Name: _____ Class: _____ Index No. : _____

2016 PRELIMINARY EXAMINATION
SECONDARY 4 (O-LEVEL PROGRAMME)

PHYSICS

5059 / 1

Paper 1 Multiple Choice

19 August 2016

1 hour

Additional Materials: Multiple Choice Answer Sheet

(1130 – 1230 hr)

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on the cover page of this Question Paper and the Answer Sheet.
Write in soft pencil on the Multiple Choice Answer Sheet.
Do not use staples, paper clips, highlighters, glue or correction fluid.

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

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

At the end of the examination, submit the Question Paper and Answer Sheet **SEPARATELY**.

For Examiner's Use	
Total	40

1 The formula used to calculate a gas constant, k is given below.

$$pV = k$$

where p = pressure of gas
V = volume of gas
k = gas constant

Which of the following is a possible unit for the gas constant?

A kg m s^{-1}
B J s^{-1}
C N
D N m

2 A micrometer is used to measure the thickness of a book that has 200 identical pages, including its front and back cover.
With the jaws completely closed, the micrometer reading is shown in Fig 2.1.
With the jaws closed around the book, the micrometer reading is shown in Fig 2.2

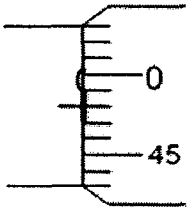


Fig. 2.1

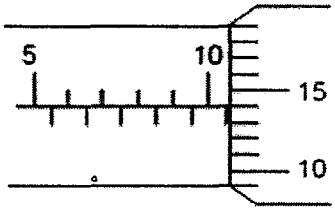


Fig. 2.2

What is the thickness of the book?

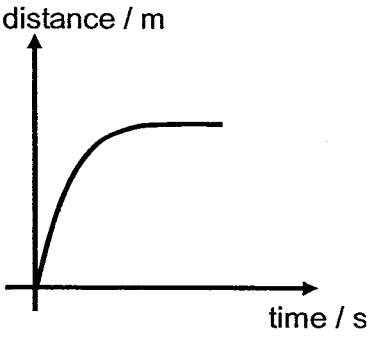
A 0.0533 mm **B** 10.64 mm **C** 10.66 mm **D** 11.12 mm

3 An object is propelled vertically upward with an initial speed of 20 m/s.
Ignoring air resistance, what is the magnitude of the displacement of the object 3.0 s later?

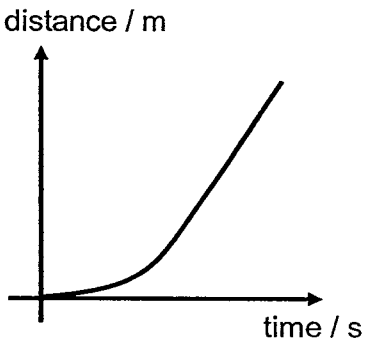
A 5.0 m
B 10 m
C 15 m
D 20 m

4 A car moves forward in a straight line.
If the driving force is constant, which of the following graphs correctly shows how the distance of the car changes with time?

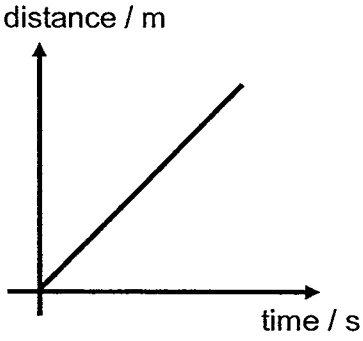
A



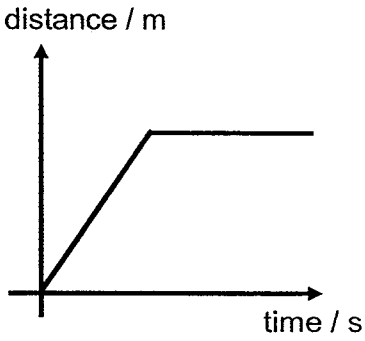
B



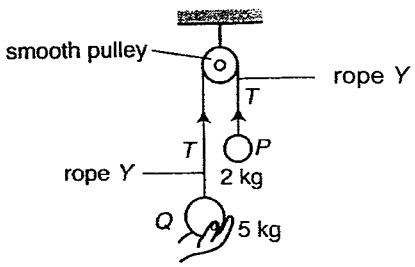
C



D



5 Two metal spheres P and Q are attached together to the same rope Y which goes round a smooth pulley as shown below. Steven places his hand to support sphere Q with a 30 N force so that the system is stationary. Take g = 10 N/kg.

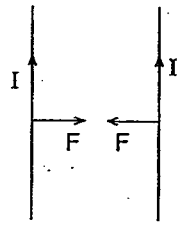


What is the magnitude of the tension, *T*?

A 20 N
B 30 N
C 50 N
D 80 N

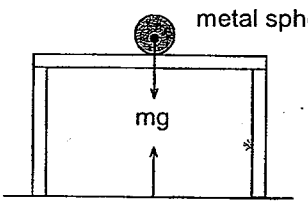
6 Which of the following pairs of forces is not a valid example of action and reaction forces according to Newton's third law of motion?

A



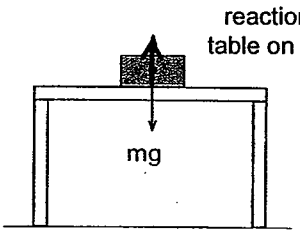
attractive forces between current carrying wires

B

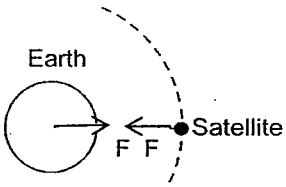


force on earth due to metal sphere

C

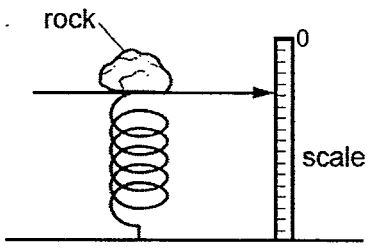


D

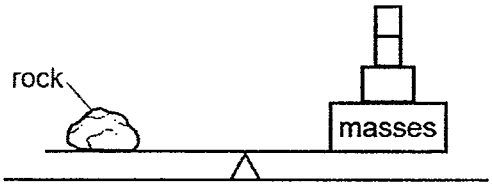


attractive forces between Earth and Satellite due to gravity

7 An astronaut conducted the same experiment as shown below on Mars and on the Moon. She placed the same rock on a spring balance and then on a beam balance. The gravitational field strength of Mars is larger than the Moon.



spring balance



beam balance

Which of the following options is correct when the experiment was conducted on the Moon?

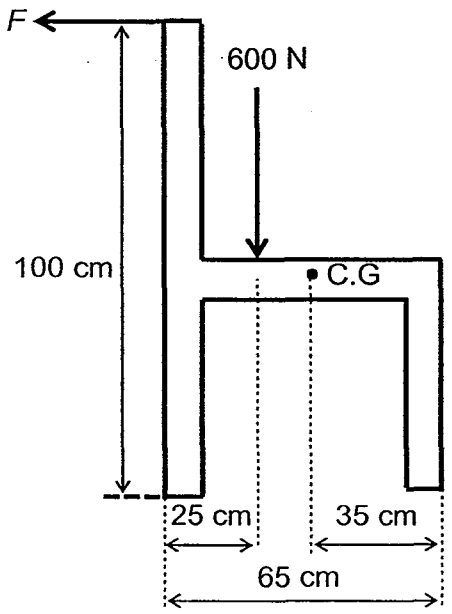
	scale readings of spring balance	*masses needed on beam balance*
A	greater than in Mars	more than in Mars
B	same as in Mars	less than in Mars
C	smaller than in Mars	less than in Mars
D	smaller than in Mars	same as in Mars

8 A mass of liquid of density ρ is thoroughly mixed with an equal mass of another liquid of density 2ρ. The final volume of the mixture is the sum of the volumes of the two liquid.

What is the density of the liquid mixture?

A $\frac{4}{3}\rho$ **B** $\frac{3}{2}\rho$ **C** $\frac{5}{3}\rho$ **D** 3ρ

9 The diagram below shows the dimensions of a chair. A boy sits on the chair and exerts a 600 N force on it as shown. The figure also shows the position of the centre of gravity (C.G.) of the chair.



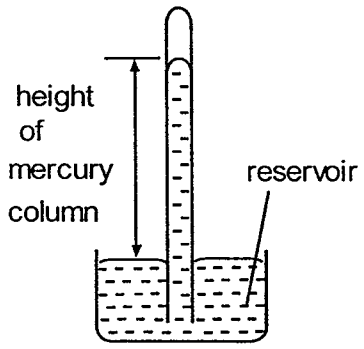
If the mass of the chair is 5.0 kg, what is the magnitude of the horizontal force, F needed to overturn the chair?

A 150 N
B 165 N
C 240 N
D 258 N

10 With reference to question 9, which of the following statements will not help to prevent the chair from overturning?

A Lower the C.G. of the chair.
B Use a heavier chair.
C The boy leaning forward.
D Increase the base area of the chair.

11 The diagram shows a simple mercury barometer.



Which of the following does not cause the height of the mercury column to vary?

A changes in atmospheric pressure
B changes in the temperature of the mercury
C changes in the value of gravitational field strength
D evaporation of mercury from the barometer reservoir

12 Which sequence represents, in the correct order, the transformation of useful energy in a nuclear power station?

A nuclear energy → chemical energy → light energy → electrical energy
B nuclear energy → gravitational potential energy → kinetic energy → electrical energy
C nuclear energy → kinetic energy → thermal energy → electrical energy
D nuclear energy → thermal energy → kinetic energy → electrical energy

13 When Peter sleeps, his body has a power output of 60 W.
He sleeps from 10.00 pm to 7.00 am.

How much energy has he expended?

A 1.5×10^{-1} J
B 3.2×10^{3} J
C 5.4×10^{2} J
D 1.9×10^{6} J

14 A sealed container filled with gas, is submerged into some hot water.

Which of the following describes the change in the density of the gas and the speed of the molecules?

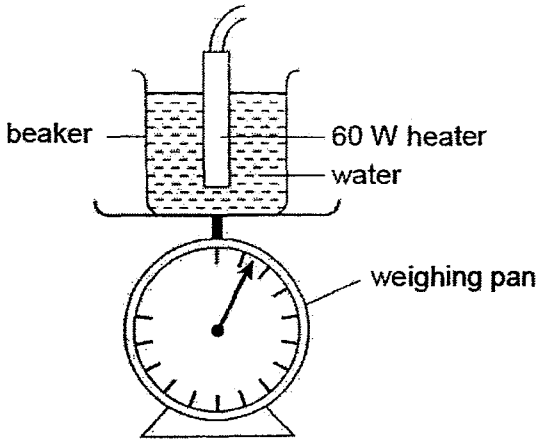
	the density of gas	*the speed of the molecules*
A	denser	faster
B	less dense	same speed
C	less dense	slower
D	remains unchanged	faster

15 A fixed mass of air is trapped inside a cylinder by a piston. The piston is pushed in slowly so that the temperature remains constant.

Which of following explains the increase of pressure of the air in the cylinder?

A Pushing in the piston speeds up the air molecules.
B The air molecules collide more frequently with one another.
C The air molecules collide more frequently with the wall of container.
D There is less wall surface for the molecules to collide with.

16 The following set-up is used to measure the specific latent heat of vaporisation of water.



Three readings are taken by the weighing pan as shown below.
m_1 = reading before heating
m_2 = reading at 3 minutes after water boils
m_3 = reading at 8 minutes after water boils

Which calculation gives the best estimation of the specific latent heat of vaporisation of water in J/kg?

A $\dfrac{300}{m_2 - m_3}$

B $\dfrac{480}{m_1 - m_3}$

C $\dfrac{10800}{m_1 - m_2}$

D $\dfrac{18000}{m_2 - m_3}$

17 Which of the following does not change when a solid is melting?

A average speed of molecules
B density of the mixture
C intermolecular forces of attraction
D internal energy of the molecules

18 The change of the resistance of a copper wire is assumed to be directly proportional to the change of its temperature. At 20 °C, the resistance of the wire is 0.51 Ω. When the wire is placed in a beaker of boiling water, its resistance is equal to 2.91 Ω. The wire is used to measure the temperature of a hot drink.

What is the temperature of the hot drink if the resistance of the wire is 2.55 Ω?

A 48 °C
B 68 °C
C 85 °C
D 88 °C

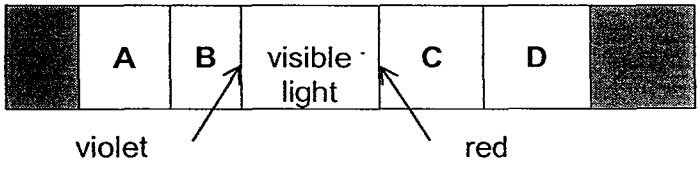
19 Wi-Fi is the name of a popular wireless networking technology that uses radio waves to provide wireless high-speed internet and network connections.

Which statement below correctly describes the type of waves that Wi-Fi uses?

A They cannot be reflected.
B They cannot travel through a vacuum.
C They have the same speed as gamma rays in air.
D The speed of the waves increase with increasing frequency.

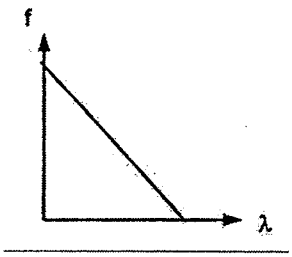
20 The diagram below shows an electromagnetic spectrum and it is not drawn to scale. The visible light spectrum is marked. One of the sections of the spectrum has the characteristic: "Able to transfer heat from high temperature region to low temperature region."

Which section is it?

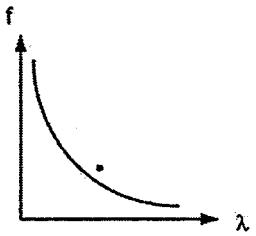


21 Which graph shows the correct relationship between the frequency, f and the wavelength, λ of a wave that is travelling in a uniform material?

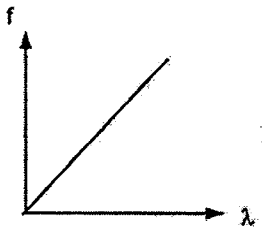
A



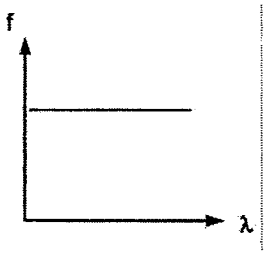
B



C



D



22 A piece of white paper cannot be used as a plane mirror.

What is the reason for this?

A The paper is white in colour.
B The light rays falling on the surface of the paper do not obey the laws of reflection.
C The surface of the paper absorbs most of the light falling on it.
D The surface of the paper is not smooth enough to allow regular reflection of light.

23 A ray of light travels from air to water along the normal at the point of incidence.

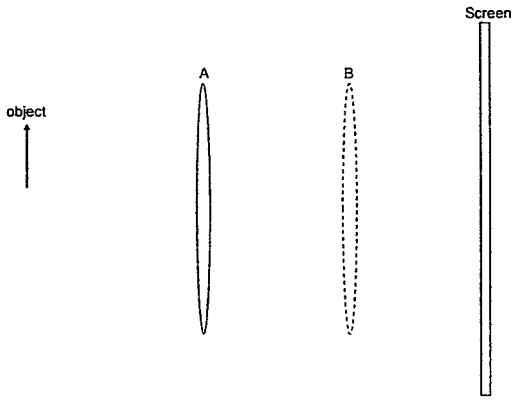
Which of the following properties of light will change?

(1) speed
(2) frequency
(3) direction of travel

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

24 When the lens is placed at A, a sharp image is formed on the screen. The image is real, inverted and magnified. After the lens is moved to B, another sharp image is formed on the screen.

What are the properties of the latter image?



A diminished and inverted
B diminished and upright
C magnified and inverted
D magnified and upright

25 A ray of light in a glass block is incident on a boundary with air at an angle of incidence of 30°. The critical angle at this boundary is 32°.

What happens to the ray of light at the boundary?

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

26 A flash of lightning and the corresponding sound of thunder are detected 6.0 s apart. A student calculates that the lightning struck about 1800 m away.

On which assumption is the calculation based on?

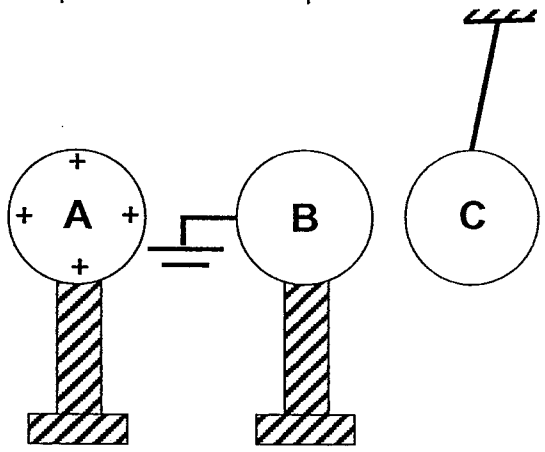
A Light reaches us almost instantaneously, but sound travels at 300 m/s.
B Light travels 300 m/s faster than sound.
C Light travels 300 times faster than sound.
D The sound of the thunder was emitted 6.0 s after the flash.

27 A musical note, of the same pitch, is played first on a flute and then on a trumpet.

Which one of the following correctly compares the notes produced by the two instruments?

A different frequency and different speeds
B different frequency and the same speeds
C same frequency but different speeds
D same frequency and same speeds

28 The diagram below shows a positively charged metal sphere A placed next to a neutral metal sphere B. Metal sphere B is earthed and metal sphere C is then freely suspended next to metal sphere B. The final position of metal sphere C is as shown.



What could be the charge of metal sphere C?

A positively charged only
B positively charged or neutral
C negatively charged only
D neutral

29 Which of the following statements correctly defines electric field direction?

A It is the direction of the electric force acting on a small negative point charge.
B It is the direction of the electric force acting on a small positive point charge.
C It points away from a negatively charged object towards a positively charged object.
D It points away from a positively charged object towards a negatively charged object.

30 Why are birds able to rest on an overhead transmission line without being electrocuted?

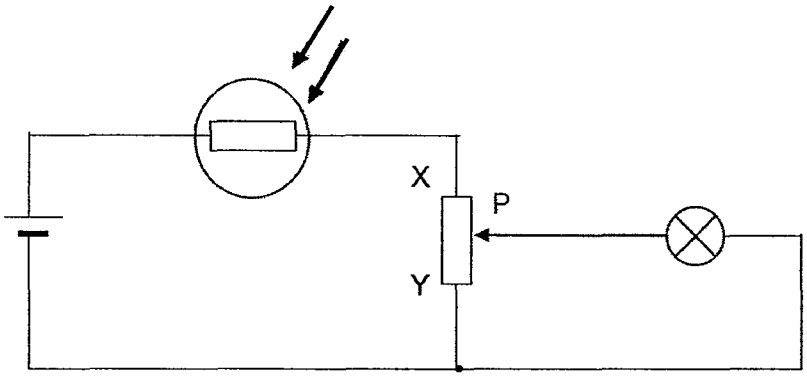
A The bodies have very high resistance.
B The current is too small.
C The air between the feathers is a very good electrical insulator.
D There is no potential difference between their feet.

31 A resistance wire, X, is connected to a battery and an ammeter in series. The reading of the ammeter is 1.60 A. The resistance wire, X is then replaced with resistance wire, Y. The length and the diameter of resistance wire, Y, is double that of resistance wire, X.

If the two resistance wires are made of the same material, what is the new reading on the ammeter?

A 0.20 A
B 0.40 A
C 1.60 A
D 3.20 A

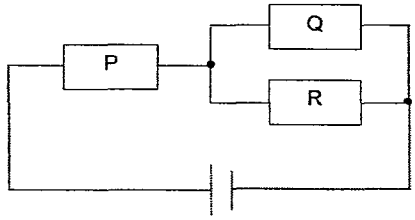
32



Which arrangement will cause the bulb, as shown in the circuit above, to be the brightest?

A Light is incident on the LDR and P is moved to X.
B Light is incident on the LDR and P is moved to Y.
C The LDR is covered and P is moved to X.
D The LDR is covered and P is moved to Y.

33 The diagram below shows 3 resistors connected to a cell of 2.0 V. The resistance of both P and Q are 2.0 Ω and the current flowing in resistor P is 0.80 A.



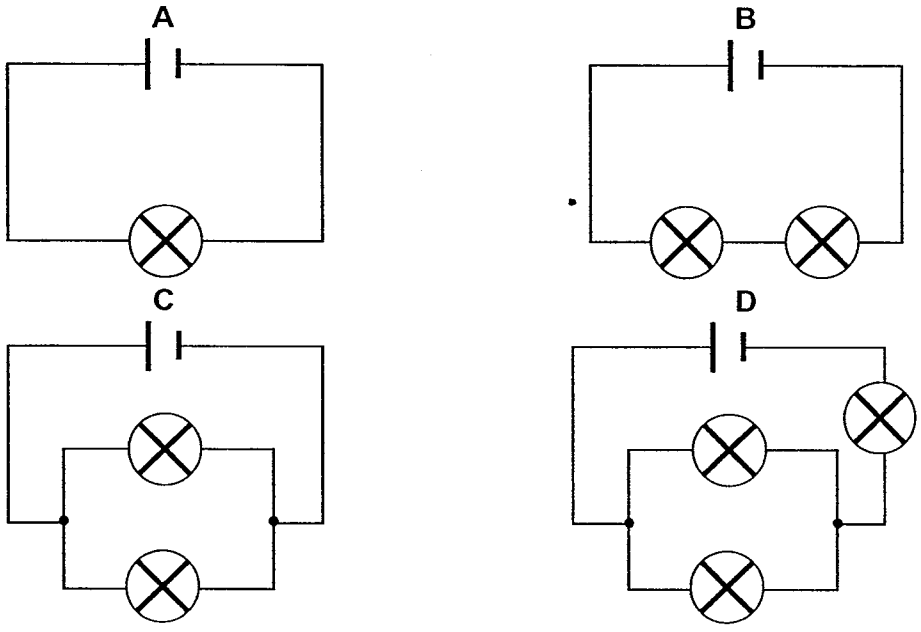
2.0 V

What is the resistance of R?

A 0.40 Ω
B 0.67 Ω
C 1.0 Ω
D 1.5 Ω

34 Identical light bulbs are connected to a cell with an e.m.f. of 3.0 V.

Which of the following arrangements will result in the smallest total power output?



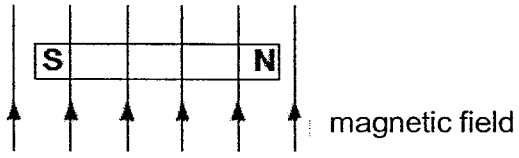
35 An appliance is used in a damp environment. The insulation of the wiring is damaged.

What is/are the possible risk(s) that could happened to the appliance?

(I) The fuse blows
(II) The user gets an electric shock
(III) Electrical fire occurs

A (I) only
B (II) only
C (I) and (II) only
D All of the above

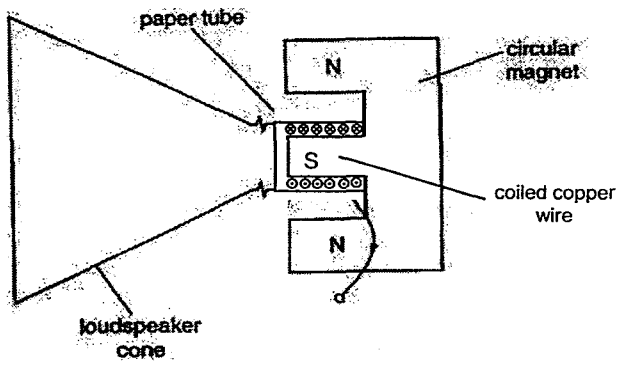
36 The diagram shows a bar magnet placed in a uniform magnetic field.



What will happen to the magnet if it is allowed to move freely?

A It will remain stationary.
B It will turn 90° anticlockwise.
C It will turn 90 ° clockwise.
D It will turn 180 ° clockwise.

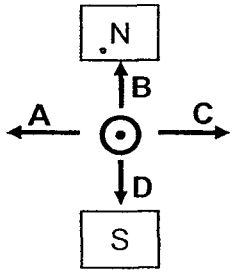
37 The diagram shows the side view of a loudspeaker, which consists of magnets and a coiled copper wire amongst other items. Direct current is flowing in the speaker's coil in the direction as shown below.



What is the direction of the force experienced by the coil?

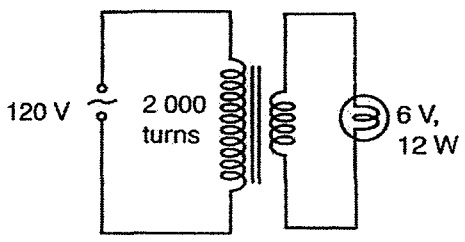
A into the page
B no force is induced
C to the left
D to the right

38 The diagram below shows an induced current, flowing through a conductor as it is moved between two magnets.



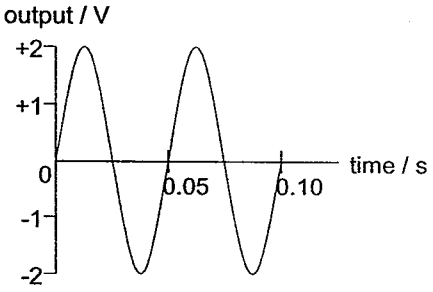
Which arrow indicates the direction of movement of the conductor?

39 A bulb, rated 6.0 V, 12 W is connected to a transformer as shown in the diagram below. The brightness of the bulb turns out dimmer than expected, which of the following is a possible number of turns in the secondary coil?



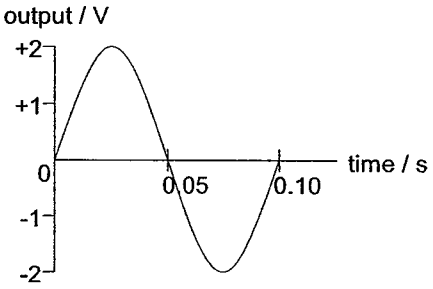
A 90
B 120
C 200
D 1000

40 The graph shows the output of an a.c. generator. The coil in the generator rotates 20 times in one second.

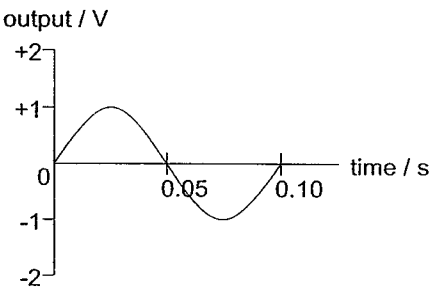


Which graph shows the output when the coil rotates 10 times in one second?

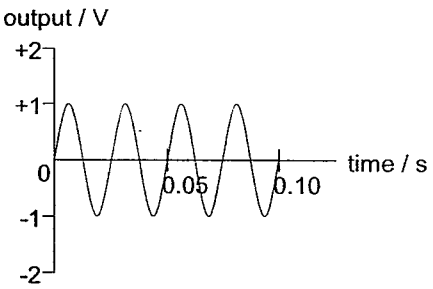
A



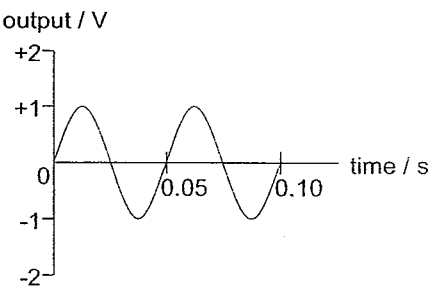
B



C



D



Name: _____ Class: _____ Index No. : _____

2016 PRELIMINARY EXAMINATION
SECONDARY 4 (O-LEVEL PROGRAMME)

PHYSICS

5059 / 02

Paper 2 Theory

17 August 2016

1 hour 45 minutes

Candidates answer on the Question Paper.

(1100 – 1245 hr)

Additional Materials: Nil

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on the cover page of this Question Paper and all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A
Answer **all** questions.

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

Candidates are reminded that **all** quantitative answers should include appropriate units.
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 the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

Section A							
Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8

Section B			
Q9	Q10	Q11(E)	Q11(O)

For Examiner's Use	
Section A	/ 50
Section B	/ 30
Total	/ 80

Section A (50 marks)

Answer all questions from this section.

1 The driver in a car travelling at 15 m/s sees a child dashing across the road in front of him. He steps onto the brake as fast as he could. Fig. 1.1 below shows how the velocity of the car changes with time.

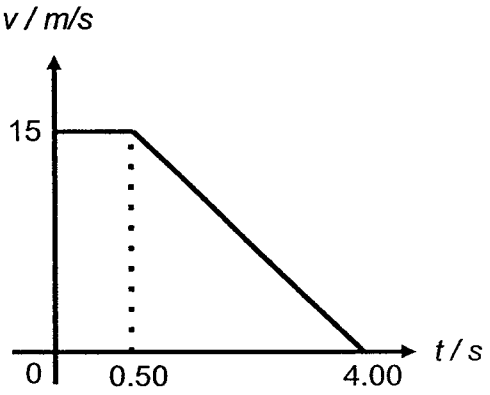


Fig. 1.1

(a) Describe the acceleration of the car after 0.50 s.

.....

.....[1]

(b) The driver managed to stop the car just in front of the child.
Determine the distance between the car and the child when the driver first saw the child.

Distance = ... [2]

(c) Determine the average speed of the car during the 4.00 s.

Average speed = ... [1]

(d) The same scenario takes place on a rainy day.

(i) On Fig. 1.1, sketch how the velocity of the car will change with time. [1]

(ii) Explain your answer in **(d)(i)**

.....

.....

.....[1]

2 Fig. 2.1 shows a box supported by two strings that hang from a rod. The resultant force of the two strings is vertically upward. The tension in string AB is 90 N.

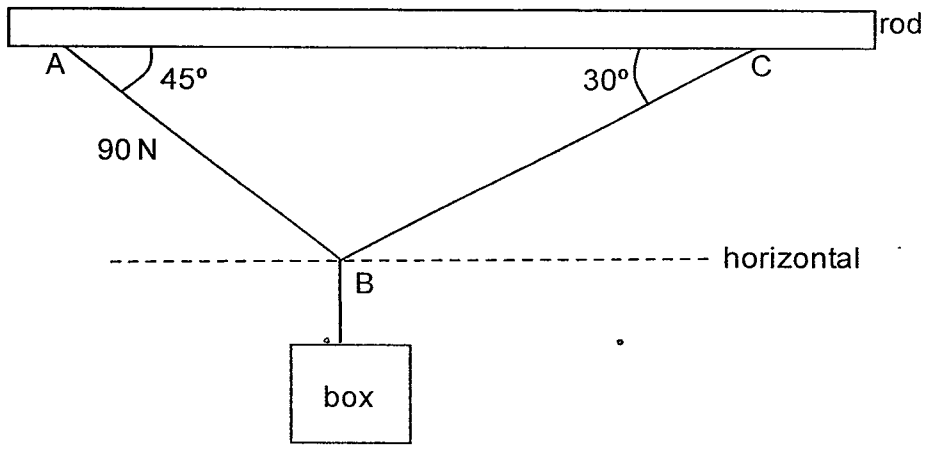


Fig. 2.1

(a) In the space below, draw a labelled diagram to show the resultant force produced by the two strings.

Determine the magnitude of the resultant force and the direction between the resultant force and the horizontal.

resultant force = ...

direction = ...[3]

(b) The box is in equilibrium. State a possible reason why the box is in equilibrium.

.....

.....[1]

(c) If string AB is cut, state the direction of acceleration of the box at that instant.

.....

.....[1]

3 Fig. 3.1 shows a barrier pole at the entrance of a sentry post. The barrier pole is made of a uniform 1.0 kg metal pole of 3.0 m long. To raise the barrier pole, a 5.0 kg uniform concrete block is attached to the end of the metal pole. The dimension of the concrete block is 50.0 cm x 50.0 cm x 50.0 cm. A rope is attached vertically downward at the opposite end of the metal pole to keep the barrier pole horizontal.

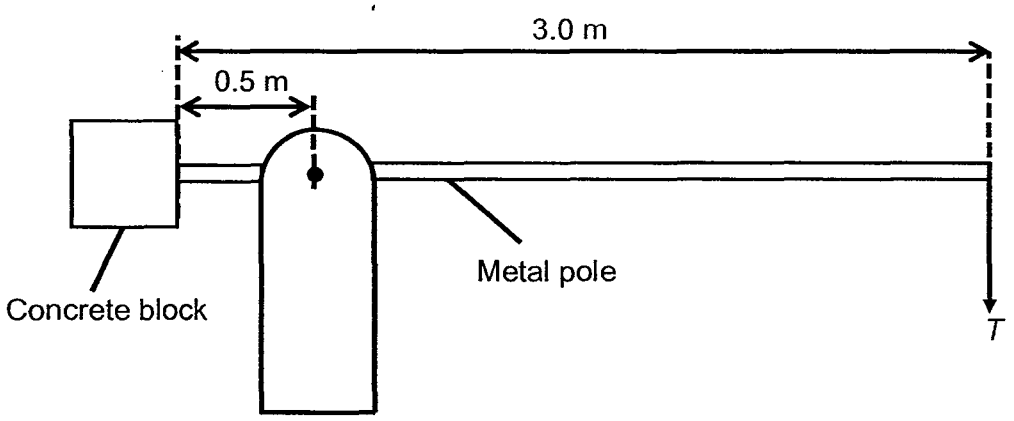


Fig. 3.1

(a) State the *principle of moments*.

.....

.....[1]

(b) Indicate with a 'X' in Fig. 3.1, the centre of gravity of the metal pole. [1]

(c) Calculate the tension, T of the string when the metal pole is horizontal.

tension = ... [2]

(d) The barrier pole is raised by a sentry guard until it is 30° to the horizontal to allow a vehicle to pass through the sentry post. State and explain what can the sentry guard do such that he only needs to exert the least amount of force on the rope.

.....

.....

.....

.....[2]

4 A hard ball of mass 1.0 kg falls freely from rest through a height of 80 m and comes to rest having penetrated 9.0 cm of sand.

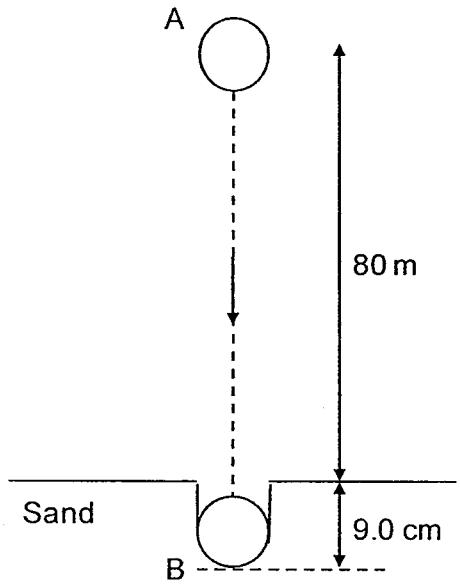


Fig. 4.1

(a) Describe how the energy changes as the ball falls from A to B.

.....

.....

.....

.....[2]

(b) Determine the velocity of the ball just before it strikes the sand.

velocity = ... [1]

(c) Determine the average resistive force exerted by the sand in bringing the ball to rest.

retarding force = ...[1]

5 **(a)** Fig. 5.1 shows the compressor unit of a refrigerator. At the compressor unit, the coolant flows through the metal pipe, giving off thermal energy to the surroundings.

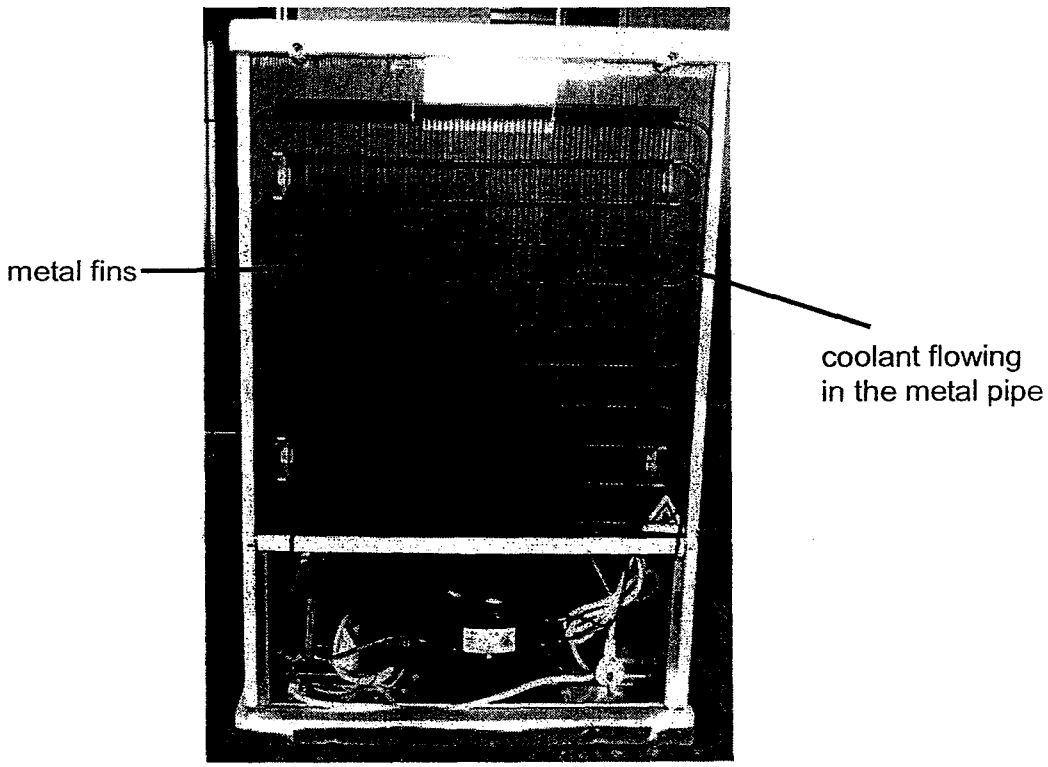


Fig. 5.1

(i) Describe using molecular terms, how thermal energy is transferred from the coolant to the surroundings through the metal pipe.

.....

.....

.....

.....[2]

(ii) Explain why metal fins are connected to the metal pipe.

.....

.....

.....

.....[2]

(iii) When the refrigerator door is opened, energy is needed to keep the freezer cold. Explain why it is more energy efficient to have the freezer unit at the bottom section of the refrigerator than at the top section of the refrigerator.

.....

.....

.....[1]

(b) Large frozen fries were taken out from the freezer of the refrigerator and dropped into a deep-frying basket as shown in Fig. 5.2 below.

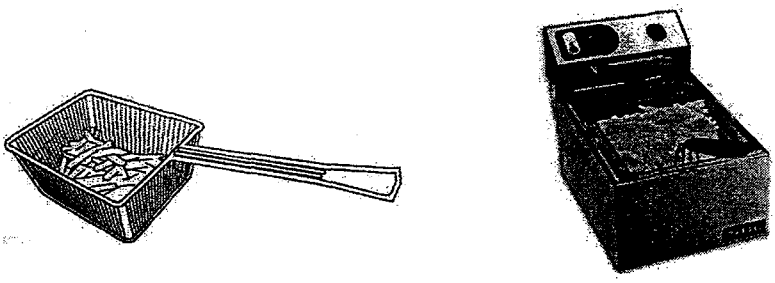


Fig. 5.2

To achieve desired quality fries, the frozen fries need to be immersed immediately into a deep fryer which has 3.0 kg of cooking oil at 180 °C. The deep fryer has a 4000 W heater. The specific heat capacity of the cooking oil is 1670 J/(kg°C), and the specific heat capacity of the fries is 3430 J/(kg°C). Assume that heat lost to the basket and the surroundings is negligible.

(i) The original temperature of the cooking oil poured into the deep fryer is 30 °C. Calculate how long will it take for the fryer to be ready to fry its first batch of fries.

time needed = ... [2]

(ii) When the cooking oil is at 180 °C, the heater is switched off and the fries at -2.0 °C is added into the fryer. Determine the mass of the fries that is added if the final temperature of the mixture is 160 °C.

mass of fries = ...[2]

6 A plane mirror is hung on the wall. Tom is able to see his whole body in the mirror. He is 150 cm tall and his eyes are 138 cm above the ground.

(a) On Fig. 6.1, draw a ray of light from point X, reflected by the mirror surface, to Tom's eye with the incident angle *i* and reflected angle *r* indicated.

[1]

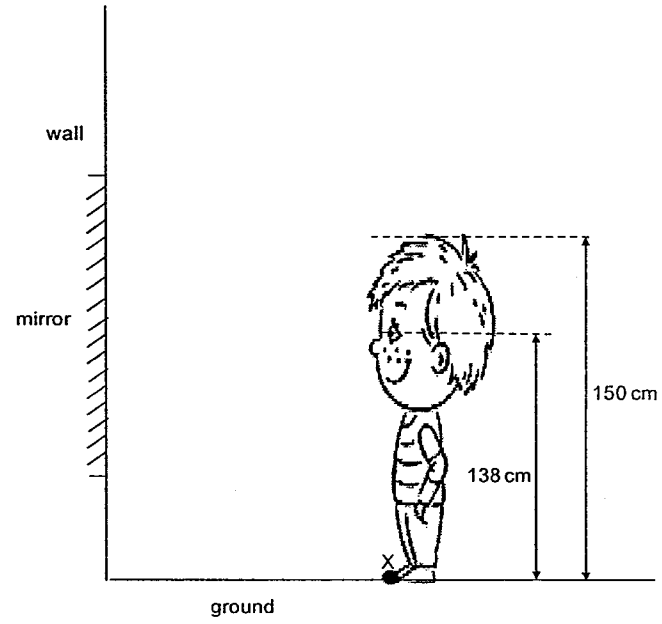


Fig. 6.1

(b) Calculate the minimum length of the mirror needed for Tom to see his whole body.

minimum length = ... [1]

(c) Tom realised that he is unable to see his whole image if he sits on the floor as compared to when he is standing upright.

Explain why he is unable to see his whole image.

.....

.....

.....[1]

(d) Fig. 6.2 (not drawn to scale) shows two rays of monochromatic light shining from two ray boxes into a semi-circular glass block with the point O as its centre. The refractive index of glass is 1.6.

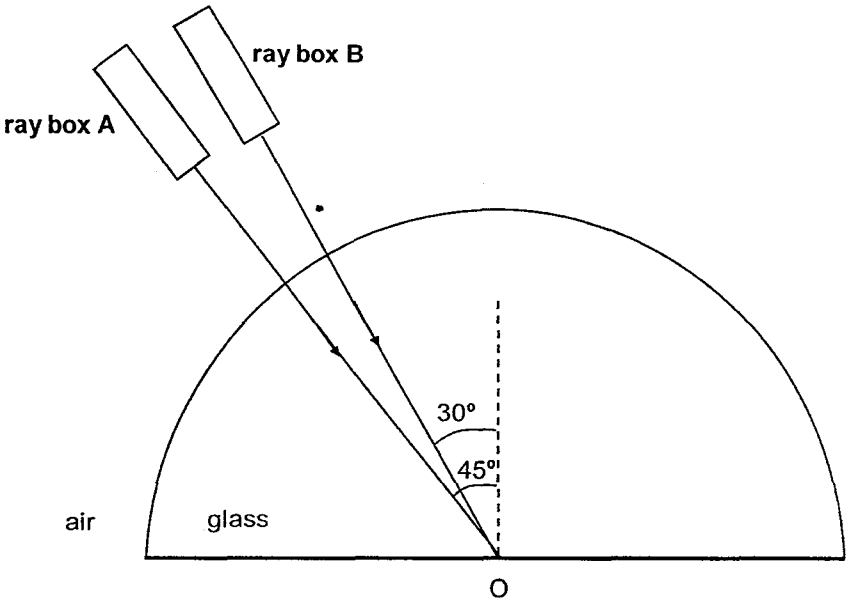


Fig. 6.2

(i) Determine the critical angle of the glass block.

critical angle = ...[1]

(ii) On Fig. 6.2, complete the light rays indicating all the important angles. [2]

7 It is a common practice that paint is electrically charged before it is sprayed onto a car in a car painting workshop. In a particular painting workshop, the outlet of a metal paint hose is charged negatively by an electrical source.

(a) State and explain the charge of the paint when it leaves the paint hose.

.....

.....

.....[2]

(b) Explain the benefit of charging the paint.

.....

.....

.....[1]

(c) The body of the car is usually charged with the opposite charge of the spray paint. Explain why it will also work if the body of the car is earthed.

.....

.....

.....[2]

(d) An ammeter is connected in series to the metal paint hose and the electrical source. As the technician sprays the paint for 5.0 minutes, the ammeter reads 200 mA.

(i) Calculate the number of electrons passing through the ammeter during the 5 minutes. The charge of one electron is -1.6×10^{-19} C.

number of electrons = ... [2]

(ii) If the spray uses 500 J of energy during the 5.0 minutes, calculate the e.m.f. of the electrical source.

e.m.f. = ... [1]

8 Fig. 8.1 and Fig. 8.2 show two possible lighting circuits, containing two identical lamps.

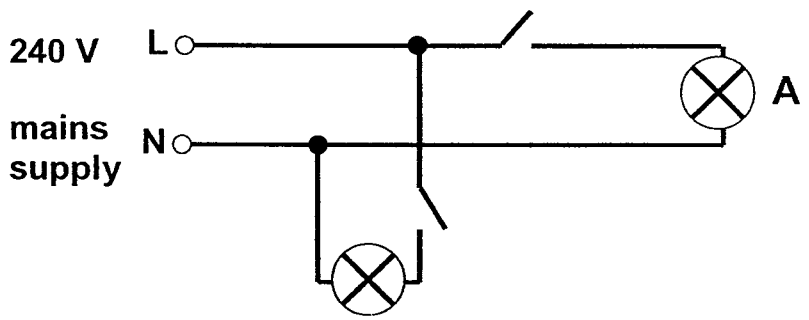


Fig. 8.1

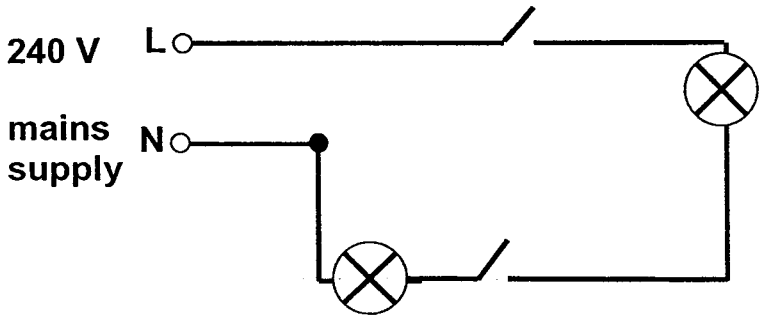


Fig. 8.2

(a) Give two reasons why the circuit in Fig. 8.1 is used in practice.

reason 1: .....

.....

reason 2: .....

.....[2]

(b) If light bulb A has a rating of "240 V, 12 W", calculate the current flowing through light bulb A

Current = ... [1]

(c) The fuse is connected to the live wire.
Explain why the fuse is connected to the live wire.

.....

.....[1]

(d) The earth wire is correctly connected to the casing of the light bulb A. Due to wear and tear, the live wire insulation is damaged and the live wire touches the metal casing of the light bulb.

Describe and explain what will happen.

.....

.....

.....[2]

Section B (30 marks)

Answer all questions from this section.

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

9 Gabriel wanted to build a simple alternating current (a.c.) temperature probe. He realised that he needed to include a thermistor in the circuit. Since the thermistor is non-ohmic, he did a simple calibration test to obtain its resistance-temperature characteristic curve as shown in Fig. 9.1.

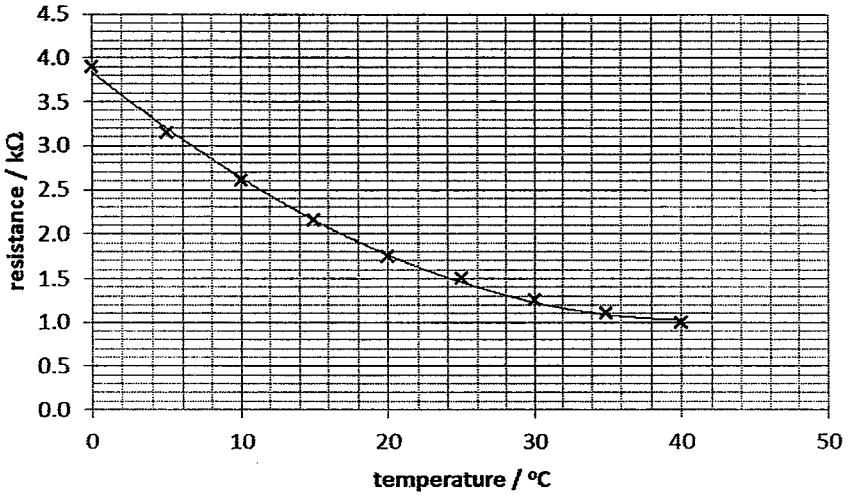


Fig. 9.1

Gabriel then set up the circuit, consisting of the thermistor, a diode and a 0.10 kΩ fixed resistor as shown in Fig. 9.2. He used an a.c. supply which has a peak voltage of 10.0 V and connected a cathode ray oscilloscope (c.r.o.) in parallel to the fixed resistor. The c.r.o. read the output voltage (V_o) across the terminals, M and N, which are connected to its Y-plates.

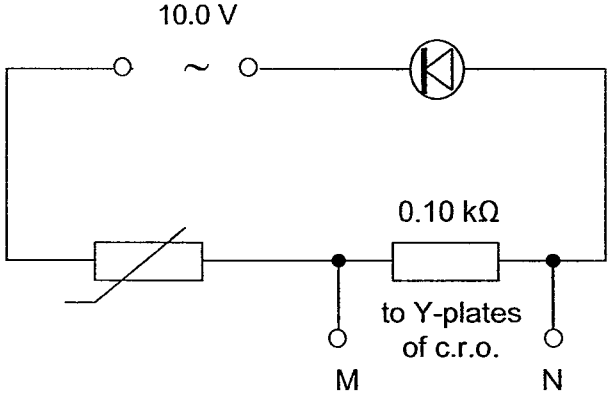


Fig. 9.2

Before using the probe to measure temperature, Gabriel did some theoretical calculations of the expected readings across different components of the circuits. He recorded his readings in a spreadsheet as shown in Fig. 9.3 below.

He keyed in the following data into the spreadsheet:

- the temperature (T),
- the corresponding resistance (R_T) of the thermistor,
- the resistance (R) of the fixed resistor and
- the peak voltage (V_P) of the a.c. supply

	A	B	C	D	E	F
1	temperature of thermistor	resistance of thermistor	resistance of fixed resistor	peak voltage of supply	current through thermistor	peak voltage of output voltage
2	T / °C	R_T / kΩ	R / Ω	V_P / V	I / mA	V_o / V
3	0	3.90	0.10	10.0	2.5	0.25
4	10	2.60	0.10	10.0	3.7	0.37
5	20	1.75	0.10	10.0	5.4	0.54
6	25	1.50	0.10	10.0		0.63
7	30	1.25	0.10	10.0	7.4	
8	40	1.00	0.10	10.0	9.1	0.91

Fig. 9.3

(a) State how Gabriel obtained the values in column B.

.....

.....[1]

(b) **(i)** Calculate the expected current, I, flowing through the thermistor when Gabriel placed the probe in water at 25 °C.

current, I = ... [2]

(ii) Calculate the magnitude of V_o when the temperature of the probe is at 30 °C.

output voltage, V_o = ... [1]

(iii) Explain why the values in column F increase as the temperature of the thermistor increases.

.....

.....

.....

.....[2]

(c) Fig. 9.4. shows the V_o trace, displayed on the c.r.o. when temperature is at 20 °C. The time base setting of the c.r.o. is at 5.0 ms/cm.

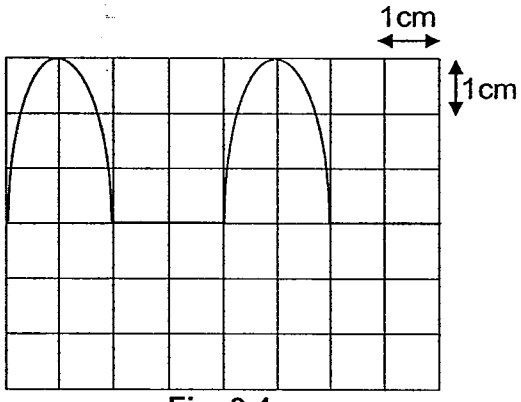


Fig. 9.4

(i) Explain why only the positive part of the a.c. voltage is shown on the c.r.o..

.....

.....

.....[2]

(ii) Calculate the period of the V_o shown in Fig. 9.4.

period = ... [1]

(iii) From Fig. 9.4, deduce the Y-gain setting of the c.r.o.

Y-gain = ... [1]

10 **(a)** A U-shaped magnet sits on an electronic balance as shown in Fig 10.1. A wire is held in place horizontally between the poles of the magnet. Current is flowing in the wire in a direction out of the paper.

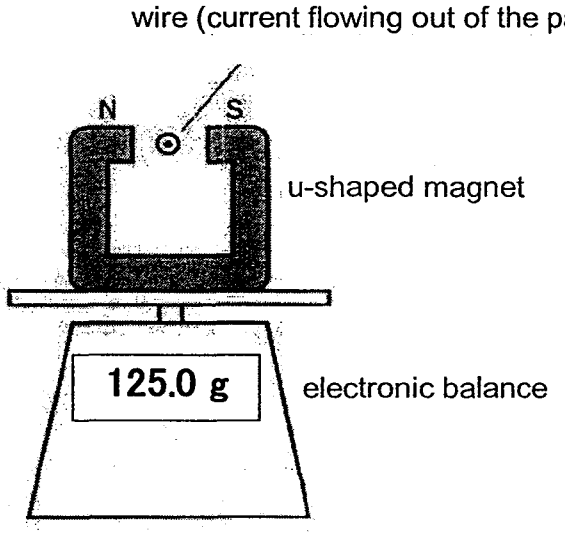
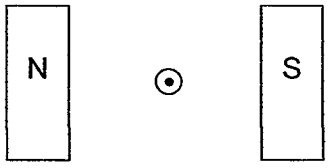


Fig. 10.1



current-carrying-wire between the poles of the magnet

Fig. 10.2

(i) Sketch on Fig. 10.2 the resultant magnetic field of the current-carrying wire and the U-shaped magnet. [2]

(ii) Determine the direction of the force acting on the wire and using Flemming's left hand rule, explain how the direction is determined.

.....

.....

.....

.....

.....[2]

(iii) It is observed that when no current flows in the wire, the balance reads 123.5 g. When a steady current flowing out of the paper is passed through the wire, the balance reads 125.0 g as shown in Fig 10.1.

(1) Calculate the magnitude of the additional force responsible for this observation.

force = ... [1]

(2) Suggest a reason for this observation.

.....

.....

.....

.....[1]

(b) Fig. 10.3 and Fig. 10.4 below show another u-shaped magnet, placed above a cardboard box. Fig 10.3 shows how the magnet was able to attract several paper clips below the box.

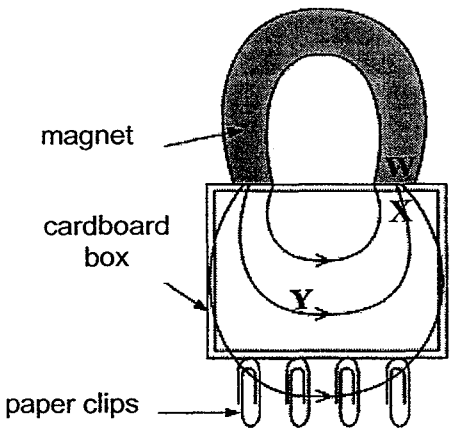


Fig. 10.3

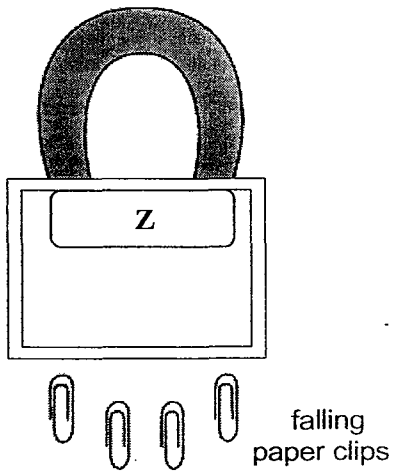


Fig. 10.4

(i) Deduce the polarity of the magnet at W.

.....[1]

(ii) Explain how does the magnetic field lines pattern in Fig. 10.3 shows that the magnetic field strength in region X is stronger as compared to that in region Y.

.....

.....[1]

(iii) When object Z is placed inside the box as shown in Fig. 10.4, the paper clips fall from the cardboard box.

Suggest what object Z is and explain why this happens.

.....

.....

.....[2]

11 EITHER

Suction cup holders are commonly used to affix objects onto non-porous vertical surfaces. The suction cups are made of elastic and flexible material. One example of usage shown below in Fig. 11.1 is the smartphone car mount, which is used to secure a smartphone to the windscreen of the car.

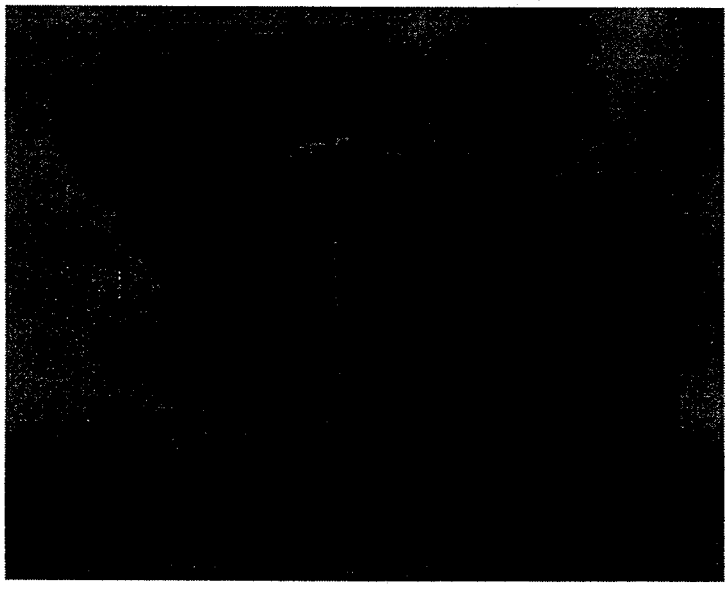


Fig 11.1

(a) To affix the suction mount in place, the suction cup is placed against the windscreen and then pressed firmly downwards. Air is expelled from the space between the suction cup and the windscreen.

(i) Using ideas about the kinetic model of matter, explain why the pressure between the suction cup and the windscreen decreases after it is pressed down.

.....

.....

.....

.....

.....[3]

(ii) Explain why the suction cup is able to 'stick' onto the windscreen.

.....

.....

.....

.....[2]

(iii) Suggest why the suction cup mount cannot be used on rough surfaces.

.....

.....[1]

(b) In Fig. 11.2, an experiment is conducted to investigate the maximum load that a suction cup is able to support. A circular suction cup with an external area of 35 cm^2 is pressed firmly onto a ceiling. Slotted masses are added onto it until the suction cup detaches and falls from the ceiling. The atmospheric pressure is 101 kPa.

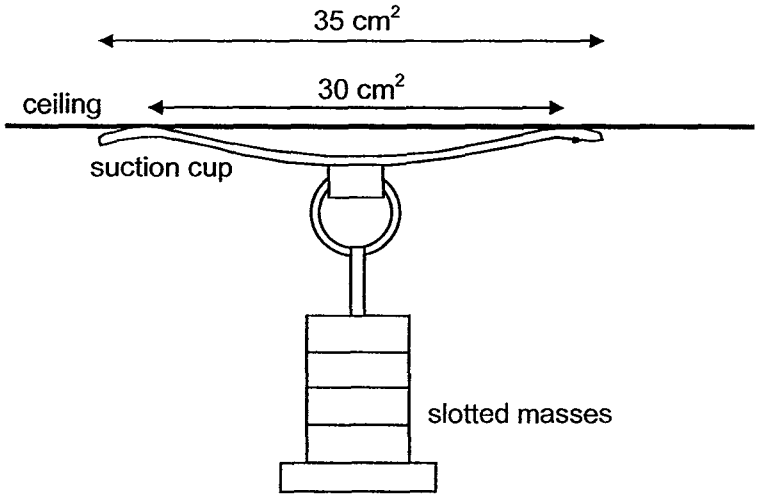


Fig 11.2

(i) Calculate the force that the atmosphere exerts on the suction cup.

force = ... [2]

(ii) Hence, determine the maximum load (in N) that the suction cup can support. The pressure between the suction cup and the ceiling is 5.0 kPa and the internal area enclosed is 30 cm^2.

load = ...[2]

11 OR

In Fig. 11.3, students A and B are facing a smooth and hard wall. When student A fires a starting pistol, student B hears two shots. The speed of sound is 320 m/s.

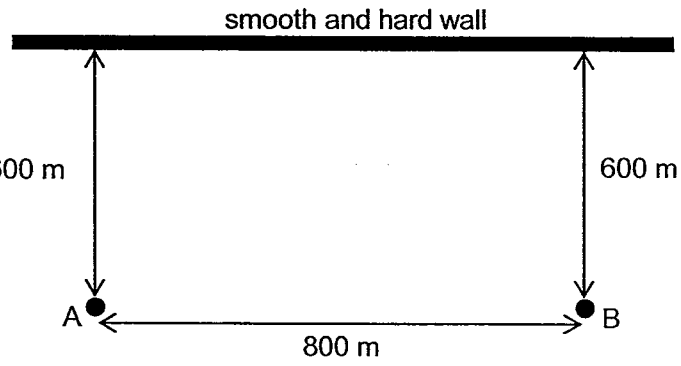


Fig. 11.3

(a) Describe how the sound is propagated from student A to student B.

.....

.....

.....[1]

(b) State what is meant by the term *wavefront*.

.....

.....[1]

(c) (i) Explain why student B hears two shots.

.....

.....[1]

(ii) Hence, calculate the time interval between the two shots heard by B.

time interval = ... [2]

(iii) As student A fires a single shot using the pistol again, a strong gust of wind blows, directed from student B to student A.

State and explain the effect of the wind on the time it takes for student B to hear the first shot.

.....

.....

.....

.....[2]

(d) Student B walks straight towards student A slowly, who continues to fire the starting pistol one shot at a time.

Without further calculation, describe and explain the effect on the time interval calculated in **(c)(ii)** as he gets nearer to student A.

.....

.....

.....

.....

.....

.....[2]

(e) The experiment is repeated with a sound of lower pitch.

State the changes to the speed and wavelength of the sound heard.

speed.....

wavelength.....[1]

– End of Paper –

2016 PRELIMINARY EXAMINATION
SECONDARY 4 (O-LEVEL PROGRAMME)

PHYSICS (MARKING SCHEME) 5059

PAPER 1

Q1	Q2	Q3	Q4	Q5
D	C	C	B	A

Q6	Q7	Q8	Q9	Q10
C	D	A	B	A

Q11	Q12	Q13	Q14	Q15
D	D	D	D	C

Q16	Q17	Q18	Q19	Q20
D	A	D	C	C

Q21	Q22	Q23	Q24	Q25
B	D	A	A	B

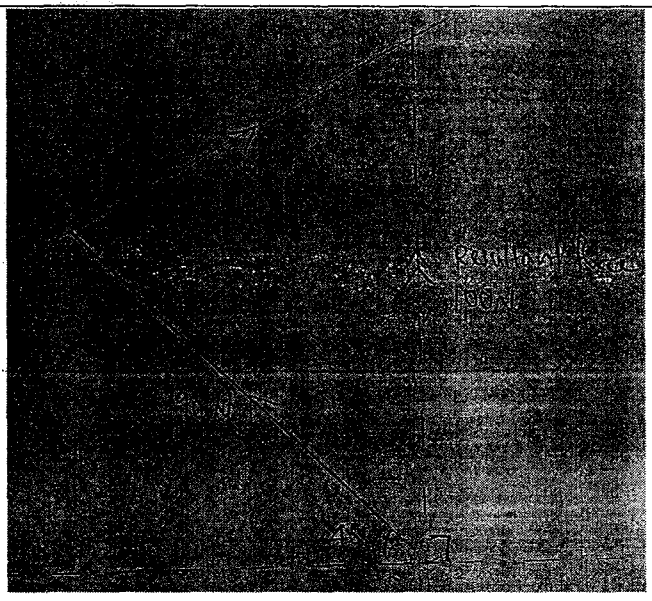
Q26	Q27	Q28	Q29	Q30
A	D	B	B	D

Q31	Q32	Q33	Q34	Q35
D	A	B	B	D

Q36	Q37	Q38	Q39	Q40
B	C	A	A	B

PAPER 2
SECTION A

1	(a)	Constant deceleration Also accepted: Negative acceleration in the same direction as his motion.	
	(b)	Distance = 0.5 x (0.5s + 4.0s) x 15m/s = 33.75 m = 33.8 m (3 s.f.)	
	(c)	average = total distance / total time = 33.8m / 4.0s = 8.45 m/s (accept 8.44 m/s , if student used 33.75)	
	d)(ii)	A more gentle gradient start from 0.5s at 15 m/s. The frictional force is smaller,hence the deceleration will be smaller.	

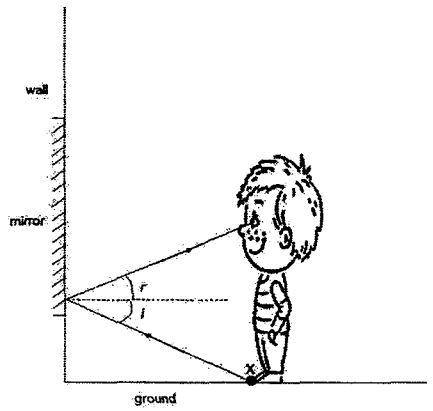
2	(a)		
		Proper diagram with vectors labelled	
		Resultant force clearly labelled in the diagram (100 ±1 N)	
		direction = 90 ±1° with reference to horizontal line	
	(b)	Any one of the following: 1. The resultant force on the object is zero 2. The resultant moment on the object is zero	
	(c)	The direction of acceleration is 45° with reference to the rod.	

3	(a)	Principle of Moment states that when an object is in equilibrium, the sum of anti-clockwise moment about any point is equal to the sum of clockwise moment about the same point.	
	(b)	Centre of the pole	
	(c)	At equilibrium, sum of ACW moment = sum of CW moment (50N)(0.75m) = T(2.5m) + (10N)(1.0m) T = 11.0 N	
	(d)	Ensure that the angle between the string and the pole is 90°. When the pole is raised, the anti-clockwise moment of the concrete block decreases as the perpendicular distance of the weight of the concrete block decrease.	
		If the angle is maintained at 90, the guard needs to apply a smaller tension to balance the smaller anti-clockwise moment.	

4	(a)	• As the ball falls from A, it loses gravitational potential energy and gains kinetic energy.	
		• As the ball penetrates through the sand, the kinetic energy is converted into sound and thermal energy (heat) before it comes to a stop	
	(b)	By Principle of Conservation of Energy, $mgh = ½ mv^2$ $v = \text{sqrt}(2 \times 10 \times 80)$ $= 40$ m/s	
	(c)	$½ mv^2 = F \times d$ $F = (½ \times 1 \times 40^2) / (9 \times 10^{-2})$ F = 8889 F = 8890 N or 8900 N	

5	(a)(i)	• The particles of the metal pipe nearest to the coolant absorb the heat energy from the coolant and vibrate faster.	
		• It collides with the neighbouring particles and thus transfer the energy. • The process continues until the other end of the metal pipe.	
	(a)(ii)	• It increases the heat lost to the surrounding by radiation • as it increase the surface area of the radiating surface	
	(a) (iii)	• The cold air in the refrigerator being denser and will sink which will be displaced by the warmer surround air which is less dense. If the freezer is below , the convection current formed is less significant	
5	(b)(i)	Q supplied = Q absorbed $4000 \text{ W} \times t = m \times c \times \Delta\theta$ $t = (3 \text{ kg} \times 1670 \text{ Jkg}^{-1}\text{°C}^{-1} \times (180 \text{ °C} - 30 \text{ °C}) / 4000 \text{ W}$	

		t = 187.875 s t = 188 s or 3 min and 8 sec	
	(b)(ii)	Let m be the mass of fries. Q need to be absorbed by fries = m x c x Δθ = m x 3430 x (160+2) = 555660 m Q supplied by the cooking oil = m x c x Δθ =3x1670 x (180-160) = 100 200 J Q absorbed = Q supplied m= 10020/555660 = 0.180 kg	

6	**(a)**	 Complete ray path with arrow indicating direction	
	(b)	Min. length of mirror = ½ x 12 + ½ x 138 = 75 cm or 0.75 m	
	(c)	As his head to floor and eye level distances have decreased, light rays from the bottom of his body are not able to be reflected into his eyes.	
	(d)(i)	$n = 1/\sin C$ critical angle, $C = \sin^{-1}(1/1.6) = 38.7°$	
	(d)(ii)	Since $i = 45° > C$, ray from box A undergoes total internal reflection with $r = 45°$. Since $i = 30° < C$, ray from box B is refracted with $r = \sin^{-1}(1.6 \times \sin 30°) = 53.1°$.	

7	(a)	• It is negatively charged.	
		• When the paint touches the negatively charged metal paint hose, electrons are transferred from the hose to the paint.	
	(b)	Since the paint are of like charges, it will repel the paint thereby ensuring that the paint is evenly painted on the body of the car.	
	(c)	• The paint will electrically induced the metal body.	
		• The surface nearer to the paint will be induced with a net positive charge and hence the paint will still be attracted to the car body.	
	(d)(i)	$I = Q/t$ $200 \times 10^{-3} A = Q/(5 \times 60s)$ $Q = 60\ C$ $Q = (1.6 \times 10^{-19} C) \times$ no of e No. of e $= 3.75 \times 10^{20}$	
	(d)(ii)	e.m.f. $= E/Q$ $= 500\ J/60\ C$ $Q = 8.33\ V$	

8	(a)	Reason 1: When one of the light bulb fuse/blow, the other light bulb can still light up.	
		Reason 2: The p.d. across the light bulb is not shared as such it will be at normal brightness.	
	(b)	$P = VI$ $12\ W = (240V)(I)$ $I = 0.050\ A$	
	(c)	When the current is too large, the fuse will melt and open the circuit, thus disconnecting the bulb from the high potential.	
	(d)	• Current will flow from the live wire to the earth wire. It is a short circuit and the current become very large.	
		• This will cause the fuse to melt and open the circuit.	

PAPER 2

SECTION B

9	(a)	- They are obtained from the resistance-temperature characteristic curve in Fig. 9.1. Also acceptable: - They are obtained from his simple calibration test - They are obtained from measuring the V and I at each different temperature and using R=V/I formula to calculate.	
	(b)(i)	$I = \frac{V_P}{R_T + R}$ I= 10V / (1.5kΩ +0.1 kΩ) = 6.25 mA = 6.3 mA Alternatively, I= V/R = 0.63/100 =0.0063 A = 6.3 mA	
	(b)(ii)	V_0= R x I at 30 °C V_0 = 0.74 A (accept 0.75 a too, depending on calculation)	
	(b)(iii)	• As temperature increases, the R_{Th} and R_{eff} / total effective resistance of the circuit decreases [1] • As such current flowing in the thermistor increases and V_o increases as V_o = R x I. [1] Alternatively, • V_{Th} decreases and Vp is constant, therefore V_o increases. $V_p = V_{Th} + V_o$	
	(c)(i)	• This is because of the diode in the circuit, • it only allows current to flow in 1 direction,	
	(c)(ii)	T = 4 x 5.0 ms/cm = 20 ms = 0.0200 s	
	(c)(iii)	Y-gain = 0.54 V/ 3 = 0.18 V/cm	

10	**(a)(i)**	• Fewer magnetic field lines above the wire & more lines below • Direction of the magnetic field lines (arrows)	
	(a)(ii)	Direction is upwards.	
		• By Fleming's left hand rule. The index finger indicates the magnetic field direction to the right (from north to south) and the middle finger indicates the direction of the current (out of the paper) hence the direction of the force as indicated by the thumb is upwards.	
	a)(iii)(1)	Force = 1.5 g /1000 x 10N = 0.015 N	
	a)(iii)(2)	By Newton's third law, as a **reaction to the induced force** acting on the wire due to the magnet, the magnet is experiencing a **downward force** due to the current-carrying wire as well. (Not acceptable: There is a downward force acting on the magnet)	
	(b)(i)	South Pole	
	(b)(ii)	The magnetic **field lines** in X are **closer together** as compared to Y.	
	(b)(iii)	• Object Z is a magnetic material (iron bar, Cobalt, Nickel, Steel, acceptable)	
		• **Magnetic shielding** takes place, so the magnetic field lines do not reach the paper clips anymore.	

EITHER

11	**(a)(i)**	As the suction cup is pressed onto the surface, an air tight seal is formed after air is expelled. • Since there are less air molecules per unit volume bombarding the walls of the suction cup and surface, • frequency of collisions decrease and • the average force per unit area exerted on the walls decrease, leading to a decrease in pressure.	
	(a)(ii)	• As the pressure within the suction cup and surface is lower than the atmospheric pressure outside it, • a net/resultant force is exerted on the suction cup that directed towards the surface, causing it to 'stick' onto it.	
	(a)(iii)	The suction cup cannot form an air tight seal with the rough surface. Air molecules cannot be expelled to create a low pressure environment within the cup.	
	(b)(i)	F = pA = 1.01 x 10^5 Pa x 0.0035 m^2 = 353.5 N = 354 N	
	(b)(ii)	Force inside the suction cup = 5 000 Pa x 0.0030 m^2 = 15 N Max load = 354 – 15 = 339 N	

OR 11	**(a)**	When the pistol is fired, layers of air particles around it are displaced/ vibrate about a fixed position. A series of compressions and rarefactions is set up in the air in the direction of the wave (from A to B)	
	(b)	It is an imaginary line on a wave that joins all adjacent points that are in phase	
	(c)(i)	He hears the sound of the first shot that travels directly from A, and the second shot that travels to the wall and reflects towards him.	
	(c)(ii)	Time taken for sound to travel from A to B = 800 / 320 = 2.5 s Distance travelled by reflected sound = 2 x $(600^2+400^2)^{½}$ = 1442.22051 m	
		Time taken for reflected sound to travel to B = 1442.22051 / 320 = 4.51s Time interval = 4.51 – 2.5 = 2.01 s	
	c)(iii)	• Due to the wind, the air molecules are moving opposite to the direction of the sound wave propagation, • it takes a longer time for the sound of the first shot to reach student B.	
	(d)	• The time interval between the claps heard by student B increases. • As the displacement between A and B decreases, the total distance travelled by the echo does not decrease at the same rate. Hence the difference in the distances travelled by the actual shot and the echo increases as he gets nearer to student A.	
	(e)	Speed – same Wavelength - increase	

– End –