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COMMONWEALTH SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2015

PHYSICS (5059/1)

PAPER 1

Name: _____ ( ) Class: _____

SECONDARY FOUR EXPRESS

1 September 2015
0945h – 1045h
1 h

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on the question paper and any separate answer sheets used.

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 Nkg^{-1}.

1 Which instrument is used to measure directly the circumference of a golf ball?

A calipers
B micrometer
C rule
D tape

2 A micrometer is used to measure the thickness of a copper rod. Fig 2.1 shows the zero error of the micrometer used. Fig 2.2 shows the micrometer reading before correction.

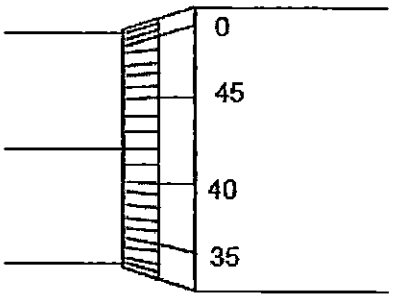


Fig 2.1

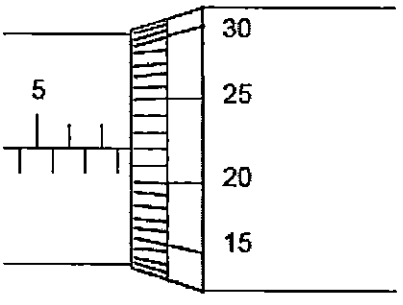


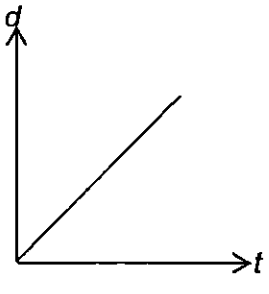
Fig 2.2

What is the thickness of the rod?

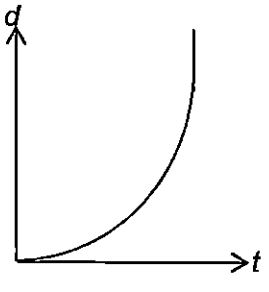
A 5.30 mm
B 7.30 mm
C 7.80 mm
D 10.14 mm

3 Which graph shows how the distance fallen *d* varies with time *t* for a body falling from rest through air from a very tall building?

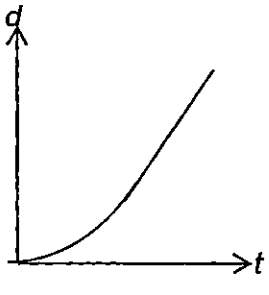
A



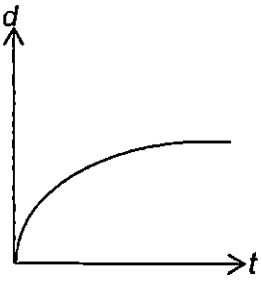
B



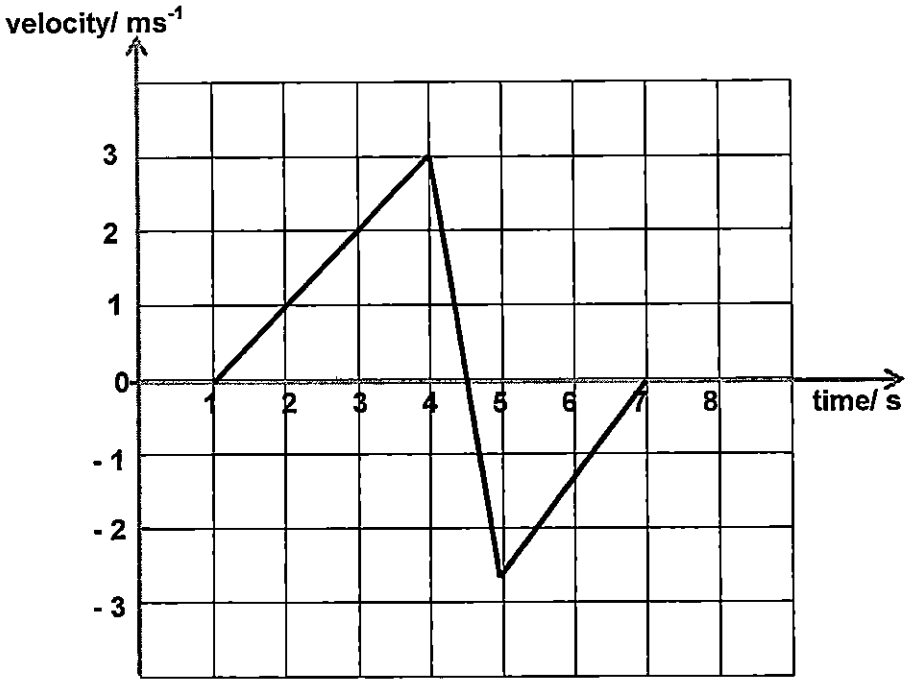
C



D



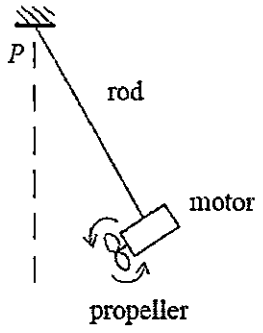
4 A ball is released from rest at a certain height, ***h***, above the ground. The diagram below shows the velocity-time graph of the ball.



Calculate the height, ***h***.

A 4.50 m
B 5.25 m
C 6.00 m
D 6.75 m

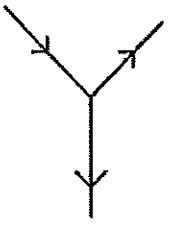
5 The diagram below shows a propeller-motor system connected by a light, rigid rod to a fixed point *P* on the ceiling. The system remains stationary when the motor is on.



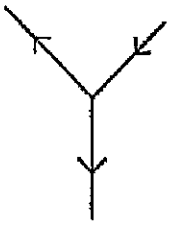
Which of the following diagrams correctly represents the forces acting on the propeller motor system?

A

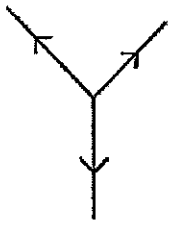
B



C



D



6 Which statement about gravitational fields is correct?

A Gravitational fields exert forces on objects because the objects are charged.
B Only planets and stars have gravitational fields.
C The gravitational field of the Earth acts inwards towards the centre of the Earth.
D The gravitational field strength on the surface of the Moon is less than that on the surface of the Earth because there is no atmosphere on the Moon.

7 A trolley runs down a slope with a constant acceleration *a*. The mass of the trolley is doubled and the trolley is allowed to run down the same slope. In both cases effects of friction and air-resistance are negligible.

Which statement is correct?

A The accelerating force is the same as before.
B The acceleration is doubled.
C The acceleration is halved.
D The acceleration is same as before.

8 Gold has a density of 19.3 g/cm^3.

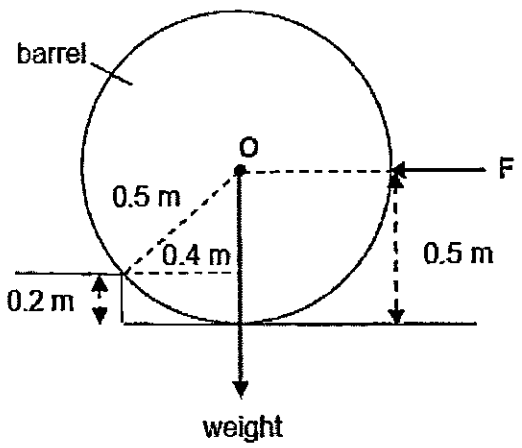
What is the mass of a cube of gold with sides of length 2 mm?

A 0.154 g
B 3.86 g
C 9.65 g
D 24.1 g

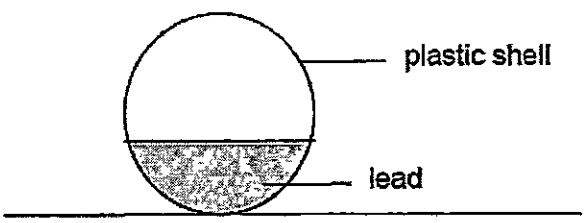
9 A horizontal force **F** is applied to a barrel through the centre **O** as shown below. The barrel has a mass of 300 kg.

Given that the radius of the barrel is 0.5 m, what is the smallest value of **F** to cause the barrel to roll up the step?

A 2250 N
B 2400 N
C 3000 N
D 4000 N

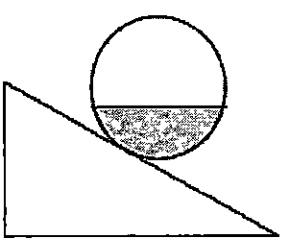


10 Tumbling Kelly is a toy which returns to its upright position after it is being tilted. The diagram shows the interior structure of a Tumbling Kelly toy.

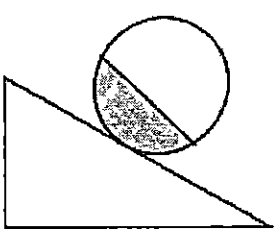


Which of the following best illustrates the final rest position of the toy when it is placed on a slope?

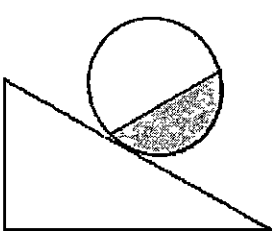
A



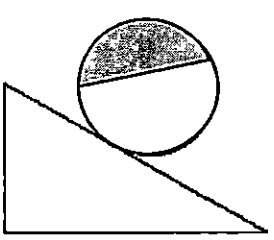
B



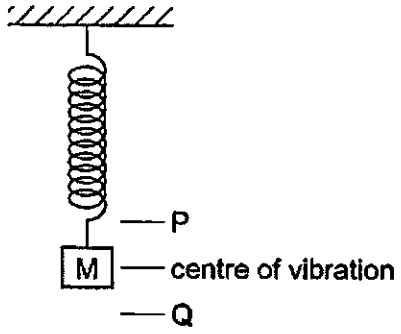
C



D



11 A mass M is hung from a spring. It is then pulled down slightly and allowed to vibrate vertically between P and Q.



Which row is correct?

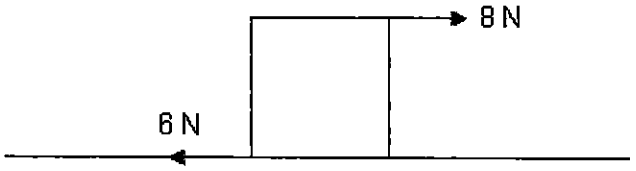
	energy at point P	energy at point Q
A	Kinetic	kinetic
B	Kinetic	potential
C	Potential	kinetic
D	Potential	potential

12 Different sources of energy can be used in a power station to generate electrical energy. Some sources of energy are renewable while some are not.

Which of the following is correct?

	renewable sources of energy	non-renewable sources of energy
A	geothermal	solar, nuclear
B	geothermal	nuclear
C	solar, nuclear	geothermal
D	Nuclear	fossil fuel

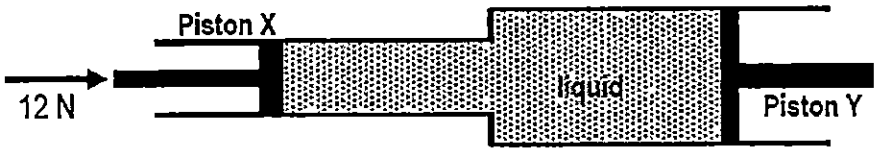
13 A box is pushed 10 m along a horizontal surface by a force of 8 N. The frictional force opposing the motion is 6 N as shown below.



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

	thermal energy/ J	kinetic energy/ J
A	20	60
B	60	20
C	60	80
D	80	60

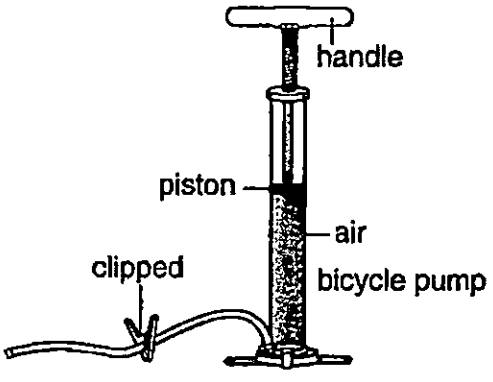
14 The diagram shows a cylinder fitted with two pistons **X** and **Y** of diameters 5.0 cm and 10.0 cm respectively. The piston **X** is pushed by a force of 12 N.



What is the force exerted on piston **Y**?

A 3.0 N
B 6.0 N
C 24 N
D 48 N

15 The figure shows a bicycle pump with its outlet tube sealed with a strong clip.



When the handle is pushed downwards, the air pressure inside the pump increases. Which of the following is a cause for this?

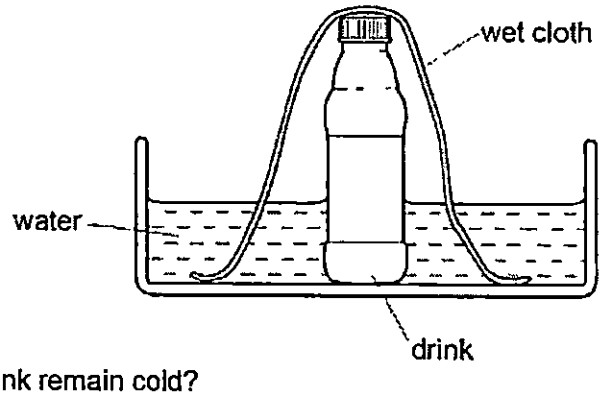
A The average distance travelled by the air molecules before colliding with the walls of the pump has decreased.
B The average speed of the air molecules has decreased.
C The number of air molecules has increased.
D The rate of collision between the air molecules has increased.

16 When one junction of a thermocouple is placed in pure melting ice at 0 °C and the other junction in steam at 100 °C the e.m.f. is 6.0 mV. The hot junction is then removed from steam and placed in a liquid at constant temperature. The e.m.f. is now -1.5 mV.

What is the temperature of the liquid?

A - 75 °C
B - 25 °C
C 25 °C
D 75 °C

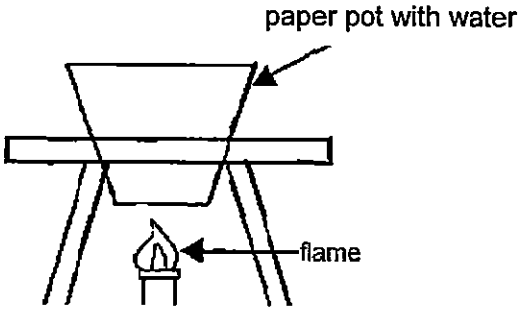
17 On a hot day, a drink in a bottle can be kept cool by standing it in a bowl of water and placing a wet cloth over it.



Why did the drink remain cold?

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

18 Some Japanese restaurants use paper pots for their customers to boil the food themselves.

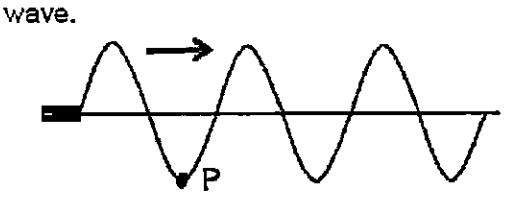


Why does the paper pot not catch fire when in contact with the flame?

I. The paper is thin and therefore heat is conducted quickly to the water in the paper pot.
II. Water has a boiling point lower than the burning temperature of the paper.
III. The paper is thick enough to withstand the high temperature of the flame.

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

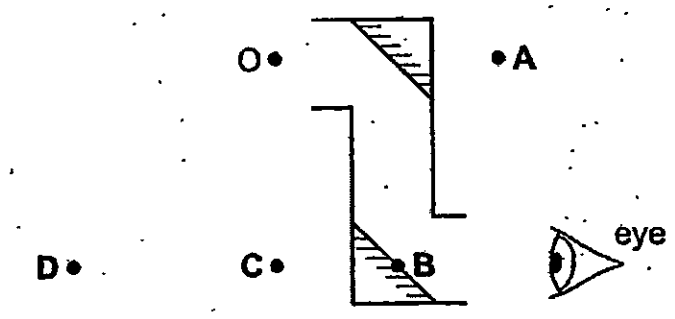
19 The transverse wave showed below was moving from left to right. At one instant, a student observed particle **P** of the wave was 5.0 cm away from the source and at the trough of the wave.



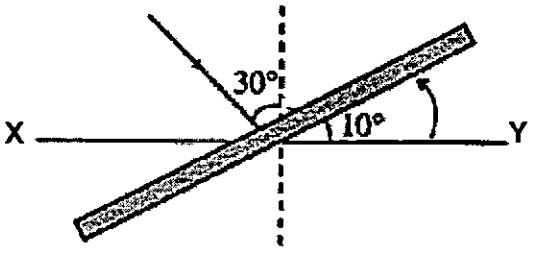
After a time lapse of one and half periods, the position of particle **P** would be at

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

20 The diagram shows an object O viewed using two mirrors.
A person looks into the mirrors as shown. At which position is the image of O seen?



21 A ray of light incident on a plane mirror **XY** at 30°. The mirror is then rotated anticlockwise with an angle of 10° as shown in the diagram below.



Through which angle does the direction of the reflected ray change?

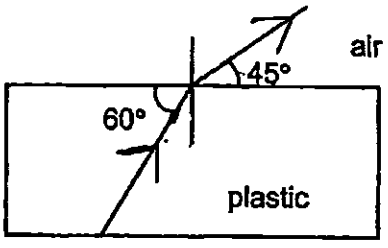
A 10°
B 20°
C 30°
D 40°

22 A ray of light in a glass block is incident on a boundary with air at an angle of incidence of 40°. The critical angle at this boundary is 43°.

What happens to the ray of light at the boundary?

A It is partly reflected back into the glass and partly refracted along the boundary.
B It is partly reflected back into the glass and partly refracted into the air.
C It is totally reflected back into the glass
D It is totally refracted into the air

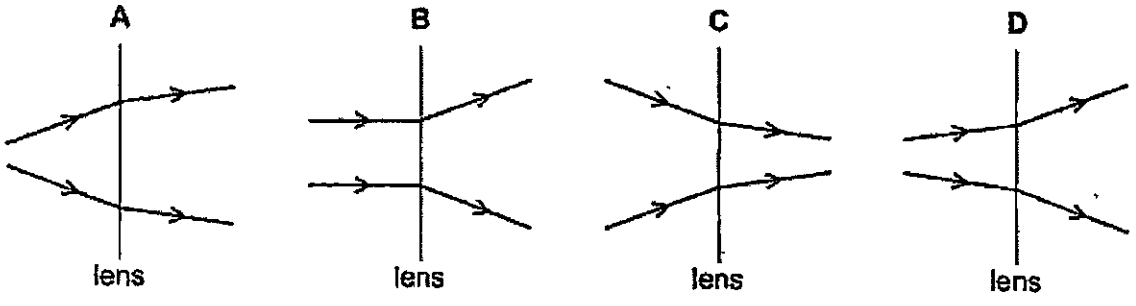
23 A ray of light from the bottom of a plastic block is incident at the plastic surface as shown below.



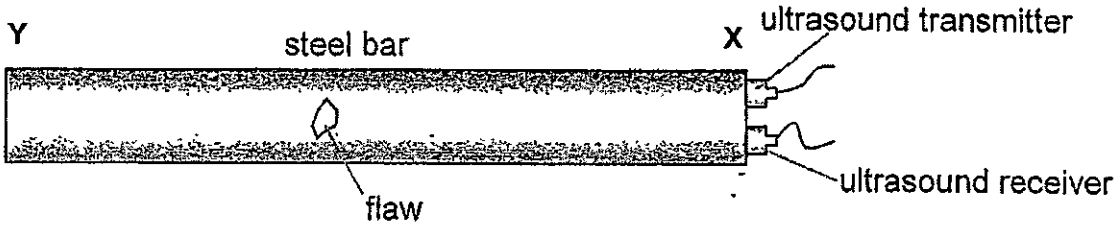
Calculate the refractive index of the plastic.

A 0.71
B 0.82
C 1.22
D 1.41

24 Which diagram shows rays of light passing through a converging lens?



25 There is a flaw in a steel bar **XY**. An ultrasonic transmitter and receiver are installed at position **X**. An ultrasonic pulse is sent to end **Y** and two pulses are received 150 μs and 200 μs later.



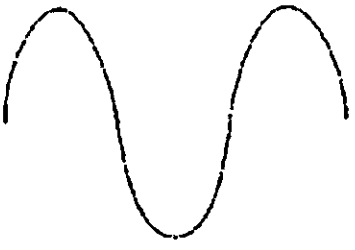
Given speed of sound in steel is 5800 ms^{-1}, what is the distance of the flaw from end **X**?

A 0.15 m
B 0.44 m
C 0.58 m
D 0.87 m

26 Two men **X** and **Y** whistle to a microphone connected to an oscilloscope in turn. The patterns produced on the oscilloscope are shown in the figures below.

pattern produced by **X**

pattern produced by **Y**



Which of the following statements gives the correct comparison?

A Both whistle at the same pitch but **Y** whistles louder than **X**.
B Both whistle at the same loudness but **Y** whistles at higher pitch.
C **X** whistles louder than **Y** but with a lower pitch.
D **Y** whistles louder than **X** but with a lower pitch.

27 Which property distinguishes electromagnetic waves from all other types of waves?

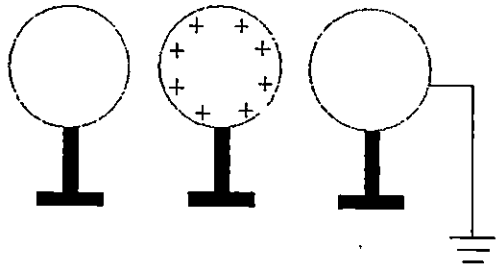
A They are charged.
B They are deflected by magnets.
C They are transverse waves.
D They can travel through vacuum.

28 X-rays are used in clinical diagnosis for taking X-ray films because

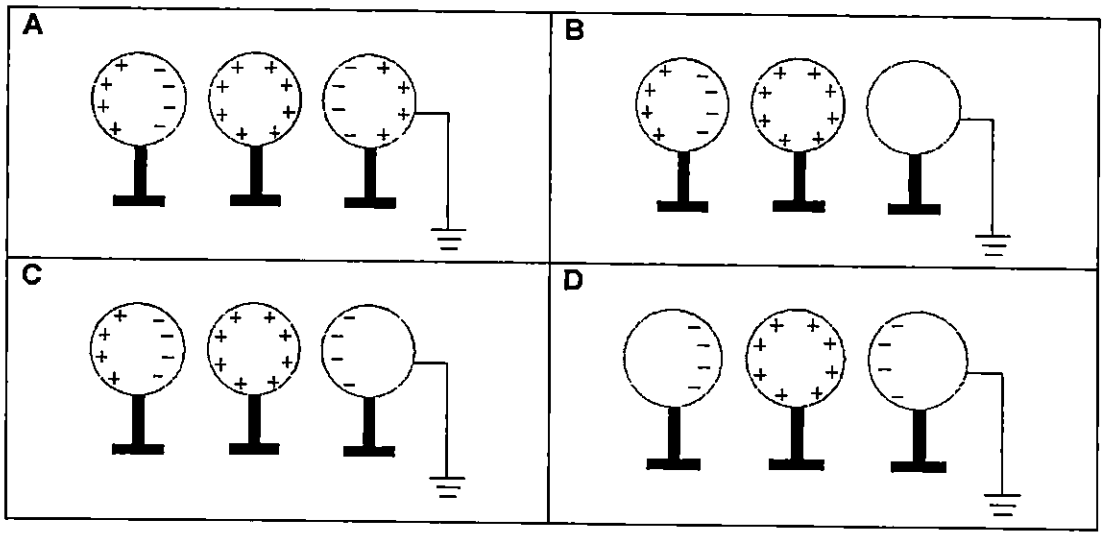
I. X-rays affect photographic plates.
II. X-rays cause ionization.
III. the absorption of X-rays is different for different materials.

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

29 A positively charged metal sphere is placed between two uncharged metal spheres, where one of which is grounded to the earth.



Which diagram correctly shows how the charges are distributed on the spheres?



30 Which of the following changes to a wire will double its resistance?

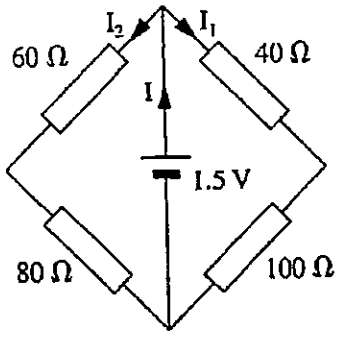
	cross-sectional area	length
A	double	double
B	double	no change
C	no change	halve
D	halve	no change

31 A charged cloud carrying a charge of 160 C passes all its charge to the earth through lightning. The lightning lasts for 0.5 ms.

What is the lightning current?

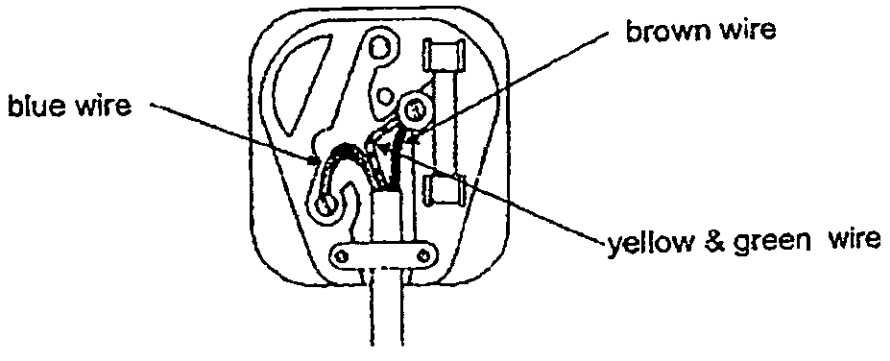
A 80 A
B 3.2×10^2 A
C 3.2×10^5 A
D 0.8×10^5A

32 What is the current I?



A 5.4 mA
B 10.7 mA
C 21.4 mA
D 42.9 mA

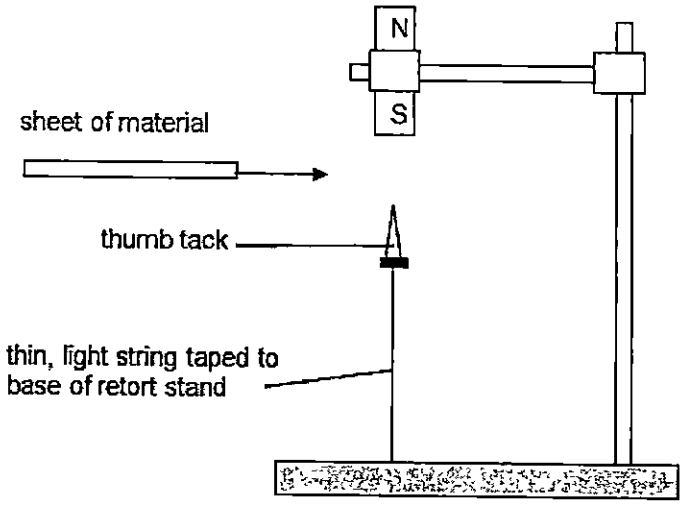
33 A plug is wrongly wired as shown in the diagram. It is connected to a washing machine which has a metal case.



Which of the following is **true**?

A The earth leakage circuit breaker will trip as soon as the socket is switched on.
B The wire in the 13 A fuse in the plug will definitely melt as soon as the socket is switched on.
C The main circuit breaker will trip as soon as the appliance is switched on.
D A person touching the washing machine may get an electrical shock and the fuse wire in the plug will melt.

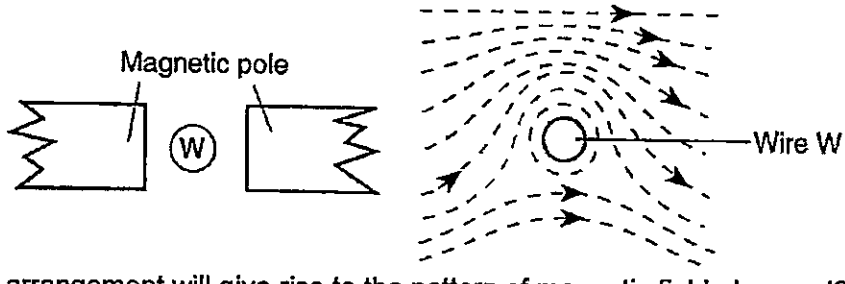
34 A light thumb tack is held in equilibrium mid-air due to the attractive force from a magnet and the gravitational force, as shown in the diagram below.



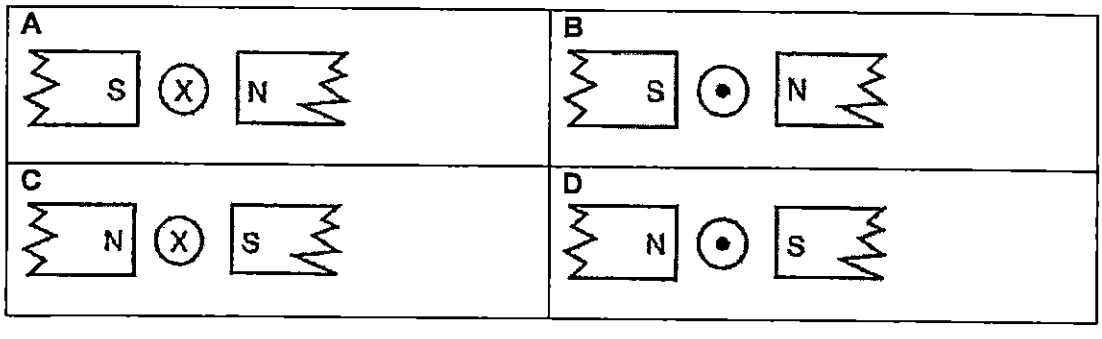
Four different sheets of material are inserted in turn between the magnet and the thumb tack. Which one will cause the thumb tack to drop?

A paper
B plastic
C iron
D copper

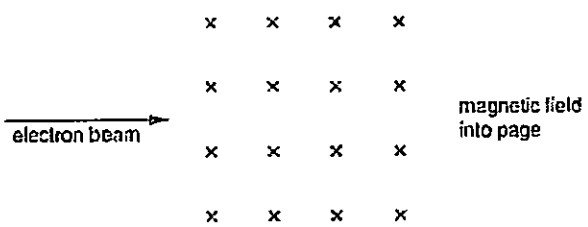
35 A long straight wire W is placed between the poles of two magnets. The pattern of the magnetic field produced is as shown below.



Which arrangement will give rise to the pattern of magnetic field observed?



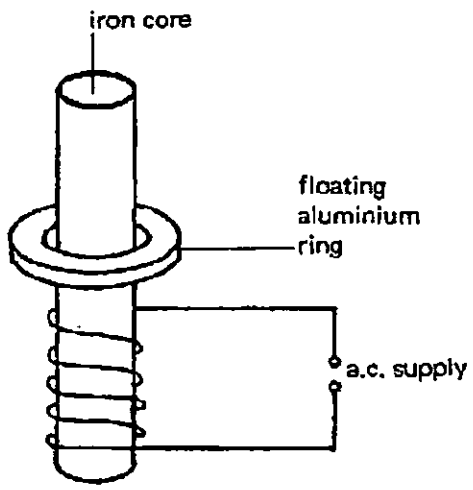
36 The diagram shows a beam of electrons entering a magnetic field. The direction of the field is into the page.



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

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

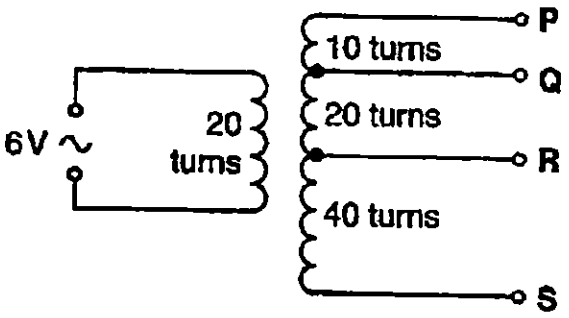
37 A coil is wound on an iron core and is connected to an A.C. supply. An aluminium ring floats above the coil.



Which of the following describes how the ring moves when the a.c. supply is replaced with d.c. supply of equivalent e.m.f?.

A The ring moves upward to the same position.
B The ring moves downward to a position nearer to the coil.
C The ring moves upward to same position momentarily and finally rests on top of the coil.
D The ring moves upward and downward repeatedly and finally rests on top of the coil.

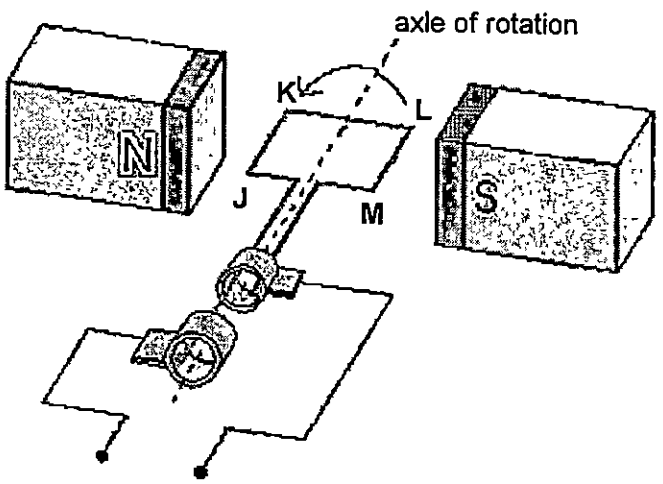
38 The number of turns between each pair of output terminals of a transformer is shown in the diagram.



Between which two terminals will the output be 12 V?

A P and Q
B Q and R
C R and S
D P and R

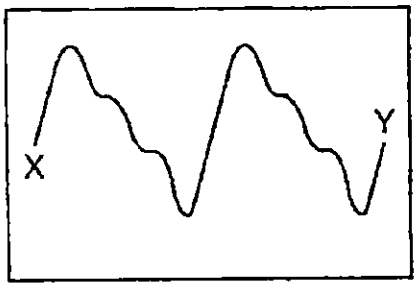
39 The diagram below shows a generator turning in the anti-clockwise direction.



Which row is correct?

	direction of current flow through the coil at the position shown	position of coil when current through the coil is maximum
A	J→K→L→M	horizontal
B	J→K→L→M	vertical
C	M→L→K→J	horizontal
D	M→L→K→J	vertical

40 The diagram shows the trace on the screen of a cathode-ray oscilloscope (c.r.o.).



The spot takes $\frac{1}{400}$ second to move across the screen from X to Y.

What is the frequency of the input signal to the c.r.o.?

A 100 Hz
B 200 Hz
C 400 Hz
D 800 Hz

Answer

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

COMMONWEALTH SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2015

PHYSICS (5059/2)

PAPER 2

Name: _____ ( ) Class: _____

SECONDARY FOUR EXPRESS

26 August 2015
0800 - 0945
1 h and 45 minutes

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on the question paper and any separate answer sheets used.
Write in dark blue or black pen.

Section A (50 marks)
Answer all questions.
Write your answers in the spaces provided on the question paper.

Section B (30 marks)
Answer all three questions.
Question 12 has a choice of parts to answer.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.
Candidates are reminded that all quantitative answers should include appropriate units.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of physics than for correct answers.

Take the gravitational field strength g on Earth to be 10 Nkg^{-1}.

At the end of the examination, ensure that you have submitted all your work.

For Examiner's Use	
Paper 1	40
Paper 2 Section A	50
Paper 2 Section B	30
Total	120

Parents'/Guardian's Signature

This paper consists of **20** printed pages.

[Turn over

SECTION A (50 marks)

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

1 A sky diver whose mass is 100 kg falls from a height of 5000 m above the ground. He falls for a while before opening his parachute. The table below shows the air resistance that acts on him during the first 6 seconds of his jump.

Time/s	Air resistance/N
0	0
1	100
2	300
3	600
4	1 000
5	1 000
6	2 000

(a) Calculate the downwards force that is acting on the sky diver. [1]

Force = ...

(b) Determine the time required for the diver to reach terminal velocity. [1]

Time = ...

(c) For the first 4 seconds of his jump, explain why the air resistance would increase as the sky diver falls. [1]

.....

....

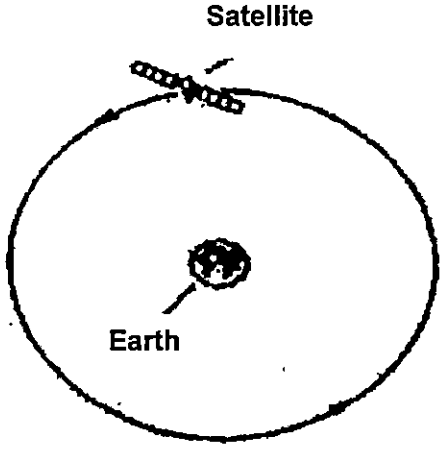
(d) Describe and explain how his acceleration changes for the first 3 seconds.[2]

....

.....

.....

2 A navigation satellite moves in a circular orbit above the Earth's atmosphere.



The mass of the satellite is 80 kg. It orbits the Earth at a speed of 4000 ms^{-1}. It is constructed mainly from a metal alloy of specific heat capacity 320 $Jkg^{-1}°C^{-1}$.

(a) Calculate the kinetic energy of the satellite when in orbit. [2]

Kinetic energy = ...

(b) Calculate the change in the temperature of the satellite if all its kinetic energy is rapidly converted to thermal energy as the satellite comes back to earth. [2]

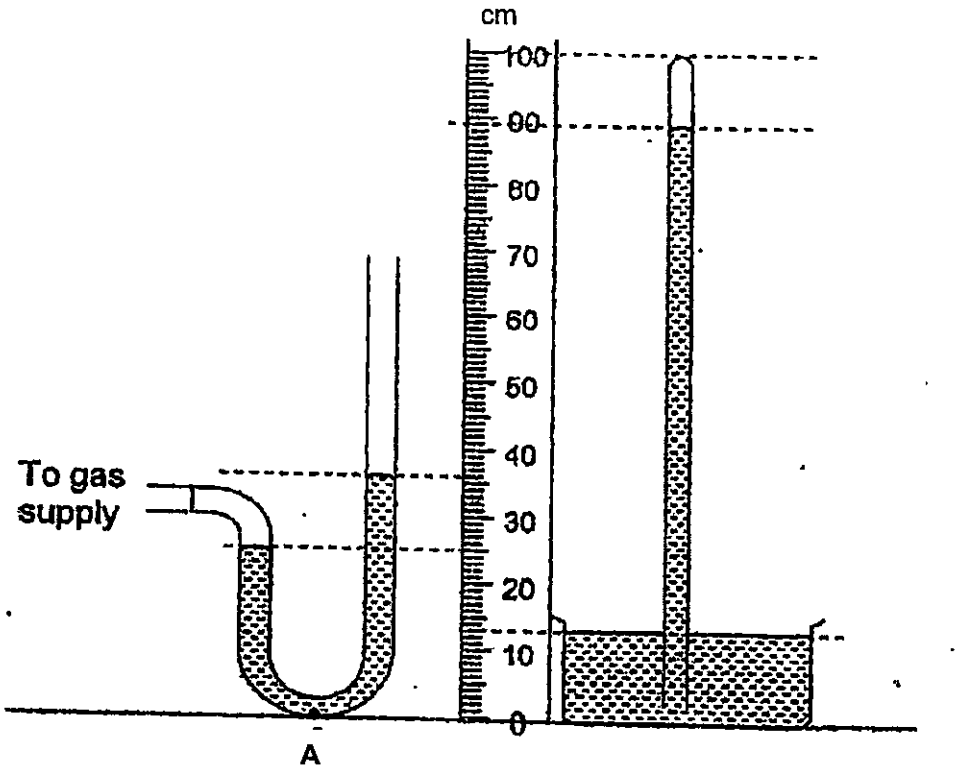
Change in temperature =.....

(c) Suggest why in practice the change in temperature you have calculated in **part (b)** will not be obtained. [1]

.....

.....

3 The diagram shows a mercury barometer and a manometer filled with mercury connected to a gas supply.



(a) (i) Determine the atmospheric pressure as indicated by the mercury barometer. [1]

Atmospheric pressure = ...

(ii) State what is meant by *atmospheric pressure.* [1]

.....

.....

(iii) Determine the pressure of the gas as indicated by the manometer. [1]

Pressure = ...

(iv) Determine the pressure at point A, at the bottom of the mercury in the manometer. [1]

Pressure = ...

(b) Explain, in terms of the motions of the molecules,

(i) why the gas exerts a pressure on the mercury, [2]

.....

.....

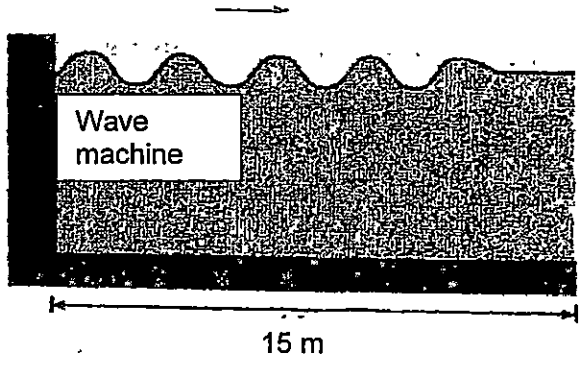
.....

(ii) why the gas pressure increases when the temperature of the gas increases. [2]

.....

.....

4 In the swimming pool at a new leisure centre, there is a 'wave machine' as shown in the diagram.



This machine makes waves in the water at one end of the pool at a frequency of 0.25 Hz. The waves take 12.0 s to travel 15 m along the pool.

(a) Define *transverse waves.* [1]

.....

.....

.....

(b) Calculate the speed of the waves. [1]

Speed = ...

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

Wavelength = ...

(d) The swimming pool operator wants to reduce the speed of the waves by reducing the frequency of the wave generated by the 'wave machine'. Explain if reducing the frequency of the wave would reduce the speed of the wave. [1]

.....

....

5 A lamp is operated from a 12 V d.c supply. The brightness of the lamp is to be varied continuously over a wide range. This is made possible by using a variable resistor **AB** of maximum resistance 6.0 Ω with sliding contact X. Two circuits for achieving the desired results are suggested and shown in Fig 5.1 and 5.2.

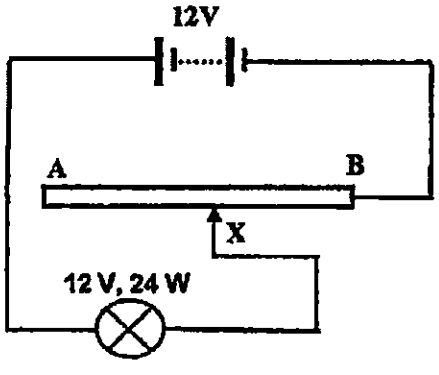


Fig 5.1

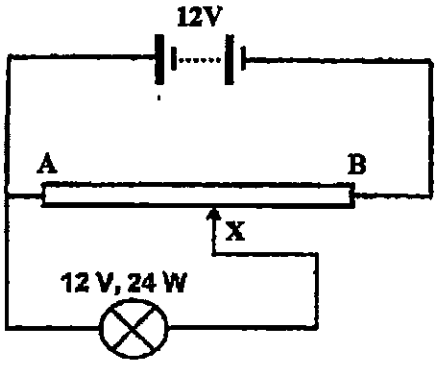


Fig 5.2

(a) Calculate the resistance of the lamp. [2]

Resistance = ...

(b) Calculate the maximum and minimum current flowing through the lamp in

(i) Circuit in Fig. 5.1, [2]

Maximum current = ...

Minimum current = ...

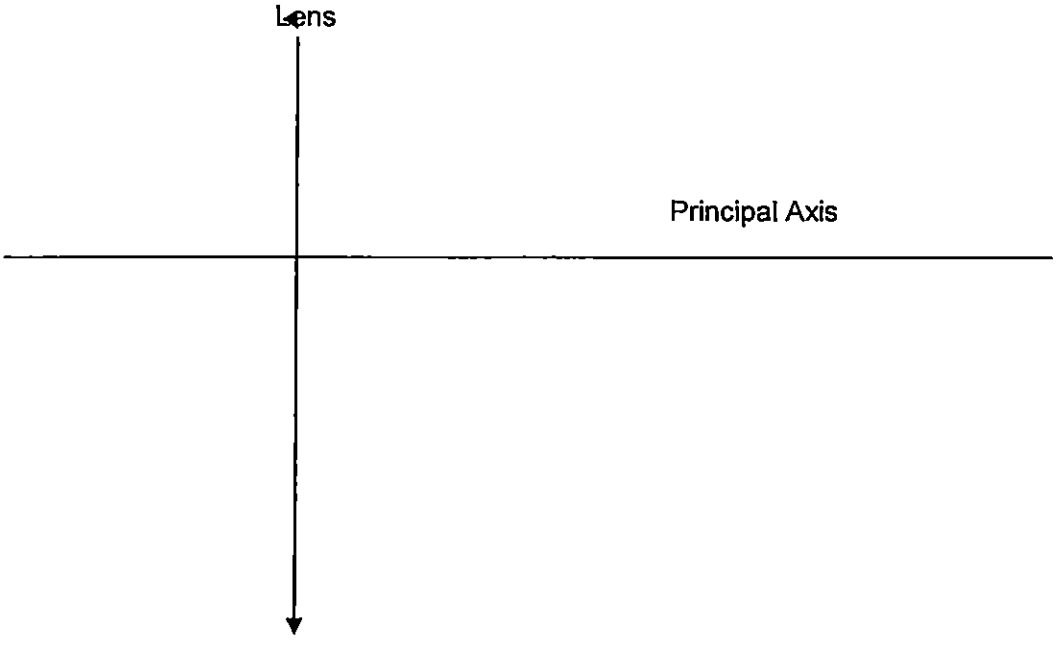
(ii) Circuit in Fig. 5.2. [2]

Maximum current = ...

Minimum current = ...

6 A student wants to project a magnified image of a 5 cm x 5 cm slide onto a screen using the apparatus given: *lamp with slide, a converging lens, a screen.* He finds that a clear image appears when the distance between the slide and the lens is 2.0 cm and the distance between the lens and the screen is 10.0 cm.

(a) By drawing a ray diagram in the space below, determine the focal length of the lens. [3]



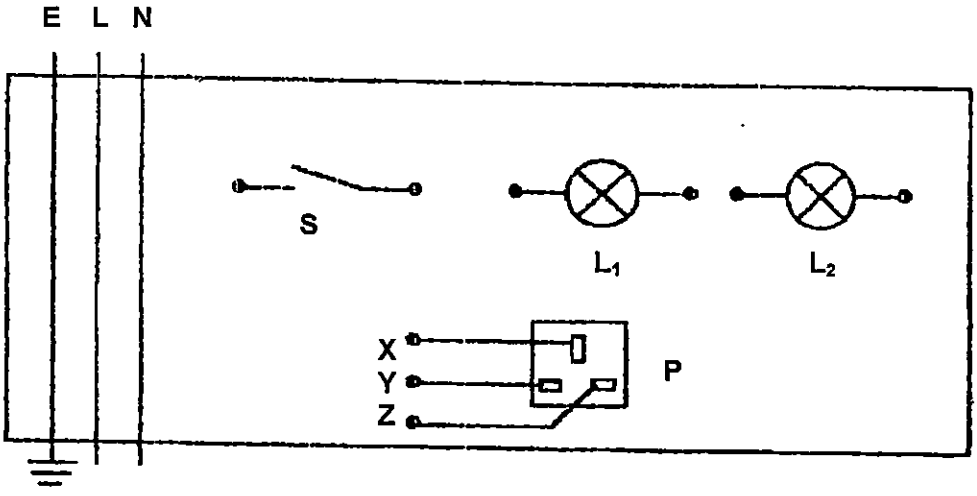
Focal length = ...

(b) Describe and explain what the student would see on the screen as he moves the slide until it is 1.0 cm from the lens. [2]

.....

.....

7 The diagram shows the incomplete wiring of a power supply (240 V) in a room.

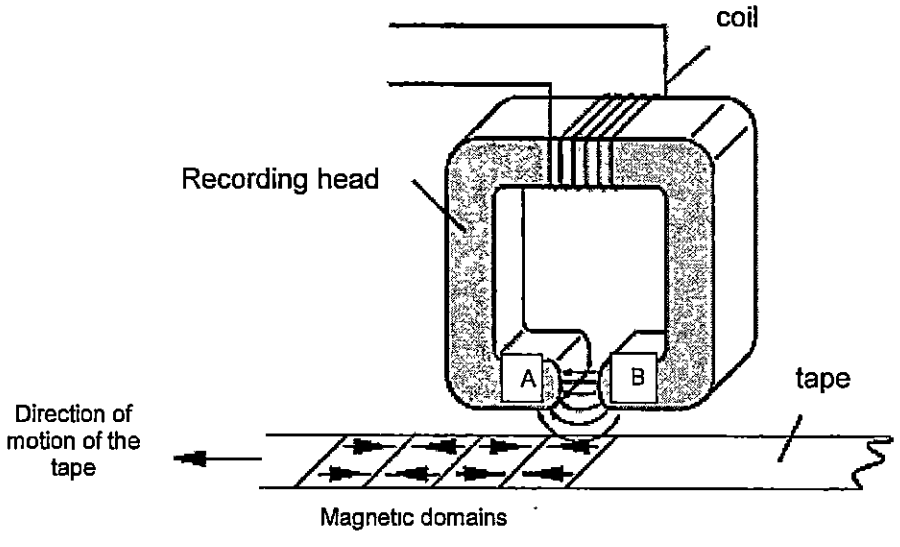


S is the switch for both the lamps L_1 and L_2. L_1 and L_2 are connected in parallel.

P is a power socket. **E**, **L** and **N** stand for Earth, Live and Neutral wires respectively.

Complete the diagram to show the wiring for the lamps and the power socket to the power supply. Include a fuse in the lighting circuit. [4]

8 The diagram shows a piece of recording tape passing under the recording head of a tape recorder at a particular time t_1. An alternating current is passed through the coil. The tape is coated with a magnetic material that becomes magnetised.



(a) **(i)** Determine the pole of the ends A and B of the recording head at t_1. [1]

A = ...

B = ...

(ii) On the diagram, indicate the direction of the current at t_1. [1]

(b) The diagram shows that sections of the tape are magnetised in opposite directions. Explain why they become magnetised in opposite directions. [2]

.....

.....

.....

(c) The tape is moved faster past the recording head. State how this changes the pattern on the tape. [1]

.....

.....

(d) The direction of the magnetic domains on the recording tape can be used to store data. Explain why iron is not a suitable material to be used for the coating on the recording tape and suggest an alternative material. [3]

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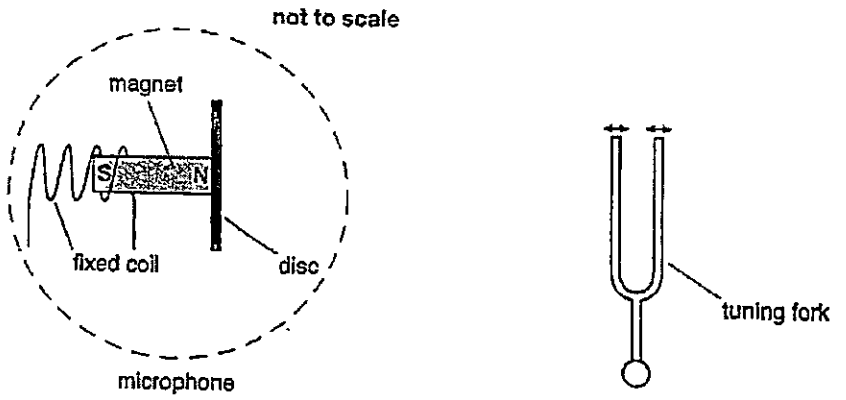
9 The following diagram shows a microphone and a tuning fork.



The microphone contains a small disc attached to a magnet. The coil inside the microphone is fixed in position and does not move.

When the tuning fork vibrates, an alternating e.m.f. is induced in the coil.

Explain in detail how the vibration of the tuning fork induces an e.m.f. in the coil. [4]

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SECTION B (30 marks)

Answer **all** the questions in this section.
Answer only one of the two alternative questions in **Question 12.**

10(a) Being under the sun's radiation for a period of time not only gets you hot, but you could also end up with a sunburn. A sunburn is basically the killing or damaging of skin cells by a particular form of ultraviolet (UV) radiation called 'UVB' from the sun.

Clothes can provide some protection from UV radiation. A common way of protecting the skin is to apply sunscreen.

Sunscreen reflects or absorbs UV radiation and blocks it from penetrating into the skin layer. Sunscreens are usually labelled with an SPF, or Sun Protection Factor. The SPF is a multiplying factor which estimates how long the sunscreen could protect you from UVB radiation. Suppose you can stay in the sun for 10 minutes without getting burnt. By applying a sunscreen of SPF 50, you could stay for 500 minutes without getting burnt. The higher the SPF, the more effective it is of reflecting or blocking the UV rays.

(i) State and explain whether dark-coloured or light-coloured clothes offer better protection against UV radiation. [1]

.....

.....

(ii) Anna intends to spend 3 hours at the beach. She can stay in the sun for 12 minutes without getting burnt.

What is the minimum SPF sunscreen that she should use? Commonly available SPF are 4, 8, 15, 30 and 45. [1]

Minimum SPF = ...

Read this next section and answer parts (iii) to (iv).

UV is part of the spectrum of electromagnetic radiation. UVB has wavelength between 280 to 315 nanometres (nm). Visible light is also part of the spectrum and can be found between 400 to 700 nanometres. UV radiation is reflected by different surfaces. Snow can reflect around 80% of UVB; and beach sand can reflect around 25%.

Figure 10.1 shows the percentage of UV radiation reflected off grass, normal sand, and concrete.

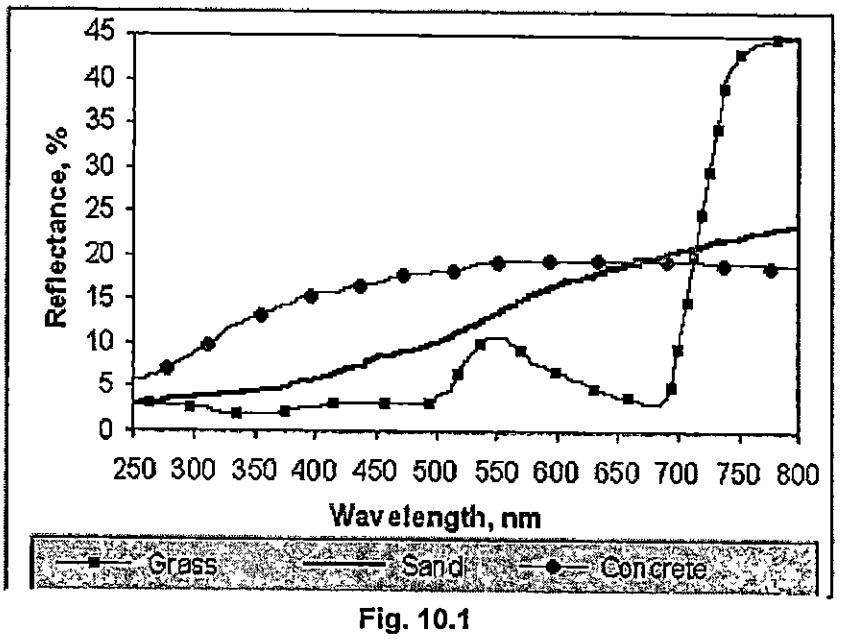

Fig. 10.1

(iii) Rank *snow*, *beach sand*, *grass*, *sand* and *concrete* in order of poorest to best reflector of UV radiation. [1]

.....

.....

(iv) Suggest why you could get snow-blinded as well as very badly sunburned when skiing. [3]

.....

.....

.....

.....

(b) The efficiency of solar energy exists primarily because it takes advantage of renewable energy, the sun, unlike typical energy solutions which use fossil fuels. The efficiency of solar energy harnesses the energy received from the sun and channels it into existing electrical grids.

One way of measuring the efficiency of solar panels is to calculate the percentage of the solar energy that a panel converts into electricity. A typical solar panel converts **15% of the sun's energy into electricity.**

Adapted from: http://www.construction21.eu/articles/h/efficiency-of-solar-energy-harvesting.html

(i) State what is meant by *renewable energy*. [1]

.....

.....

(ii) 6.44 Wm^{-2} of sunlight falls on a typical solar cell of surface area 2.0 m^2. Calculate the amount of electrical energy harnessed from the sun over a period of 30 hours. [2]

Electrical energy = ...

(iii) Discuss briefly, how, when compared to a conventional fuel, solar powered panels can be considered 'pollution free'. [1]

.....

.....

11 (a) A veterinarian wants to do some minor surgery on a dog. She sterilizes her instruments, comprising of a scalpel and a hemostat, by immersing them in 2.0 kg of boiling water for 30 minutes. She then quickly transfers the instruments to a well-insulated tray containing 200 g of sterilized water at room temperature (28°C) which fully covers the instruments. After a few minutes, the instruments and water reach the same temperature, y °C.

The mass of the scalpel is 50 g and the mass of the hemostat is 70 g. Both are made from steel with a specific heat capacity of 450 J/kgK. The specific heat capacity of water is 4200 J/kgK.

(i) Determine, in terms of y, the

1. heat lost by the scalpel and hemostat [2]

Heat lost = ...

2. heat gained by the sterilized water [1]

Heat gained = ...

(ii) From **(i)**, write an equation relating the heat exchange between the scalpel, hemostat and water. [1]

....

....

(iii) Hence or otherwise, determine y. [1]

y = ...

(b) The apparatus are set up to determine the specific latent heat of fusion of ice as shown in Fig. 11.1.

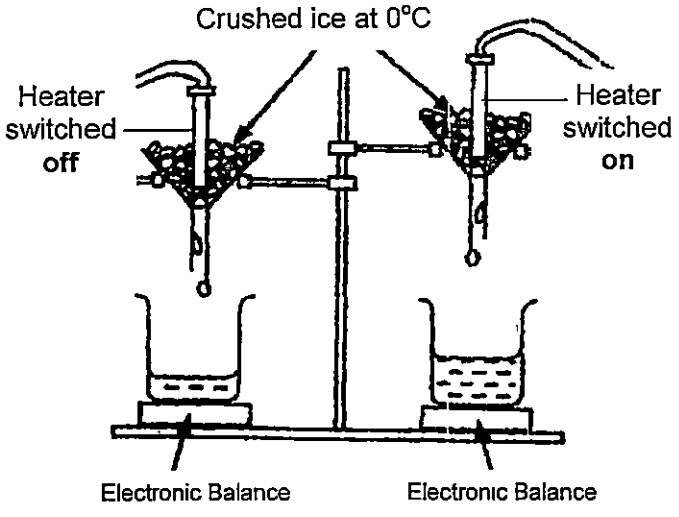

Fig. 11.1

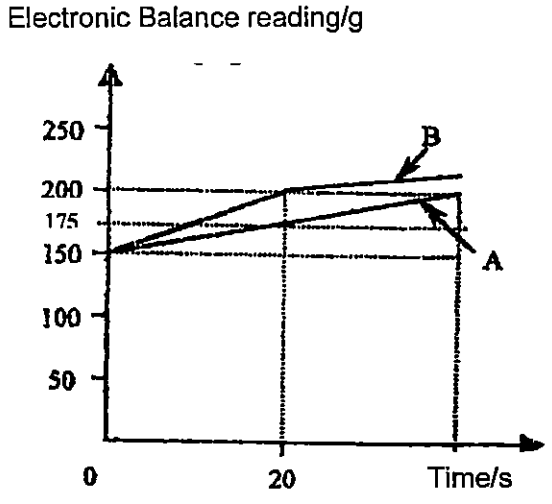

Fig. 11.2

Both setups used similar apparatus and materials. The heater in A is switched off while the heater in B is switched on. The balance readings are recorded at regular time intervals and the results are plotted against time as shown in Fig. 11.2.

(i) State what is meant by the *specific latent heat of fusion* of ice. [2]

.....

.....

.....

(ii) Determine the mass of ice melted by the heater in the first 20 s. [1]

Mass of ice = ...

(iii) If energy is being supplied at a rate of 400 Js^{-1}, calculate the specific latent heat of fusion of ice, assuming that all the energy released from the heater is absorbed by the ice. [2]

Specific latent heat of fusion = ...

12 EITHER

(a) Figure 12.1 shows the I-V characteristics of a filament lamp.

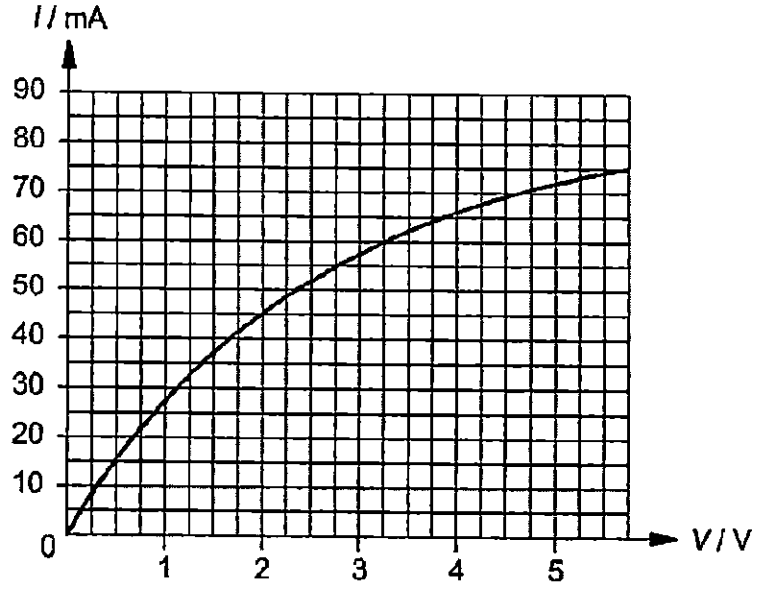

Fig. 12.1

(i) Explain why the filament lamp is a non-ohmic conductor. [1]

.....

.....

.....

(ii) Calculate the resistance of the filament lamp when V = 2.0 V. [2]

Resistance = ...

(b) A thermistor is an input transducer that has a resistance which changes with temperature.

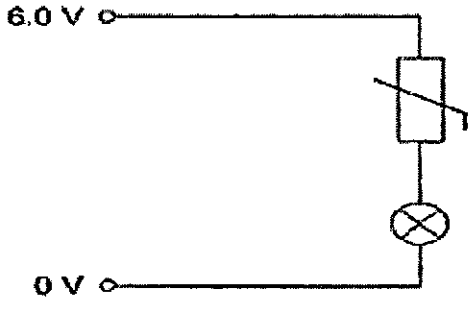

Fig. 12.2

Figure 12.2 shows the filament lamp in (a) connected in series with a thermistor and a 6.0 V source. The thermistor is an NTC (Negative Temperature Coefficient) type.

If the ambient temperature increases, **state** and **explain** whether the resistance of the filament lamp will increase or decrease. [4]

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(c) A thermistor has a resistance of 3 900 Ω at 0°C. It is connected to a circuit as shown in Fig. 12.3 in order to monitor temperature changes.

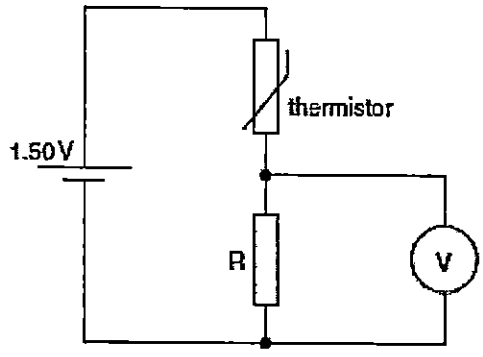


Fig. 12.3

A battery, with negligible internal resistance, has an e.m.f. of 1.50 V. The voltmeter is assumed to be an ideal voltmeter with infinite resistance.

(i) State what is meant by an *e.m.f. of 1.50 V.* [1]

.....

.....

.....

(ii) If the voltmeter has a reading of 1.00 V at 0°C, calculate the resistance of resistor R. [2]

Resistance of resistor R = ...

12 OR

A boy of mass 30 kg riding on a skate scooter is shown in Fig. 12.4 below.

Fig 12.4

The boy pushes off with his rear foot momentarily to accelerate. He then cruises for a while and allows resistive forces to slow him down. He then pushes off with his rear foot again. The cycle is repeated.

Fig 12.5 shows how the velocity of the boy changes over the first 6.0 s of his journey.

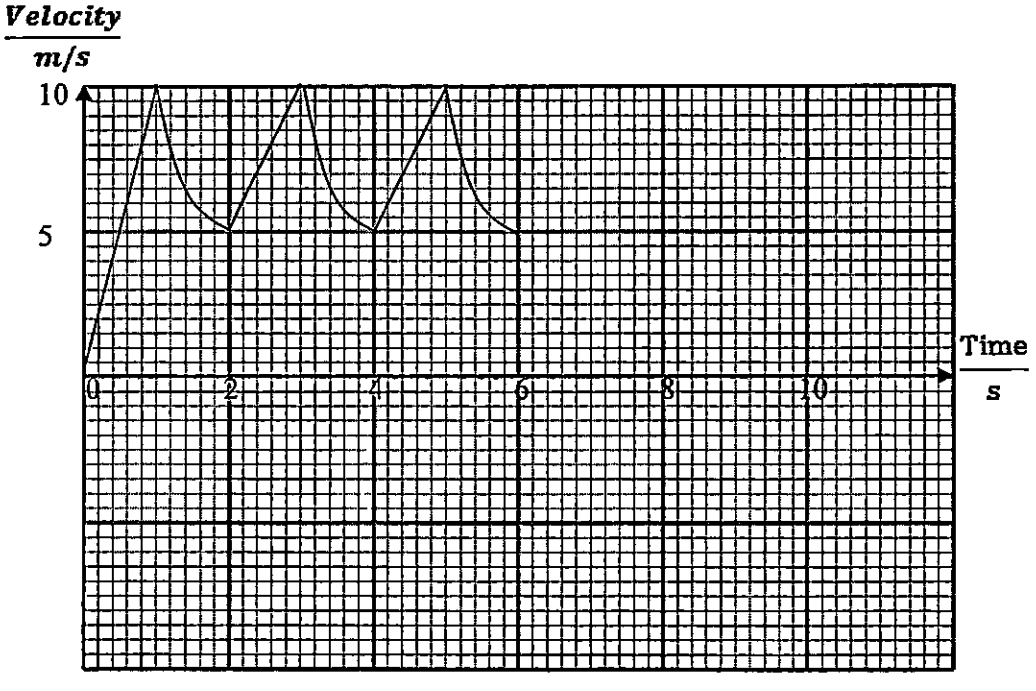


Fig 12.5

(a) Describe the boy's acceleration over the first 2.0 s of his journey. [2]

.....

.....

.....

(b) Determine the

(i) value of the instantaneous velocity at 1.0 s. [1]

Instantaneous velocity = ...

(ii) total displacement at 1.0 s. [1]

Total displacement = ...

(iii) value of the average velocity at 1.0 s. [1]

Average velocity = ...

(c) Calculate the

(i) acceleration of the boy at 0.50 s. [1]

Acceleration = ...

(ii) resultant force of the boy at 0.50 s. [2]

Resultant force = ...

(iii) forward driving force acting on the boy at 0.50 s if the total resistive force acting on him is 5.0 N. [1]

Forward driving force = ...

(d) Describe the other force that is part of an action-reaction pair with the forward driving force calculated in **(c)(iii).** [1]

.....

.....

COMMONWEALTH SECONDARY SCHOOL
SECONDARY FOUR EXPRESS PHYSICS
PRELIMINARY EXAMINATION 2015
MARK SCHEME & EXAMINERS' REPORT

Section A (50 marks)

1 **(a)** Force = m ×g = 100 kg × 10 Nkg^{-1}
= **1000 N** [1]

(b) **4 seconds** (accept 2 or 3 s.f.) [1]

(c) As sky diver falls, his **speed/velocity increases** [1]
Or: sky diver accelerates
Or: KE increases

(d) **Acceleration decreases** [1]
Resultant force decreases as air resistance increases [1]

Total mark for Q 1 **[5]**

2 **(a)** K.E = ½mv^2
= ½**(80 kg)(4000 ms^{-1})^2** [1]
= **6.4 x 10^8 J** [1]

(b) 6.4 x 10^8 J = mcΔθ
6.4 x 10^8 J = 80 kg x 320 $Jkg^{-1}°C^{-1}$xΔθ [1]
Δθ = **25000°C** [1]

e.c.f. from (a)

(c) The satellite would **melt** before this temperature could be reached. [1]
Or: Energy is lost to surrounding.
Or: Not all energy is converted to thermal energy.
Or: Some energy is converted to other forms or heat or light

Total mark for Q2 **[5]**

3 **(a)** **(i)** **76 cmHg** [1]

(ii) Atmospheric pressure is the pressure caused by **the weight of the atmosphere** acting on the **surface of the earth.** [1]

(iii) 76 + 11 = **87 cmHg.** [1]
e.c.f. from (i)

(iv) 76 + 36 = **112 cmHg** [1]
e.c.f. from (i)

Or: 87 cmHg + 25 cmHg
= **112 cm Hg**

e.c.f. from (iii)

Accept unit in mmHg or Pa provided conversion/calculation is correct.

(b) (i) The gas molecules **hit/collide** the mercury and exert a **force** on the mercury. [1]

The **force** that acts on the mercury **per unit area** is the gas pressure. [1]

(ii) Gas molecules **move faster** or possess **greater kinetic energy** [1]
thus colliding on the walls of the manometer (or mercury)
more frequently and
forcefully (or more vigorously or greater force per collision) [1]

Total mark for Q 3 **[8]**

4 (a) Transverse waves are waves that **travel in a direction perpendicular to the direction of vibration.** [1]

(b) Speed of wave, v = 15 m / 12.0 s
= **1.25 ms^{-1}** (accept unit as m/s) [1]

(c) $\lambda = v / f$
= **1.25 ms^{-1} / 0.25 Hz** [1]
= **5.00 m** (accept 2 s.f.) [1]
e.c.f. from (ii)

(d) No, he will not be successful. Since the **depth/medium of the pool remains unchanged**, the speed of the waves will not change. [1]

Total mark for Q4 **[5]**

5 (a) $P = V^2 / R$
$R = V^2/P$
= **(12 V)^2 / 24 W** [1]
= **6.0 Ω** (accept 3 s.f.) [1]

(b) (i) Maximum current $= \frac{12}{6.0}$

= **2.0 A** [1]

Minimum current $= \frac{12}{6+6}$

= **1.0 A** [1]
e.c.f. from (a)

(ii) Maximum current $= \frac{12}{6.0}$

= **2.0 A** [1]

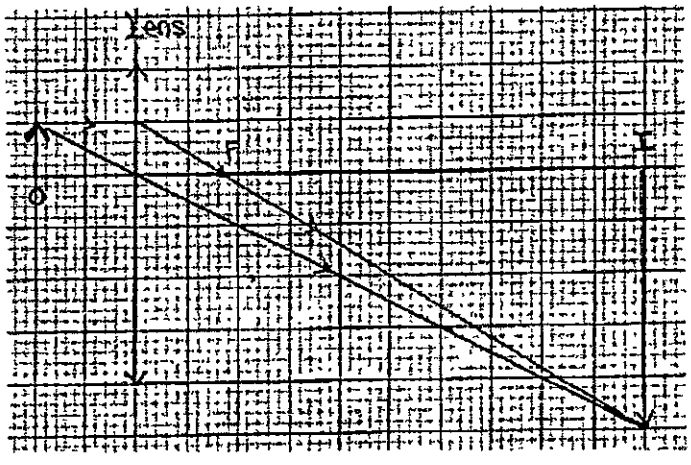
Minimum current $= \frac{0}{6.0}$ (accept if working is not written)

= **0 A** [1]

e.c.f. from (a)

Total mark for Q 5 **[6]**

6 (a)



focal length in the range **1.5 cm to 1.8 cm** [1]

2 light rays correctly drawn with arrows [1]
To penalise if dotted lines are drawn for rays.

Correct object and image distances (+/- 0.1 cm) [1]

(b) **No image** is formed on the screen. [1]

The **object distance is smaller than the focal length** of the lens, hence image is **virtual.** [1]

e.c.f. from (a); one mark for description of the image and another mark for correct corresponding explanation.

Total mark for Q 6 **[5]**

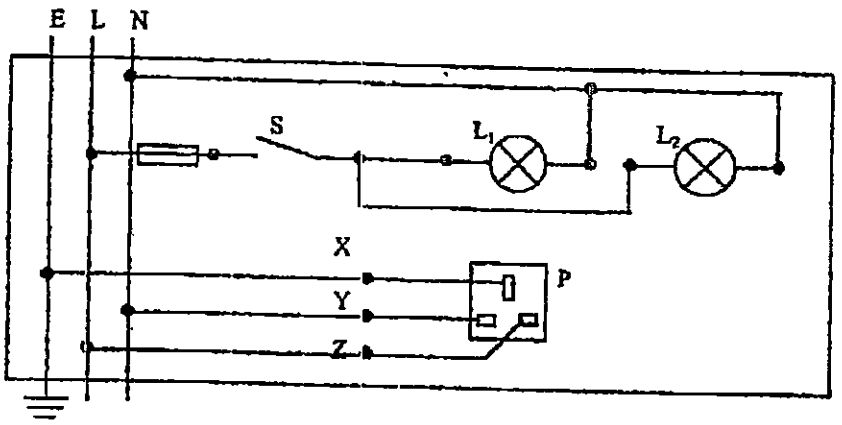
7 **Fuse** on **live** wire [1]
Award mark only if **symbol** of fuse is correctly drawn.

Switch on **live** wire and **controls both** L_1 and L_2 [1]

L_1 and L_2 connected to **both Live and Neutral wire** [1]
To penalize (in third mark) if L_1 and L_2 are not in parallel or if the lamps do not work as intended.

X, Y and Z connected correctly [1]

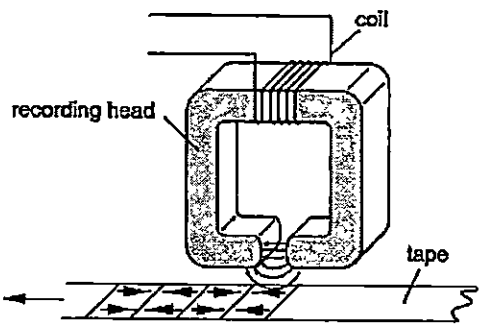
To penalize once for inconsistent use of dots to show connection of wires.



Total mark for Q 7 **[4]**

8 **(a)** **(i)** A: South
B: North [1]

(ii) Correct direction for current
e.c.f. from (a) (i) [1]



(b) **Direction of current changes** periodically or current is alternating [1]

Magnetic poles of A and B of the recording head near to the tape also **changes accordingly** and thus, sections of tape are magnetized in opposite direction due to induced magnetism. [1]

Accept: alternating poles or field

(c) **Longer length / sections** of the tape will be magnetized in the same direction. [1]

(d) The tape must **not lose magnetism/does not get demagnetised easily.** [1]

Thus, iron being a **soft magnetic material**, is not suitable as it will **lose its magnetism easily.** [1]

A suitable material will be **steel.** [1]

Total mark for Q 8 **[8]**

9 Any two of the following. One mark each. [2]

- o As the tuning fork vibrates, the **air particles/molecules** between the tuning fork and the disc **vibrate to and fro (or left and right)**
  Or: **along the direction of the sound wave**
  Or: **the tuning fork shifts layers of air inward and outward.**
- o Sound is **longitudinal wave.**
- o Hence creating a series of **compressions and rarefactions.**

As a result, the disc and the magnet **vibrate in and out of the coil.** [1]

This **changes the magnetic field linking the coil** [1]
Or: The **magnetic flux** in the coil **changes**

Total mark for Q9 **[4]**

Section B (30 marks)

10(a) (i) **Dark-coloured clothes** as they are **better absorber** of UV **radiation.** [1]

(ii) (3 x 60) | 12 = **15**
The minimum SPF is **15.** [1]

(iii) Grass, sand, concrete, beach sand, snow [1]

(iv) Snow is a **good reflector** of **UV radiation** (or **light** or **both**), [1]
or Snow can **reflect 80% of UVB.**

When skiing, we are exposed to **more UV radiation** (or **light** or **both**) that is being **reflected by snow** to us. [1]

Our **eyes and skin** receive this additional UV/light hence resulting in snow-blindness and severe sunburn respectively. [1]

(b) (i) Renewable energy is defined as energy from sources that **can be replenished** naturally. [1]

(ii) Sun's energy = 6.44 Wm^{-2} X 2.0 m^2 X (30 x 3600) s
= **1.39 X 106 J** [1]

Electrical Energy harnessed = 15 % of 1.39 X 106 J
= **2.09 x 10^5 J** [1]

(iii) **Air pollutants** are produced when conventional fuels are burned. [1]
Or: No air pollutants or greenhouse gases produced for solar cells

Total mark for Q 10 **[10]**

11 (a) (i) 1. Heat lost by scalpel and hemostat

= **(0.050 kg + 0.070 kg) x (450 J/kgK) x (100°C -*y*)** [1]
= (0.120 x 450 x 100) J - (0.12 x 450 x *y*) J
= **(5 400- 54 *y*) J** or **54(100 –y) J** [1]

Do not penalize if unit is not written.

2. Heat gained by the sterilized water, Q=mcθ
= 0.200 kg x 4 200 J/kgK x (*y*-28°C)
= **(840*y* - 23 520) J** or **840(y -28) J** [1]

Do not penalize if unit is not written.

(ii) **Heat lost by scalpel and hemostat = heat gained by water** [1]
Accept symbols instead of statement

e.c.f. from (i)

(iii) 5 400 - 54y = 840*y* -23520
5 400 + 23520= 840 *y* + 54 *y*
28920 = 894*y*
y= **32** or **32.3** [1]

Do not penalize if unit for y is written.

e.c.f. from (i) or (ii)

(b)(i) Specific latent heat of fusion of ice is the **amount of thermal energy required** to change **1 kg** of ice from its **solid to liquid state,** without a change in temperature. [2]

[1] for '1 kg' or unit mass
[1] for 'amount of thermal energy required to change from solid to liquid state without a change in temperature'
Deduct one mark if students wrote 'body' or 'substance' instead of 'ice'.

(ii) Mass of ice melted by the heater alone in the first 20 s = 200 g – 175 g
= **25 g** [1]

(iii) Latent heat gained by ice = heat supplied by heater
Specific latent heat of fusion = Pt / m
= **400 J/s × 20s / 25g** [1]
= **320 J/g** [1]
e.c.f. from (b) (ii)

Total mark for Q 11 **[10]**

12 **EITHER**

(a) (i) The current flowing through the filament lamp is **not directly proportional** to the p.d./ **not proportional** to the p.d across it. [1]

(ii) R = V/ I

= **2.0 V/ 45 x 10^{-3}A** [1]
= **44.4 Ω** [1]

(b) As temperature increases, the **resistance of the thermistor decreases.** [1]

Hence the **p.d. across thermistor decreases.** [1]

Since the e.m.f. is shared between the filament lamp and thermistor, **the p.d. across the filament lamp will increase.** [1]

Based on the I-V graph of the filament lamp, the **resistance of the lamp will increase.** [1]

(c) **(i)** The work done to drive an unit charge through the complete circuit is 1.50 J. [1]

(ii) **[R / (R + 3900 Ω)] x 1.5 V = 1.0 V** [1]
1.5 R= R + 3900
R=7800 Ω [1]

Total mark for Q 12 EITHER [10]

12 OR

(a) From 0 s to 1.0 s: positive **uniform/constant** acceleration [1]
From 1.0 s to 2.0 s: **negative** and **non-uniform** acceleration [1]
Or: Acceleration is non-uniform and becoming less negative.

(b) **(i)** **10 ms^{-1}** [1]

(ii) Total displacement = ½(1.0 s)(10 ms^{-1})
= **5.0 m** [1]
e.c.f. from (i)

(iii) Average velocity = total displacement/total time
= 5.0 m/ 1.0 s
= **5.0 ms^{-1}** [1]
e.c.f. from (ii)

(c) **(i)** a = (10 ms^{-1} -0 ms^{-1})/(1.0 s – 0 s)
= **10 ms^{-2}** [1]

Or: a = (5 ms^{-1} -0 ms^{-1})/(0.5 s – 0 s)
= **10 ms^{-2}**

(ii) Resultant force = **30 kg x 10 ms^{-2}** [1]
= **300 N** [1]

e.c.f. from (c) (i)

(iii) **300 N = forward force – 5.0 N**
Forward force = **305 N** [1]

e.c.f. from (c) (ii)

(d) (Backward) Force on the floor/ground by the boy [1]

Total mark for Q 12 OR **[10]**