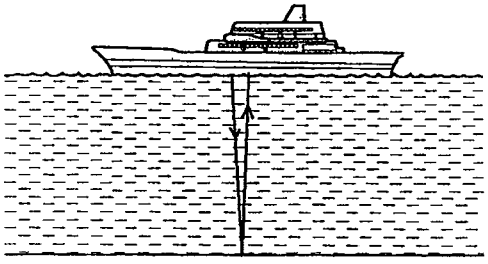
28 In the diagram below, a self-luminous object is located at O and is assumed to be faraway from the converging lens. Point E, F, G and H are points equally spaced along the axis of the lens. A real, inverted image of the object O is found at point G.



When the object is moved between E and F, what will happen to the image?

A It moves away from point G towards a point between G and H.
B It moves away from point G towards a point beyond H.
C It remains inverted at point G but becomes bigger.
D It remains inverted at point G but becomes smaller.

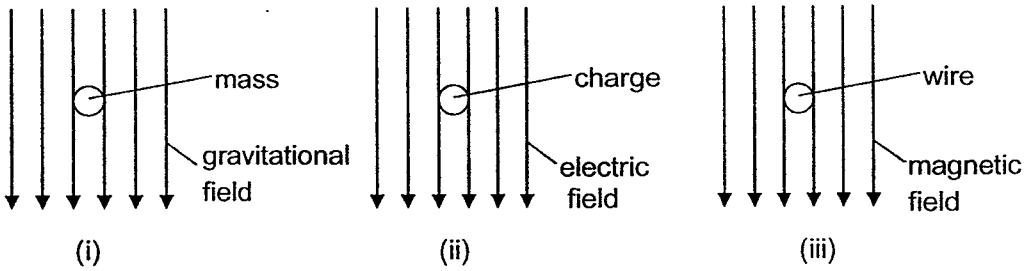
29 The diagram below shows a ship measuring the depth of the sea. The ship sends down an ultrasonic pulse and receives an echo from the sea bed 0.6 s later.



Calculate the depth of the sea if the speed of sound in water is 1400 m/s.

A 210 m **B** 420 m **C** 630 m **D** 840 m

30 The diagrams show (i) a mass in a gravitational field, (ii) an unknown charge in an electric field and (iii) a current-carrying wire at right angles to a magnetic field.

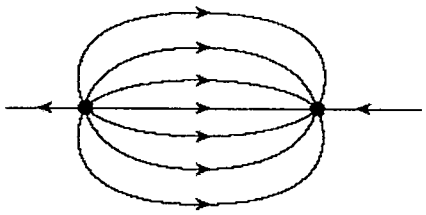


Which are the possible direction(s) the forces act on the mass, unknown charge and the current-carrying conductor?

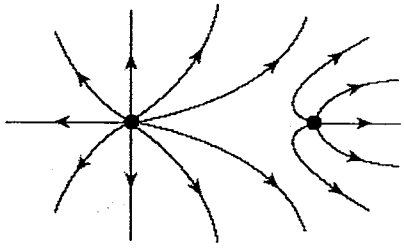
	Gravitational field	Electric field	Magnetic field
A	Force down	Force down	Force down
B	Force down	Force up or down	Force left or right
C	Force down	Force up or down	Force right
D	Force up or down	Force up or down	Force up or down

31 Which of the following shows two opposite electric charges of different magnitude?

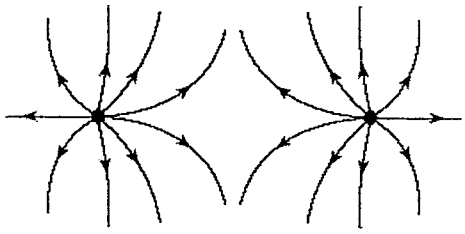
A



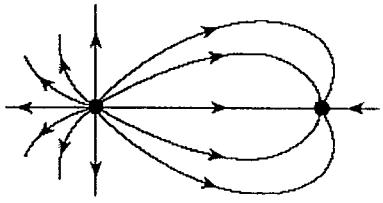
B



C



D

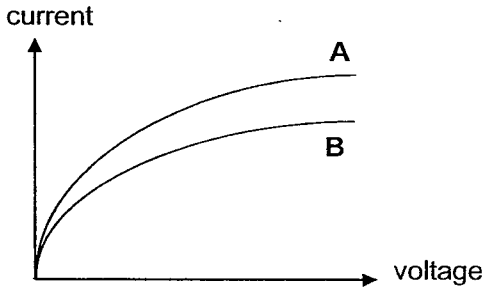


32 A battery moves a charge of 20 C round a circuit in a time of 5.0 s.

What is the current in the circuit?

A 0.25 A **B** 4.0 A **C** 80 A **D** 100 A

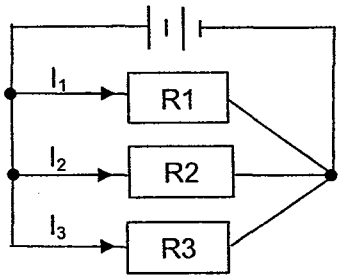
33 The graph shows the current and voltage relationship of two filament lamps made of the same type of metal.



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

A Both filament A and filament B obey Ohm's law.
B Filament A is longer and thinner than filament B.
C The resistance of A is smaller than the resistance of B.
D The resistance of both filaments decreases with temperature rise.

34 The circuit below shows three resistors, R1, R2 and R3, connected to batteries and their resistances of the three resistors is $R_1<R_2<R_3$.



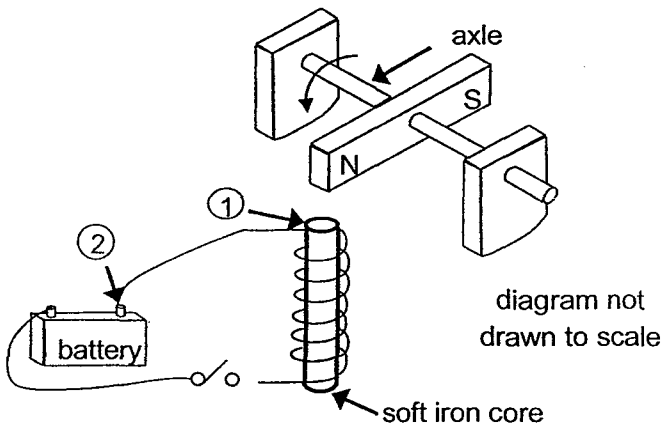
Which of the following shows correctly, in increasing order, the currents I_1, I_2 and I_3?

A $I_1 < I_2 < I_3$ **B** $I_1 < I_3 < I_2$ **C** $I_2 < I_3 < I_1$ **D** $I_3 < I_2 < I_1$

35 Which of the following is correct for domestic lighting circuits?

	Circuits connected in	Fuse placed in	Switch placed in
A	parallel	live lead	live lead
B	parallel	neutral lead	Neutral lead
C	series	live lead	live lead
D	series	neutral lead	Neutral lead

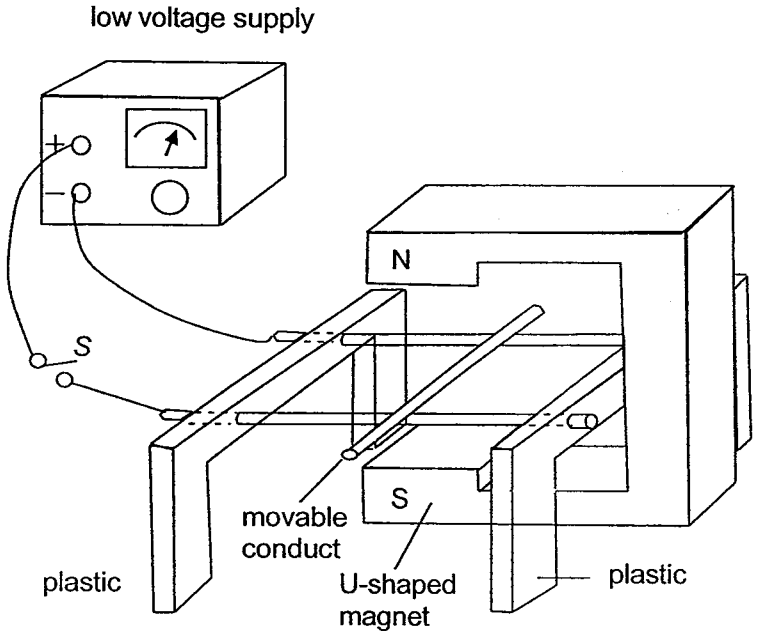
36 A magnet is free to spin. When the switch is closed, the magnet spins in the direction shown.



What is the magnetic polarity of the end of the soft iron core marked as (1) and the polarity of the battery terminal marked as (2)?

	Polarity of Magnet (1)	Polarity of Battery (2)
A	North	Negative
B	North	Positive
C	South	Negative
D	South	Positive

37 A movable conductor is placed on two parallel conductors and in the magnetic field of a U-shaped magnet. The two parallel connectors are connected to a low voltage supply.

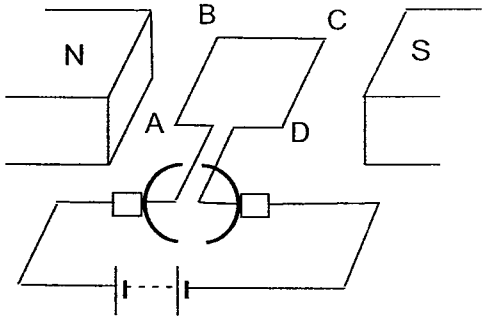


Which of the following can increase the magnetic force acting on the movable conductor when the switch is closed?

(1) Increasing the current
(2) Increasing the strength of the magnetic field
(3) Increasing the length of the movable conductor

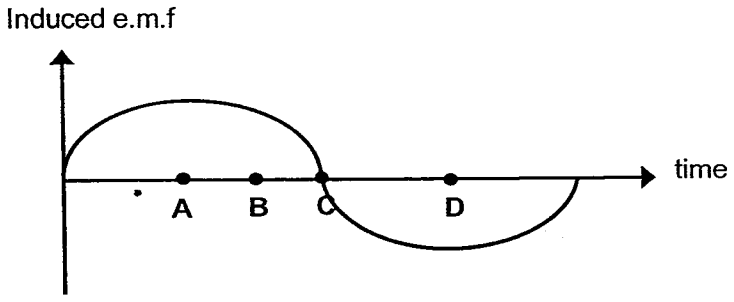
A (1) and (2) **B** (1) and (3) **C** (2) and (3) **D** (1), (2) and (3)

38 Why is a commutator used in a d.c. motor?



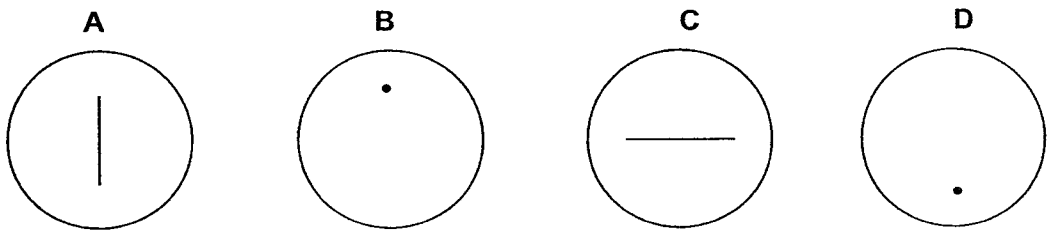
A	It allows the coil to rotate by allowing the wires to be entangled.
B	It allows the coil to rotate by reversing the current through the coil every half-turn.
C	It produces a greater turning effect by becoming magnetically induced.
D	It produces a greater turning effect by increasing the current through the coil

39 When an a.c. generator is rotating in a magnetic field, the induced e.m.f changes due to position of the coil.



Which point of the following graph shows that the area of the coil is at an oblique angle to the magnetic field?

40 Which of the following would be observed on the screen of the CRO if an alternating voltage supply is applied to the Y-input and the time-base is turned off?



The END

Name: Register Number: Class:

PRELIMINARY 3 EXAMINATION 2016
SECONDARY FOUR EXPRESS

PHYSICS (SPA) **5059/02**

Paper 2 Theory 15 September 2016, Thursday
1 hour 45 mins.

Candidates answer on the Question Paper.
No additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Section A: [50 marks]
Answer **all** questions.

Section B: [30 marks]
Answer **all** questions. Question 12 has a choice of parts to answer.

Candidates are reminded that all quantitative answers should include appropriate units.
The use of an approved scientific calculator is expected, where appropriate.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

	For Examiner
Section A	/ 50
Section B	/ 30
TOTAL	/ 80

Section A (50 marks)

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

1 A student carries out an experiment to measure the power he produces. He runs up from floor of a hall to the top of the raised platform as shown in Fig. 1.1

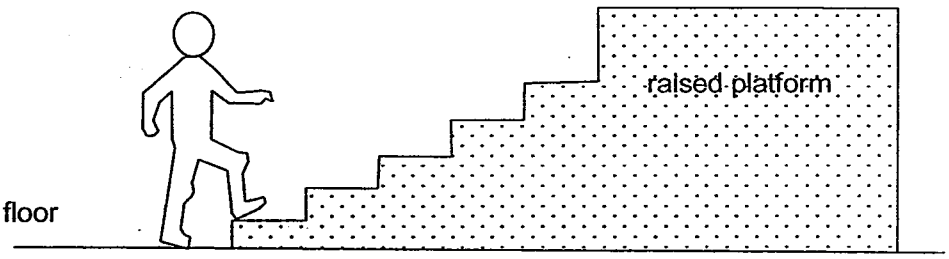


Fig. 1.1

(a) The student takes readings to calculate his power.

(i) List all the readings he must take. [2]

_____

_____

_____

(ii) State one step he should take to make sure one of his readings is accurate. [1]

_____

_____

(iii) State one limitation in the way he determines his power. [1]

_____

_____

(b) Write down all of the equations he must use to calculate his power from the readings. You may use SI symbols or words in your equations. [1]

_____

_____

_____

2 **Fig. 2.1** shows a 500 kg hovercraft accelerating from right to left while maintaining a constant height above the land. The four forces acting on it are Drag, Lift, Weight and Thrust.

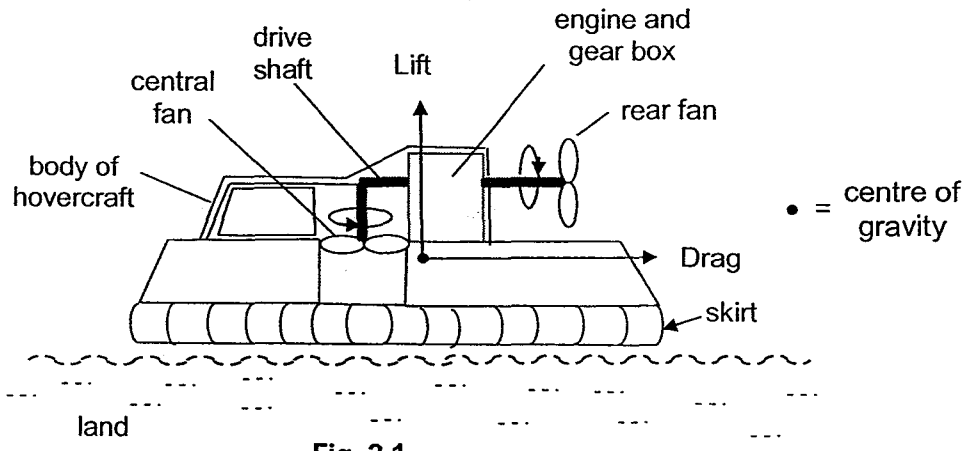


Fig. 2.1

(a) Draw and label the other two forces. [1]

(b) The hovercraft is travelling at constant acceleration.

State and explain the relationship between the four forces. In the relationship state whether the forces is less or equal or more than each other. [2]

(c) Calculate the Thrust needed if the acceleration of the hovercraft is 2.4 m/s^2 and the Drag is 200 N. [2]

(d) From **Fig. 2.1**, suggest how the Lift force is produced. [1]

3 **Fig. 3.1** shows a type of weighing machine. The two sliding weights can be moved independently along the rod. With no load on the hook and the sliding weights at the zero mark on the metal rod, the metal rod is horizontal. The hook is 4.8 cm from the pivot.

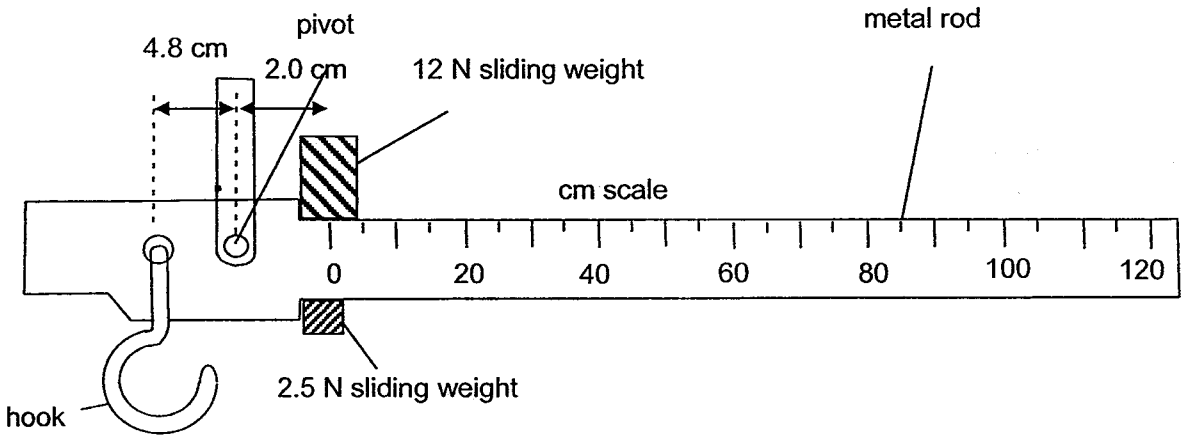


Fig. 3.1

(a) Explain what is meant by the moment of a force. [1]

(b) A sack of flour is suspended from the hook. In order to return the metal rod to the horizontal position, the 12 N sliding weight is moved 84 cm along the rod and the 2.5 N weight is moved 72 cm.

(i) Calculate the weight of the sack of flour. [2]

(ii) Suggest why this weighing machine would be imprecise when weighing objects with a weight of about 2.5 N and how would you overcome this limitation. [2]

4 **Fig. 4.1** shows a narrow beam of light, **AB** from a ray box directed towards the surface **ST** of an irregular shaped glass block **PQRSTU**. The glass block is fixed to a table.

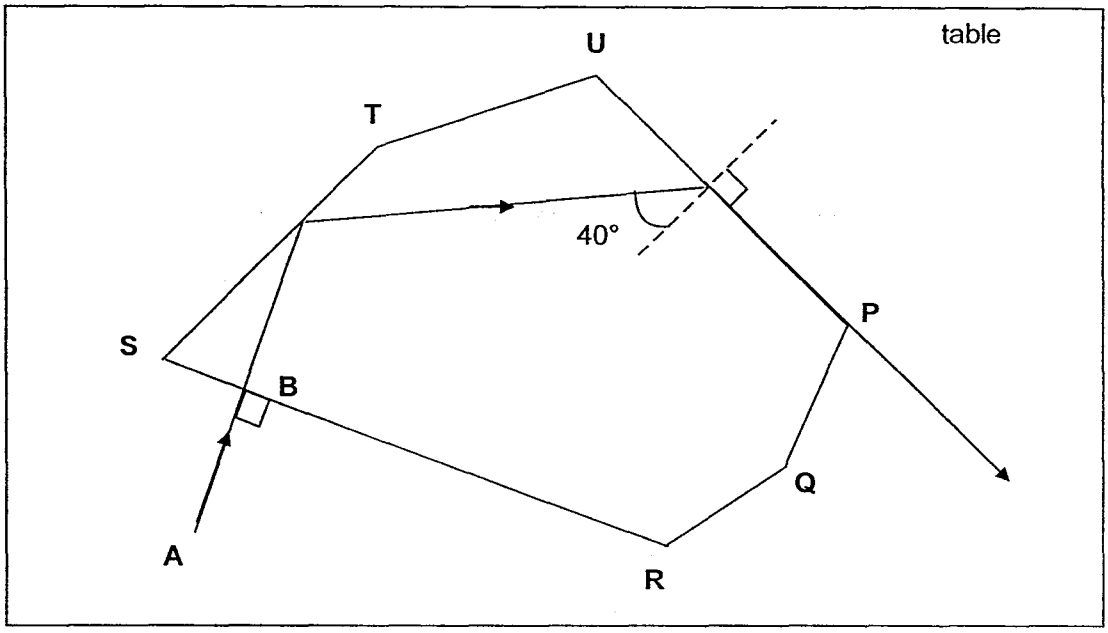


Fig. 4.1

(a) Calculate the refractive index of the glass. [2]

[b) Explain why the beam of light **AB** does not refract when it enters the glass block. [1]

_____

_____

_____

(c) The ray from A is rotated in anti-clockwise direction while maintaining the **same** point of incidence B. At a new direction, it is found that the ray emerges along the surface **ST** of the glass block.

(i) On **Fig. 4.1**, sketch the new path and label the essential angles for this new emergent ray. [1]

(ii) Calculate the new angle of incidence if the angle at corner S is 65°. [2]

5 **Fig. 5.1** shows a diver working 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.

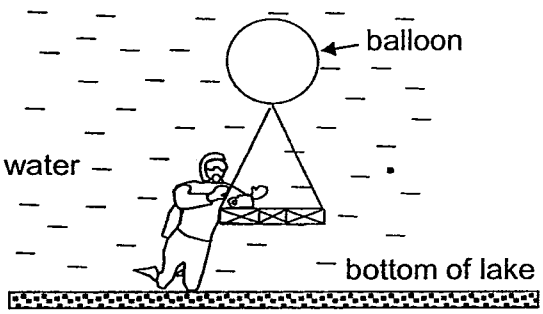


Fig. 5.1

(a) Calculate

(i) the pressure due to 15 m of water in Pa, [2]

(ii) the total pressure at 15 m below the surface of the lake. [1]

(b) The pressure of the air inside the balloon is less 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 less. 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]

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]

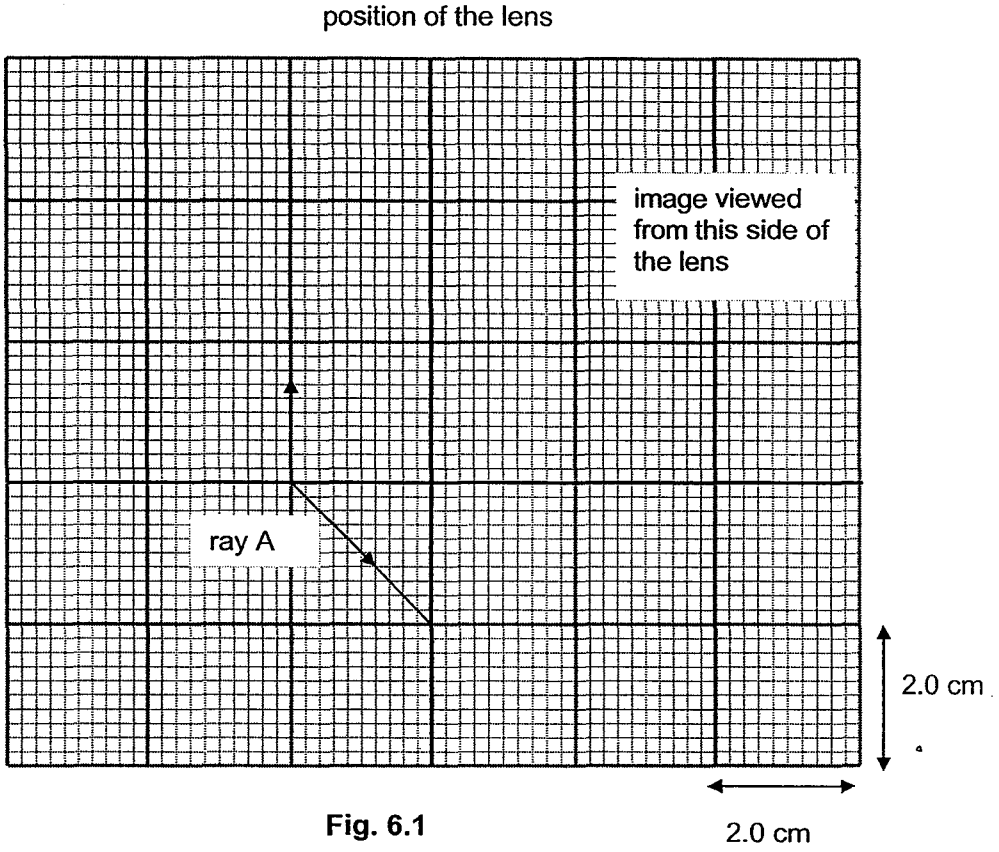


Fig. 6.1

(b) State what is meant by a virtual image. [1]

_____

_____

(c) Use your drawing to determine the focal length of the lens. [1]

_____

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

7 **Fig. 7.1** shows the position after a negatively charged sphere **C** on an insulating stand is brought close to a small, uncharged metal sphere **U** which is suspended from an insulating thread.

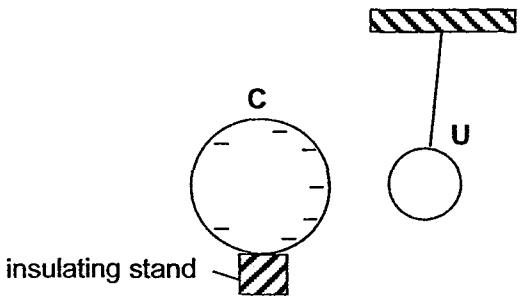


Fig. 7.1

(a) On **Fig. 7.1**, draw the induced charges on sphere **U**. [1]

(b) Sphere **C** is moved towards sphere **U** until the spheres touched. Sphere **U** is then repelled by sphere **C**, as shown in **Fig. 7.2**. The charges on **C** and **U** are not shown.

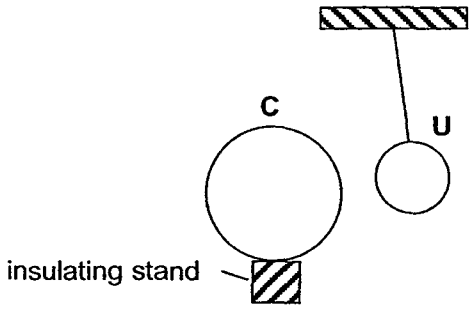


Fig. 7.2

(i) On **Fig. 7.2**, draw the resultant charges on spheres C and U after the spheres made contact. [2]

(ii) Explain what happens to the charges on the two spheres **C** and **U** as they touch. [2]

8 **Fig. 8.1** shows a circuit containing a variable resistor and two identical lamps each of resistance 10.0 Ω.

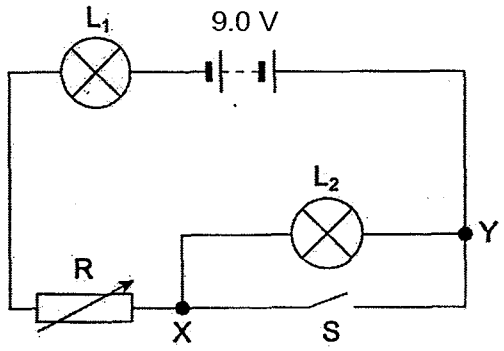


Fig. 8.1

(a) The switch S is open and the resistance of the variable resistor is gradually reduced to the minimum setting.

State and explain what happens to the brightness of both lamps. [2]

(b) Switch S is now closed with the variable resistor at its minimum setting.

(i) State the value of the potential difference across XY. [1]

(ii) State what happens to the brightness of lamp L_1. [1]

(c) Explain what happen to the brightness of L_1 at night when the rheostat is replaced by a light dependent resistor and the switch is open. [1]

9 **Fig. 9.1** shows a long flexible copper wire coil suspended vertically from a fixed clamp at A so that its lower end just dips into mercury in a container at B.

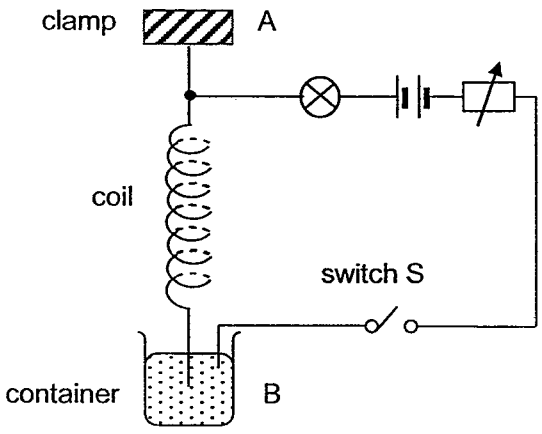


Fig. 9.1

Switch S is closed and when the current in the coil is gradually increased until the coil contracts such that the lower end loses contact with the mercury and the lamp goes out.

(a) Explain the above observation why the current need to be adjusted to a certain value for the lamp to be not lit. [2]

(b) State and explain what will take place after breaking contact with the mercury when switch S is still closed. [2]

(c) If the current in the coil is further increased, describe and explain what will happen to the lamp. [2]

Section B [30 marks]

Answer **all** questions in this sections.

Answer only one of the alternative questions in **Question 12.**

10 **Fig. 10.1** shows a graph of pressure against distance of a travelling wave at time $t = 0$ s. The speed of sound in air can be taken as 340 m/s.

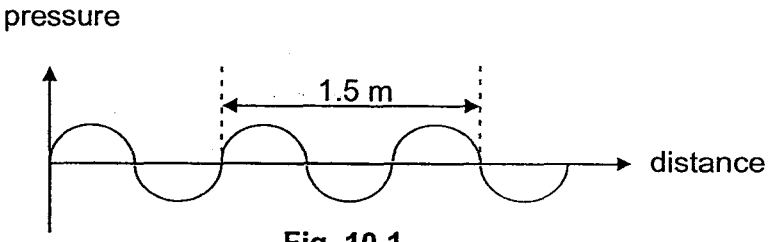


Fig. 10.1

(a) Determine the following characteristics by completing the table below. [4]

(i) Wavelength	
(ii) Frequency	
(iii) periodic time	

(b) As the wave travels to the right, sketch on **Fig. 10.1**, the pressure variation at half a period later. [2]

(c) An oscillator is used to set up water waves in a ripple tank which is slightly inclined. **Fig. 10.2** shows the top view and the wavelength in region X and wavelength in region Y is 2.5 cm and 3.5 cm respectively.

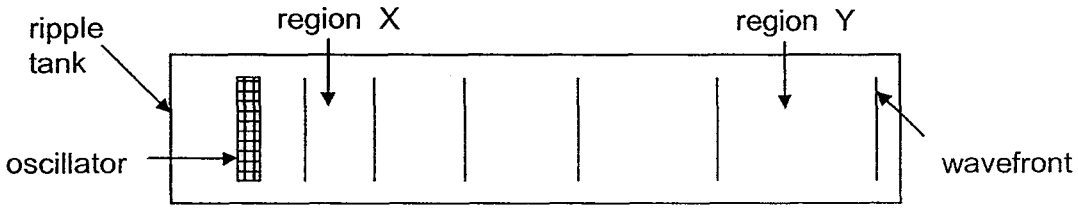


Fig. 10.2

(i) Which region X or Y is the shallower region? Explain your answer. [2]

(ii) State what is meant by a wavefront. [1]

(iii) Explain the formation of the above pattern of wavefront. [1]

11 In an experiment using a datalogger, a ball M is released from rest at a certain height *h* above the ground and the speed *v* is measured at a frequency of 10 Hz.

Some air is then released from the ball M and the altered ball is renamed ball L.
The same setting for the data logger is then repeated when ball L is released from rest and the height *h*.

Fig. 11.1 shows the results obtained with the ball M (with more air) and ball L (with less air).

time t / s	0.0	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80
Ball 1 v / m/s	0.0	1.0	2.0	3.0	4.0	0.0	-1.5	-0.5	0.0
Ball 2 v / m/s	0.0	1.0	2.0	3.0	4.0	2.0	0.0	-0.5	0.0

Fig. 11.1

(a) Plot the above data for balls 1 and 2 and label correctly the two graphs as ball M and ball L in **Fig. 11.2.** [3]

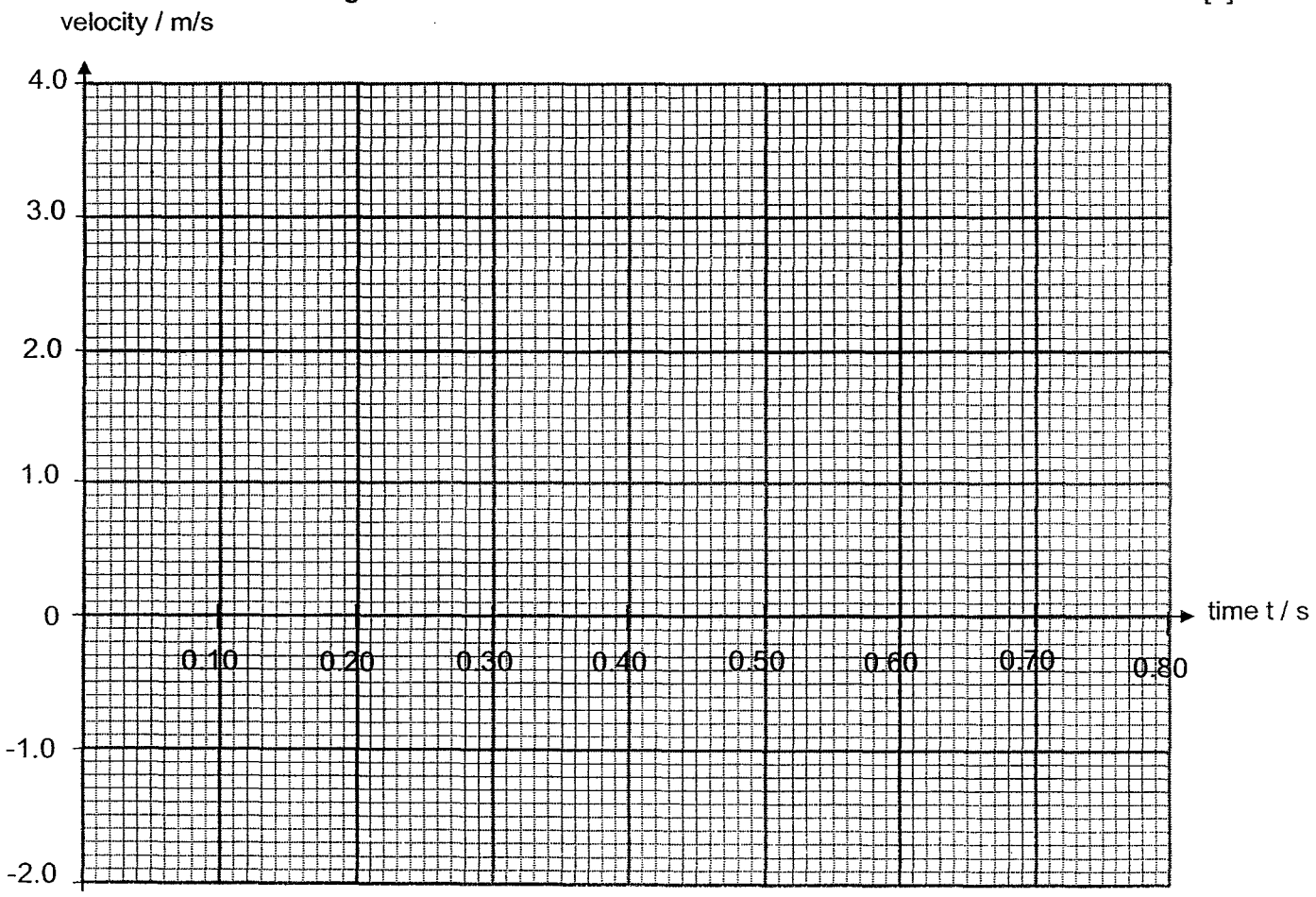


Fig. 11.2

(b) Explain your labelling of the graph as ball M. [1]

(c) Determine from the graph, h, the height from the ground at which the ball was initially released. [2]

(d) Explain how the graph shows that the ball in both instances was released from the same height. [1]

(e) From the data or graph, state the velocity of ball L when it first rebound from the ground.

[1]

(f) Using the answer to **(e)** and the *Principle of Conservation of Energy*, explain why "more energy was lost to the ground" for the ball (with less air). [2]

12 **EITHER**

Fig. 12.1 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.

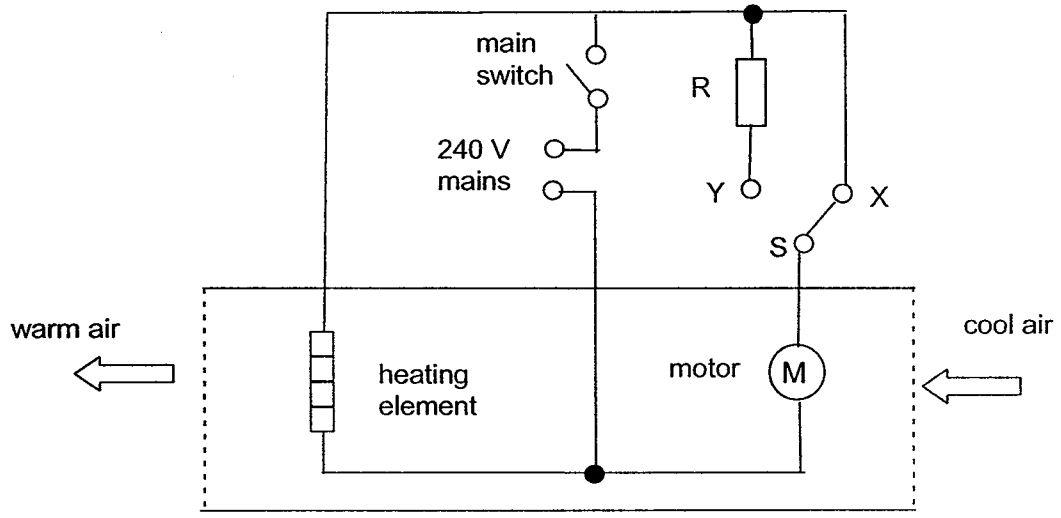


Fig. 12.1

(a) The hairdryer is used to dry wet hair.

Explain, using kinetic theory 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. 12.2**.

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. 12.2

(i) Estimate the temperature of the air flowing out of the hairdryer. [2]

(ii) State one assumption in your calculation. [1]

_____

_____

(c) Switch S is then connected to contact Y. State and explain whether there is any change in the temperature of the air flowing out of the hairdryer, as compared to when switch S is connected to contact X. [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. [2]

12 **OR**

Two coils, A and B, are placed one on top of the other, as shown in **Fig. 12.3.** Coil A is connected in series with a battery and a switch. A millivoltmeter is connected across the terminals of coil B

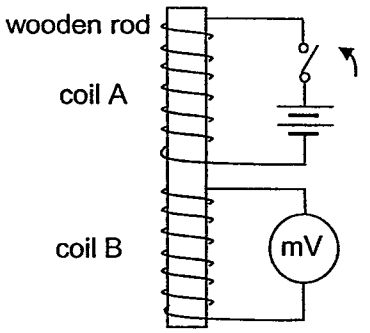


Fig. 12.3

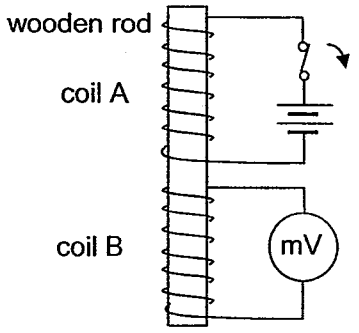


Fig. 12.4

(a) Explain why, when the current in coil A is switched on, the millivoltmeter indicates an induced e.m.f. for a short period of time and then reduces to zero rapidly in **Fig. 12.3.** [2]

(b) **(i)** On **Fig. 12.4**, 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. 12.5 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.

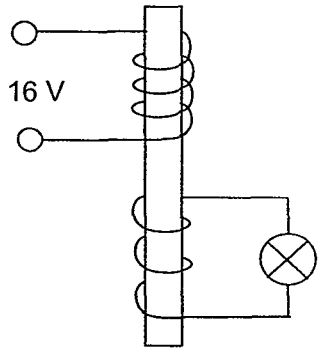


Fig. 12.5

(c) The lamp is operating at its correct rating.

Calculate the minimum current drawn from the 16 V supply. [2]

(d) However the current drawn from the supply is found to be 1.7 A.

(i) Calculate the input power to the transformer. [1]

(ii) How much electrical energy is lost by the transformer each second? [1]

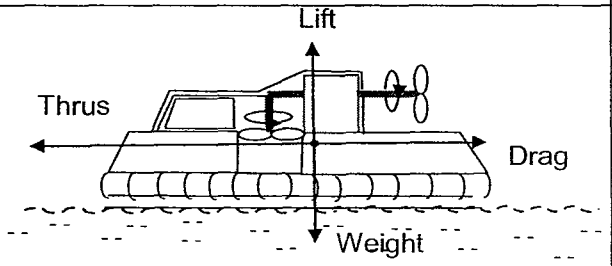
(iii) State one reason why a transformer is not 100% efficient. [1]

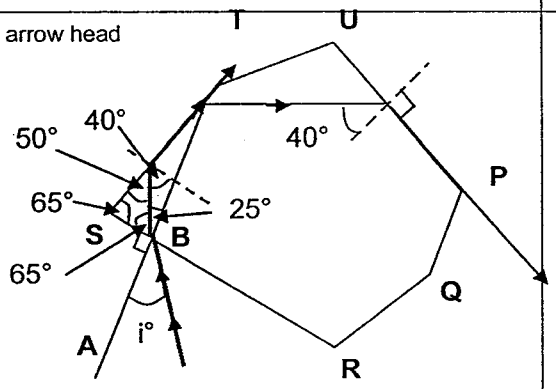
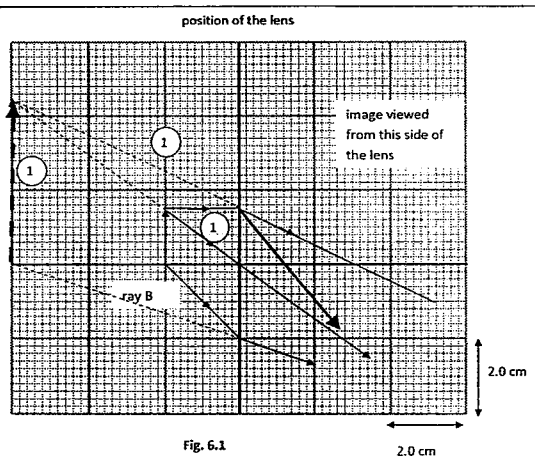
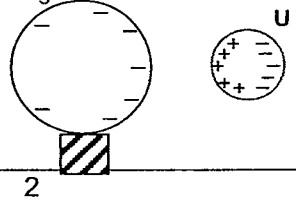
THE END

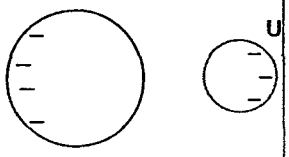
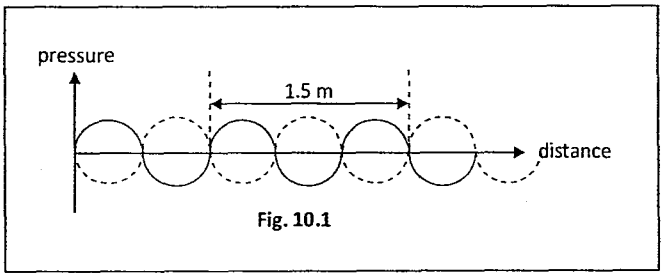
Sec 4 Express
Physics (SPA)
Paper 1,2 Solution V2
2016 Prelim 3 Examination

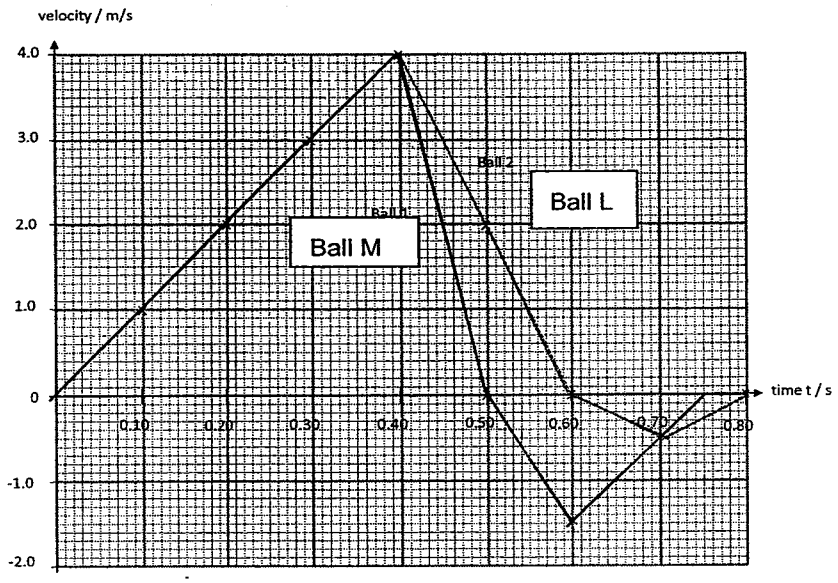
Paper 1 (40 marks)

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

Paper 2 Section A (50 marks)			
1	(ai)	>**m**, mass and g=10m/s^2 or **W**, weight >**t**, time he takes to reach the top and **h**, height of platform	[A1] [A1]
	(aii)	>Repeat or take several readings to find the average of h or t	[A1]
	(aiii)	>% error in timing t is significant in comparison for the time taken to complete his run. Or reaction time is not negligible in comparison to time of run.	[A1]
	(b)	P= mgh / t where P is Power or Wh/t	[A1]
2	(a)	>Horizontal line drawn longer than Drag line and opposite direction to Drag and Weight line drawn equal to Lift line but opposite direction 	[A1[]
	(b)	>Thrust > Drag >Lift = Weight	[A1] [A1
	(c)	>F=ma, or Thrust – 200 = 500 (2.4) >Thrust = 1,400 N	[B1] [A1]
	(d)	>Lift force is produced when the force of air from the central fan or boat hits the land and the lands reacts by exerting an upward force back to the hovercraft.	[A1]
3	(a)	>Moment is the turning effect and the magnitude is given by Force x perpendicular distance between line of action of force and pivot	[B1]
	(bi)	> sum of clockwise moments = sum of anti-clockwise moments W × 4.8 = (12 × (84) + (2.5 × (72) > W = 247.5 N = 248 N (3sf) or 250 N (2sf)	[M1] [A1]
	(bii)	> Imprecise due to either friction at the pivot or pivot is not a sharp point or small movement of weights The 2.5 N sliding weight has to move 4.8 cm away which is not measurable on the existing scale. >Improve by using smaller weights less than 2.5 N eg 0.50 N or oiling the pivot.	[M1] [A1]

4	(a)	>n = 1 / sin c = 1 / sin 40 >n = 1.5557 = 1.6 (2sf) or 1.56 (3sf)	[B1] [A1]
	(b)	>The angle of incidence is 0° and from sin il / sin r = n, r = 0° No mark if restate question or mention that beam is striking the surface at right angle or angle i = 0° as answer is incomplete.	[A1]
	(ci) (cii)	>Correct drawing for new ray with double arrow head >sin i / sin 25 = 1.5557 > i = 41.1° (3sf) OR i = 41° (2sf)	
5	(ai)	>P=hρg = 15 x 1000 x 10 >P = 150,000 Pa or 1.5 x 10^5 Pa	[B1] [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. >At depth of 15 m, the volume is smaller so the air molecules are moving a shorter distance before it impacts on the balloon or the **frequency of collisions is higher although its speed of impact and KE remains unchanged.**	[A1] [B1]
	(c)	>The molecules of air are arranged in a random manner whereas the water molecules are loosely packed formation. The difference is no fixed arrangement for air versus regular arrangement for water or air molecules are further space apart than water molecules.	[A1]
6	(a)	>correct position (6 cm) or height for image (4.5cm) >drawing of ray passing through centre of lens and extending backwards to meet image. >correct drawing of second ray	 Fig. 6.1 [A1] [A1] [A1]
	(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 of bottom of object originate from bottom of image	[B1]
7	(a)	>equal number of positive and negative charges on LHS and RHS of sphere U	 [B1]

	(b)(i)	>Unequal number of negative charges on C and U Note the total number of negative charges must be Equal to above diagram (Eg 5 and 2 neg charges for C and U) >Both negative charges  	[B1] [B1]
	(bii)	>During contact electrons from RHS of sphere C flow to neutralise the positive charges on LHS of sphere U due to the potential difference or unlike charges attract. >Redistribution of electron charges occur and since like charges repel, the movable sphere U moves away.	[B1] [A1]
8	**(a)**	>The brightness of both lamps increases >because the potential of each lamp increases due to the drop in potential across R as V_{L1} + V_{L2} + $V_{rheostat}$ = 9.0 V	[B1] [A1]
	(bi)	>0 V	[B1]
	(bii)	>Increase in brightness	[B1]
	(c)	>The brightness of L_1 in the night is not lit because the resistance of LDR is very large compared to resistance of L_1.	[B1]
9	**(a)**	> The adjacent coils have current flowing in the same direction. This results in the adjacent coils attracting each other as combined magnetic field of all the various concentric fields produces an attractive forces in the upwards direction. > When the current reaches a certain value, this upwards force is greater than the weight of the coil which is acting downwards.	[B1] [B1]
	(b)	>On losing contact, the compressed coil extends itself and touches the mercury again[1]. > It will oscillate up and down and the lamp blinks at regular intervals[1].	[A1] [A1]
	(c)	>The coil will compress more/becomes shorter and the lamp will blink at a slower rate [1]. >The coil will rise higher and fall through a bigger distance. This results in a bigger time interval between the lamp switching off and lighting up [1].	[A1] [A1]
Section B			
10	**(ai)**	>wavelength = 1.0 m	[B1]
	(aii)	>f = v / λ = 340 / 1.0 >f = 340 Hz	[B1] [A1]
	(aiii)	>T=1/f = 1/340 = 2.94 x 10^{-3} s	[B1]
	(b)	>correct shape >correct amplitude and position  **Fig. 10.1**	[B1] [B1]
	(ci)	>Region X is shallower >smaller wavelength for X compared to Y	[B1] [B1]
	(cii)	>A wavefront is an imaginary line on a wave that joins all adjacent points that are in phase.	[B1]
	(ciii)	The wavefront is the bright line formed by the converging action of the adjacent wave crest of an advancing wave. The darkest region which is at the centre of the wavelength is formed by	[A1]

		the diverging action of the trough.	
11	(a)	>Points plotting >Label Ball 1 as ball M and ball 2 as ball L correctly >Shape. Most student loses this mark as they will draw line joining 0.70 s to 0.80 s directly instead to 0.75s and then a horizontal line.  	[B1] [B1] [A1]
	(b)	>Ball M has more air/mass and a higher pressure results in a larger force of impact on the ground. From N3L, the Reaction Force from ground to ball pushes the ball to rebound..	[B1]
	(c)	>Distance = area = 0.5 x 0.40 x 4.0 >Distance = 0.80 m	[B1] [A1]
	(d)	>Both balls travels the same distance before it hits the ground at 0.40 s. Or on the graph both line coincides for 0 to 0.40 s.	[B1]
	(d)	>Rebound velocity of ball L = -0.50 m/s	[B1]
	(e)	○ $GPE_{ball\ L}$ =mx10x0.80 = 8m J $GPE_{ball\ M}$ = Mx10x0.80 = 8M J $KE_{ball\ L}$=0.5xmx4.0^2 = 8m J $KE_{ball\ M}$ = 0.5xMx4.0^2 = 8M J $KE_{ball\ L}$=0.5xmx0.5^2 = 0.125m J $KE_{ball\ M}$ = 0.5xMx1.5^2 = 1.125M J Ball compressed KE of impact change to Elastic PE + Sound + Thermal energy Ball uncompressed and rises. >From POCOE, energy before impact = energy after impact. >As speed of rebound of ball L(=0.50 m/s) < speed of rebound of ball M (=1.50 m/s), KE of rebound of ball L during rebound < KE of rebound of ball M during rebound, implies energy lost for ball L during impact > energy lost for ball M during impact Assume mass of ball L = 0.9 kg, mass of ball M=1.0 kg Energy lost during impact = KE before impact – KE after impact Ball L:=0.5 x 0.9 x(4.0^2 – 0.5^2) = 7.0875 J Ball M = 0.5 x 1.0 x (4.0^2 – 1.5^2) = 6.875 J Hence more energy is lost for ball L. as 7.0875 J> 6.875 J OR a smaller KE of the first rebound implies more energy is lost to the ground as sound and	[B1] [B1]

		thermal energy	
12E	**(a)**	>Hair dryer produces fast moving hot air molecules which collide with the water molecules on the hair and transfer thermal energy to it. >**More** water molecules increase its KE and they move more vigorously. >**The larger** number of fast moving surface water molecules successfully breaks the bonds of attraction between the remaining molecules and doing work to overcome atmospheric force. OR combine with >The water molecules once evaporated from the hair are removed away by the movement of the air molecules from the motor thus freeing up the space for the remaining water molecules to escape. > The water molecules can evaporated at a greater rate at a lower humidity level as the hot air from the motor reduces the water moisture level in the air	[B1] [B1] [B1]
	(bi)	>Heat lost by heater in 1 s = heat gained by air in 1 s $V^2/R=mc(\Delta\theta)$ or 2402/30 = 0.055 x 1000 x $\Delta\theta$ $\Delta\theta$ = 34.9 >Temperature of air flowing out = 34.9 + 25 = 59.9 °C or 60 °C	[B1] [A1]
	(bii)	>Assume room temperature is constant or >Assume no heat is lost by the heating circuit to other parts of the circuit or >All the heat energy is transferred to the cold air and not lost to the surrounding eg by radiation Or >Assume resistance of motor is zero ohm.	[B1]
	(c)	>No change in temperature >because pd across the heater is unchanged in a parallel circuit OR the addition of resistor R only reduces current flow to the motor and speed of rotation of the motor produces moving cool air at a slower rate.or OR temperature of air will be hotter <u>after a while</u> because the incoming air later has smaller mass of air per second (=flow rate) and will be heated up.	[B1] [B1]
	(d)	>Total Power of heating element and motor = $240^2/30 + 240^2/20$ = 1920 + 2880 = 4,800 W >Cost = (4,800/1000) x (10/60) x 20 = 16.6 cents	[B1] [A1]
12 **OR**	(e)	>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. >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] [B1]
	(fi)	>Direction of current in the outer coil of B is to the right in Fig.12.4	[B1]
	(fii)	>By Lenz's Law, the induced current must be in such a direction as to oppose the decreasing magnetic flux linkage from A to coil Bwhen the switch is off. >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. >From Flemimg's Right Hand Grip rule, the thumb indicates the direction of North pole and the direction of the curled fingers indicate the direction of the convection current.	[B1] [B1]

	(g)	>P=VI, I=P/V = I_S = 24/12 = 2.0 A >$I_P/I_S = V_S/V_P$ I_P =(12/16) x 2.0 = 1.5 A	[B1] [B1]
	(hi)	>Input Power = IV = 1.7 x 16 = 27.2 W	[B1]
	(hii)	>Lost power = 27.2 – 24 = 3.2 W	[B1]
	(hiii)	>Copper loses ie. Work done against the resistance of the copper wire OR Eddy Current loses OR Leakage of Magnetic flux OR Hysteresis Loses	[B1]

The END