Bukit Batok Secondary School
GCE O-Level Preliminary Examination 2017
Secondary Four Express

PHYSICS
Paper 1 Multiple Choice

5059 / 01
21 August 2017 (Monday)
(1130h to 1230h)
1 hour

Additional materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue, correction fluid or correction tape.

Write your name, class and class register number on the Answer Sheet in the space provided unless this has been done for you.

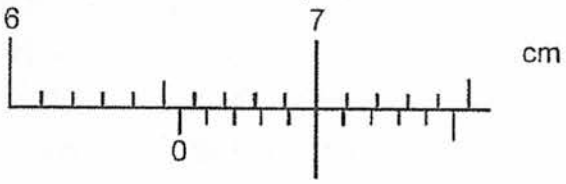
There are **forty** questions in this paper. Answer **all** questions. For each question, there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
The use of appropriate scientific calculator is expected, where appropriate.

This Question Paper consists of **16** printed pages

1 The diagram shows part of a vernier calipers.

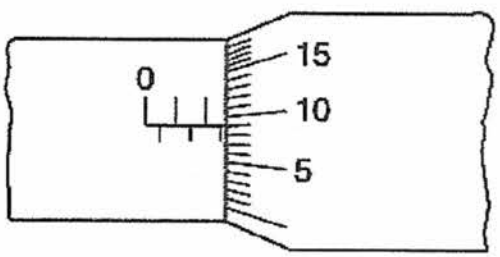


What is the reading shown on the vernier calipers?

A 6.50 cm **B** 6.55 cm **C** 7.00 cm **D** 7.45 cm

2 A micrometer screw gauge is used to measure the diameter of a wire.

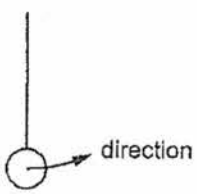
The scale of the micrometer screw gauge is shown on the right.



What is the diameter of the wire?

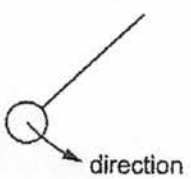
A 2.56 mm
B 2.59 mm
C 5.06 mm
D 5.09 mm

3 A simple pendulum has a period of 2.0 s.
A stopwatch is started when the pendulum is vertical and moving to the right, as shown below.

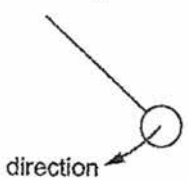


Which diagram below shows the position and the direction of the pendulum 3.0 s later?

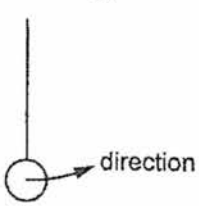
A



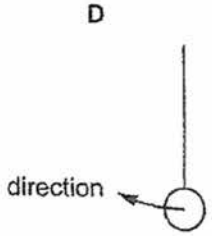
B



C



D



Apply past knowledge to new situations

4 A stone is dropped from rest and falls freely from the top of a tall building.
Taking g, the acceleration of free fall near the surface of Earth, to be 10 m/s^2, the ratio

"distance fallen in first 1.0 s : distance fallen in first 2.0 s"

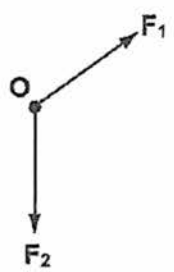
should be _____.

A 1 : 4
B 1 : 2
C 2 : 1
D 4 : 1

5 An object is falling under gravity with terminal velocity.
Which statement below is correct?

A The air resistance acting against the object at this instant is negligible.
B The object falls with zero acceleration at this instant.
C The object slowed down before it achieves terminal velocity.
D No force acts on the object at this instant.

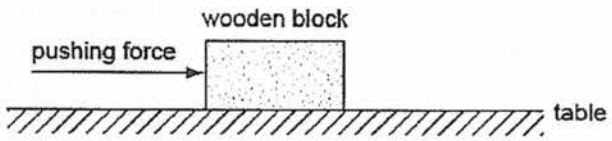
6 Two forces F_1 and F_2 act on an object **O** in the directions shown.



What is the direction of the resultant force?

A B C D

7 A wooden box of mass 2.0 kg is pushed horizontally across a table.



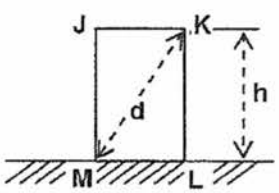
If the acceleration of the block is 0.40 m/s^2 and the frictional force acting against the block's motion is 20 N, then the magnitude of the pushing force is _____.

A 0.80 N
B 19.2 N
C 20 N
D 20.8 N

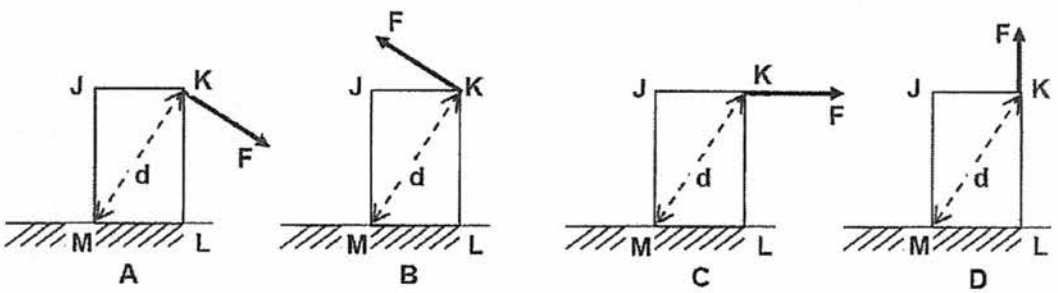
8 Paper is sold in packets labelled 80 g/m^2. A sheet of this paper of area 10 000 cm^2 has a mass of 80 g.
The thickness of each sheet is 0.11 mm.
What is the density of the paper?

A 0.073 g/cm^3
B 0.088 g/cm^3
C 0.73 g/cm^3
D 0.88 g/cm^3

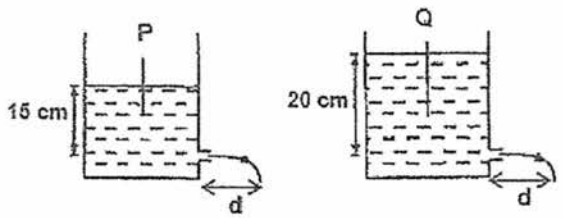
9 A uniform rectangular block **JKLM** of height **h** and diagonal **d** rests on the ground as shown on the right.



Which diagram below shows the easiest way for a force F to topple the block?



10 The diagram below shows two identical containers containing liquid **P** and liquid **Q**.



Water spurts out to the same horizontal distance **d** when the depth of liquid **P** is 15 cm and the depth of liquid **Q** is 20 cm.

The density of liquid **P** is 2.00 g/cm^3.

What is the density of liquid **Q** in g/cm^3?

A 0.67
B 1.30
C 1.50
D 2.70

11 The diagram on the right shows a mercury barometer. Some liquid less dense than mercury exists above the mercury column.

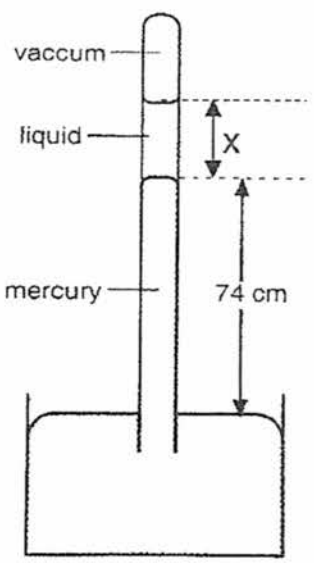
This liquid does not mix with mercury.

Given that:

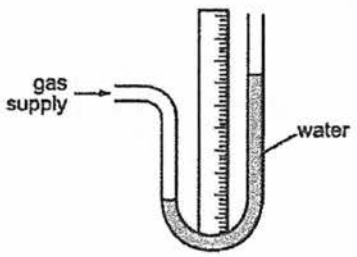
atmospheric pressure = 76 cmHg
density of liquid = 1200 kg/m^3
density of mercury = 13600 kg/m^3

What is the height **X** of the liquid column?

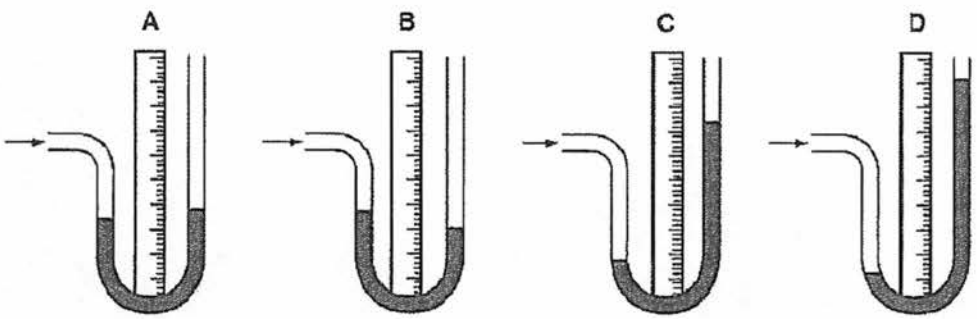
A 2.0 cm
B 22.7 cm
C 26.0 cm
D 76.0 cm



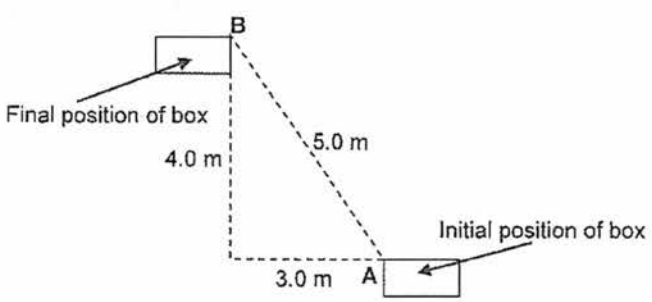
12 The diagram below shows a water manometer connected to a gas supply.



The water in the manometer is then replaced by cooking oil, which is less dense than water. Which diagram shows the cooking oil levels when the manometer is connected to the same gas supply?



13 A box of mass 500 grams is lifted diagonally from point **A** to point **B** as shown.



Given that the acceleration of free fall is 10 m/s^2, what is the gravitational potential energy gained by the box?

A 20 J
B 25 J
C 20000 J
D 25000 J

14 A stone is dropped from a cliff. After some time, the stone falls at constant velocity.
Which of the following shows the overall energy change of the stone when it is falling at constant velocity?

A chemical potential energy to kinetic energy
B chemical potential energy to thermal energy
C gravitational potential energy to kinetic energy
D gravitational potential energy to thermal energy

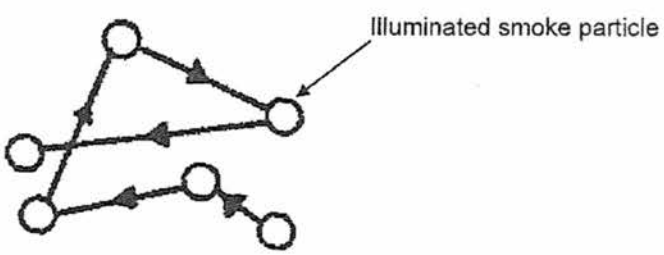
15 A car, of mass 1000 kg, is slowly going down a steep hill. The brakes fail and the driver uses a horizontal sand-filled safety road at the bottom of the hill to stop the car.
The car enters the sand at a speed of 10 m/s and is subjected to a stopping force of 2500 N.
How far does the car travel before coming to rest?

A 2.0 m
B 4.0 m
C 20 m
D 40 m

16 A 100 W spotlight has an efficiency of 40%. How much light energy can the spotlight produce in one hour?

A 144 kJ
B 216 kJ
C 360 kJ
D 600 kJ

17 An illuminated smoke particle, suspended in air, is viewed with a microscope.
It is seen to move randomly as shown below.



What does the motion of smoke particle tell us about the molecular movement of air molecules?

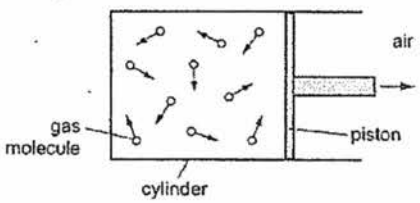
A air molecules are in continuous motion
B air molecules move in clusters
C air molecules move just as fast as smoke particles
D air molecules have the same amount of average kinetic energy at different temperatures

18 A fixed mass of gas is sealed in a container of fixed volume.
If the gas is heated, which of the following quantities will increase?

(I) average speed of the gas molecules
(II) average frequency of collision between gas molecules and container walls
(III) average distance between the molecules

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

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



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

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

20 The lengths of mercury thread in a uniform tube above the bulb of a mercury-in-glass thermometer are as follows:

- 20 mm when the bulb is in melting ice
- 120 mm when the bulb is in steam above boiling water
- 40 mm when the bulb is in sea water

What is the approximate temperature of sea water?

A 20°C B 33°C C 40°C D 80°C

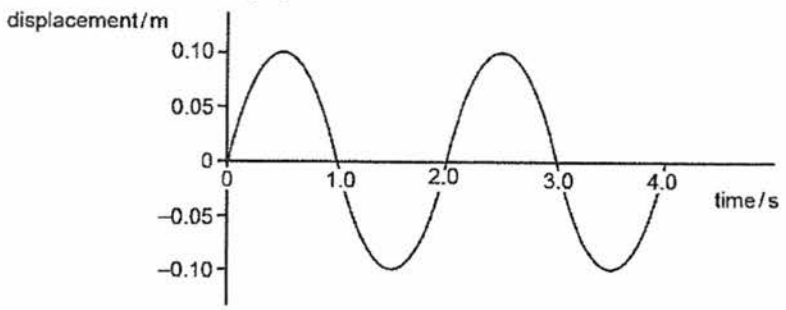
21 Which of the following sentence about internal energy is correct?

A When water at 100°C boils to become steam at 100°C, its internal kinetic energy increases.
B When water is heated such that its temperature rises from 30°C to 80°C, its internal potential energy increases.
C The internal energy is a measure of the total kinetic and potential energies of the molecules in the body.
D Two substances at the same temperature must have the same amount of internal energy.

22 A 5.0 g bullet travelling at 400 m/s penetrates a copper block of mass 2.0 kg. Assume that there is no loss of thermal energy to the surroundings and that all the thermal energy generated during the penetration was absorbed by the copper block, what is the increase in temperature of the copper block after the bullet has stopped?
(Specific heat capacity of copper = 400 $Jkg^{-1}K^{-1}$)

A 0.50°C
B 5.0°C
C 50°C
D 500°C

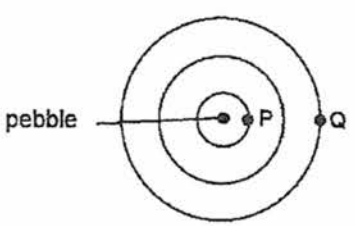
23 The displacement-time graph below illustrates the motion of a wave.



Given that the wavelength of the wave is 10 cm, the speed of this wave is _____.

A 0.050 m/s
B 0.20 m/s
C 5.0 m/s
D 20 m/s

24 A pebble is dropped into still water so that circular wavefronts are seen to travel outwards with a speed of v.



If the wavelength is λ, what is the time taken for the wave to travel from P to Q?

A $\lambda / (2v)$
B λ / v
C $3\lambda / (2v)$
D $2\lambda / v$

25 Diagram 1 shows a convex lens being used to view some small print on a page of a book.
Diagram 2 shows the small print without the convex lens.

Diagram 1

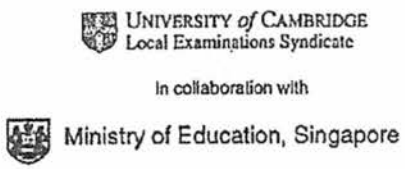


Diagram 2

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

A The image of the small print is real.
B The image distance is longer than the object distance.
C The object distance is shorter than the focal length of the lens.
D The small print and its image are on the same side of the lens.

26 Different types of electromagnetic radiation have different uses.
Which common use of electromagnetic radiation listed below are **incorrect**?

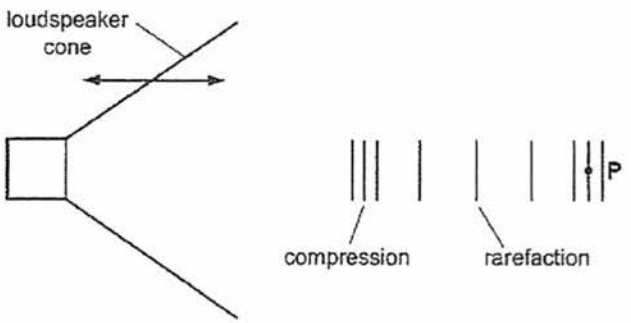
(I) X-rays are used for pre-natal scanning of the foetus
(II) infra-red radiation are used in sunbeds
(III) microwaves are used in wireless telecommunication

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

Apply past knowledge to new situations

10

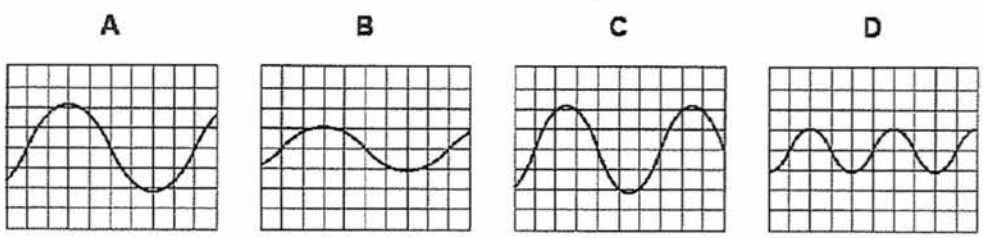
27 Compressions and rarefactions are sent out from a loudspeaker cone as it vibrates horizontally. The frequency of vibration is 50 Hz.



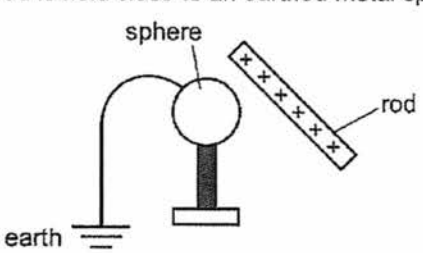
A compression is at point P. How much time elapses before the next rarefaction arrives at P?

A 0.010 s B 0.020 s C 25 s D 50 s

28 The diagrams show oscilloscope traces of sounds picked up by microphones.
The oscilloscope controls are set in the same setting for all the traces.
Which trace shows the sound that is both soft and low-pitched?



29 A positively charged rod is held close to an earthed metal sphere.

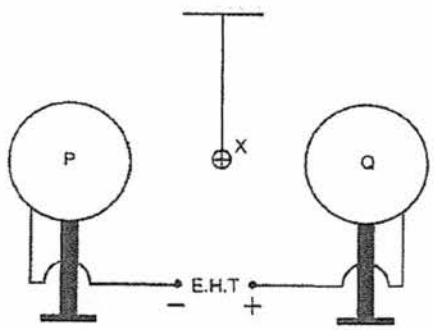


Which of the following describes the charge on the metal sphere?

A It is negative because electrons are attracted towards the rod.
B It is negative because protons are repelled by the rod.
C It is neutral because it is earthed.
D It is neutral because electrons are attracted towards the rod and protons are repelled.

Apply past knowledge to new situations

30 The diagram below shows a light spherical conductor X that is positively charged and suspended in between two insulated copper spheres, P and Q, which are connected to an extra high tension (E.H.T.) supply.
(NOTE: extra high tension supply = high voltage supply)



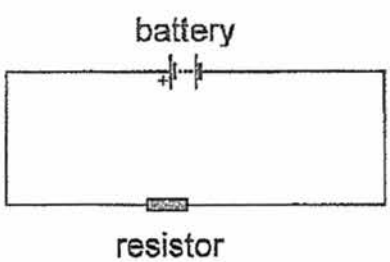
When the switch is closed, conductor X will _____.

A move to P and stay attached to P
B move to P and then oscillate between Q and P
C move to Q and stay attached to Q
D move to Q and then oscillate between P and Q

31 In a given circuit, the current is 0.32 A. If the charge of an electron is 1.6×10^{-19} C, how many electrons will flow past a fixed point in the circuit in 1 second?

A 1×10^{18}
B 2×10^{18}
C 5×10^{18}
D 8×10^{18}

32 In the circuit below, 9.0 J of energy is supplied by a battery when 3.0 C of charge passes through it.



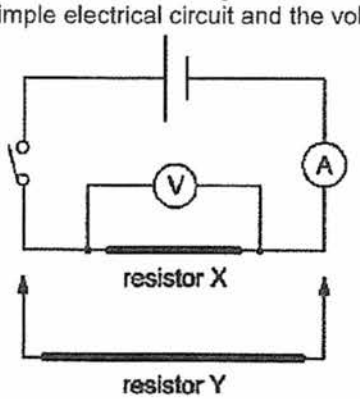
Which of the following statements is true?

A The current flowing through the circuit is 3.0 A.
B The electromotive force (e.m.f.) of the battery is 3.0 V.
C The e.m.f. of the battery is 27 V.
D The resistance of the resistor is 0.33 Ω.

Apply past knowledge to new situations

12

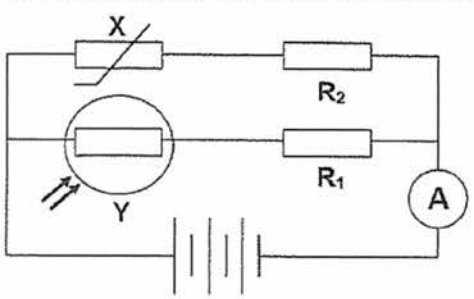
33 A resistor **X** with resistance R is made from a length L of resistance wire with a cross-sectional area A. It is connected to a simple electrical circuit and the voltmeter and ammeter readings are recorded.



A second resistor **Y** is made from wire of the same material as **X**.
It has length 2L and cross-sectional area A, and it is connected in parallel to wire **X**.
Which of the following correctly describes the readings observed from the voltmeter and ammeter?

	ammeter reading	voltmeter reading
A	decrease	decrease
B	decrease	no change
C	increase	decrease
D	increase	no change

34 In the circuit shown, R_1 and R_2 are identical resistors.



Which of the following changes to the electrical components **X** and **Y** will increase the reading of the ammeter by the greatest amount?

	Component X	Component Y
A	immerse completely in cold water	decrease the light intensity on Y
B	immerse completely in cold water	increase the light intensity on Y
C	immerse completely in hot water	decrease the light intensity on Y
D	immerse completely in hot water	increase the light intensity on Y

Apply past knowledge to new situations

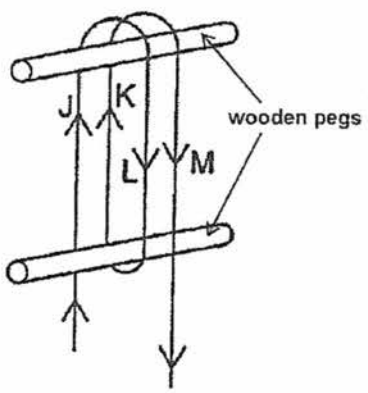
13

35 A combined bathroom unit of a heater and a lamp is controlled by one switch. The unit contains a 2 kW heater and a 100 W lamp.
In one week, the lamp uses 1 kWh of electrical energy.
How much electrical energy is used by the heater alone?

A 2.0 kWh
B 4.0 kWh
C 10 kWh
D 20 kWh

36 A long flexible wire is wrapped around two wooden pegs.
A large current is passed in the direction shown.
In which two pairs do the lengths of wire attract each other?

	first pair	*second pair*
A	J and K	K and M
B	J and K	L and M
C	J and L	K and M
D	J and L	L and M

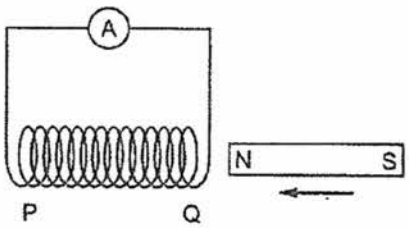


37 What is the part of a simple d.c. motor that reverses the direction of electric current through the coil every half-cycle?

A the armature
B the carbon brushes
C the commutator
D the slip rings

Apply past knowledge to new situations

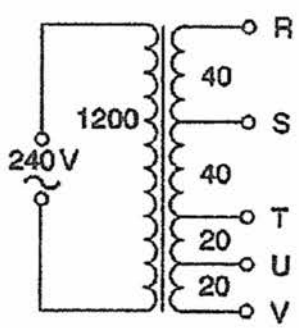
38 A bar magnet approaches a coil of wire PQ as shown below. The coil PQ is connected to a sensitive centre-zero ammeter.
As the N-pole of the magnet approaches end Q of the coil, the pointer of the sensitive centre-zero ammeter deflects momentarily to the right.
The N-pole of the magnet is then pulled towards the right, away from end Q of the coil, at a faster speed.



What would be observed on the pointer of centre-zero ammeter?

A It deflects to the left momentarily by a larger deflection.
B It deflects to the left momentarily by a smaller deflection.
C It deflects to the right momentarily by a larger deflection.
D It deflects to the right momentarily by a smaller deflection.

39 A transformer consists of a coil of 1200 turns and another coil, with a total of 120 turns, which can be tapped at various places.



A 20 V, 24 W lamp is to be lit normally.
Between which two terminals should you connect the lamp?

A Terminals R and S
B Terminals R and T
C Terminals R and U
D Terminals S and U

Apply past knowledge to new situations

15

40 Diagram 1 shows the oscilloscope trace produced by an input of voltage 2.0 V and frequency 50 Hz.
Without changing the input, the Y-gain and time base of the oscilloscope are then adjusted and the waveform as shown in Diagram 2 is then obtained.

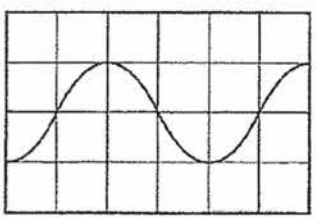


Diagram 1

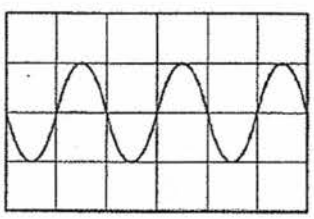


Diagram 2

Which adjustments were made to the Y-gain and time base that resulted in the waveform as shown in Diagram 2 to be displayed?

	Y-Gain	Time base
A	1.0 V / division	5.0 ms / division
B	1.0 V / division	10 ms / division
C	2.0 V / division	5.0 ms / division
D	2.0 V / division	10 ms / division

*** END OF PAPER ***

Apply past knowledge to new situations

Name: ..... ( ) Class: _____

Bukit Batok Secondary School
GCE O-Level Preliminary Examination 2017
Secondary Four Express

PHYSICS
Paper 2 Theory

5059 / 02
16 August 2017 (Wednesday)
0745h to 0930h
1 hour 45 minutes

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

READ THESE INSTRUCTIONS FIRST

Write your name, class, and class register number on all the work you hand in.
Write in dark blue or black ink.
You may use a HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Section A
Answer **all** questions.

Section B
Answer **all** questions. Question 12 has a choice of parts to answer.

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

At the end of examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

FOR EXAMINER'S USE	
Section A	
Section B	
TOTAL	

This Question Paper consists of 21 printed pages.

Section A

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

1 Fig. 1.1 shows the horizontal forces acting on a car moving on a straight level road.
You may assume that the friction between the car and the road is constant.

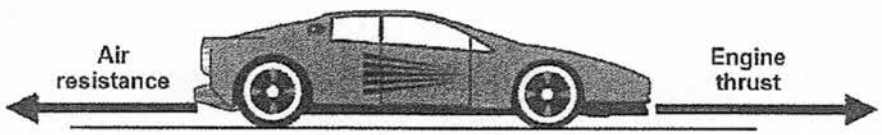


Fig. 1.1

Fig. 1.2 shows the speed-time graph for the first 24 s of the motion of the car along the straight level road.

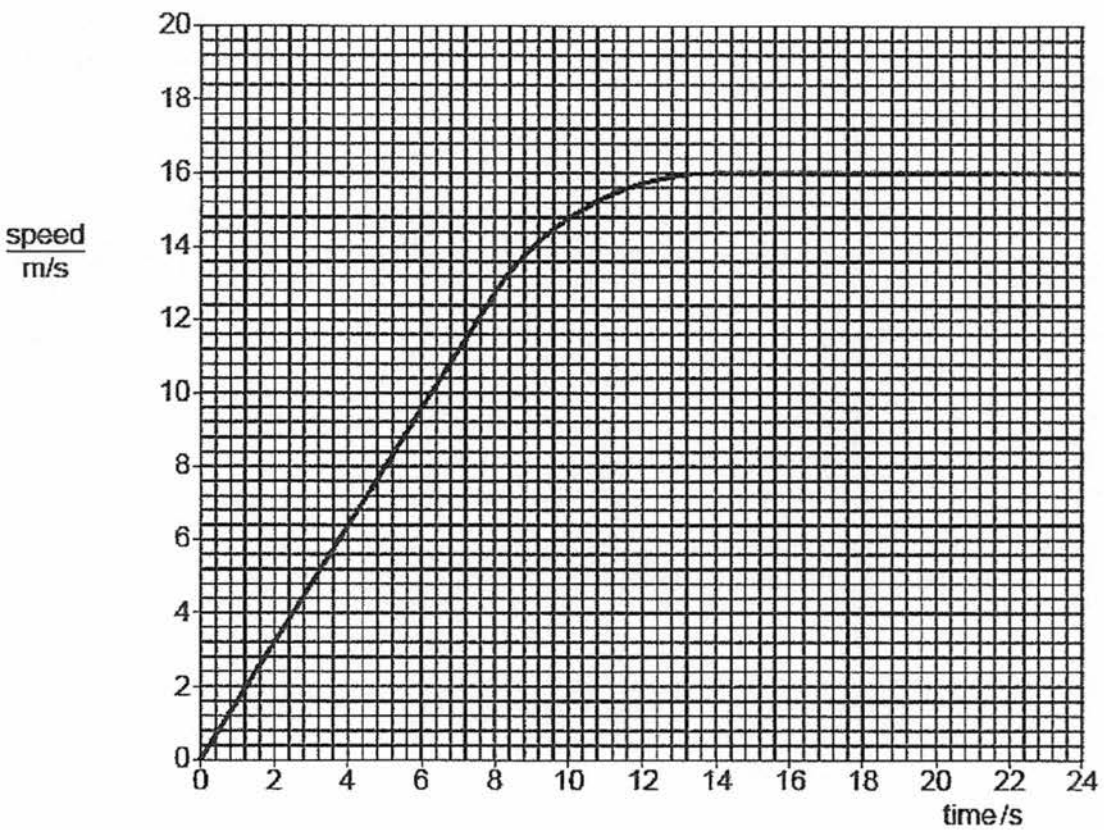


Fig. 1.2

(a) Determine the acceleration of the car during the first 8 s.

acceleration = ... [1]

(b) Determine the distance travelled by the car in the first 6 s.

distance travelled = ... [1]

(c) Use Newton's laws to explain why the acceleration of the car decreases to zero eventually.

.....

.....

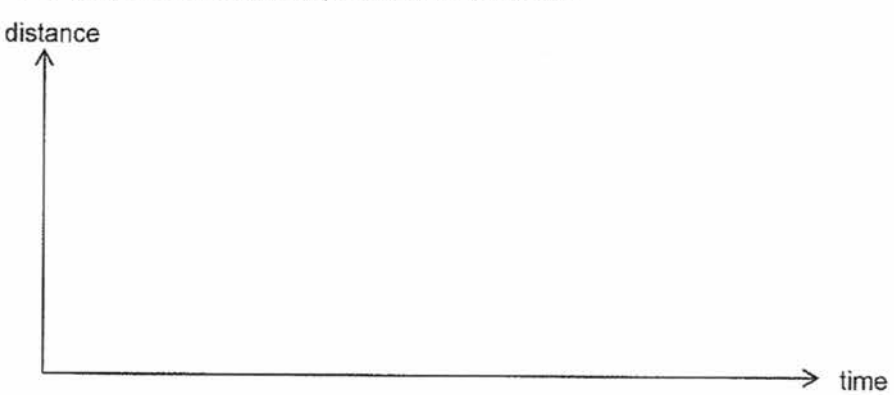
.....

.....

.....

..... [3]

(d) In the axes below, sketch the distance-time graph of the car for the first 24 s. You do not need to give any details on both axes. [2]



2 In a space mission to the Moon, a spacecraft enters the Moon's gravitational field and descends towards the Moon's surface. Halfway through the descent, a piece of equipment became detached from the spacecraft and descends towards the Moon's surface on its own. There is no atmosphere present on the Moon, and the gravitational field strength of the Moon is one-sixth of that on Earth.

(a) Define the terms **(i)** *gravitational field* and **(ii)** *gravitational field strength.*

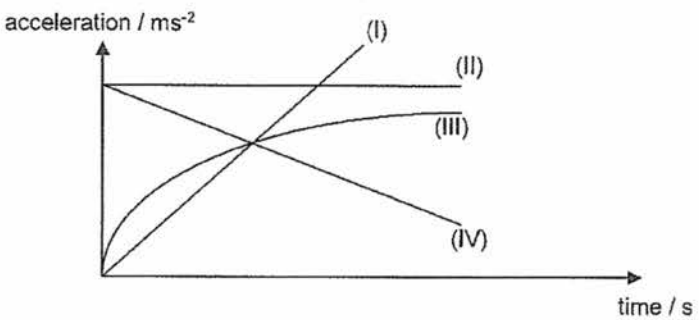
.....

.....

.....

..... [2]

(b) Which acceleration-time graph below – (I), (II), (III) and (IV) – best represents the motion of the spacecraft and the detached piece of equipment?



Spacecraft : acceleration-time graph ..... [1]

Detached equipment : acceleration-time graph ..... [1]

3 Fig. 3.1 shows a firefighter of total weight 840 N in equilibrium at the top of a ladder that is pivoted at point **P**.

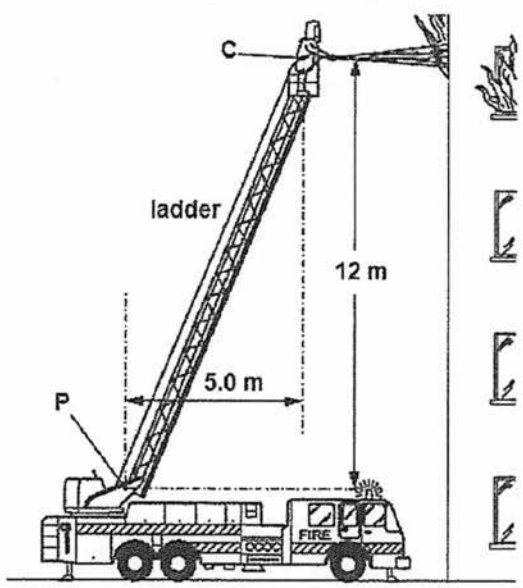


Fig. 3.1

Question continues on next page...

The ladder leans towards a burning building at an angle such that the centre of gravity **C** of the firefighter is 12 m above and 5.0 m to the right of **P**. The firefighter holds a hose that directs a high-speed jet of water horizontally into a burning building.

(a) Calculate the moment M of the firefighter's weight about **P**.

moment M = ... [2]

(b) The jet of water causes a horizontal force R on the firefighter that acts towards the left, through **C**. This opposes the turning effect of his weight. Calculate the magnitude of force R that, on its own, ensures that M is exactly cancelled.

force R = ... [2]

(c) Suggest a third force that has a clockwise turning effect about **P** on the ladder.

..... [1]

4 500 g of water at a temperature of 16°C enters an ice-making machine and emerges as ice cubes at a temperature of –5°C. The freezing point of water is 0°C. Given that:

- specific heat capacity of water = 4.2 J/(g°C)
- specific latent heat of fusion of water = 336 J/g
- specific latent heat of vaporization of water = 2260 J/g
- specific heat capacity of ice = 2.1 J/(g°C)

Calculate the thermal energy removed from

(a) the water during freezing,

thermal energy = ... [2]

(b) the frozen water as it cools further.

thermal energy = ... [2]

(c) Using ideas about molecules, suggest why more energy is needed to change water into steam than to change the same mass of water into ice.

.....

..... [1]

5 In cold countries, people wear coats that are designed to reduce the rate at which thermal energy is lost from their bodies.
The material for some coats is made from a layer of thin strips of silver-coloured plastic between two layers of fabric, as shown in Fig. 5.1.

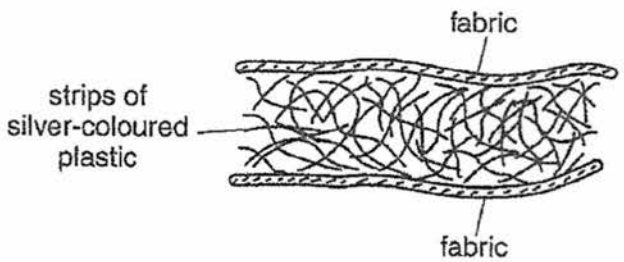


Fig. 5.1

The plastic strips trap small pockets of air between them.
Explain why the layer of silver-coloured plastic strips reduces loss of thermal energy by

(a) conduction,

.....

.....

.....

..... [2]

(b) convection,

.....

..... [1]

(c) radiation.

.....

..... [1]

6 Fig. 6.1 shows a ray of light passing through a semi-circular plastic block.
Q is the centre of the straight side of the block.

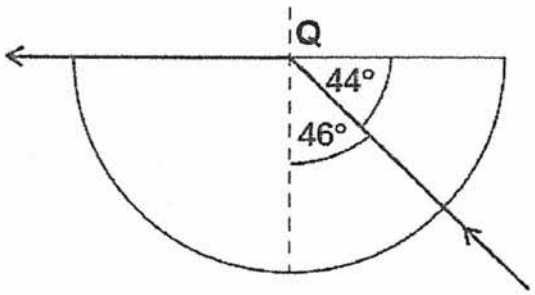


Fig. 6.1

(a) State the value of the critical angle in the plastic.

critical angle = ... [1]

(b) Define what is meant by *critical angle*.

.....

.....

..... [1]

(c) Calculate the refractive index of the plastic.

refractive index = ... [2]

(d) Another semi-circular block of identical dimensions as that shown in Fig. 6.1 is made of diamond.
Diamond has a refractive index of 2.13.
Suggest why more internal reflections occur inside this semi-circular diamond block than inside the piece of semi-circular plastic block shown in Fig. 6.1.

.....

.....

.....

.....

.....

..... [3]

7 Fig. 7.1 shows how ultrasound is used to produce an image of the heart.

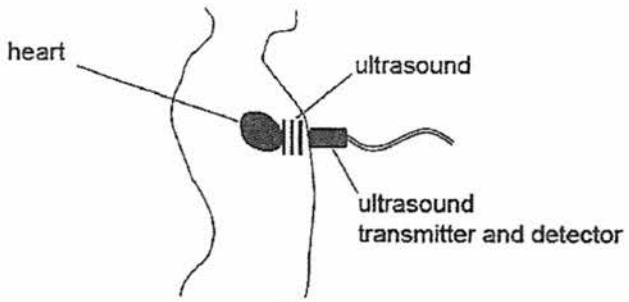


Fig. 7.1

(a) Define *ultrasound.*

.....

..... [1]

(b) The ultrasound has a wavelength of 1.2 mm. The speed of the ultrasound in the human body is 1500 m/s.
Calculate the frequency of the ultrasound.

frequency = ... [2]

(c) Explain how the vibrations of the transmitter produce waves of ultrasound between the transmitter and the heart.

.....

.....

..... [2]

8 Fig. 8.1 shows a mains extension lead. The six sockets allow several electrical appliances to be connected to the mains supply through one cable.
The cable connects the sockets to the mains supply.

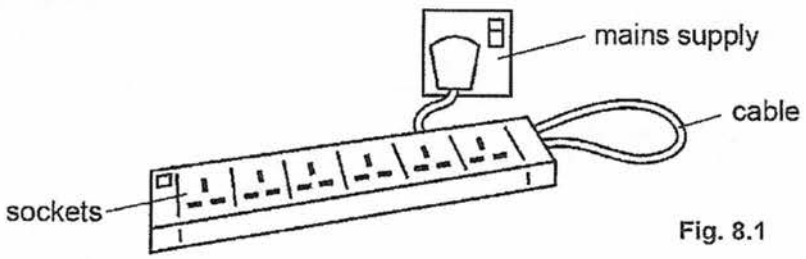


Fig. 8.1

(a) Explain why such a mains extension lead may pose an electrical hazard in the house.

.....

.....

..... [2]

Fig. 8.2 shows the wiring inside the mains plug of an electric kettle that is plugged into the extension lead.

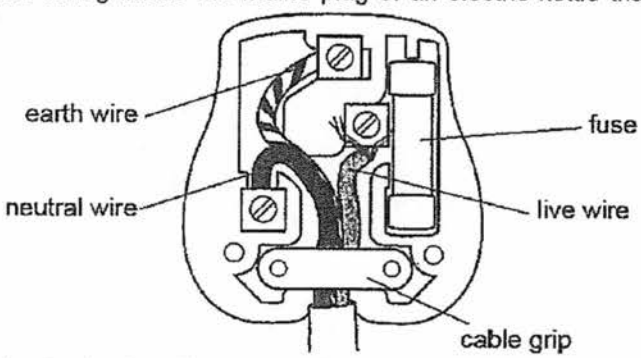


Fig. 8.2

(b) State two mistakes in the wiring of the plug.

1. .....

.....

2. .....

.....

[2]

(c) Explain why it is dangerous to handle the plug with wet hands.

.....

.....

..... [2]

9 Fig. 9.1 shows a magnet, two compasses and two steel nails J and K.
For this question, you may ignore any effects due to the Earth's magnetic field.

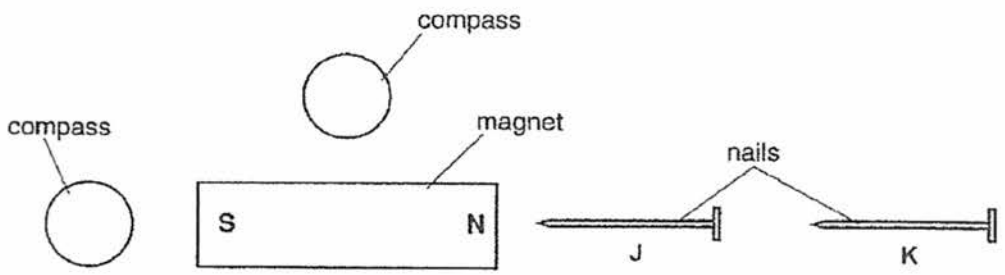


Fig. 9.1

(a) On Fig. 9.1, draw an arrow in each compass to show the direction of the magnetic field of the magnet at the two positions. [1]

(b) When nail J is brought near the magnet, it is attracted to the magnet.
Explain why this attraction occurs.

.....

.....

..... [2]

(c) When the magnet is removed, the nails are still magnetised.

(i) Describe how to test whether the nails are still magnetised when they are away from the magnet.

.....

..... [1]

(ii) Describe, with the aid of a labelled diagram, how the nails are demagnetised.

.....

.....

.....

..... [3]

Section B

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

10 In an experiment to investigate Bernoulli's Principle on a wing of an aircraft, the effects of air velocity and pressure are recorded as the aircraft moves through air.

Fig. 10.1 shows how the air flow passes the wing. The velocity of air above the wing is higher than the velocity of air below the wing.

The pressure and velocity data of the aircraft and air (above and below the wing) are recorded in Fig. 10.3.

Bernoulli's Principle explains why there is a pressure difference above and below the wings (see Fig. 10.2), which produces lift.
Lift is an upward force produced on the wings of an aircraft, allowing it to take off from a runway.

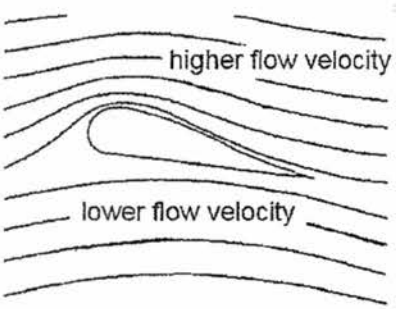


Fig. 10.1

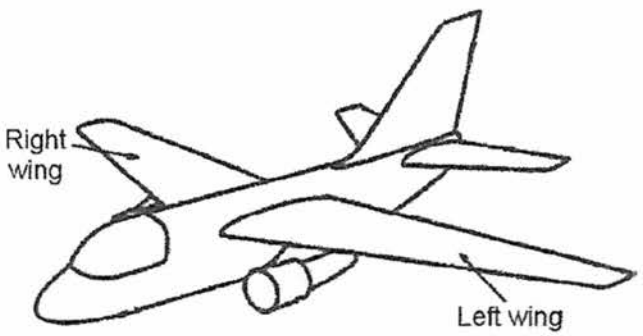


Fig. 10.2
(Image from Google)

	Aircraft Speed / ms^{-1}	30.0	40.0	50.0	60.0	70.0	80.0
Above both wings	**Air Velocity / ms^{-1}**	36.0	48.0	60.0	72.0	84.0	96.0
	Air Pressure / Pa	551	980	1531	2205	3001	3920
Below both wings	**Air Velocity / ms^{-1}**	30.0	40.0	50.0	60.0	70.0	80.0
	Air Pressure / Pa	794	1411	2205	3175	4322	5645

Fig. 10.3

Question continues on next page...

(a) Based on the data provided above, state the relationship between the speed of the aircraft and the air pressure difference above and below the wing.

..... [1]

(b) Bernoulli's Principle is essential for the production of the lift force.
Based on Fig. 10.3, explain how the lift force is produced and how this force is able to cause the aircraft to take off.

.....

.....

.....

.....

.....

..... [3]

(c) Given that the area of the underside (bottom) of all wings of the aircraft is 25 m^2, determine the lift force produced when the aircraft is moving at 30 m/s.

lift force = ... [2]

(d) Given that the weight of the aircraft is 25 kN, estimate the speed of the aircraft necessary for it to take off from a runway.

speed = ... [2]

Question continues on next page...

(e) Before platform doors were installed on all above-ground MRT stations in Singapore, all commuters waiting for trains at such MRT stations are told to stand behind the yellow line for their own safety (see Fig. 10.4)

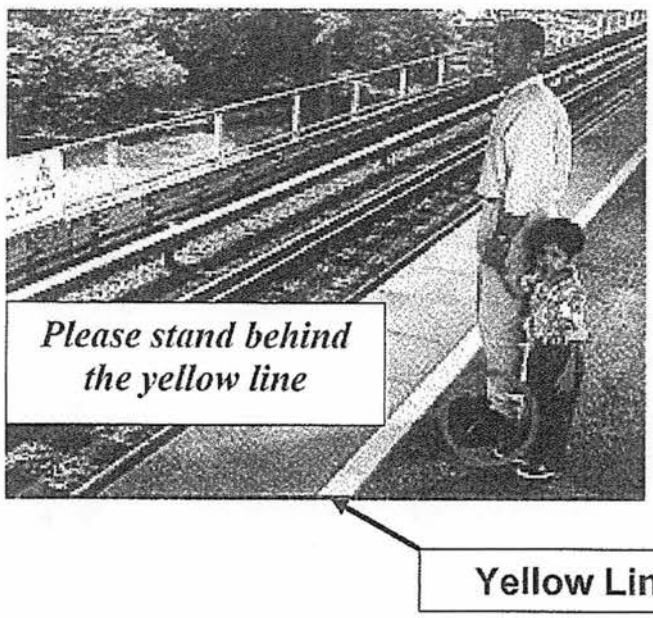


Fig. 10.4

(Reference: http://i.colnect.net/f/1467/907/Stand-behind-yellow-line.jpg)

By referring to your responses to the earlier parts of the question, explain why it is dangerous for commuters to stand on the yellow line, or too close to the rail tracks, when a train is entering the MRT station.

.....

.....

.....

..... [2]

11 Fig. 11.1 shows the top view of a simple physics demonstration, which comprises of a plotting compass being placed above a copper wire.

When there is no current flowing through the wire, the plotting compass points towards the North.

A large direct current then flows through the wire from point J to point K.

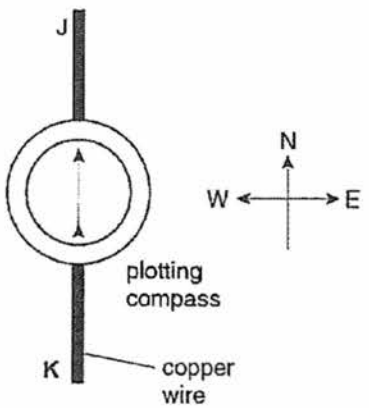


Fig. 11.1

(a) (i) State what happens to the compass needle.

..... [1]

(ii) State what happens to the compass needle if the compass were placed under the wire.

..... [1]

(iii) State and explain what is observed if there were a 50 Hz alternating current flowing through the wire.

.....

.....

..... [2]

Question continues on next page...

(b) Fig. 11.2 shows a coil in a magnetic field. The coil is able to rotate about the axis.
The ends **X** and **Y** of the coil are connected directly to a d.c. power supply.
The arrows on the sides of the coil show the direction of the current in the coil.

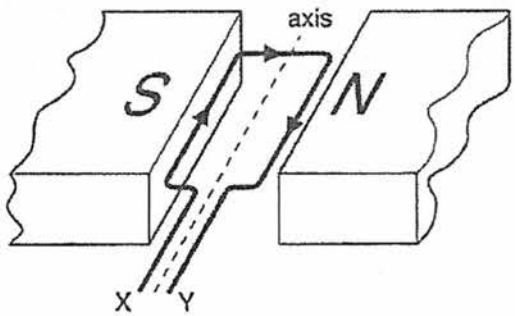


Fig. 11.2

(i) On Fig. 11.2, draw arrows to show the directions of the forces acting on the sides of the coil. [1]

(ii) Explain why the forces act on the sides of the coil.

.....

.....

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.....

.....

..... [3]

(iii) An observer (not shown in Fig. 11.2) looks at the coil while standing at point **X**.
Describe the motion of the coil as viewed by the observer.

.....

.....

.....

..... [2]

12 EITHER

(a) Fig. 12.1 shows a variable potential divider (potentiometer), a power supply and a lamp.

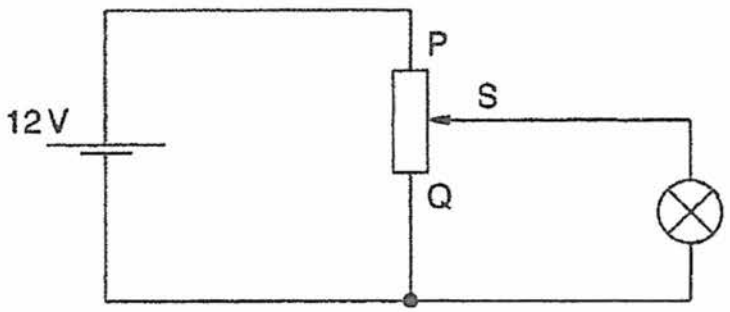

Fig. 12.1

(i) On Fig. 12.1,

1. mark with a letter **X** the position of an ammeter to measure the current in the lamp,
2. add a voltmeter to measure the potential difference (p.d.) across the lamp. [2]

(ii) The sliding contact **S** moves from **P** to **Q**. Describe what happens to the brightness of the lamp.

..... [1]

(b) The lamp is marked 12 V, 200 mA.
When the potential difference across the lamp is in the range 0 to 1.0 V, the resistance of the lamp has a constant value of 11 Ω.

(i) Calculate the current in the lamp when the potential difference across it is 1.0 V.

current = ... [2]

(ii) Calculate the power dissipated by the lamp when the potential difference across it is 1.0 V

power = ... [2]

Question continues on next page...

(iii) On Fig. 12.2, sketch a graph to show how the current in the lamp changes with the p.d. across it. [3]

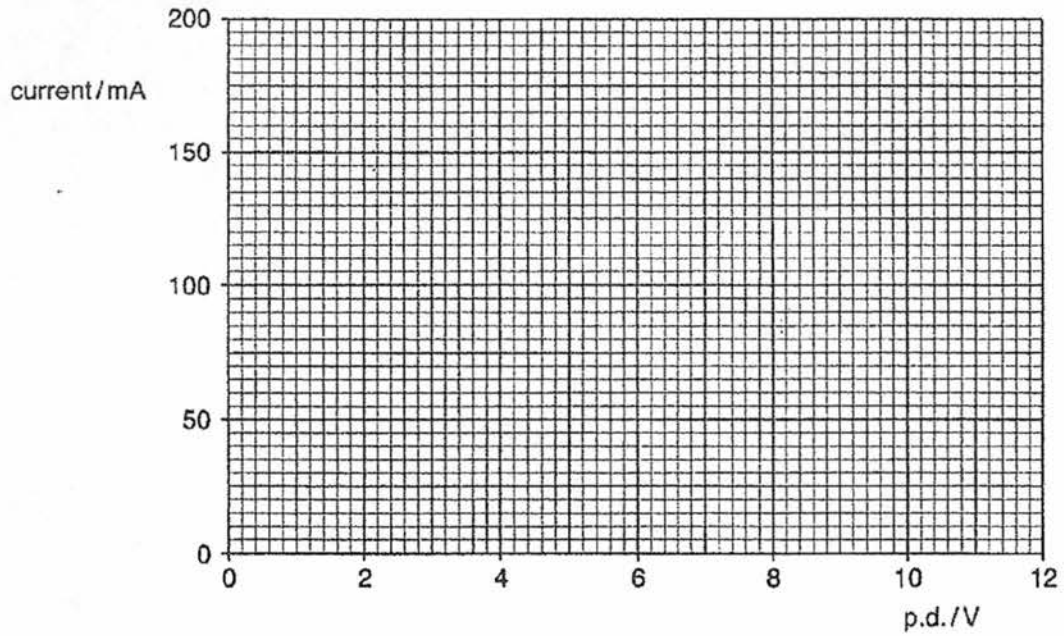

Fig. 12.2

12 OR

(a) Fig. 12.3 shows a device used to measure the flow of air. The turbine is made to rotate by the air that flows through it.

When viewed from **X**, the turbine is rotating in an anticlockwise direction.

The rim of the turbine contains small magnets.

When a small magnet goes near and then away from the coil (wound on a soft-iron core), a trace (which looks like a sine curve) is formed on the graph of induced e.m.f. against time (see Fig. 12.4). This trace is due to an alternating e.m.f. being induced in the coil.

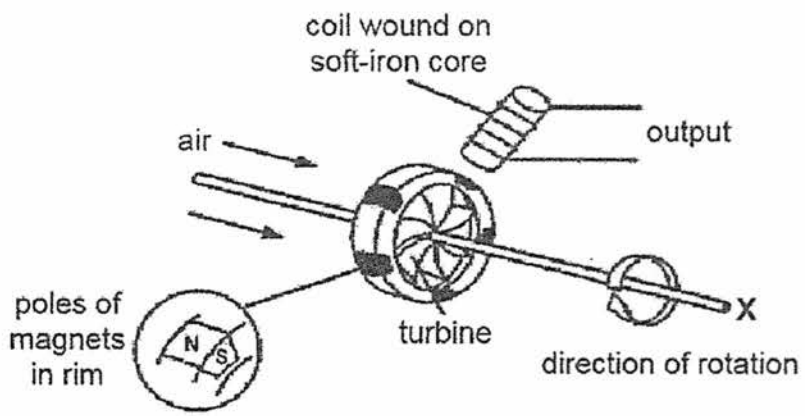

Fig. 12.3

(i) Explain why an alternating e.m.f. is induced in the coil.

.....

.....

.....

.....

.....

.....

..... [3]

Question continues on next page...

(ii) The traces (two separate sine curves) on Fig. 12.4 show how the induced e.m.f. varies with time when the turbine rotates at a steady speed.

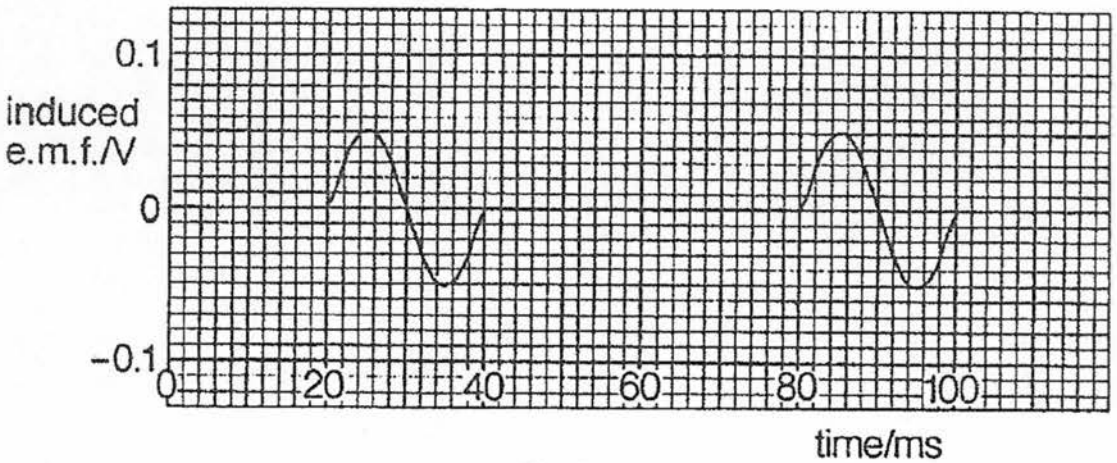

Fig. 12.4

The turbine now rotates twice as fast.

Draw on Fig. 12.4 the new traces to show how the induced e.m.f. varies with time. [3]

(b) Fig. 12.5 shows high voltage cables used to transmit electrical energy.

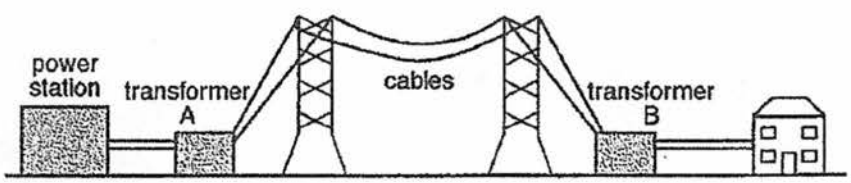

Fig. 12.5

(i) State the purpose of transformer B.

..... [1]

(ii) Explain why high voltages are used to transmit electrical power.

.....

..... [1]

Question continues on next page...

(iii) Fig. 12.6 shows how the loss of thermal energy from a cable varies with the thickness of the cable.

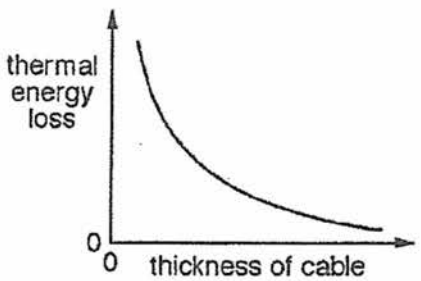

Fig. 12.6

Explain why the loss of thermal energy is less if the cable is thicker.

.....

.....

.....

..... [2]

*** END OF PAPER ***

PAPER 1:

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

2017 BBSS SEC 4E PHYSICS (5059) O PRELIM EXAM
MARK SCHEME (FOR TEACHERS ONLY)

PAPER 2: (W = working), (C/F = concept / formula), (A & U = answer & unit)

- Penalize 1 mark per question for no / wrong unit.
- Penalize 1 mark per question for failure to show concept / formula clearly **and explicitly** at the beginning of each mathematical working.
- Mark for 2 / 3 s.f. in **Q10(c) only**.

Q	Suggested Answer	Remarks
1(a)	When t = 8s, v = 12.8 m/s acceleration = gradient of v-t graph = (12.8 – 0) / (8 – 0) = **1.6 m/s²**	[1]: W, C/F, A & U
1(b)	When t = 6s, v = 9.6 m/s Distance = area under v-t graph (1st 6 s) = ½(6)(9.6) = **28.8 m**	[1]: W, C/F, A & U
1(c)	• Constant engine thrust & increasing air resistance leads to • decreasing net force acting on car (and acceleration decreases). • Eventually, engine thrust and air resistance are equal in magnitude and opposite in direction / balanced, leads to zero net force (and zero acceleration)	[1] [1] [1]
1(d)	• Curve of positive increasing gradient • Straight line of positive gradient	[1] [1]
2(a)	(i) *Gravitational field*: region in which a mass experiences a gravitational force. (ii) *Gravitational field strength*: gravitational force acting on unit mass (of body).	[1] [1]
2(b)	Spacecraft : graph (II) Equipment : graph (II)	[1] [1]
3(a)	Moments (M) = F × d = (840N)(5.0m) = **4200 Nm**	[1]: W & C/F [1]: A & U
3(b)	Apply principle of moments about P: (R)(12) = (840)(5.0) Force R = **350 N**	[1]: W & C/F [1]: A & U
3(c)	weight of ladder / hose / fire engine	[1]
4(a)	Q = ml_f = (500)(336) = **168 000 J**	[1]: W & C/F [1]: A & U
4(b)	Q = mcΔθ = (500)(2.1)(5 – 0) = **5250 J**	[1]: W & C/F [1]: A & U
4(c)	Any one of the following: More energy needed to completely break intermolecular forces (during vaporization) than to strengthen it (during freezing) / incomplete breaking of intermolecular forces during melting but complete breaking of such forces during boiling / work is done to push back atmosphere during boiling but not so during melting	[1]
5(a)	• Fabric and plastic are good thermal insulators. • Trapped air (between fabric) is a good thermal insulator.	[1] [1]
5(b)	Trapped air prevents formation of convection currents	[1]
5(c)	Silver-coloured plastic are good reflectors of radiant heat (reflects radiant heat back to the human body)	[1]
6(a)	46°	[1]
6(b)	Angle of incidence in optically denser medium where the corresponding angle of refraction in optically less dense medium is 90°.	[1]
6(c)	sin c = 1/n sin 46 = 1/n ⇒ n = 1.39 (to 3 s.f.) or 1.4 (to 2 s.f.)	[1]: W & C/F [1]: A & U
6(d)	• Critical angle for diamond = $\sin^{-1}(1/n) = \sin^{-1}(1/2.13)$ = **28°** (to 2 s.f.) • Critical angle for diamond < critical angle for plastic (46° – allow for ecf) • Higher chance of incident light ray in diamond (with an incident angle above 28°) to undergo internal reflection in diamond than in plastic.	[1] [1] [1]

Q	Suggested Answer	Remarks
7(a)	Sound with frequencies above / beyond the upper limit of the human range of audibility / 20 kHz.	[1]
7(b)	$v = f\lambda \Rightarrow f = v/\lambda = 1500 / 1.2 \times 10^{-3}$ = 1 250 000 Hz (or **1.25 MHz**)	[1]: W & C/F [1]: A & U
7(c)	• (Vibration of transmitter causes) body cells / tissues to vibrate parallel to direction of travel of sound wave • Forming regions of compressions and rarefactions	[1] [1]
8(a)	• Total current drawn by all appliances may exceed the maximum current that the mains supply can conduct safely. • Live wire of mains supply will overheat (and may start a fire)	[1] [1]
8(b)	1. Some strands of live wire were not connected properly to the live pin. 2. Cable grip should grip the outer insulation and not the inner (live, neutral & earth) wires.	[1] [1]
8(c)	• Water is a conductor of electricity. • Resistance of wet skin / hand is reduced and a larger electric current could flow through the body.	[1] [1]
9(a)	S N	[1]: compass above magnet points to the left **AND** compass next to S-pole points to the right
9(b)	• LHS / tip of nail J magnetically induced to be S-pole. • Like poles repel and unlike poles attract (law must be stated in full).	[1] [1]
9(c)(i)	Bring both ends of permanent magnet near one end of nail and repulsion observed (at one instance).	[1]
9(c)(ii)	• Correct diagram with key parts (solenoid, nail and a.c. supply) labelled. • While a.c. still flows through solenoid, pull nail out of solenoid • in east-west direction till some distance away (from solenoid).	[1] [1] [1]
10(a)	The faster the aircraft, the greater the pressure difference	[1]
10(b)	• Air velocity above wings > air velocity below wings will cause air pressure above wings < air pressure below wings. • Upward net force acts on unit area of the wings. • Once upward net force > weight of aircraft, the aircraft takes off. (NOTE: students can repeat the point "the faster the aircraft, the greater the pressure difference" here, as part of their answer. But this point should not earn any credit in this part of the question – as it is a repetition of 10(a))	[1] [1] [1]
10(c)	(At 30m/s), pressure difference = 794 – 551 = 243 Pa (Lift)force = pressure × area = 243 × 25 = 6075 N = **6080 N** (3 s.f.) or **6100 N** (2 s.f.)	[1] [1]
10(d)	Pressure difference = F/A = 25000 / 25 = 1000 Pa From the table, minimum aircraft speed = **70 m/s**	[1] [1]
10(e)	• (Due to approaching train) air between commuter and train will have high speed, resulting in lower pressure of air (between commuter and train). • Air behind commuter at relatively higher pressure than air between commuter and train. Net force acts on commuter, pushing him towards the train.	[1] [1]
11(a)(i)	Needle points to west / left	[1]
11(a)(ii)	Needle points to east / right	
11(a)(iii)	• Needle will remain stationary / point to north / neither deflect left nor right / neither deflect east nor west / vibrates slightly about vertical axis. • (50 Hz a.c. causes) magnetic field around wire to reverse its direction 50 times per second / rapidly. Inertia of needle prevents it from deflecting / causes it to vibrate slightly about its vertical axis.	[1] [1]

Q	Suggested Answer	Remarks
11(b) (i)	Coil nearer to S-pole experiences vertically upward force AND Coil nearer to N-pole experiences vertically downward force.	[1]
11(b) (ii)	• Both the permanent magnet and the current carrying coil produce separate magnetic fields and they interact with each other. • Where the fields act in the same direction, they reinforce each other and create a stronger resultant field. Where the fields act in opposite directions, they create a weaker resultant field. • Difference in magnetic field strength results a net force to act from stronger field to weaker field.	[1] [1] [1]
11(b) (iii)	• Coil rotates clockwise • For quarter of a rotation before it oscillates back and forth with decreasing amplitude, and then comes to rest in a vertical position.	[1] [1]
12(E) (a)(i)	1. Ammeter must be connected in series with the lamp. 2. Voltmeter must be connected in parallel to the lamp.	[1] [1]
(a)(ii)	Brightness of lamp decreases.	[1]
12(E) (b)(i)	Current (I) = V / R = 1.0 / 11 = **0.091A** (to 2 s.f.) or **0.0909A** (to 3 s.f.)	[1]: W & C/F [1]: A & U
12(E) (b)(ii)	Power = $V^2/R = 1^2 / 11$ = **0.0909W** (to 3 s.f.)	[1]: W & C/F [1]: A & U
12(E) (b)(iii)	• Graph is a straight line from the origin to (1,91) ← **accept (1,90)** • and then a smooth curve of decreasing gradient after that • and pass through the point (12,200)	[1] [1] [1]
12(O) (a)(i)	• Relative motion between magnet(ic field) and (conducting) coil leads to a change in magnetic flux linking the coil per second (or: rate of change of magnetic flux linking the coil) and this induces an e.m.f. • As magnetic field is brought near the coil, there is an increase in magnetic flux linking the coil per second. This causes a peak in the alternating signal. • As magnetic field is brought away from the coil, there is a decrease in magnetic flux linking the coil per second. By Lenz's Law, this causes a trough in the alternating signal.	[1] [1] [1]
12(O) (a)(ii)	• Each new signal has twice the amplitude (0.1V) and • half the period (10 ms) as old signal. • Start of new signals at t = 20 ms, 50 ms and 80 ms	[1] [1] [1]
12(O) (b)(i)	Transformer B is used to step down voltage.	[1]
12(O) (b)(ii)	Electric current flowing in the cables will be low (when high voltages are used). Hence the power loss (I^2R) would then be minimised.	[1]
12(O) (b)(iii)	• Thick wires have large cross-sectional areas A, and thus low resistance because resistance R inversely proportional to cross-sectional area A. • Since power loss (P) = I^2R, less resistance would mean less power loss.	[1] [1]