REGENT SECONDARY SCHOOL
PRELIMINARY EXAMINATION - 2016
SECONDARY 4 EXPRESS
PHYSICS PAPER 1
(5059/1)

	40
Target:	

Name: _____ ( ) **Date:** 30 August 2016

Class: Sec _____ **Duration :** 1 Hour

Setter: Mrs Ivy Lim **Parent's Signature:** _____

INSTRUCTIONS TO CANDIDATES:

Do not turn over the pages until you are told to do so.
Write your name, index number on the answer sheet in the top spaces provided.

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

Read carefully the instructions on the answer sheet.

Hand in the OMR Answer Sheet and the Question paper separately.

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 g = 10 m/s^2 or 10 N/kg for this paper

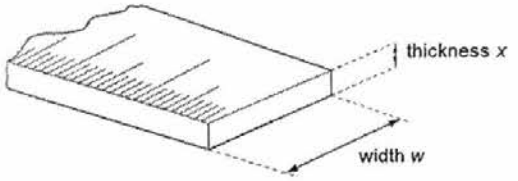
This paper consists of 40 questions on 18 printed pages.

Choose the correct answers and shade it in the spaces provided on the OMR sheet.

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

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

2 In an experiment, the width ***w*** and the thickness ***x*** of a metre rule are to be measured as precisely as possible using regular laboratory apparatus.



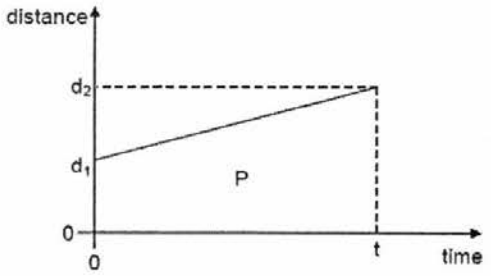
Which combination of instruments is most appropriate for these measurements?

	measurement of *w*	**measurement of *x***
A	half-metre rule	half-metre rule
B	half-metre rule	vernier caliper
C	vernier caliper	half-metre rule
D	vernier caliper	vernier caliper

3 Which of the following are vector quantities?

A Velocity, Force, Weight
B Acceleration, Mass, Force
C Energy, Power, Work done
D Distance, Velocity, Acceleration

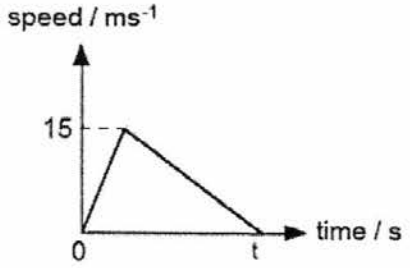
4 The distance-time graph below shows the distance travelled by a moving car. P represents the area under the graph.



Which of the following expressions would be used to determine the average speed of the car?

A P / t
B d_2 / t
C $(d_2 + d_1) / t$
D $(d_2 - d_1) / t$

5 The speed-time graph below shows the motion of a car. If the car travelled a total distance of 30 m during the time interval t shown, calculate the value of t.



A 0.50 s
B 2.0 s
C 4.0 s
D 450 s

6 To avoid an accident, the brakes of a car travelling at 30 m/s were applied suddenly.

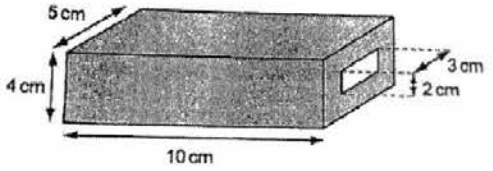
If the driver has a mass of 80 kg and it takes 3.0 s for the car to decelerate to rest, what is the average force exerted by the safety belt on the driver during deceleration?

A 240 N
B 400 N
C 500 N
D 800 N

7 A man finds it difficult to push a stationary truck along a road. Which property of the truck is responsible for this?

A inertia of the truck
B density of the truck
C friction between the truck and the road
D gravitational potential energy possessed by the truck

8 A hollow rectangular metal block has the dimensions shown.



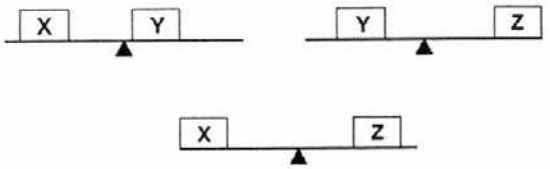
The hole in the middle goes all the way through the block.

The density of the metal is 10 g/cm^3.

What is the mass of the block?

A 14 g
B 400 g
C 1400 g
D 2000 g

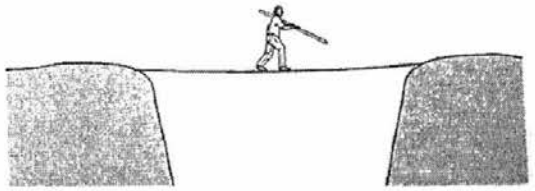
9 Three blocks **X**, **Y** and **Z** are balanced on a beam with the pivot at its mid-pivot.



Which of the following gives the arrangement of the blocks in order of increasing mass?

A X, Y, Z
B X, Z, Y
C Y, Z, X
D Z, X, Y

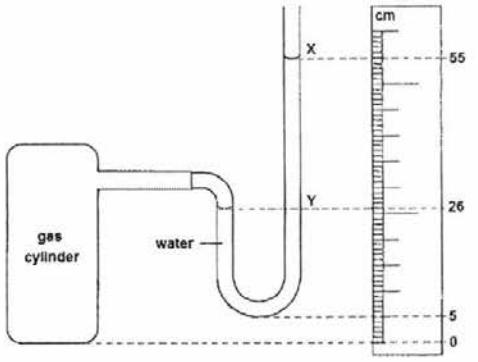
10 A man walks along a tight rope, carrying a long pole.



Why does he carry the pole?

A to spread out his weight.
B to raise his centre of gravity.
C to reduce his pressure on the rope.
D to keep his centre of gravity over the rope.

11 A manometer is attached to a gas cylinder as shown below.



What is the pressure difference, in cm of water, shown by the manometer?

A 26 B 29 C 50 D 55

12 The greatest pressure that a wooden floor surface can withstand is 5.0×10^6 Pa without being damaged. Which of the following conditions would damage the floor surface?

A An elephant with a weight of 40 000 N standing on one foot, which has an area of 1 000 cm^2 in contact with the floor.
B A drawing pin, whose pointed end has an area of 0.01 cm^2 being pushed onto the floor with a force of 10 N.
C A female dancer with a weight of 500 N standing on the heel of one shoe, which has an area of 10 cm^2 in contact with the floor.
D A metal cupboard with a weight of 1 000 N, supported on 4 legs with a total area of 75 cm^2 in contact with the floor.

13 Which of the following sequences of useful energy conversions in a nuclear power station is listed correctly?

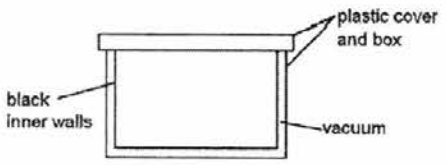
A Nuclear energy → Chemical energy → Magnetic energy → Electrical energy
B Nuclear energy → Kinetic energy → Thermal energy → Electrical energy
C Nuclear energy → Gravitational potential energy → Kinetic energy → Electrical energy
D Nuclear energy → Thermal energy → Kinetic energy → Electrical energy

14 Water from a reservoir is fed to the turbine of a hydroelectric system at a rate of 500 kgs^{-1}. The reservoir is 300 m above the level of the turbine. The electrical output from the generator driven by the turbine, is 220 A at an electromotive force of 6 kV.

What is the efficiency of the system?

A 70 %
B 75 %
C 86 %
D 88 %

15 The diagram below shows the cross-section of a plastic container that a manufacturing company has created.



The company claims that the container can keep food warm for a duration that surpasses other brands of container. It offers the following explanations to justify their claims:

1. The plastic cover will reduce heat loss through conduction as plastic is a poor conductor of heat.

2. The black inner walls will absorb heat from the environment to keep food warm since black surfaces are good absorbers of heat.

3. The vacuum between the interior and exterior walls of the container will prevent heat losses to the surroundings through conduction, convection and radiation.

Which of the statements is/are correct?

A 1 only
B 1 and 2 only
C 2 and 3 only
D All of the above

16 In an experiment to demonstrate Brownian motion, a transparent container is filled with smoke particles suspended in air.

What can be seen when the contents of the container are strongly illuminated and viewed through a microscope?

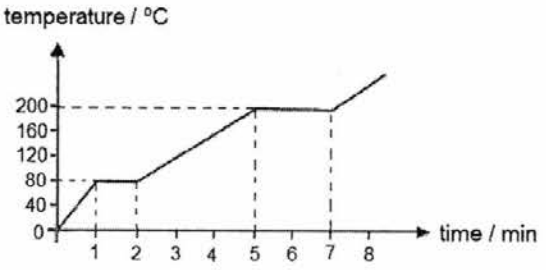
A smoke particles vibrating regularly
B smoke particles in random motion
C air molecules in random motion
D air molecules vibrate regularly

17 Two blocks of copper, **R** and **S**, each receives the same amount of heat. The mass of **R** is twice that of **S**. Which statements about **R** and **S** are correct?

(1) The heat capacity of **R** is twice the heat capacity of **S**.
(2) The temperature rise of **R** is half the temperature rise of **S**.
(3) The specific heat capacity of **R** is twice the specific heat capacity of **S**.

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

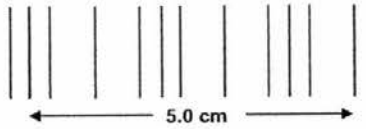
18 A substance at solid state is heated by a constant heat source. The graph shows the change of temperature of 2.0 kg of the substance when a 1 500 W heater us used.



What is the specific latent heat of vaporization of the substance?

A 1 500 J/kg
B 3 000 J/kg
C 45 000 J/kg
D 90 000 J/kg

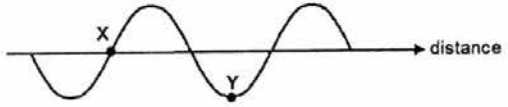
19 As a sound wave progresses at 300 m/s, regions of compression and rarefaction appear. One typical waveform is drawn below.



What can be deduced about the frequency of the sound wave?

A 600 Hz
B 6.0×10^3 Hz
C 1.2×10^4 Hz
D 1.5×10^4 Hz

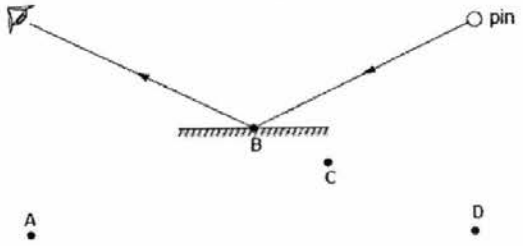
20 At a particular instant, a transverse wave of frequency 25 Hz is travelling to the right, as shown in the diagram below. At that instant, the displacement at point X is zero.



What is the shortest time elapsed before the displacement at point Y becomes zero?

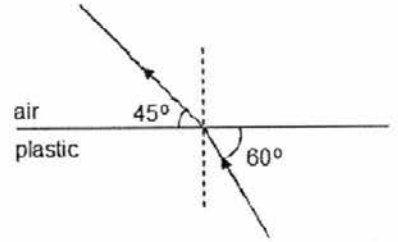
A 0.01 s B 0.02 s C 0.03 s D 0.04 s

21 A pin is placed in front of a plane mirror as shown.



Where is the image of the pin?

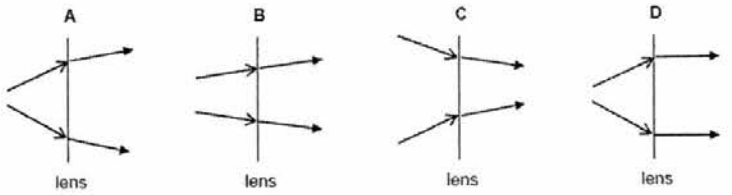
22 The diagram shows a ray of light moving from plastic to air.



What is the refractive index of plastic?

A 0.707
B 0.816
C 1.22
D 1.41

23 Which diagram shows rays of light passing through a diverging lens?

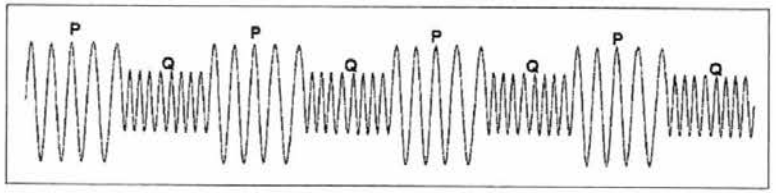


24 Waves **P** and **Q** are components of the electromagnetic spectrum. **P** has a longer wavelength than **Q**. Which of the following statements is **true** about **P** and **Q**?

A **P** is radiowave and **Q** is infrared radiation.
B **P** can travel faster than **Q** in vacuum.
C **Q** has a lower frequency than **P**.
D **Q** is ultraviolet ray and **P** is X-ray.

25 A police sounds its siren when travelling to an emergency. The siren produces two different sounds **P** and **Q**, which are emitted alternately.

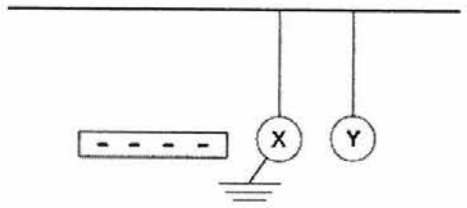
The diagram represents the sound emitted by the siren.



Which of the two sounds **P** and **Q** is the softer and which has the lower pitch?

	Softer sound	Sound of lower pitch
A	P	P
B	P	Q
C	Q	P
D	Q	Q

26 A negatively charged rod is brought near two isolated metal balls **X** and **Y**. **X** is then earthed momentarily as shown in the diagram. If the rod is then removed, how would the balls be charged?



	X	Y
A	Negative	Positive
B	Neutral	Neutral
C	Positive	Negative
D	Positive	Neutral

27 A resistor with resistance **R** is made from a length **L** of resistance wire with a cross-sectional area **A**. A second resistor with resistance **3R** is made from wire of the same material with a cross-sectional area of **0.5A**.

What length of wire is needed for the second resistor?

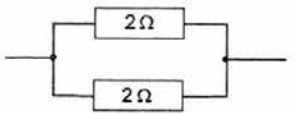
A 2L
B 1.5L
C L
D 0.5L

28 Tiffany connects various resistors in parallel pairs.

Underneath each diagram is a statement about the total resistance of each pair of resistors.

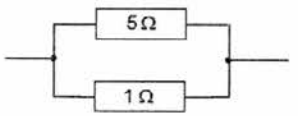
Which statement is correct?

A



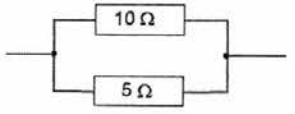
The total resistance is 4Ω

B



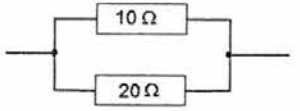
The total resistance is between 4Ω and 5Ω

C



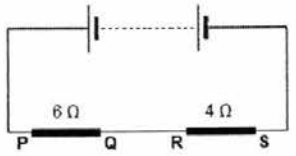
The total resistance is less than 5Ω

D

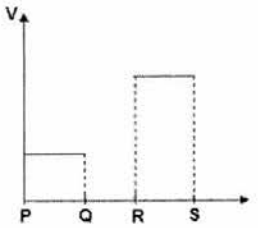


The total resistance is more 20Ω

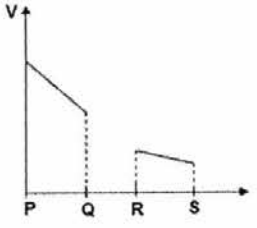
29 The circuit consists of two resistors **PQ** and **RS** connected in series. **PQ** has a resistance of 6 Ω and **RS** has a resistance of 4 Ω.



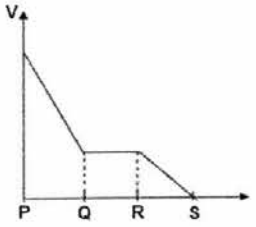
Which of the following graphs best shows how the electric potential varies along **PS**?



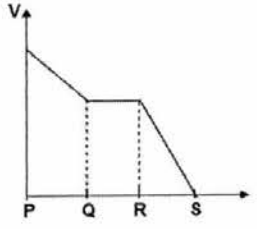
A



B

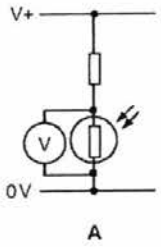


C

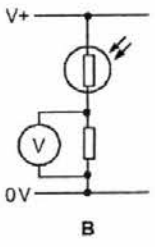


D

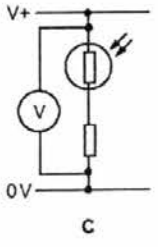
30 In which circuit does the voltmeter reading fall when light shines on the light dependent resistor?



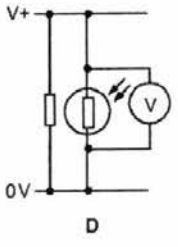
A



B

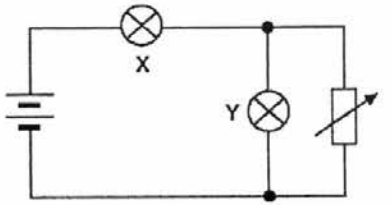


C



D

31 Two lamps, **X** and **Y**, are connected to a battery and a rheostat as shown below.



What will happen to the brightness of the lamps if the resistance of the rheostat is decreased?

	X	Y
A	dimmer	dimmer
B	dimmer	brighter
C	brighter	dimmer
D	brighter	brighter

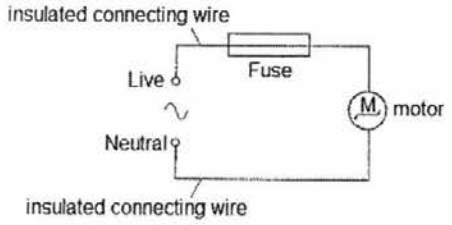
32 An electrical cable contains three wires: live, neutral and earth. The cable is correctly wired to a plug which contains a 3 A fuse. The insulation becomes damaged and the bare metal wires can be seen. Five possible events may occur.

- A person touches the earth wire.
- A person touches the neutral wire.
- A person touches the live wire.
- The live wire touches the neutral wire
- The live wire touches the earth wire.

How many of these events will cause the fuse in the plug to blow?

A 1
B 2
C 3
D 4

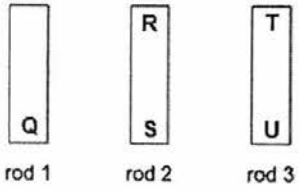
33 An electric motor is connected to the mains supply by insulated wires. The circuit is protected by a fuse, but the connecting wires become hot.



How could the wires be prevented from becoming so hot?

A Connect a second fuse in the neutral wire.
B Use a fuse with a higher rating.
C Use thicker connecting wires.
D Use thick insulation on the connecting wires.

34 The ends of three metal rods are tested by holding end **Q** of rod 1 close to the others in turn.



The results are as follows.

End **Q**: attracts end **R**, attracts end **S**, attracts end **T**, repel end **U**.

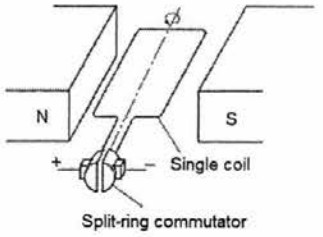
Which of the metal rods is a magnet?

A rod 1 only
B rod 3 only
C rod 1 and rod 2
D rod 1 and rod 3

35 Which of the following will NOT increase the speed of rotation of an electric motor?

A Increase the number of turns in the armature.
B Using a copper core in the armature.
C Using a stronger magnet.
D Increasing the current.

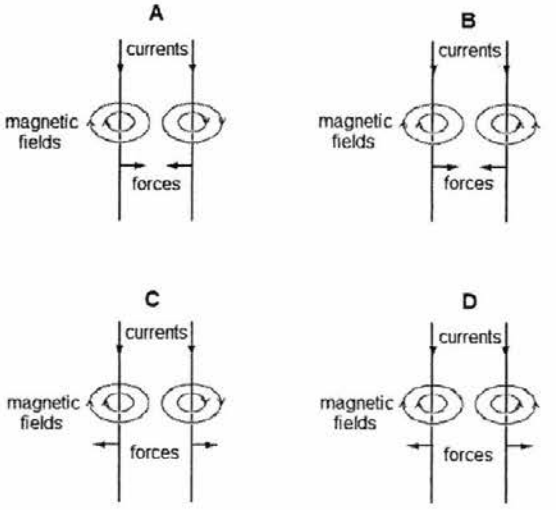
36 The diagram shows a two-pole single-coil electric motor.



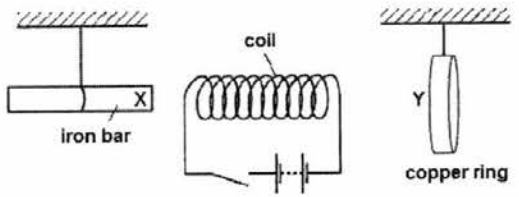
The split-ring commutator reverses the current in the coil as it rotates.
How many times is the force on the coil reversed if the coil is rotated once?

A 1 B 2 C 3 D 4

37 Two parallel wires carry currents in the same direction.
Which diagram shows the magnetic field around each wire and the direction of the force on each wire?



38 The diagram shows a coil connected to a battery and a switch. An iron bar and a copper ring hang freely near opposite ends of the coil.



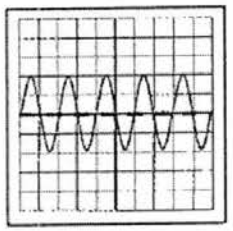
What will happen when the switch is closed?

A Both end **X** and end **Y** move towards the coil.
B End **X** moves towards the coil, end **Y** remains stationary.
C End **X** moves towards the coil, end **Y** moves away from the coil.
D End **X** moves away from the coil, end **Y** moves towards the coil.

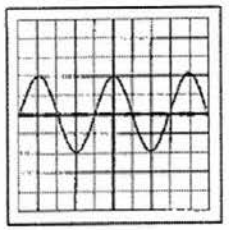
39 The Y-inputs of a cathode-ray oscilloscope (c.r.o.) are connected to a supply of amplitude 5.0 V and frequency 50 Hz. The time-base is set at 10 ms per division and the Y-gain at 2.5 V per division.

Which trace is obtained?

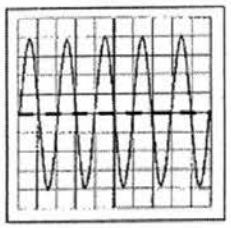
A



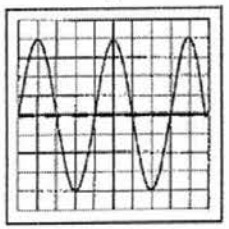
B



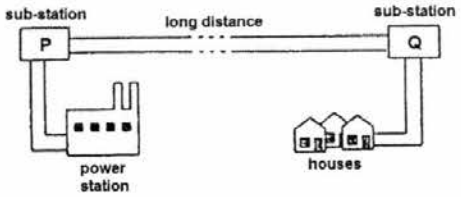
C



D



40 **P** and **Q** are sub-stations of an electricity generating and transmitting system. The distance between **P** and **Q** is much greater than the distance between **P** and the generating power station or the distance between **Q** and the houses.



For efficient transmission, what should **P** and **Q** be?

	P	Q
A	Step-up transformer	Step-down transformer
B	Step-up transformer	Step-up transformer
C	Step-down transformer	Step-down transformer
D	Step-down transformer	Step-up transformer

End of Paper

REGENT SECONDARY SCHOOL
PRELIMINARY EXAMINATION - 2016
SECONDARY 4 EXPRESS
PHYSICS PAPER 2
(5059/2)

/80
Target:

Name: ________________ (   )

Date: **29 August 2016**

Class: Sec __________

Duration : **1 Hour 45 Mins**

Setter:

Parent's Signature: __________

INSTRUCTIONS TO CANDIDATES:

Do not turn over the pages until you are told to do so.
Write your name, index number on the answer sheet in the top spaces provided.

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

Section B
Answer **all** the questions 10 and 11.
Answer only one of the two alternative questions in **Question 12**.
Write your answers in the spaces provided on the question paper.

INFORMATION FOR CANDIDATES

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

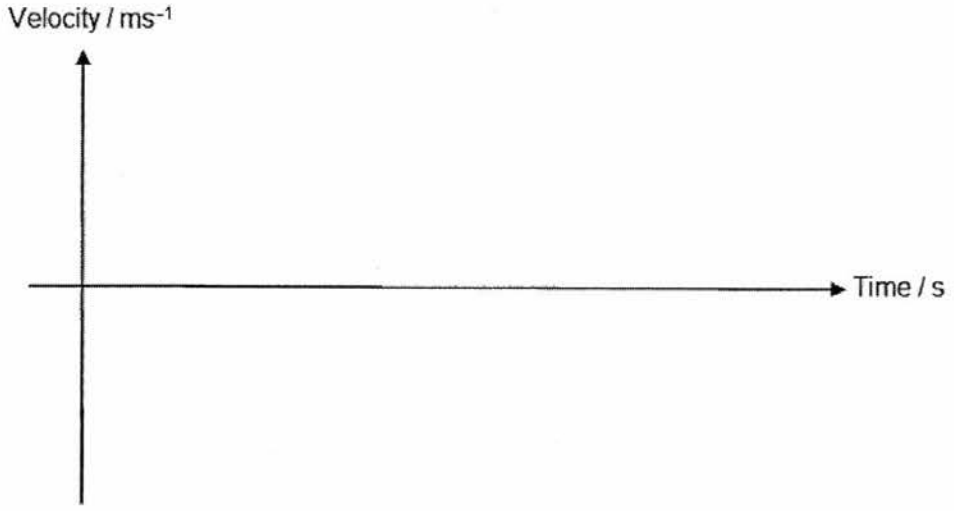
This paper consists of 12 questions on 22 printed pages.

Section A (50 marks)

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

1 A rubber ball is dropped freely from a height of 20 m. The ball hits the ground at time t and rebounds vertically upwards with half its maximum velocity. The maximum velocity of the ball just before it hits the ground for the first time is V.

(a) In the axes below, sketch the velocity-time graph of the ball from the point of released to the time when it has rebounded to its new maximum height.
(Ignore air resistance) [1]



(b) Determine from the graph the velocity of the ball just before it hits the ground for the first time.

Velocity = ...[2]

(c) Find the displacement of the ball after it has rebounded to its maximum height.

Displacement = ... [2]

(d) What is the change in velocity of the ball during its rebound?

Change in velocity = ... [1]

2 **Fig. 2.1** shows a simple hydraulic system. The cross-section areas of piston X and piston Y are 50 cm^2 and 400 cm^2 respectively. The pistons at both limbs can be assumed to be frictionless and of negligible weight.

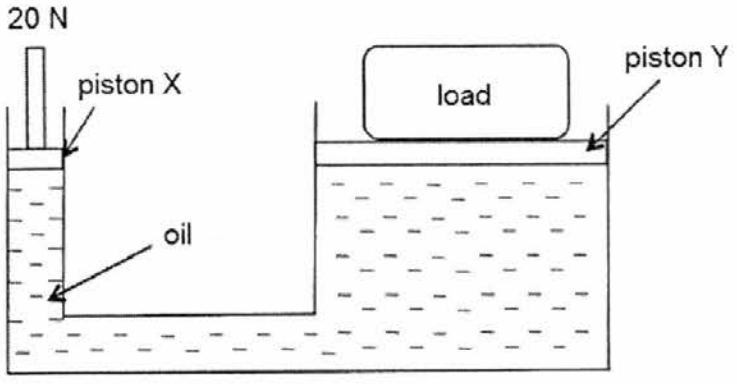


Fig. 2.1

(a) **(i)** A force of 20 N is applied on the piston X which raised a heavy load on the piston Y.
Determine the pressure exerted by piston X on the oil.

Pressure = ... [1]

(ii) Hence, determine the maximum weight that can be lifted at piston Y.

Maximum weight = ... [1]

(b) Through prolonged use, some air eventually seeps into the oil. State how this would affect the maximum load that can be lifted by the system and give a reason for your answer.

.....

.....

.....[2]

3 **Fig. 3.1** shows part of a smooth roller coaster track from A to C.

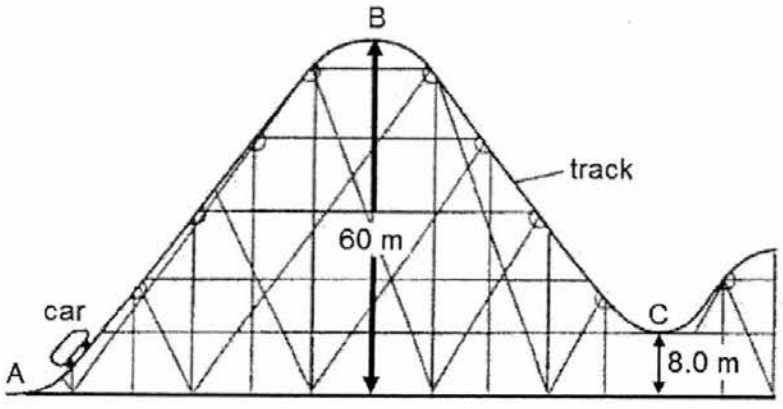


Fig. 3.1

The roller coaster car is initially moving at A and rises to a height of 60 m to B.
It continues to move along the track to a height of 8.0 m at C.
The mass of the car is 500 kg. The gravitational field strength g is 10 N/kg.

(a) Calculate the increase in gravitational potential energy of the car between A and B.

Increase in gravitational potential energy = ...[1]

(b) At B, the kinetic energy of the car is 9 kJ. Calculate the speed of the car at C.

Speed = ...[2]

(c) The roller coaster track after C is rough.
Explain how the law of conservation of energy applies to the motion of the car as it travels past C.

.....

.....

.....

.....[2]

4 Electronics components are easily overheated and damaged. They are thus usually attached to heat sinks which will transfer thermal energy from the electronic components to the surroundings.

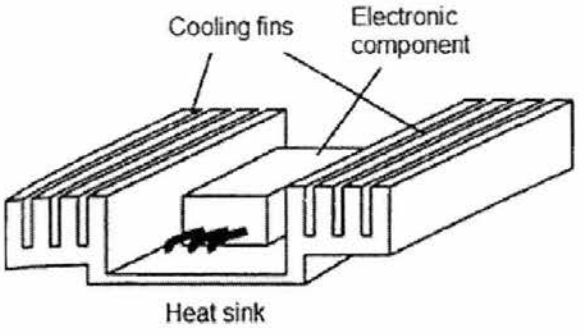


Fig. 4.1

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

.....

.....[2]

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

.....

.....[2]

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

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

Temperature = ...[1]

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

.....

.....[1]

5 (a) **Fig. 5.1** below shows circular wavefronts produced at the centre of a circular ripple tank.

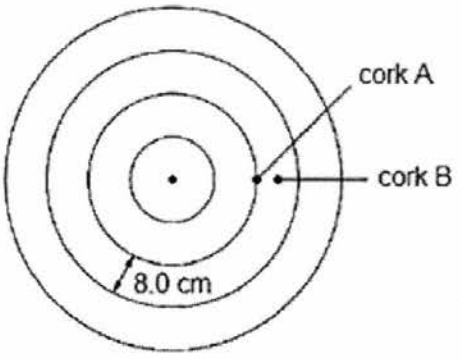


Fig. 5.1

Two corks, A and B, float on the water in the ripple tank. The distance between successive wavefronts is 8.0 cm. **Fig. 5.2** shows how the displacement of cork A varies with time.

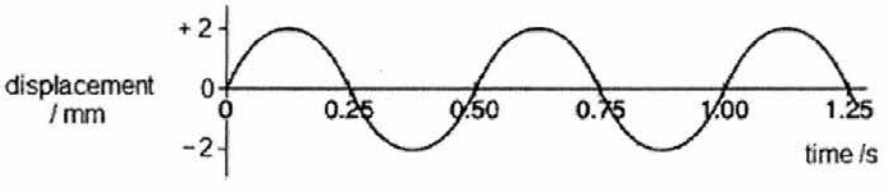


Fig. 5.2

(i) State the displacement of cork B, when the displacement of cork A is 2 mm.

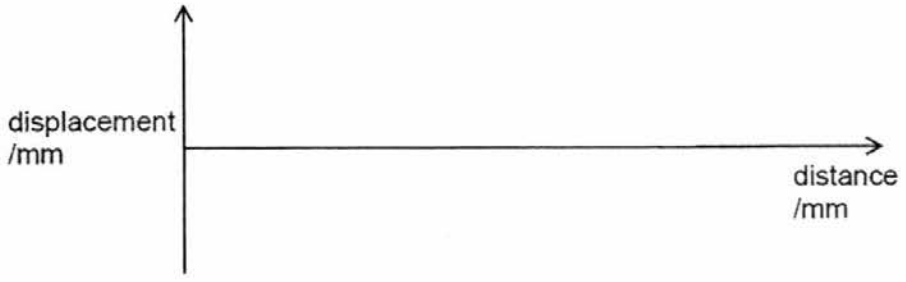
Displacement of cork B = ...[1]

(ii) The diameter of the ripple tank is 80 cm.

Determine the time taken by a wavefront to travel from the centre of the tank to the edge.

Time taken = ...[2]

5 (a) (iii) Sketch the displacement-distance graph of the wave, for one complete wave. [1]



(b) A ray of light from an underwater laser pointer, is incident upon a spherical air bubble as shown in **Fig. 5.3**. The refractive index of water is 1.33.

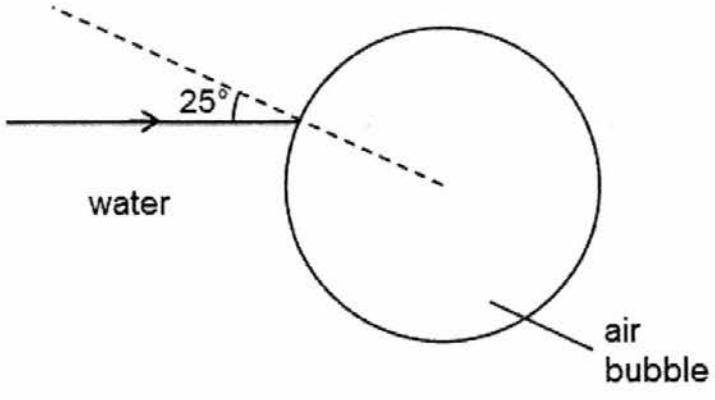


Fig. 5.3

Complete the path of the ray until it exits the air bubble, showing clearly all angles at the boundaries. Show the workings to calculate these angles in the space below. [2]

6 The setup of an experiment shown in **Fig. 6.1** was carried out to measure the speed of sound.

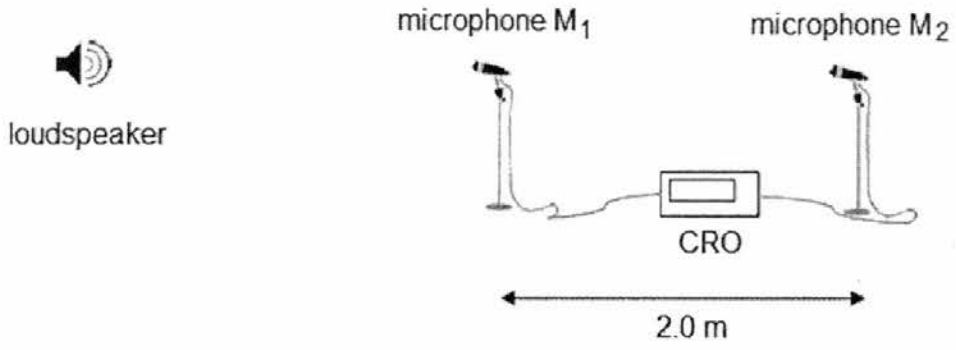


Fig 6.1

Two microphones M_1 and M_2 are placed 2.0 m apart and are connected to a Cathode Ray Oscilloscope (CRO). The CRO is used to measure the time taken for sound to travel between M_1 and M_2.

(a) Suggest a reason why the CRO is used to measure the time taken for sound to travel between M_1 and M_2 instead of a student using a stopwatch.

.....[1]

(b) The loudspeaker produces a loud bang and the time taken recorded by the CRO is 5.9 ms.

Calculate the speed of sound in air.

Speed of sound in air = ... [2]

(c) Suggest a modification to the experimental set-up to improve the accuracy of the time for sound to travel between M_1 and M_2.

.....

.....[1]

7 **Fig. 7.1** shows a metal can connected to a galvanometer.

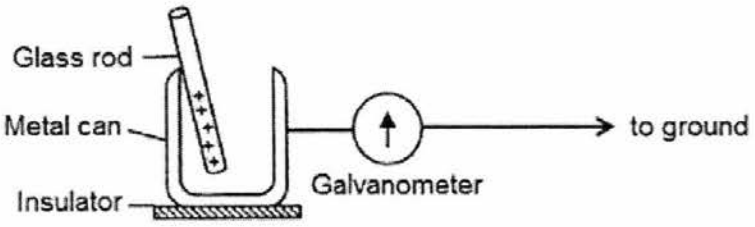


Fig. 7.1

(a) When a positively-charged glass rod is lowered into the metal can, the galvanometer shows a deflection but returns to zero soon after. Explain what has happened.

.....

.....

.....

.....

.....[2]

(b) State one way to

(i) increase the deflection of the galvanometer and

.....

.....[1]

(ii) change the direction of the deflection of the galvanometer.

.....

.....[1]

(c) A student holds a copper rod, tries to charge it and then lowers it into the metal can. State and explain what happens.

.....

.....

.....[2]

8 **Fig. 8.1** shows how a thermistor is connected to a circuit.

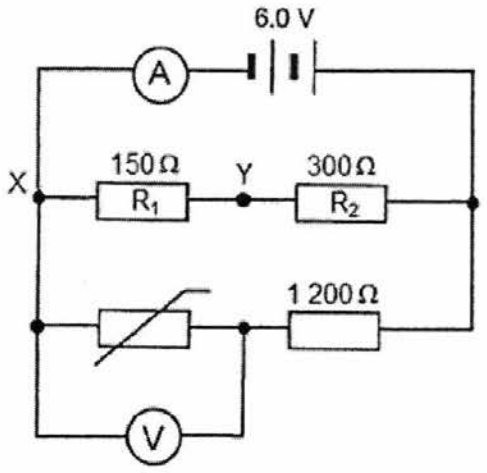


Fig 8.1

At room temperature of 26 °C, the resistance of the thermistor is 3600 Ω. When the temperature is 80 °C, its resistance is 1200 Ω.

(a) Calculate the reading on the voltmeter V at room temperature.

Reading on V = ...[2]

(b) Calculate the reading on the ammeter A at 80 °C.

Reading on ammeter A = ...[3]

(c) A copper wire of negligible resistance is connected across terminal XY. Explain any changes, if any, to the reading on the voltmeter V.

.....

.....

.....[2]

Fig. 9.1 shows an ideal transformer. There are 1880 turns on the primary coil and 94 turns on the secondary coil. The primary coil is connected to the 240 V, 50 Hz main supply. A resistor of resistance 800 Ω is connected across the secondary coil.

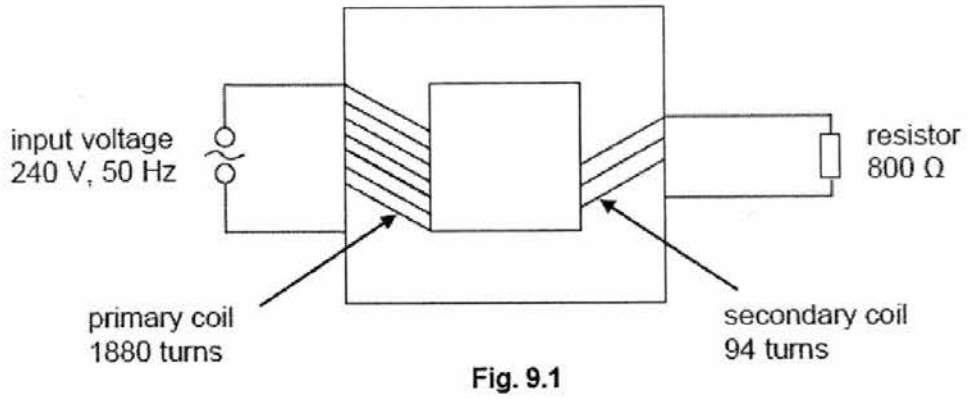


Fig. 9.1

Assuming that the transformer has an efficiency of 90%, calculate

(i) the current in the secondary coil.

Current in the secondary coil = ... [3]

(ii) the current in the primary coil.

Current in the primary coil = ...[2]

9 **(b)** **Fig. 9.2** shows the form of the variation with time t of the current I in the primary coil of the transformer in **9 (a)**.

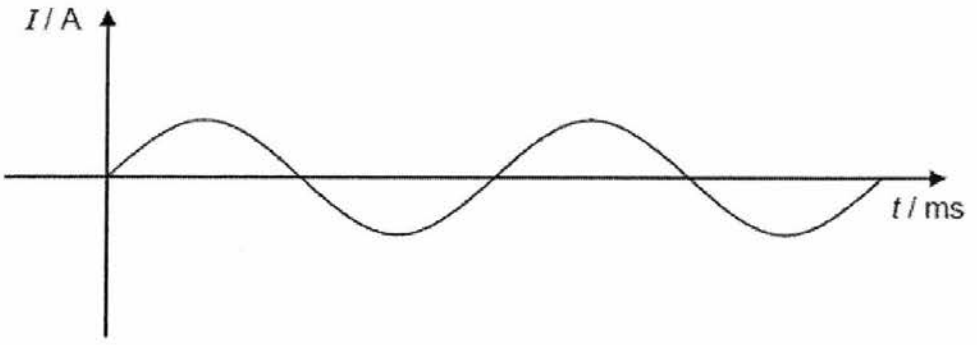


Fig. 9.2

On **Fig. 9.2**, sketch the graph to show the possible form of the variation of the induced current in the secondary coil. Label the graph '**S**'. [1]

Section B (30 marks)

Answer **both** questions 10 and 11.

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

10 **Fig. 10.1** shows a wireless charging process of an electric-vehicle. It usually involves an electromagnetic mat, which can transfer energy to the vehicle's batteries without touching the vehicle itself.

It is hoped this wireless charging technology will enhance the appeal for electric-vehicles, as owners can simply park over the mat on their garage floor and walk away as the system begins charging automatically.

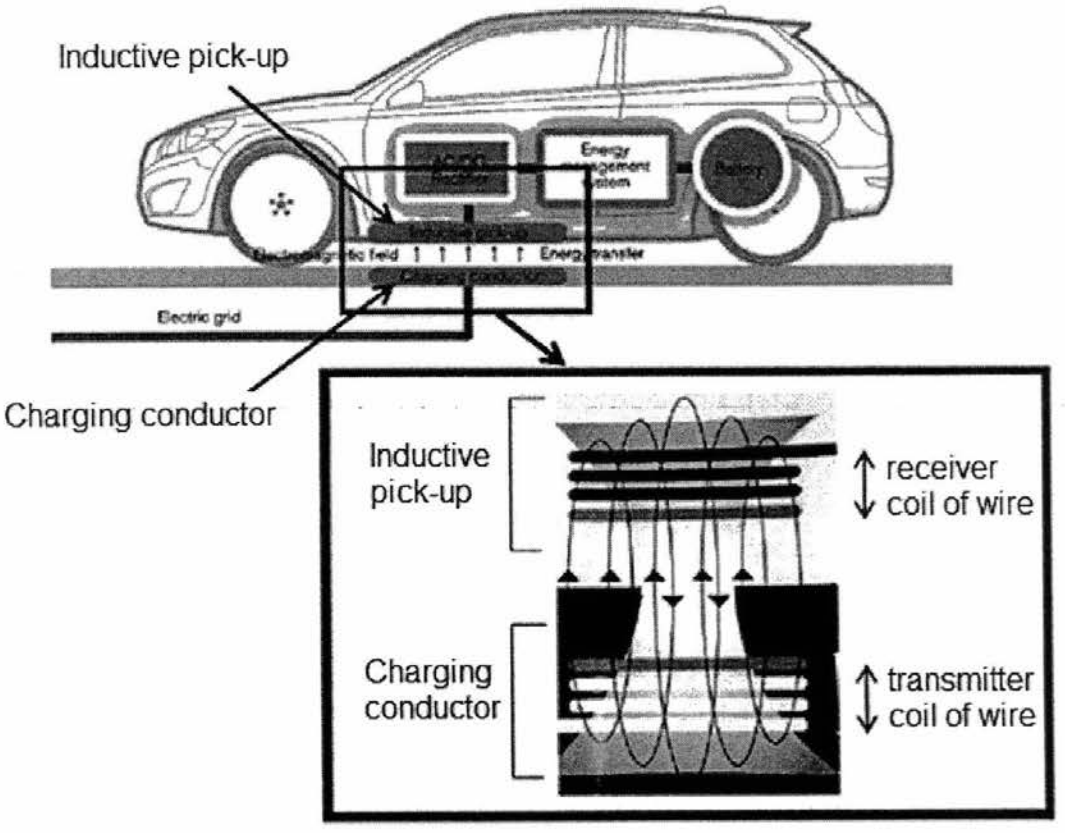


Fig. 10.1

The charging conductor is an electromagnetic mat which contains a transmitter coil of wire. This charging conductor is connected to a power supply. Any time electrical current flows through the wire, a small electric field is created around the wire.

The inductive pick-up is then connected to the vehicle's battery which requires a recharge by a high current.

(a) State the type of current that should be connected to the power supply.

..... [1]

10 **(b)** Explain why an electrical current is induced in the receiver coil of wire in the inductive pick-up.

.....

.....

.....

.....

.....[3]

(c) State and explain which of the coil (transmitter coil or receiver coil) would have a larger number of loops in the coil.

.....

.....

.....[2]

(d) **Fig. 10.2** describes the power received by the vehicle's battery over time. The energy received by the vehicle's battery is given by the area under the power-time graph.

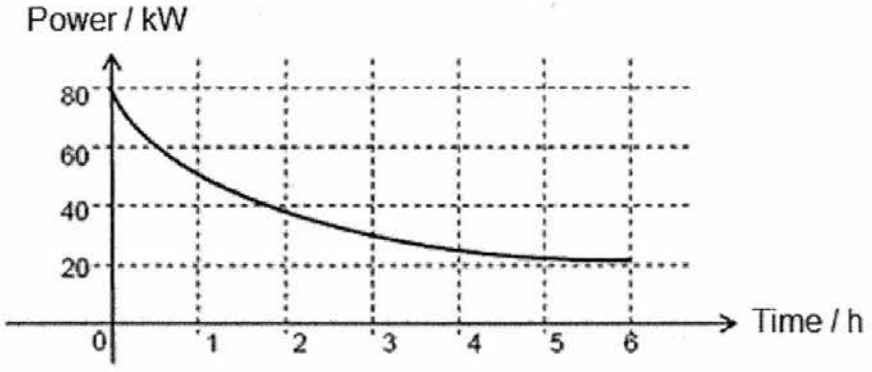


Fig. 10.2

(i) Estimate the energy received, in joules, by the vehicle's battery for the initial 3 hrs.

Energy received = ... [2]

10 (d) (ii) Determine the average power received by the vehicle's battery for the initial 3 hrs.

Average power received = ... [1]

(iii) Suggest a reason why the power received by the vehicle's battery decreases over time.

..... [1]

11 A 15 kg lever is pivoted 0.30 m from its left end. A 8 kg soft iron is attached at the left end of the lever and a 10 kg sliding mass placed 0.15 m from the pivot as shown in **Fig. 11.1**. The setup is balanced when there is no current flowing through the solenoid.

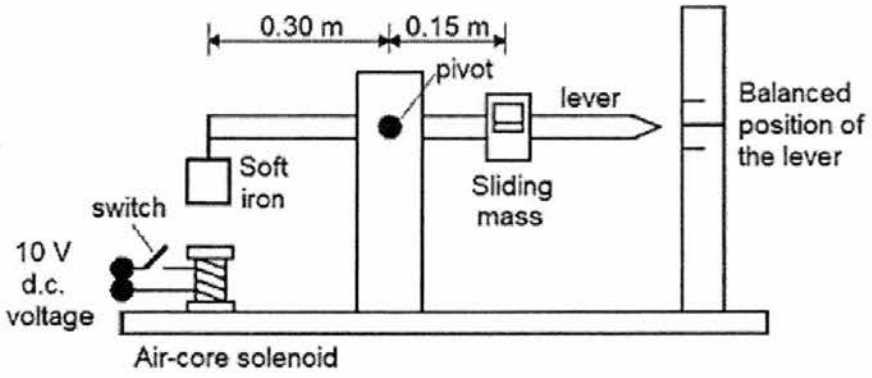


Fig. 11.1

11 (a) Find the weight of the soft iron and the sliding mass respectively.

Weight of soft iron = ... [1]

Weight of sliding mass = ... [1]

(b) Using Principle of Moments, determine the distance of the centre of gravity of the lever from the pivot.

Distance = ... [3]

11 (c) Explain what would happen to the position at which the pointer of the lever is pointing when the switch is closed.

.....

.....[1]

(d) When the switch closes, state **and** explain the effect on the pointer of the lever if

(i) the soft iron is replaced by brass of similar mass,

.....

.....

.....[2]

(ii) the d.c. supply is now of a higher value.

.....

.....

.....[2]

EITHER

12 **Fig. 12.1a** shows a diver salvaging items from a plane wreck below the surface of a lake. The density of the water in the lake is 1000 kg/m^3 and the atmospheric pressure at the surface is 1.0×10^5 Pa.

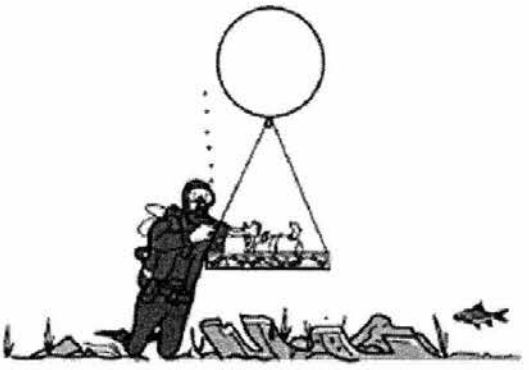


Fig. 12.1a

The diver inflates a balloon with air at a depth of 15 m and attaches the balloon to a tray of objects.

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

Total pressure = ... [2]

(b) The air in the balloon occupies a volume of 0.048 m^3 at the pressure calculated in **(a)**. The diver releases the tray and the balloon, and they begin to rise. The temperature of the air in the balloon does not change.

(i) Calculate the volume occupied by the air in the balloon at atmospheric pressure.

Volume = ...[2]

12 **(b)** **(ii)** The pressure of the air inside the balloon is less at the surface than at a depth of 15 m. Explain, in terms of the air molecules inside the balloon, why the pressure is less.

.....

.....

.....[2]

(c) When the diver releases the tray, the balloon accelerates upwards and reaches a constant speed before it arrives at the surface.

(i) Explain how the forces acting on the balloon cause it to behave in this way.

.....

.....

.....

.....

.....[3]

(ii) On the axes in **Fig. 12.1b**, sketch the distance-time graph for the balloon as it travels 15 m to the surface. [1]

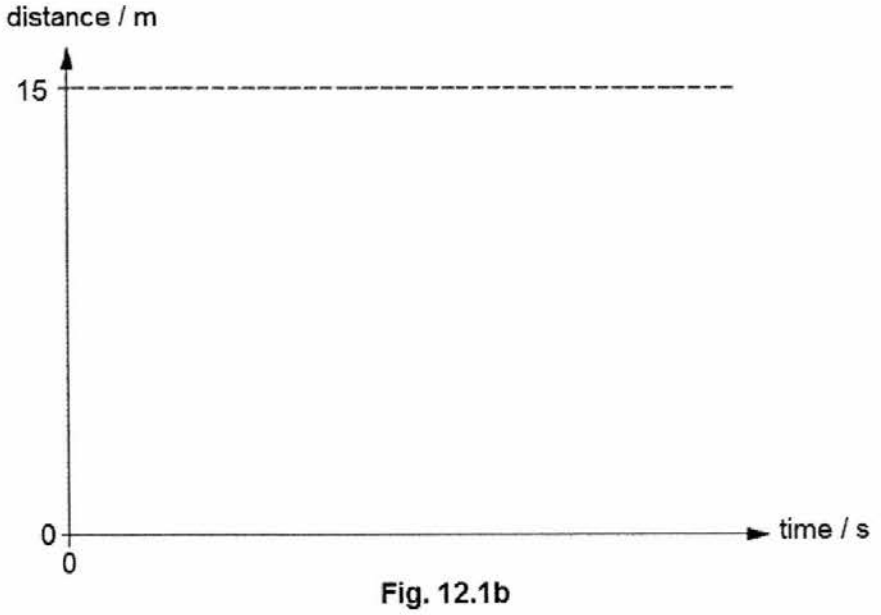


Fig. 12.1b

OR

12 In a power station, electrical energy is generated and then transmitted via transmission cables to all households and industries.

Some countries use wind turbines to generate electrical energy. This form of generation is pollution free and renewable.

Some other countries use a nuclear reaction to generate electrical energy. This alternative form of generation is also pollution free.

(a) State what is meant by a renewable source of energy.

.....

..... [1]

(b) **(i)** Discuss briefly, how when compared to a gas-fired power station, a nuclear power station, is pollution free.

.....

.....[1]

(ii) Discuss, on the suitability, of a nuclear power station, in Singapore.

.....

.....[1]

(c) The current in the transmission line used to supply electrical power to a suburb is 65 A. The power is transmitted at a voltage of 23 000 V

The transmission line has a resistance of 3.0 Ω. Calculate

(i) The potential difference across a 3.0 Ω resistor that carries a current of 65 A.

Potential difference = ... [1]

12 (c) (ii) The thermal energy produced in 1.0 s in a 3.0 Ω resistor that carries a current of 65 A.

Thermal energy = ... [1]

12 (d) **Fig. 12.2** shows the mapping of a Mains Circuit Breaker (MCB) electric supply to a household with an alternating voltage supply of 240 V

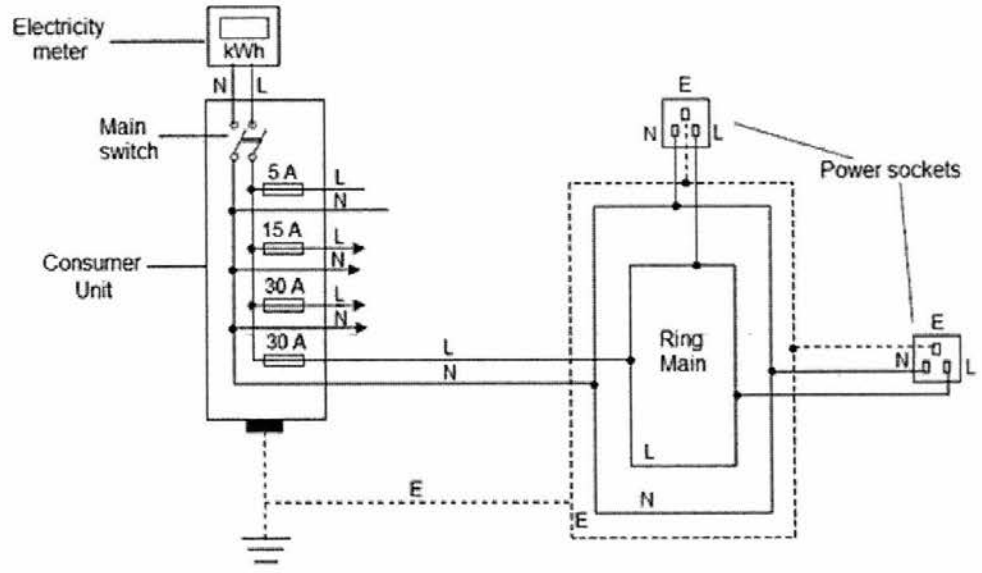


Fig. 12.2

A **MCB** unit shows the individual circuit breakers wired to different electrical appliances.

A ring main (drawn from a 30 A circuit breaker) is usually allocated to a room in the household.

(i) What is the purpose of an earth wire in the MCB?

.....

..... [1]

12 (d) (ii) An owner decides to convert the room to a gaming unit and starts to install laptops rated at 240 V, 1.2 A.

1. Determine the maximum power that can be supplied to one main ring.

Maximum power = ... [1]

2. Determine the maximum number of laptops he can set up.

Maximum number of laptops = ... [1]

(iii) An electrical fault occurs and the MCB trips. Suggest how to determine the source of fault.

.....

.....

.....

.....

.....

.....

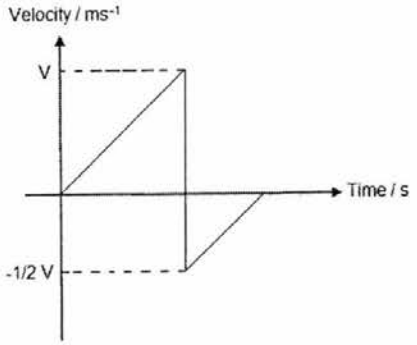
.....[2]

End of Paper

REGENT SECONDARY SCHOOL
4E Physics MYE 2016 – Mark Scheme

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

1 (a) Correct diagram with label – [A1]



(b) $a = (v-u)/t$
$10 = (v-0)/t$
$t = v/10$

$\frac{1}{2} \times t \times v = 20$
$\frac{1}{2} \times (v/10) \times v = 20$ [M1]
$v^2 = 400$
$v = 20$ m/s [A1]

(c) Rebound height = ½ x 1 x 10 = 5m [M1]
Displacement of the ball = 20 – 5 = 15 m [A1]

(d) Changed in velocity = 20 – (-10) = 30 m/s [A1]

2 (a) $P = F/A = 20 / 50 = 0.40$ N/cm^2 [A1]

(b) $F = P \times A = 0.40 \times 400 = 160$ N [A1]

(c) Maximum load would be smaller; [A1] as some force exerted on piston X would be used to compressed the air. [A1]

3 (a) GPE = mgh
= 500 x 10 x 60
= 300 000 J [A1]

(b) Energy at B = Energy at C
$(GPE + KE)_B = (GPE + KE)_C$
$300000+9000 = (500 \times 10 \times 8) + (\frac{1}{2} \times 500 \times v^2)$ [M1]
V = 33 m/s [A1]

(c) Some kinetic energy of the car at C is converted to thermal energy due to friction and lost to surroundings causing speed of the car to be lesser. [A1] The total kinetic and thermal energy is equal to the total kinetic and gravitational potential energy at B. [A1]

4 (a) Material: Any type of metal [A1]
Explanation: Metals are better conductors of thermal energy than non-metals so it allows more heat to be conducted from the component to the heat sink. [A1]

(b) Colour: Any dark colour [A1]
Explanation: Dark colours are better emitters of thermal energy than light colours so it increases the rate of emission of thermal energy. [A1]

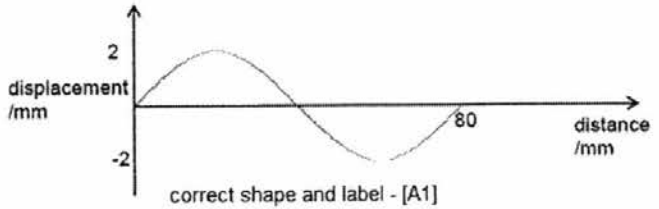
(c) Temperature rise = (2)(10) = 20 °C [A1]

(d) Rate of conduction of thermal energy from electronic component = rate of emission of thermal energy to surroundings. [A1]

5 (a)(i) -2.0 mm [A1]

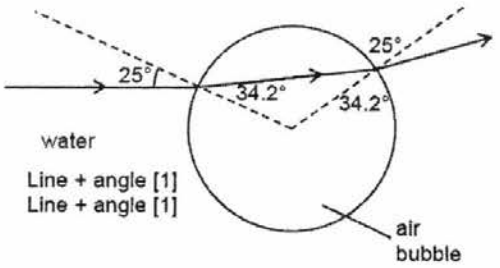
(a)(ii) T = 0.50 s
$V = f\lambda$
= (1/0.5) x 8 = 16 cm/s [M1]
Distance from centre to edge = 80/2 = 40 cm
Time taken = 40 / 16 = 2.5 s [A1]

(a)(iii)



correct shape and label - [A1]

(b) [A2]



Line + angle [1]
Line + angle [1]

$n = \sin i / \sin r$
$1.33 = \sin 25 / \sin r$
$r = 34.2°$

6 (a) Human reaction time to operate stop watch is too slow to measure the time duration. [A1]

(b) $v = d/t$
$= 2 / (5.9 \times 10^{-3})$ [M1]
$= 339$ m/s [A1]

(c) Relocate loudspeakers to opposite ends to reduce the effects of wind. [A1]

7 Unlike charges attract. [A½] Electrons from the outer layer of the can are attracted to the inner layer by the positively-charged glass rod. [A½] Electrons from the ground are attracted to the outer layer of the can. The electron flow causes a deflection [A1/2] Once the charges are balanced, there is no more electron flow and the deflection is zero. [A1]

Increase the charge of the positively-charged (glass) rod. [A1]

Use a negatively-charged (glass) rod / Withdraw positively-charged (glass) rod [A1]

Nothing happens. No deflection on the galvanometer. [A1]

A copper rod cannot be charged when the student is holding it as the rod is earthed. [A1]

8 (a) $V = 3600 / (3600 + 1200) \times 6$ [M1]
$= 4.5$ V [A1]

(b) $1/R = 1/450 + 1/2400$ [M1]
$R = 378.95\ \Omega$

$6 = I \times 378.95$ [M1]
$I = 0.0158$ A [A1]

(c) No changes. [A1]

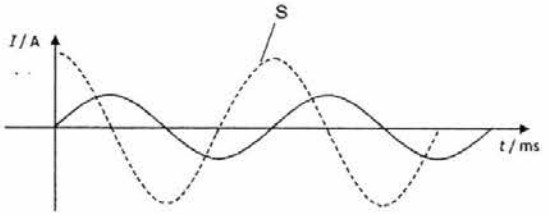
The potential difference across the thermistor and the 1200 Ω is still the same because they are connected in parallel with the battery. [A1]

9 (a) $V_S = V_P \times (N_S / N_P)$
$= 240 \times (94/1880)$
$= 12$ V [M1]

$I_S = 12 / 800$ [M1]
$= 0.015$ A [A1]

(b) Power in secondary coil = 90% Power in primary coil
$(12 \times 0.015) = 90/100 \times (240 \times I_P)$ [M1]
$I_P = 0.00083$ A [A1]

(c) Correct waveform (higher current) – [A1]



10 (a) alternating current [A1]

(b) The alternating current creates an alternating magnetic field in the transformer coil. This causes a rate of change of magnetic flux linking the receiver coil. By Faraday's Law, an induced emf will be produced in the receiver coil. Hence, an induced current will be produced because of a closed circuit.

(c) Transmitter coil. Receiver coil would then have a greater induced current as required to charge the battery.

(d)(i) 5.22×10^8 J

(d)(ii) 48300 W

(d)(iii) Energy loss due to eddy current

11 (a) Weight of soft iron = 8 x 10 = 80 N [A1]
Weight of sliding mass = 10 x 10 = 100 N [A1]

(b) Clockwise moment = Anticlockwise moment
$(100 \times 0.15) + [(15 \times 10) \times d] = 80 \times 0.30$ [M2]
$15 + 150d = 24$
$D = 0.060$ m [A1]

(c) When the switch is closed, current flows through the solenoid and the solenoid will attract the soft iron above it. The soft iron will move down causing the pointer to turn and point above the balanced position.

(d) The pointer will not turn. [A1] Brass is not a magnetic material. Thus, it will not attracted to the magnetised solenoid. [A1]

More current will flow through the solenoid, making the solenoid a stronger electromagnet. Thus, the force of attraction between the solenoid and the soft iron will be stronger, [A1] causing the pointer to turn through a larger distance above the balanced position. [A1]

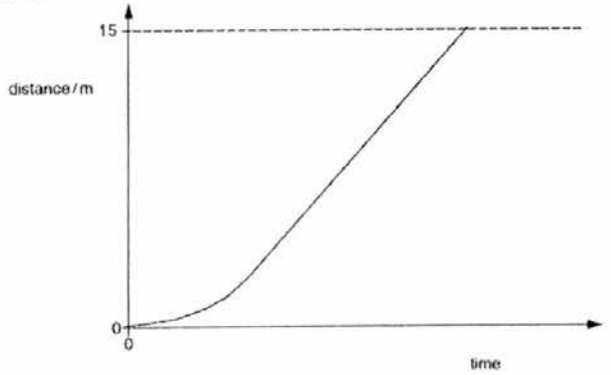
12 (a) Total pressure $= h\rho g + P_{atm}$
$= (15 \times 1000 \times 10) + 1.0 \times 10^5$ [M1]
$= 2.5 \times 10^5$ Pa [A1]

(b)(i) Using $P_1V_1 = P_2V_2$
$2.5 \times 10^5 \times 0.048 = 1.0 \times 10^5 \times V_2$ [M1]
$V_2 = 0.12\ m^3$ [A1]

(b)(ii) At the surface, the air molecules inside the balloon occupy a larger space / are further apart [A1], hence the frequency of collisions with the inner walls of the balloon is lower. [A1]

(c)(i) When the diver first releases the tray, there is a net upward force causes the balloon to accelerate [A1]. As it moves upwards, the downward water resistance/ friction increases. [A1] Eventually, when the upward force is balanced by the downward force, there will be no net force acting on the balloon and it will move at a constant speed [A1].

(c)(ii) [A1]



12 (a) Renewable means plentiful / in abundance / will not run out. [A1]

(b)(i) Nuclear plant do not produce fumes / gases unlike gas powered station. [A1]

(b)(ii) [A1]
Suitable – large amount of energy generated from a small volume of nuclear reaction. If set up properly, energy is clean, efficient and plentiful.

Unsuitable – A nuclear meltdown is always a risk. In land scarce Singapore, this is a very big risk to take.

(c)(i) $V = IR = 195$ V [A1]

(c)(ii) $E = I^2Rt = (65)^2(3.0)(1.0) = 12700$ J [A1]

(d)(i) Earth wire provides a path of low resistance for current at high potential to flow when the live wire touches the casing of an electric appliance. This will cause the current to surge and blow the fuse, user will not get an electric shock. [A1]

(d)(ii) 1. $P = IV = 30 \times 240 = 7200$ W [A1]

2. No. of lap tops $= 30 / 1.2 = 25$ [A1]

(d)(iii) [A2]
1. Switch off the Main Switch and all individual circuit breakers [A½]
2. Switch on the Main Switch and the individual circuit breakers one at a time [A½]
3. If a particular breaker trip when it is switched on, the fault lies along that ring circuit setup. [A½]
4. The ring circuit setup can then locate the faulty electric appliance. [A½]