Exam Index Number	

PRELIMINARY EXAMINATION 2016

SECONDARY FOUR EXPRESS

PHYSICS 5059/01
(PAPER 1 Multiple Choice)

TIME: 1 HOUR

READ THESE INSTRUCTIONS FIRST

Write your Exam Index Number in the box provided at the top of this page and any separate answers paper provided.
Write in soft pencil.

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

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.

1 A light year is defined as the distance light travels in 1 year. The speed of light is 3×10^8 m/s.

Which of the following is the nearest estimate of 1 light year?

A 10^2 Gm
B 10^4 Gm
C 10^5 Gm
D 10^7 Gm

2 Vernier calipers are used to measure the length of a few turns of wire, L.

Diagram 1 shows the calipers when the jaws are closed.

Diagram 2 shows the calipers when the wire is between the jaws.

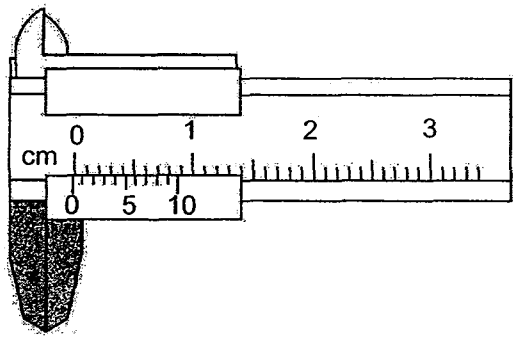


diagram 1

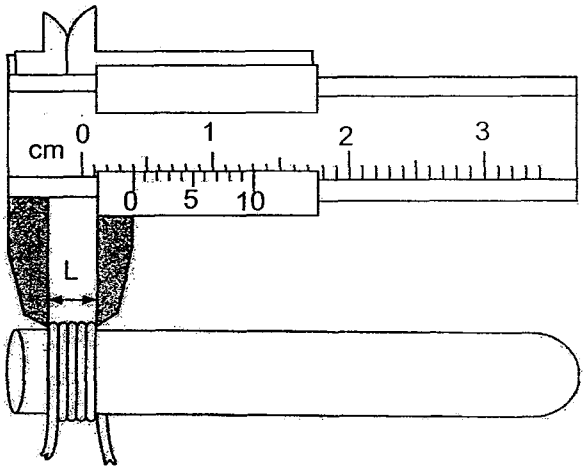


diagram 2

What is the length, L?

A 0.43 cm **B** 0.47 cm **C** 0.86 cm **D** 0.94 cm

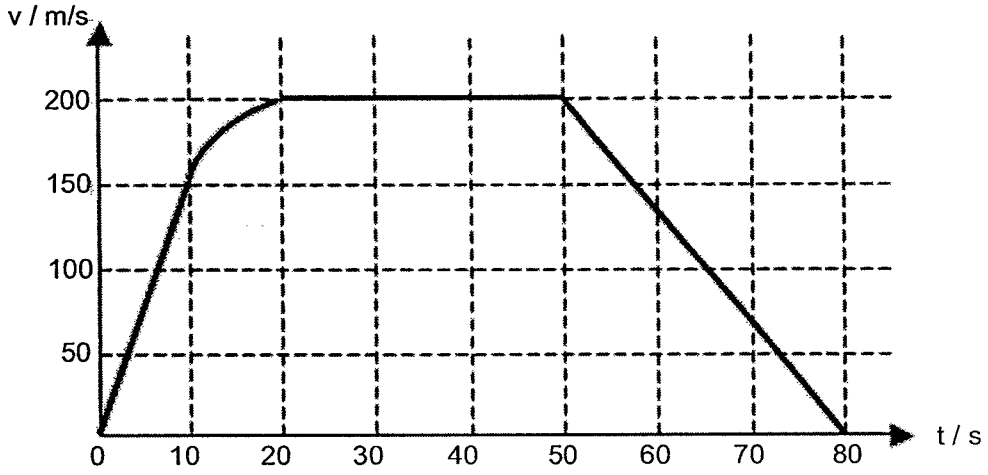
3 The velocity of a moving object is given by

A the area below a displacement-time graph.
B the area below a velocity-time graph.
C the gradient of a displacement-time graph.
D the gradient of a velocity-time graph.

4 A boy throws a ball vertically upwards with a speed of 10 m/s. What is the acceleration of the ball three seconds after leaving the boys hand?

A 0 m/s^2
B 5 m/s^2 upwards
C 10 m/s^2 downwards
D 10 m/s^2 upwards

5 The diagram below shows the speed-time graph of a bullet train.



What is the train's acceleration in the final 30 s?

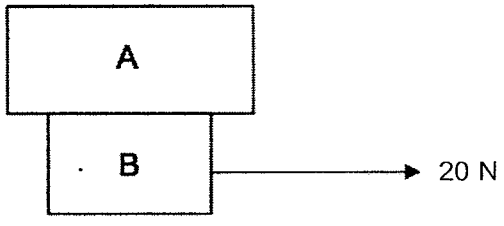
A -6.7 m/s^2
B -2.5 m/s^2
C 6.7 m/s^2
D 2.5 m/s^2

6 A 40 kg mass is moving across a horizontal surface at 5 m/s.

What is the magnitude of the uniform net force required to bring the mass to a stop in 8.0 s?

A 1 N
B 5 N
C 25 N
D 40 N

7 Two objects, A (mass 6 kg) and B (mass 4 kg), are stacked one on top of the other as shown.

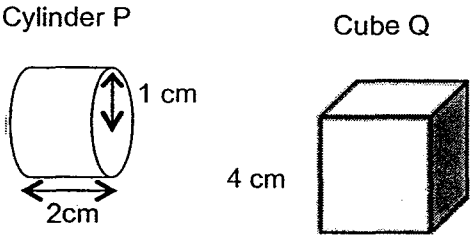


B is pulled by a force of 20 N and all surfaces are frictionless.

What is the acceleration of A?

A 0 m/s^2
B 2 m/s^2
C 3.3 m/s^2
D 5 m/s^2

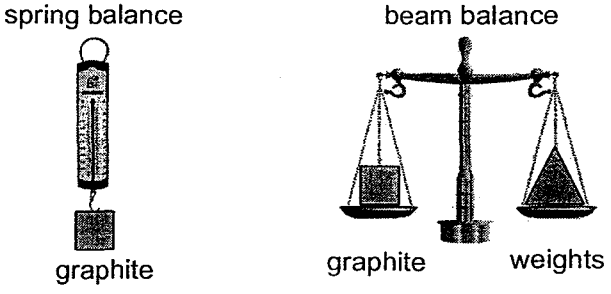
8 The diagram below shows cylinder P and Cube Q. They are made of the same material. Cylinder P has radius of 1 cm and length of 2 cm. Cube Q has sides 4 cm.



If cube Q has a mass of 128 g, what is the density of cylinder P?

A 1 g/cm^3
B 2 g/cm^3
C 4 g/cm^3
D 8 g/cm^3

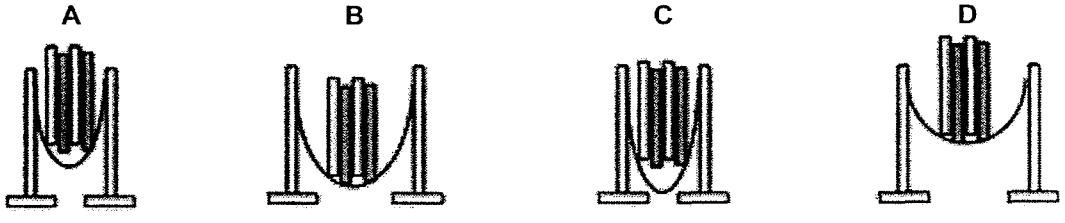
9 A block of graphite is weighed on the surface of the moon using a spring balance and a beam balance as shown below. The experiment is repeated on earth with the same piece of graphite.



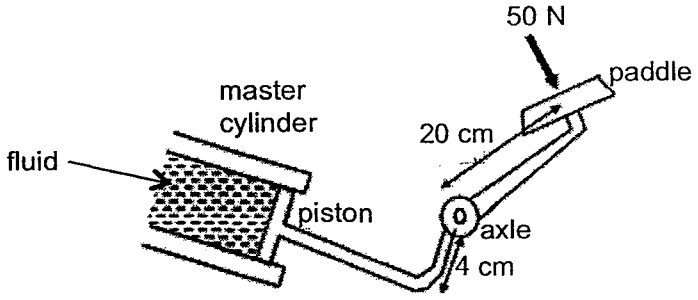
How will the readings of the two instruments change?

	spring balance reading	beam balance reading
A	decrease	decrease
B	decrease	remains unchanged
C	increase	increase
D	increase	remains unchanged

10 Magazines are placed in four magazine racks. Which magazine rack is most unlikely to fall if tilted?



11 The diagram below shows a part of a car braking system. The master cylinder has a cross sectional area of 5.0 cm^2.



The driver exerts a force of 50 N on the paddle. What is the pressure transmitted to the fluid?

A 25 N/cm^2
B 50 N/cm^2
C 125 N/cm^2
D 250 N/cm^2

12 A rectangular box of dimensions 4.0 m by 2.0 m by 3.0 m weighs 50 N.

What is the minimum pressure it exerts on the surface it rests on?

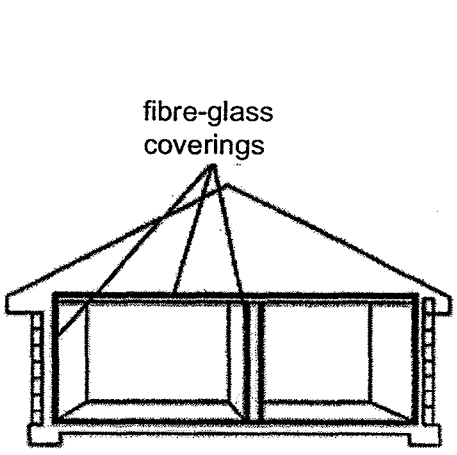
A 2.1 Pa
B 4.2 Pa
C 6.3 Pa
D 8.3 Pa

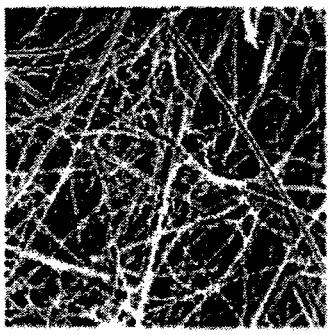
13 In a marathon, a runner of mass 60 kg runs up a slope of height 40 m with constant speed of 4.0 m/s. The length of the path is 600 m.

Neglecting friction and air resistance, what is the runner's power output from the muscles?

A 3 W
B 16 W
C 64 W
D 160 W

14 Fibre-glass is a material that consists of a large amount of fine glass threads. Coverings made of fibre-glass are laid on the floor, walls and ceilings of a house to reduce heat loss to the surroundings.





fine glass
threads

Which is/are the reason(s) for the use of fibre glass?

i. The specific heat capacity of fibre-glass is small.
ii. The glass threads trap air which is a very poor conductor of heat.
iii. Fibre-glass reflects heat.

A (i) only
B (ii) only
C (i) and (ii) only
D (i) and (iii) only

15 In calibrating a thermocouple thermometer, one of its junctions is kept in melting pure ice and the other in boiling pure water. The current reading on the microammeter is 50 μA.

The 'hot junction' is immersed in a substance of -10°C. What would be the current reading on the ammeter?

A 0.5 μA
B 2.5 μA
C 5 μA
D 50 μA

16 What is the internal energy of a system?

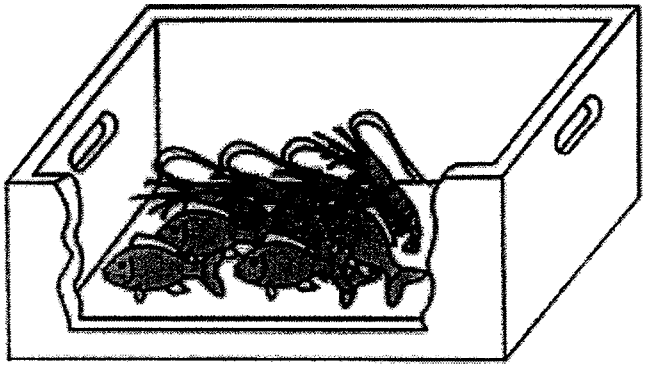
A The maximum amount of work that can be extracted from the system.
B The sum of kinetic and potential energies of the particles.
C The total amount of work done on the system.
D The thermal energy needed to raise the temperature of the system by 1 K.

17 A student investigates changes that take place as wax solidifies.

Which statement describes these changes?

A A transfer of energy and a change in temperature.
B A transfer of energy but no change in temperature.
C No transfer of energy and no change in temperature.
D No transfer of energy but a change in temperature.

18 A box shown below is used for storing seafood.



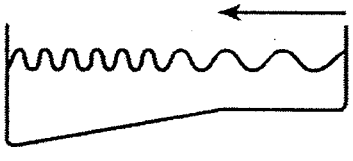
What property should the box have in order to keep the seafood fresh?

A high density
B high specific heat capacity
C low specific heat capacity
D low specific latent heat

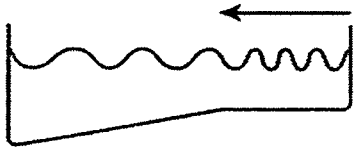
19 A ripple tank contains water of varying depths. The speed of the wave increases as it travels from the shallow to the deeper region. The frequency of the wave remains constant.

Which diagram correctly represents the water waves as they travel from the shallow to the deeper region?

A

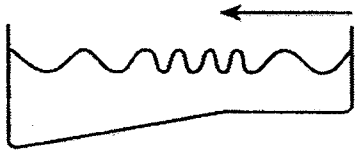


B

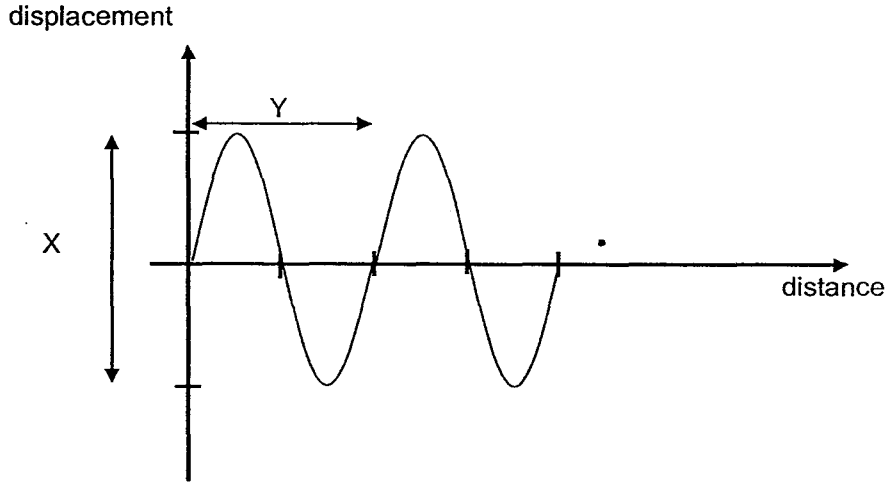


C

D



20 The graph below describes a wave.



What can you conclude from the graph?

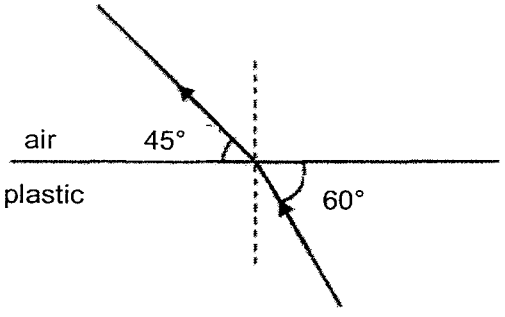
A The amplitude is X.
B The amplitude is X/2.
C The period is Y.
D The period is Y/2.

21 The critical angle of a medium is 45°.

What is the refractive index of the material?

A 0.71 **B** 1.00 **C** 1.33 **D** 1.41

22 The diagram shows a ray of light travelling from plastic to air.



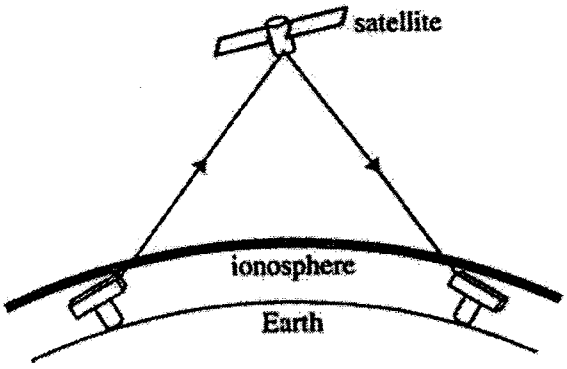
What is the refractive index of the plastic?

A 0.707
B 0.816
C 1.22
D 1.41

23 Which of the following about ultraviolet ray is incorrect?

A They are absorbed by plants to perform photosynthesis.
B They are widely employed for burglar alarm.
C They may be used for sterilization.
D They produce fluorescence in fluorescent material.

24 Electromagnetic waves are used in satellite communication.



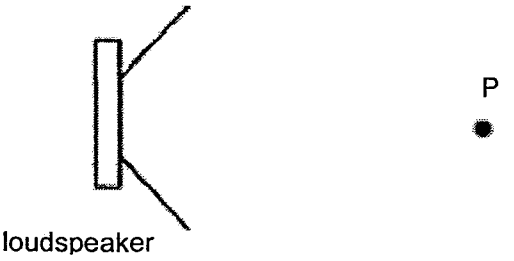
What type of electromagnetic waves is used?

A infra-red radiation
B gamma rays
C microwaves
D radio waves

25 In which situation could sound waves not travel?

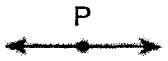
A along a metal railway line
B between two spaceships in space
C from a surface ship to submarine
D through a balloon filed with helium

26 The diagram shows a loudspeaker which emits a sound.



Which shows the motion of a particle at P caused by the sound wave?

A

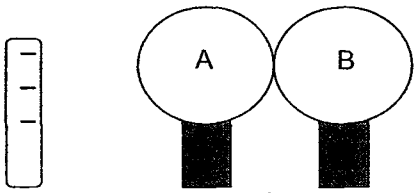


C

B

D

27 Two insulated and uncharged metal spheres, A and B, are touching each other.



A negatively-charged rod is placed near sphere A. B is then earthed by touching it with a wire which is then removed. The negatively-charged rod is then removed. A is then moved far away from B.

What is the charge on sphere B?

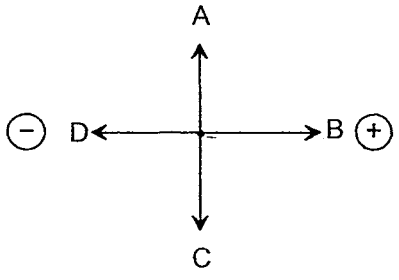
A Negative, and equal in magnitude to that on sphere A.
B Negative, but smaller in magnitude to that on sphere A.
C Positive, and equal in magnitude to that on sphere A.
D Positive, but smaller in magnitude to that on sphere A.

28 An electrostatically charged object will pick up small pieces of paper. Which will not pick up pieces of paper?

A a plastic rule pulled through dry air
B a polythene rod rubbed with silk cloth
C a rubber balloon rubbed on a woolen shirt
D an earthed metal rod rubbed with a duster

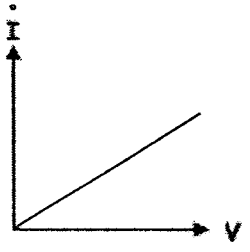
29 The diagram below shows two charges.

In which direction will the electric field act?

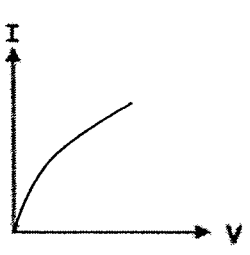


30 Which graph represents how current I varies with voltage V in a component in which the resistance decreases as the current increases?

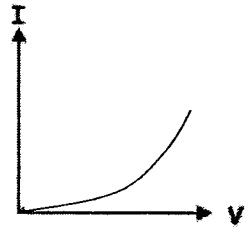
A



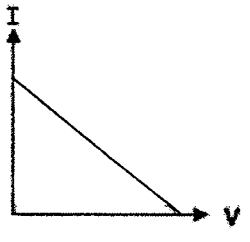
B



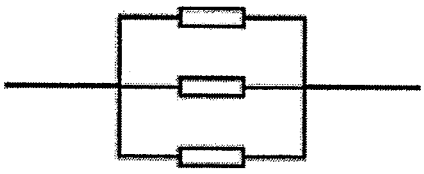
C



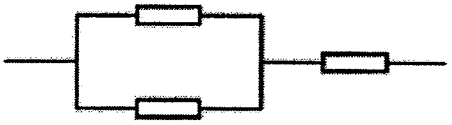
D



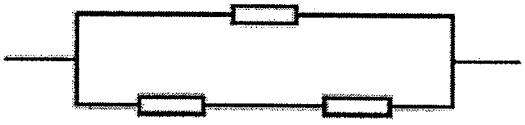
31 Three identical resistors are connected together to form three different networks.



network W



network X



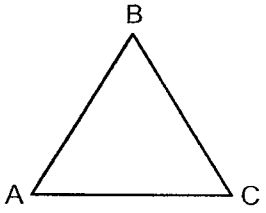
network Y

network Z

What is the correct order, going from the network with the smallest resistance to the network with the largest resistance?

A W → X → Y → Z
B W → Y → X → Z
C Z → X → Y → W
D Z → Y → X → W

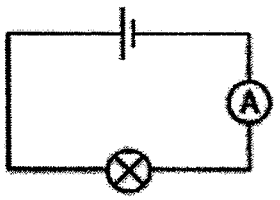
32 A uniform wire of length 30 cm and resistance 9.0 Ω is bent into the shape of an equilateral triangle ABC.



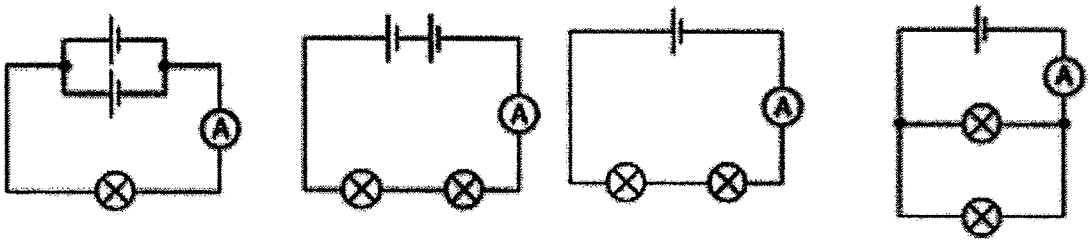
What is the effective resistance between B and C?

A 1.0 Ω
B 2.0 Ω
C 3.0 Ω
D 9.0 Ω

33 A dry cell is connected in series with an ammeter and a lamp. The ammeter reading is 1.0 A.



Using identical cells, lamps and ammeters, in which circuit is the ammeter reading 2.0 A?



A B C D

34 The cost of 1kWh of electricity is 30 cents.

electrical appliance	rating
television	235 W
air-conditioner	2.75 kW
lamps	100 W

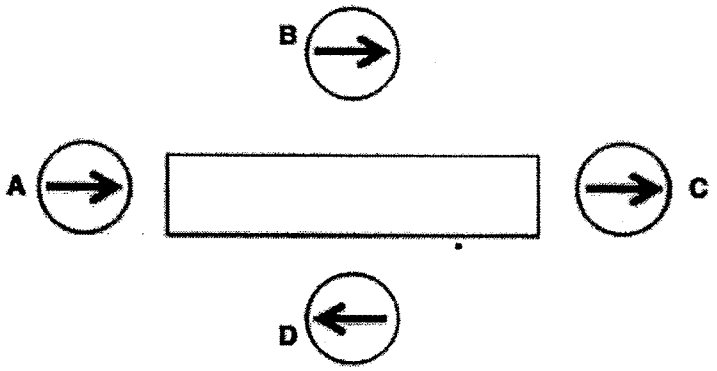
What is the total cost of operating the above appliances for 3 hours?

A $2.78
B $5.49
C $30.85
D $303.98

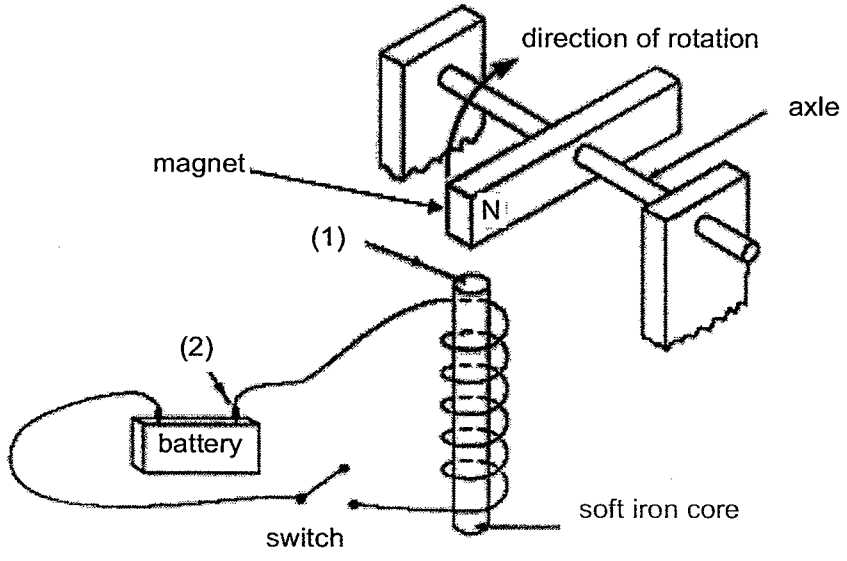
35 After some building work in a house, a bare (uninsulated) live wire is left protruding from a wall. What is the greatest hazard?

A a fire
B a fuse will blow
C an electric shock
D no current will flow

36 Four magnetic compasses are placed around a permanent bar magnet. Which compass needle is pointing in the wrong direction?



37 A magnet mounted on an axle is free to spin. When the switch is closed, the magnet spins in the direction shown.



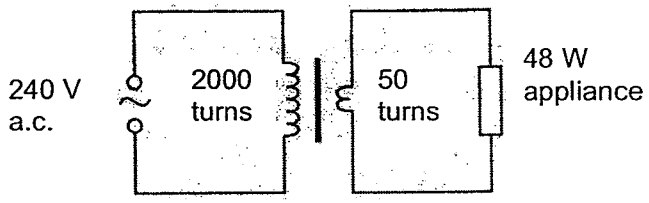
What is the magnetic polarity of the end of the soft iron core marked (1) and the polarity of the battery terminal marked (2)?

	polarity of soft iron core (1)	polarity of battery (2)
A	north	negative
B	north	positive
C	south	negative
D	south	positive

38 Which of the following explains why electricity delivered to homes from power stations is transmitted at high voltages and low currents.

A Electricity can travel faster along the cables.
B It is safer for engineers to repair the overhead cables.
C It reduces energy loss along the cables.
D It reduces resistance of the cables.

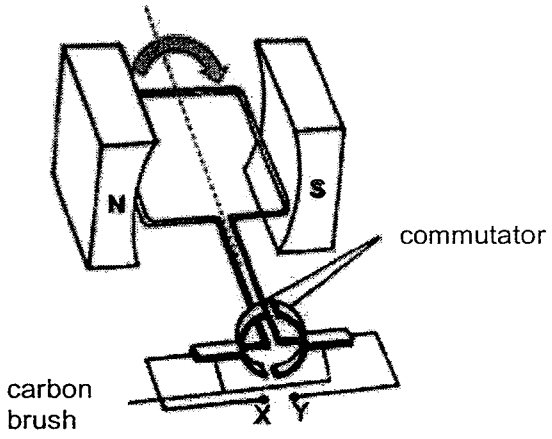
39 An appliance marked 48 W is connected across the secondary coil.



For the appliance to work normally, what is the current passing through it?

A 0.025 A
B 6.0 A
C 8.0 A
D 48.0 A

40 The diagram shows a simple generator.



If the coil is made to rotate in a clockwise direction, which of the following statements are true?

I. The e.m.f. across XY will reach its maximum value when the plane of the coil is horizontal.
II. Y will be the negative terminal of the output.
III. It will be harder to turn the coil if a lamp is connected to the X and Y terminals.

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

Exam Index Number	

PRELIMINARY EXAMINATION 2016

SECONDARY FOUR EXPRESS

PHYSICS 5059/02
(PAPER 2 Theory)

TIME: 1 HOUR 45 MINUTES

READ THESE INSTRUCTIONS FIRST

Write your Exam Index Number in the box provided at the top of this page and any separate answers paper provided.
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams or graphs.

Section A
Answer **all** questions.

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

Candidates are reminded that **all** quantitative answers should include appropriate units.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

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

For Examiner's Use		
PAPER 1		/ 40
PAPER 2		
Section A		/ 50
Section B		/ 30
Total		/ 80

Section A

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

1 Fig. 1.1 shows a ship-to-ship cable used to transfer people and goods from one ship to another.

(a) A 500 N object is suspended at the mid-point of the cable ABC. By using a suitable scale drawing, find the tension present in the cable AB and BC.

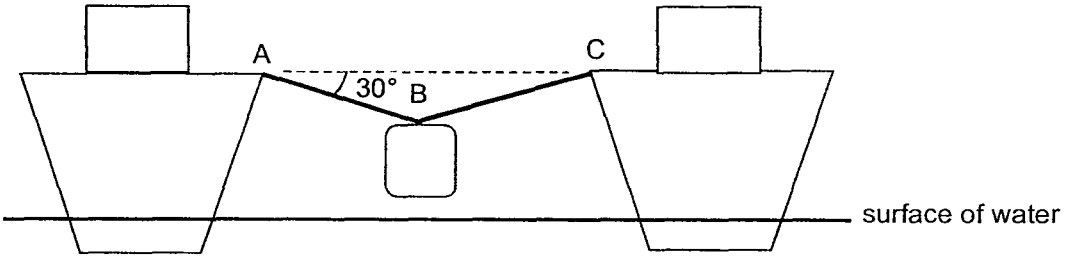


Fig. 1.1 (not drawn to scale)

tension in AB= .....

tension in BC = ... [4]

(b) When both ships are moving apart, the cable may break and cause severe injury. Suggest why an almost horizontal cable is more likely to break as compared to the cable in **(a)**.

.....

..... [1]

(c) Fig. 1.2 shows all the forces acting on one of the ship. The tension, T, of the cable is 100 kN. The centre of gravity is at point C. The weight of the ship, W, is 500 kN. The buoyant force, F_B, by the water acts at point D.

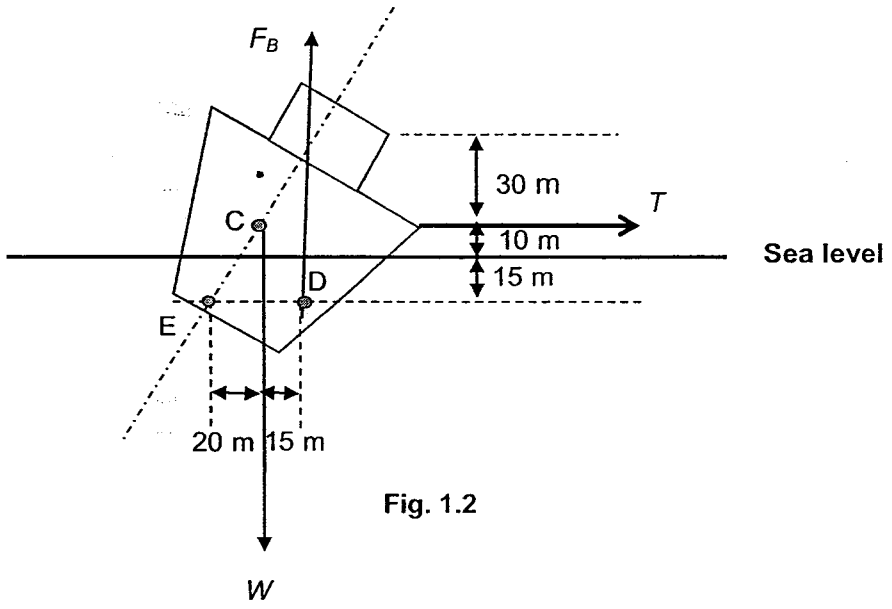


Fig. 1.2

(i) Calculate the sum of the clockwise moments due to the tension of the cable and the weight of the ship about point E. Leave your answer in kNm.

moment = ... [2]

(ii) Calculate the minimum buoyant force, F_B required to prevent the ship from toppling.

force = ... [2]

2 When large buildings are being erected, particularly on soft ground, piles are driven into the ground to provide a firm foundation. Fig. 2.1 shows a pile hammer in operation. The pile hammer has a mass of 5000 kg.

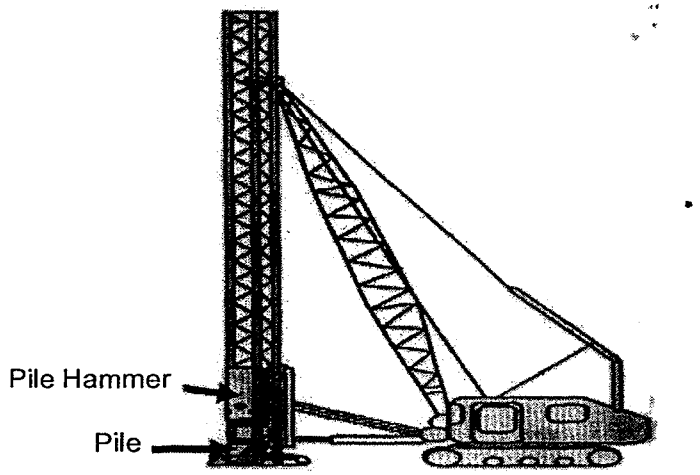


Fig. 2.1

(a) Calculate the loss of gravitational potential energy when the hammer falls 4.0 m to hit the pile.

loss of gravitational potential energy = ... [2]

(b) Assuming negligible air-resistance, calculate the speed of the hammer when it hits the pile.

speed = ... [2]

(c) Calculate the efficiency of the piling process given that 50 000 J of energy is converted sound and thermal energy.

efficiency = ... [2]

3 Fig. 3.1 shows a magnet picking up an iron coin.

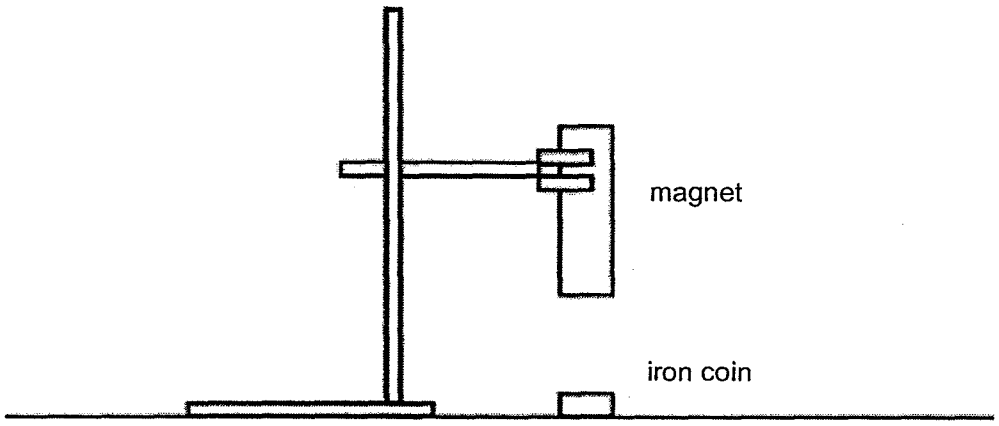


Fig. 3.1

The coin has a mass of 0.02 kg.
The initial attractive force on the iron coin by the magnet was 0.3 N.

(a) Explain why there is an attractive force on the iron coin by the magnet.

.....

.....

..... [2]

(b) Calculate

(i) the initial resultant force acting on the coin,

resultant force = ... [2]

(ii) the initial acceleration of the coin.

acceleration = ... [2]

4 Fig. 4.1 shows a long vertical glass tube with one end immersed in mercury and the other connected to a vacuum pump. The tube fits tightly into a bell jar. With tap B open, and air pumped out via A, the mercury rises to a maximum height of 76.0 cm above the dish.

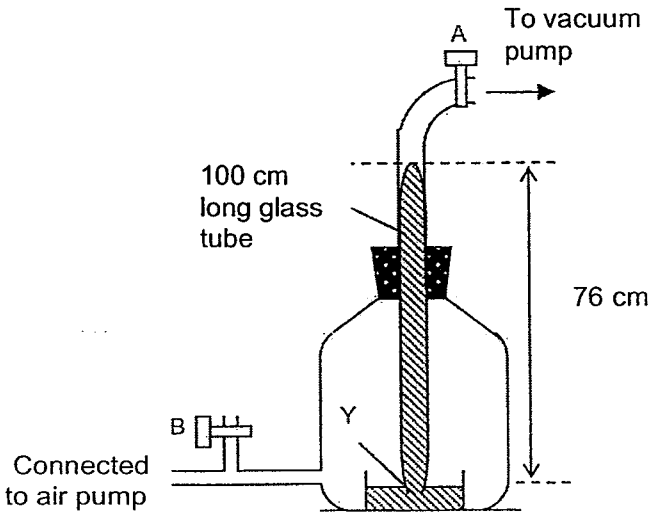


Fig. 4.1

(a) Explain why the mercury in the tube above Y can only rise to a maximum height of 76.0 cm.

.....

.....

..... [2]

(b) Given that the density of mercury is 13 600 kg/m^3, calculate the pressure at Y. Leave your answer in Pa.

pressure = ...Pa [2]

(c) Suggest how you can make the mercury column rise to a greater height.

.....

..... [1]

5 The piston for the bicycle pump in Fig. 5.1 is pushed in slowly until the piston comes to its positions shown in Fig 5.2. The air in the pump remains at a constant temperature throughout.

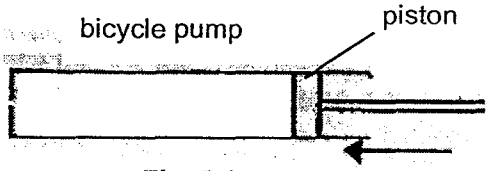


Fig. 5.1

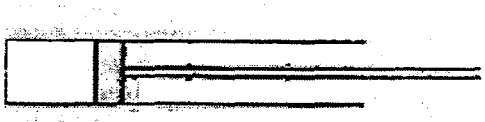


Fig. 5.2

(a) Describe the motion of the air molecules in the pump in Fig. 5.1.

.....

..... [1]

(b) Using ideas about molecules, explain why the pressure in Fig. 5.2 is greater than in Fig. 5.1.

.....

.....

.....

..... [3]

(c) If the piston was pushed in quickly instead, the temperature of the air in the pump would have increased. Using ideas about molecules, explain how this would affect the pressure in the pump as compared to your answer in **(b)**.

.....

.....

.....

..... [3]

6 Fig. 6.1 shows the screen of a cathode ray oscilloscope. The time-base is set at 0.4ms/mm and the length of the time-base sweep MN is 100mm.

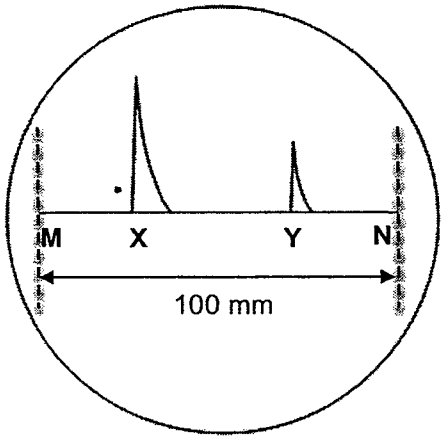


Fig. 6.1 (scaled diagram)

(a) Calculate the time represented by MN.

time = ... [1]

(b) A radar signal, sent from the radar station to a distant aircraft, is displayed on the CRO at X and the signal received back from the aircraft is displayed at Y. The speed of radio waves is 3.0×10^8 m/s. Calculate the distance of the aircraft from the radar station.

distance = ... [3]

(c) State why the signal displayed at Y is weaker than that at X.

.....

..... [1]

7 Fig. 7.1 shows a thin converging lens used to improve the efficiency of a solar cell.

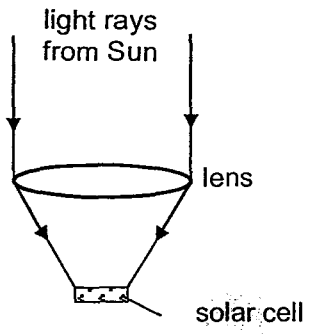


Fig. 7.1

Fig. 7.1 is drawn to scale.

(a) **(i)** State what is meant by the focal point of a lens.

.....

..... [1]

(ii) On Fig. 7.1, draw construction lines to determine the focal length of the lens.

focal length = ... [2]

(b) Explain how the lens affects the amount of electrical power generated by the solar cell.

.....

.....

.....

..... [2]

(c) The lens is replaced with a replacement lens that has a longer focal length compared to the original lens.

State and explain whether the replacement lens has to be placed closer or further away from the solar cell in order for the efficiency of the solar cell to remain the same.

.....

.....

.....

..... [1]

8 Fig. 8.1 shows a magnet being dropped vertically down through a solenoid. Fig. 8.2 shows how the induced current in the solenoid changes with time.

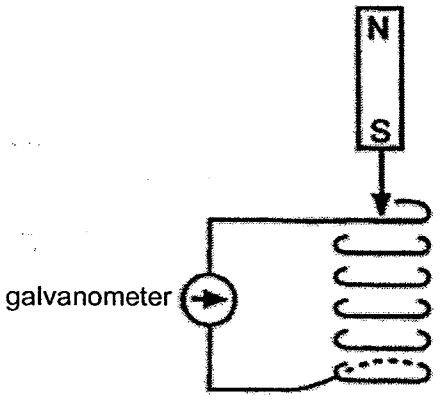


Fig. 8.1

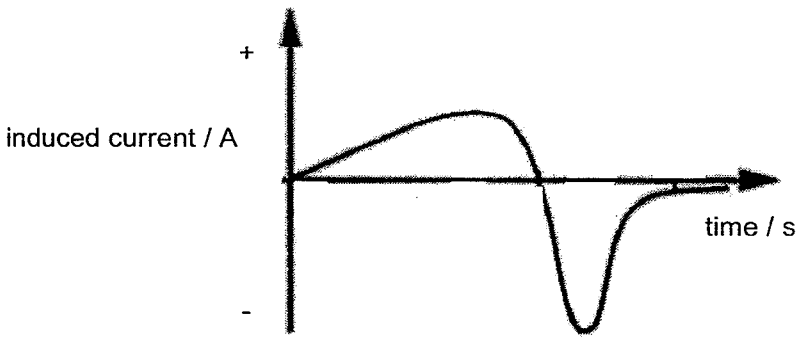


Fig. 8.2

(a) Explain why the second (negative) pulse of induced current is shorter in duration.

.....

.....

..... [1]

(b) Explain why the second pulse of current has a greater magnitude that the first (positive) pulse of induced current.

.....

.....

.....

..... [2]

(c) In the space below, sketch the graph, if the North end of the magnet was dropped first into the coil instead of the South end. [1]

(d) State two ways in which the magnitude of the induced current generated can be increased.

.....

.....

..... [2]

Section B

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

9 In recycling plants, electromagnets are used to separate empty drink cans from the rest of the other materials. Fig. 9.1 shows an example of an electromagnet used to lift some cans.

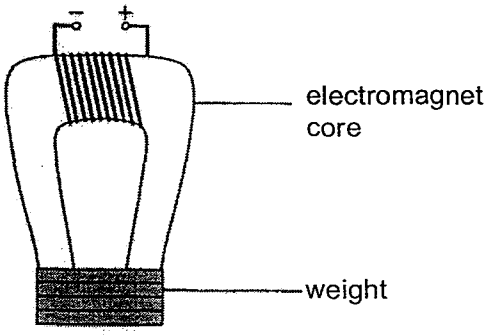


Fig. 9.1

Fig. 9.2 shows the data for four cores made from different materials.

Material	Density / gcm^{-3}	Relative Permeability	Resistivity / Ωm
H	7.87	5000	1×10^{-7}
I	7.85	1000	2.2×10^{-7}
J	8.90	600	6.84×10^{-8}
K	2.71	1	2.62×10^{-8}

Fig. 9.2

The relative permeability of a material is the ease at which the material can be magnetised. The strength of the magnet increases with the ease at which a material can be magnetised.

(a) Identify the best material to be used as an electromagnet core for lifting the most number of cans. Explain why.

.....

.....

..... [1]

(b) If material K is used for the manufacture of the drink cans, explain whether there is an increase or decrease in the number of drink cans that the electromagnet is able to lift compared to the other materials.

.....

.....

..... [1]

(c) The cans are attracted to the electromagnet through the process of induced magnetism. Describe what is induced magnetism.

.....

.....

..... [1]

(d) From Fig. 9.2, state and explain the relationship between hard magnetic materials and their electrical resistance.

.....

..... [2]

(e) Fig. 9.3 shows how the weight lifted by the electromagnet using material **H** core is dependent on the current in the coil.

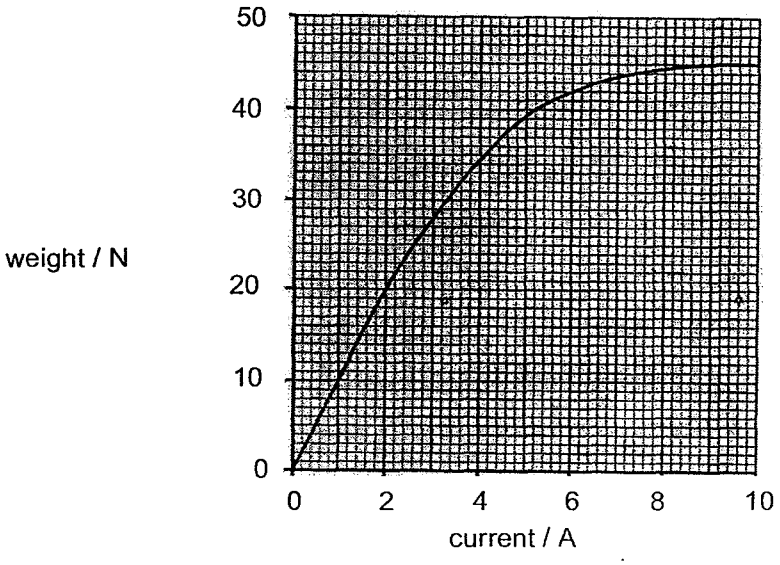


Fig. 9.3

(i) Suggest two methods to modify the electromagnet to lift a heavier load.

.....

.....

..... [2]

(ii) On Fig. 9.3, sketch the relationship between weight and current if material J is used for the core. [1]

(iii) The current is set so that the electromagnet can only lift the weight of 10 cans. One can weighs 2.5 N.

Using Fig. 9.3, explain if the electromagnet is able to lift 20 cans at the same time if the current is doubled.

.....

.....

.....

..... [2]

10 The brightness of the lamp inside a train is built in such a way that it becomes brighter as the external environment gets darker. The train enters a tunnel at t = 0 s.
Fig. 10.1 shows how the brightness of the lamp inside the train changes as it enters and moves through the tunnel at constant speed.

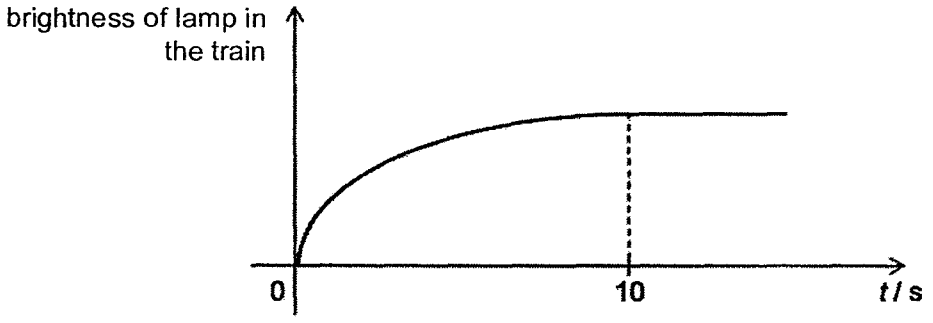


Fig. 10.1

(a) Suggest 2 possible reasons for the shape of the graph in Fig. 10.1 after t = 10 s.

1: .....

2: ..... [2]

(b) If the train were to move at twice the original speed, sketch on Fig. 10.1., how the brightness of the lamp inside the train will change as it moves through the same tunnel. [2]

(c) Fig. 10.2 shows the equipment that is connected in a circuit with the lamp in the train.

Equipment	Quantity
12 V dry cell	1
fixed resistor	1
light-dependent resistor (LDR)	1
lamp	1

Fig. 10.2

(i) In the space below, draw a circuit using the equipment from Fig. 10.2, which can be used for the lighting in the train [2]

(ii) Explain how the circuit in **c(i)** increases the brightness of the lamp in the train as it enters the tunnel.

.....

.....

.....

.....

.....

..... [2]

(d) (i) The lamp in the train is connected to a 12 V dry cell, which dissipates energy at a rate of 270 mW.

Calculate the current flowing through the lamp.

current = ... [1]

(ii) The lamp uses an input transducer to control the brightness of the lamp in the train.

Define the term input transducer.

.....

..... [1]

11 EITHER

A vacuum flask is a container that keeps a substance hot or cold by means of a double wall enclosing a vacuum. Fig. 11.1 shows a cross-sectional view of a vacuum flask.

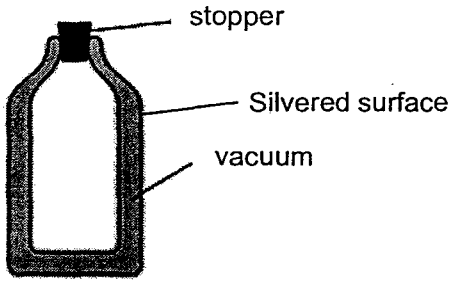


Fig 11.1

(a) Explain why it is not essential to close the top of the vacuum flask to keep water cold for a period of time.

.....

..... [1]

(b) Explain how a silvered surface is able to keep water in the flask cold.

.....

..... [1]

(c) Explain the ways in which a vacuum flask keeps hot liquid warm for a long time.

.....

.....

..... [2]

(d) When a flask was filled with hot water, it felt warm.

Identify and explain the fault(s) present in the flask.

.....

.....

..... [3]

(e) An immersion heater producing 300 W of power is placed in a vacuum flask containing ice at -5 °C.

Calculate the time taken to melt 0.2 kg of ice completely, assuming that all the energy dissipated by the heater is absorbed by the ice.

Specific latent heat of ice = 330 000 J/kg
Specific heat capacity of ice = 2000 J/kg°C

time taken for ice to melt = ... [4]

11 OR

Fig 11.2 shows a part of the main electrical circuit in a house.

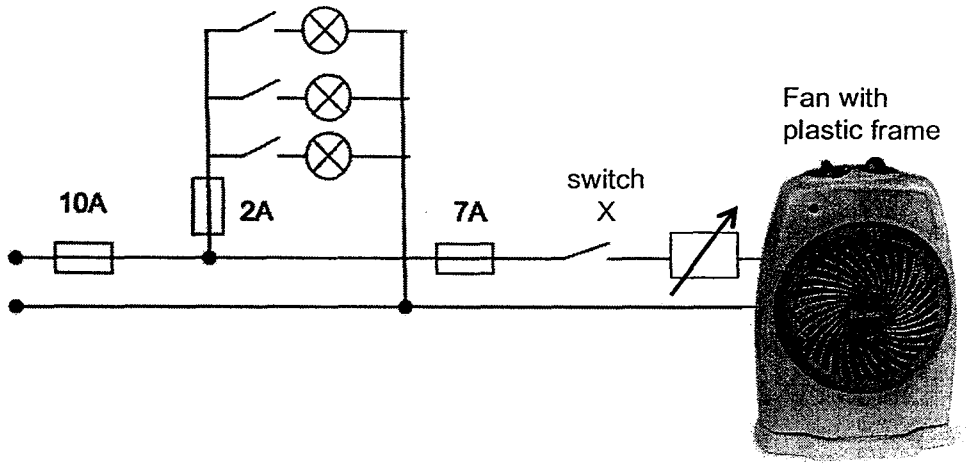


Fig. 11.2

Three lamps, each rated 60 W, 960 Ω are connected to the live wire through a 2 A fuse. An electrical fan rated at 1200 W, 240 V is connected to the live wire through a 7 A fuse. There is a 10 A fuse protecting the whole circuit. The mains supply is 240 V.

(a) State the function of the neutral wire in a circuit.

.....

..... [1]

(b) Explain if it is dangerous to connect only the live and neutral wire to the fan.

.....

.....

..... [1]

(c) Describe how the speed of the rotation of the fan blades can be increased.

.....

.....

.....

..... [2]

(d) Determine the current in each of the fuses when all the appliances are switched on.

current in 2 A fuse = ...

current in 7 A fuse = ...

current in 10 A fuse = ... [3]

(e) With all the appliances being switched on, the live wire touches the neutral wire at switch X.

(i) Describe and explain the effect on the lamps, fan and fuses when this fault happens.

.....

.....

.....

.....

..... [2]

(ii) Suggest another device that can replace the fuse in the circuit. State the advantage of using the device instead of the fuse.

.....

.....

..... [1]

End of Paper

2016 Sec 4 5059 Prelim

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

Qn.		Answers	Marks	Markers' Comments
1	(a)	Scale: 1 cm : 50N (490N – 510N) or 1cm: 100N (480N to 520N) Correct shape Correct direction of arrows Tension = 500 N Comments: Scale must be mentioned and not inferred from the vector diagram.	B1 B1 B1 B1	Students made common mistakes in the identification of the direction of the tensional forces. Most students make the mistake of pointing the tensional forces towards the weight. Most students have trouble in identifying that the two tensional forces will act to have a resultant upwards force. Students could properly identify a proper scale.
	(b)	As the angle between the ropes increase, tension in the rope increases, causing it to break.	A1	Generally well done although a few students made the mistake of using moments to answer the question.
	(c)	(i) Total clockwise moments =T(25) + W(20) = 100(25)+500(20) = 2500 + 10000 = 12,500 kNm	M1 A1	Many students had trouble identifying the correct perpendicular distances to calculate the moments cause by each force.
		(ii) Take moments about E, T(25) + W(20) = F_B(35) 12500 = F_B(35) F_B = 357 kN	M1 A1	Most students got this question correct due to ecf. Students were able to identify the correct perpendicular distance.

2	(a)	GPE = mgh = 5000 x 10 x 4 = 200, 000 J	 M1 A1	
	(b)	Loss in GPE = Gain in KE 200,000 = 0.5 x 5000 x v^2 v = 8.94m/s	 M1 A1	Most students were able to equate the GPE to KE.
	(c)	Efficiency = (Output / Input) x 100% = (150 000 / 200 000) x 100 = 75%	 M1 A1	Most students were able to use the correct values to calculate the efficiency. Some students showed lack of understanding and used 200 000 / 250 000 to calculate

3	(a)	Iron is a magnetic material. The coin becomes a induced magnet which cause an attraction between the coin and the magnet. Comments: Accept magnetic object (given BOD), magnetic conductor is not accepted. An explanation involving magnetic poles being induced and therefore attracting each other because unlike poles attract.		M1 A1	Most students were able to correctly use the term magnetic material. Some students use magnetic object and were given BOD marks. Students were unable to adequately explain the second point on the induction of magnetic properties/polarity on the coin.
	(b)	(i)	F = 0.3 – (0.02 x 10) = 0.1 N	M1 A1	Some students were unable to identify that the attractive force and weight acted in opposite direction.
		(ii)	F = ma = 0.1 / 0.02 = 5m/s^2	 M1 A1	Most were able to get this question correct due to ecf
4	(a)	Atmospheric pressure of 76 cmHg, acts on the surface of mercury reservoir. The pressure at Y will only be due to the mercury acting above it, so the mercury will rise to a height of 76cm Hg.		M1 A1	Most were able to get answer that atmospheric pressure acted on the surface of the mercury but only a small percentage of students were able to identify that the pressure at Y was due to the height of mercury above it.
	(b)	Pressure = density x g x h = 13 600 x 10 x (76/100) = 1.03 x 10^5 Pa		M1 A1	
	(c)	Pump more air into the bell jar through tap B. Or any logical answer Comment: Accept 1) increase temperature in the jar 2) bring to lower elevation		A1	Most students were able to give sound and logical answers.

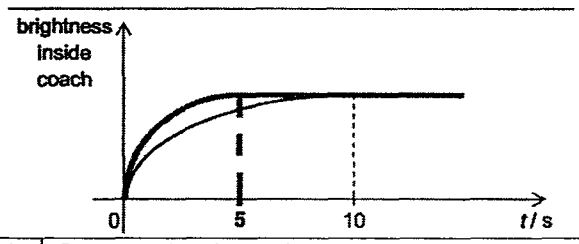
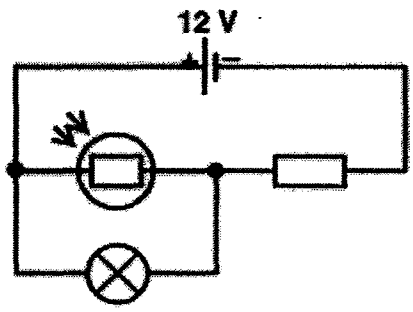
5	(a)	Air molecules are in **continuous random motion** and moving at **high speeds.** Comment: Kinetic energy may be accepted in exchange for speed.	A1	Some of students were unable to give both portions of the answers in the description of the motion.
	(b)	Because the pump is pushed in, the **number of molecule per unit volume is greater.** The **frequency of collision** of the molecules with walls of the pump **increases**, therefore causing a force to be exerted on the piston to be higher. Since pressure is **force per unit area**, pressure is higher Comment: Accept 'space' in exchange for 'volume'	M1 M1 A1	Most of the students had trouble obtaining full credit for this question. They failed to give the following 1) Correct description of no. of molecules per unit volume 2) Identifying the increase in frequency as the cause of the increase in force on the walls 3) Stating that the increase in force per unit area as pressure
	(c)	**Kinetic energy of the molecules increase** due to increase in temperature. Pressure would increase even more than in (b), As molecules will collide **more frequently** and with **greater force** on the walls of the pump. Comment: Accept the use of the word 'speed' instead of 'kinetic energy'	M1 B1 A1	Most students were unable to state that the increase in KE of the molecules results in a increase in frequency of collision and the force of collision.
6	(a)	Time = 100 x 0.4ms = 40 ms or 4 x 10^{-2}s or 0.04s	A1	Some students incorrectly used 100/0.4 to calculate the answer.
	(b)	Time taken = [(2.2/5) x 100] x 0.4 =17.6 ms 2d = speed x time d = [(3x10^8) x (17.6 X 10^-3)]/2 d = 2 640 000 m Comment: Accept range of measurement between 5.1cm to 5cm Range for time taken = 17.2 ms or 17.6ms Range for d = 2 580 000m or 2 640 000m	M1 M1 A1	Most students were unable to calculate the time taken from X to Y. Most students incorrectly used speed x time to calculate the distance when they should have divided that value by 2 to calculate due to the echo.
	(C)	Energy is absorbed by the surrounding air. Thus less energy is received by the radar.	A1	Generally well done although a handful of students were unable to adequately describe energy loss.

7	(a)i	It is the point at which all light rays that travel parallel to the principal axis converge on	1	Most students were unable to correctly define this.
	(a)ii	Correct drawing to extend the light rays to converge at a point 2cm (accept 1.9 to 2.1)	[B1] [B1]	Most students were able to draw the path of the light ray however some students made the error in measuring the focal length from the top part or bottom part of the lens instead of the center.
	(b)	The lens converges the light rays, Allowing more **solar energy** to reach the solar cell **per unit time** which will allow the solar cell to increase the amount of electrical power generated. Comment: Accept as long as the idea of convergence is shown	[M1] [A1]	Most students were able to identify the convergence as a lens for the reason for an increase in solar energy hitting the surface of the solar cell but were unable to relate the quantity energy and power.
	(c)	The lens will have to be positioned further away from the cell. With a larger focal length, light rays will need to travel a longer distance to converge on the same area Comment: Accept as long as the idea of the point of convergence is at a point that that is a longer distance away from the lens is shown	[M1]	*Question Voided* Most students were unable to adequately explain that the longer focal length results in the light rays converging at a distance that is greater.

8	a	The magnet is travelling faster and therefore takes a shorter time to leave the solenoid Comment: Accept – accelerating, speed increasing. Do not accept – Faster velocity/speed	A1	Most students were able to answer the question although a small amount of students used faster velocity instead of greater or larger velocity.
	b	The magnitude of the induced emf and the current is proportional to the rate of change of magnetic flux linkage with coil. Since the magnet is moving faster through the coil as it exits, there is a higher rate of change of magnetic flux linkage with coil. Comment: Accept (BOD) if 'with coil' is not present	[M1] [A1]	Most students could identify the 'rate of change of magnetic flux linkage with coil' as the reason for the greater current. However, most students used the term 'rate of change of magnetic flux'. Most students did not explain why the increase in rate of change of magnetic flux linkage with coil would result in a greater magnitude of current.
	c	The first pulse of the induced current will be negative and the second pulse will be positive	[A1]	

	d	Use a stronger magnet Increase the amount of coils in the solenoid. Comment: Do not accept the use of a soft iron core. Accept - throw the magnet in at a higher speed.	A1 A1	Some students incorrectly used soft iron core. Context of problem makes this method to increase the current impossible.

9	(a)	Material H Its high relative permeability allows the material to be magnetized easily		[A1]	Some students incorrectly identified K as the best material due to the lower density. The permeability is 5000 times greater in H compared to K, while the density is 3 times greater. The effect of the increase in permeability outweighs the increase in density
	(b)	Number of drink cans are reduced. Material K is difficult to magnetize compared to material H, I, J		[A1]	
	(c)	Induced magnetism is the process in which an object made of a magnetic material becomes a magnet when it is near or in contact with a magnet. Comment: Accept if 'magnetic material' is replaced with 'magnetic object'		A1	Most students had trouble defining induced magnetism adequately.
	(d)	Hard magnetic material corresponds to low resistivity. Since resistance is proportional to resistivity, hard magnetic materials corresponds to low resistance.		[A1] A1	Very few students were able to use the data to correctly identify the relationship between hard magnetic materials and resistivity. An even smaller amount of students were able to relate the quantities resistivity and resistance
	(e)	i	Increase current in the coil. Increase the number of turns in the coil	[A1] [A1]	
		ii	A curve below curve for material H	[A1]	
		iii	The current required to lift ten can of 25 N is 2.6 A. When the current is doubled to 5.2 A it can only lift up to 40 N. The electromagnet is unable to lift 20 cans which weigh 50N	[M1] [A1]	

10	(a)	1: There is no change in the surrounding light intensity 2: The lamps are already operating at its maximum power / brightness Comment: Accept if the idea of light intensity is not changing is shown.		[A1] [A1]	Most students were able to identify that no change in external light condition as a reason but were unable to identify that the lamp has reached the maximum brightness as a reason.
	(b)	Steeper Value of brightness reach the same max level  		[A1] [A1]	
	(c)	i	Correct circuit symbols used Correct connection with LDR in parallel with lamp  	[A1] [A1]	Most students incorrectly drew LDR. A large number of student were unable to draw a correct circuit.
		ii	As the train enters the tunnel, the intensity of the surrounding light decreases, the resistance of the LDR increases. The higher the resistance, the higher the voltage across lamp, therefore increasing the brightness of the lamp.	[M1] [A1]	Most students incorrectly identified the relationship between the brightness of external condition and resistance of LDR. Most students were unable to identify the effect of increasing the resistance of the LDR.
	(d)	i	$I = P / V$ $= (270 \times 10^{-3}) / 12$ $= 0.0225$ A	 [A1]	Some students were unable to change milliwatt to watt.
		ii	Input transducer is an electronic device that converts non-electrical energy to electrical energy.	[A1]	Definition was poorly done

11 E	(a)	Cold air sinks as it is denser, hence heat loss via convection cannot effectively occur.	A1	Very few students are able to answer correctly. Most students were not able to identify effective convection cannot occur.
	(b)	Silver surfaces are good reflectors/poor absorbers of thermal energy and reduce heat gain from the surrounding via radiation	[A1]	Very few students are able to answer correctly. Most students were unable to adequately state that silver are poor absorbers of thermal energy and instead only state that silver reflects thermal energy.
	(c)	Surfaces of the walls are silver surfaces reduces heat loss by radiation. OR Vacuum layer reduces heat loss by conduction or convection OR Stopper prevents heat loss via convection and evaporation	M1 [A1]	Most students could only identify one proper way in which thermal energy is kept in the flask.
	(d)	The inner lining would have been damaged Therefore, air replaces the vacuum, hence heat can be lost through conduction. OR The surface maybe black due to accumulation of dirt or wear and tear. Therefore since black are better radiators of thermal energy, the bottle feels warm to the touch.	A1 A1	Most students did not understand the question. They were unable to identify possible faults and what form of transfer of thermal energy was involved to make the flask feel warm.
	(e)	$Q = mc(\Delta\theta)$ $= (0.2)\ (2000)\ (5)$ $= 2000$ J $Q = ml$ $= (0.2)\ (330\ 000)$ $= 66\ 000$J $t = E / P$ $= (66\ 000 + 2000) / 300$ $= 227$ s	B1 B1 [M1] [A1]	Most students are able to answer correctly.

11 O	(a)	The neutral wire allows current to return from the appliance to the power supply. <u>Comment:</u> Accept 'to complete the circuit'	[B1]	Most students are able to answer correctly
	(b)	No. The fan has a plastic casing and is doubly insulated. As such, the casing can		Most students could not adequately explain that the

		never be live even when there is a fault Comment: Accept if the idea of current not being able to flow through is shown		[1]	plastic frame protects the user since current cannot flow through an insulator.
	(c)	When **resistance of the rheostat is reduced**, the current running through the fan will increase and increase the speed of rotation of the fan		[1] [1]	Most students could not link the information given in 11.2 to solve the question. Some incorrectly identified the rheostat as a thermistor and hence gave weird answers.
	(d)	P = I^2 x R 60 = I^2 x 960 I = 0.25 A I(in 2A fuse) = 0.25A x 3 = 0.75A P=IV 1200 = I x 240 I = 5A Current (10A) = 5 + (0.25x3) = 5.75 A		[1] [1] [1]	Most students had trouble using the correct formula to identify the current running through each of the fuses.
	e	i	Short circuit will occur and the lamps and fans will not light up. A large current flows in the circuit and the 7A and 10A fuse will blow	M1 [A1]	Most students could identify that a short circuit will occur but were unable to identify that the 2A fuse will not blow.
		ii	Circuit breaker. It can be reset conveniently after the fault is corrected.	[A1]	