Bukit Batok Secondary School
O-LEVEL PRELIMINARY EXAMINTION 2018
SECONDARY FOUR EXRESS

PHYSICS **6091 / 01**

Paper 1 Multiple Choice

21 August 2018
1115 — 1215 hrs
1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, class, and class register number on the answer sheet in the spaces provided unless this has been done for you.

There are **forty** questions on this paper. Answer **all** questions. For each question, there are four possible answers **A**, **B**, **C** and **D**.
Choose **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 an approved scientific calculator is expected, where appropriate.

This document consists of **15** printed pages (including this cover page)

1 Which of the following quantities is a base quantity?

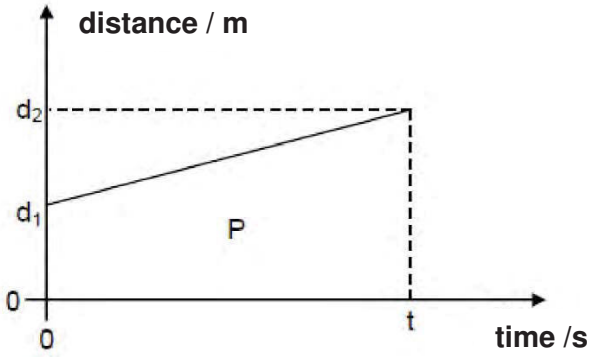
A charge
B energy
C force
D temperature

2 A student wanted to measure the diameter of a pen.

Which steps provide most accuracy in the measurement?

A Take average values of the diameter using a ruler.
B Take average values of the diameter using vernier calipers with zero error.
C Take average values of the diameter using vernier calipers without zero error.
D Take one value of the diameter using a micrometer with zero error.

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



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

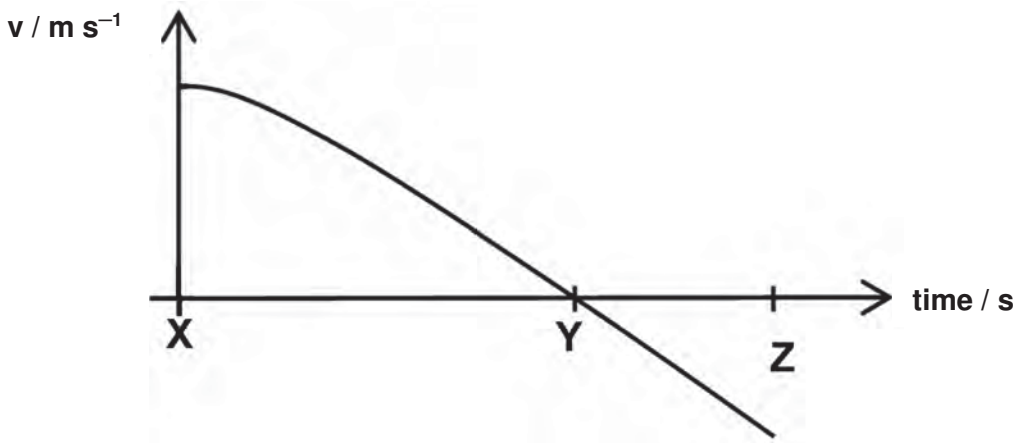
A P / t
B d_2 / t
C (d_2 + d_1) / t
D (d_2 – d_1) / t

4 A bus was travelling at a speed of 20 m/s. When the bus was 50 m from a traffic light, the light turned red. The bus driver reacted immediately and applied a constant braking force for 5.0 s. The bus decelerated at 4.0 m/s^2.

Which of the following correctly describes the motion of the bus?

A The bus stopped past the traffic light.
B The bus stopped at the traffic light.
C The bus stopped before the traffic light.
D The bus continued to move past the traffic light with decreasing speed.

5 A toy rocket is accelerated vertically upwards. The velocity-time graph below shows the relationship between the velocity of the rocket and time.

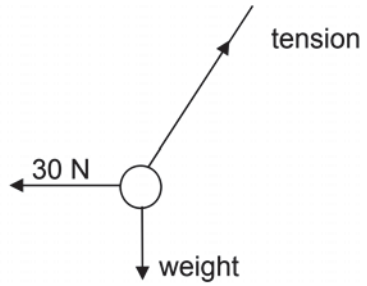


Which of the following statements is/are correct?

(1) The rocket reaches the highest position at instant X.
(2) The resultant force acting on the rocket is zero at instant Y.
(3) The rocket is still in the air at instant Z.

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

6 A pendulum bob of mass 2.0 kg is pulled horizontally to the left by a 30 N force as shown.



Which will be the approximate final tension in the string when the bob is in equilibrium?

A 30 N
B 36 N
C 40 N
D 45 N

7 A constant force of 40 N acts on an object of mass 2.0 kg. The object moves along a rough horizontal surface with an acceleration of 5.0 m/s^2.

What is the average frictional force acting on the object?

A 8.0 N
B 10 N
C 30 N
D 50 N

8 Which property of an object resists a change in the state of rest or motion of the object?

A acceleration
B density
C mass
D volume

9 A bottle full of mercury has a mass of 730 g. When the same bottle is filled with an unknown liquid P, its mass is 100 g. The mass of the empty bottle is 50 g.

Calculate the density of the unknown liquid P. (Take density of mercury to be 13.6 g/cm^3)

A 1.0 g/cm^3
B 2.0 g/cm^3
C 7.0 g/cm^3
D 14.4 g/cm^3

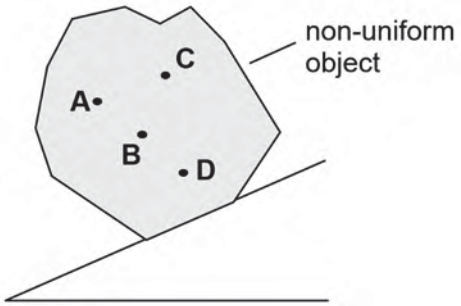
10 A uniform rectangular board (8.0 m x 2.0 m), pivoted at its centre X, is acted on by three forces on the edges.

What is the size of force *F* such that the board remains in equilibrium?

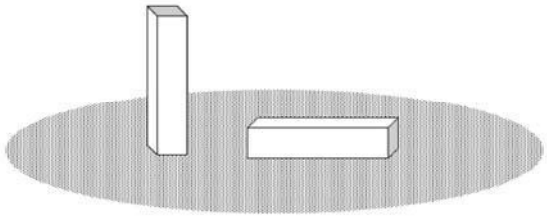
A 40 N
B 45 N
C 85 N
D 90 N

11 A non-uniform object is placed on an inclined plane as shown below.

If the object is just about to topple, which position is the centre of gravity?



12 A student left two identical, heavy, stone blocks resting on soft earth.
One is vertical and the other is horizontal as shown in the diagram below.

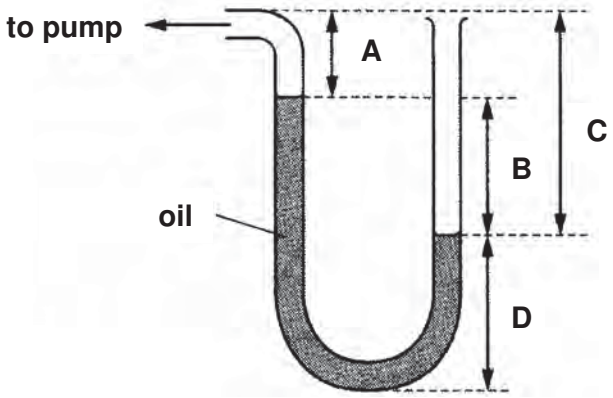


Which row correctly compares the force and the pressure that the two blocks exert on the earth?

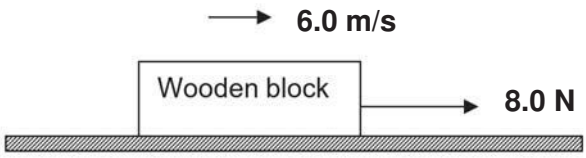
	force	pressure
A	same	different
B	same	same
C	different	different
D	different	same

13 One end of an oil-filled manometer is connected to a pump. The other end is open to the atmosphere.

Which length is used when calculating the difference between pressure of the air in the pump and atmospheric pressure?



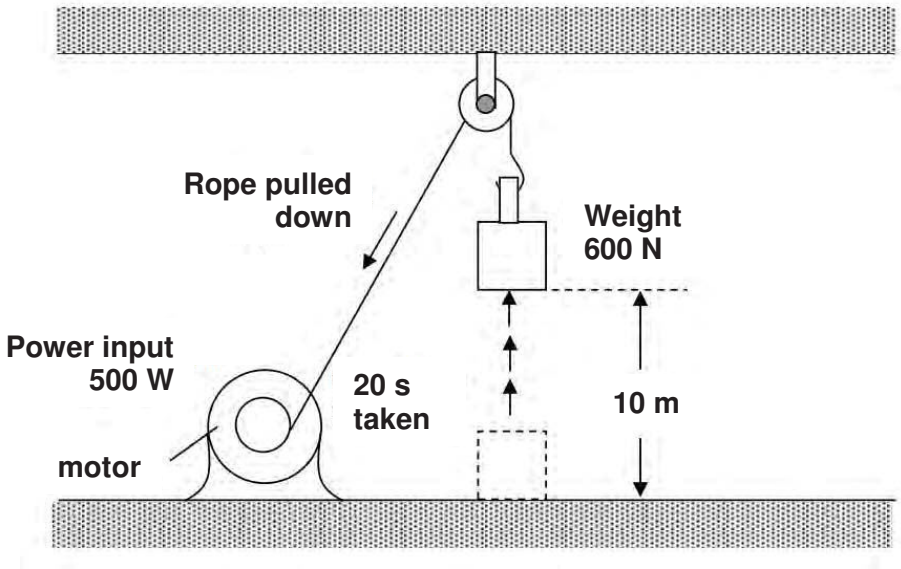
14 A block of wood is pulled along a horizontal bench at a constant speed of 6.0 m/s by a force of 8.0 N.



How much work is done in 5.0 s against the frictional force?

A 40 J
B 48 J
C 240 J
D 480 J

15 The diagram below shows a motor having a power input of 500 W.



It is used to lift a load weighing 600 N through a vertical height of 10 m in 20 s.

What is the useful power output of the motor?

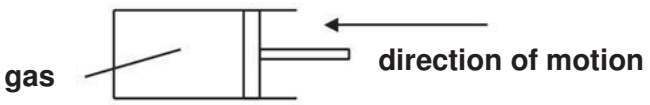
A 300 W
B 390 W
C 500 W
D 800 W

16 When a tennis ball drops onto a hard and smooth horizontal surface, it bounces up and down in the air. The height of each bounce gradually reduces until the ball stops moving.

Which of the following statements is true?

A The kinetic energy of the ball is constant.
B The potential energy of the ball is constant.
C The sum of the kinetic energy and potential energy of the ball is constant.
D The sum of the kinetic energy and potential energy of the ball is not constant.

17 Gas inside a cylinder is cooled slowly to a lower temperature. The pressure inside the cylinder remains constant as the piston moves inwards.



How do the speed of the particles and their rate of collisions with the cylinder and piston compare with their initial values at the higher temperature?

	average speed	rate of collision
A	lower	reduced
B	lower	increased
C	same	same
D	same	reduced

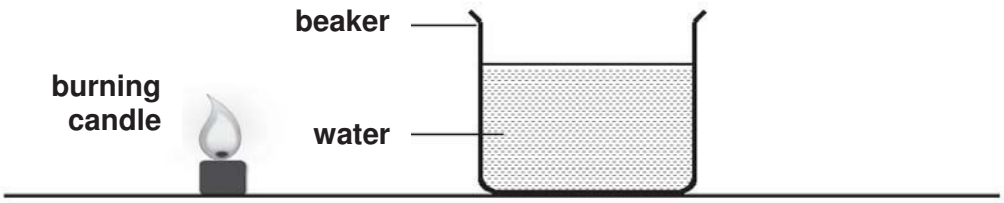
18 The figure below shows a rug and a tiled floor. The rug has been on the floor for a long time.

Which statement(s) correctly explain(s) why the floor feels colder than the rug?

(1) The floor is at a lower temperature than the rug.
(2) The floor is a better conductor of heat than the rug.
(3) The floor has a smaller specific heat capacity than the rug.

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

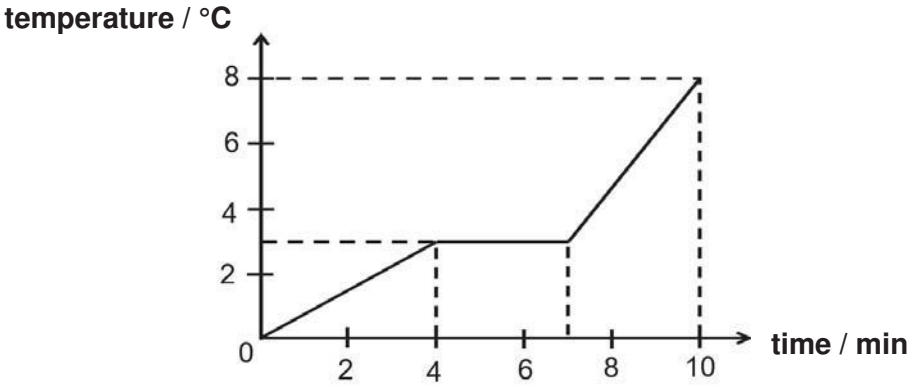
19 The diagram shows a beaker of water placed near a burning candle.



How does thermal energy from the candle reach the water in the beaker?

A conduction, followed by convection
B radiation, followed by conduction
C convection, followed by conduction
D radiation, followed by convection

20 The diagram shows the rise in temperature of 2.0 kg of a substance, X. The substance is initially in solid state and it was heated uniformly at the rate of 2000 J/min.



Which of the following sets of data about X is correct?

	specific heat capacity of solid X in J / (kg °C)	specific latent heat of fusion of X in J / kg
A	8000	6000
B	1330	6000
C	4000	3000
D	1330	3000

21 The water taken from two buckets is mixed together. One bucket contains 5.0 kg of water at 20 °C and the other contains 1.0 kg of water at 80 °C.

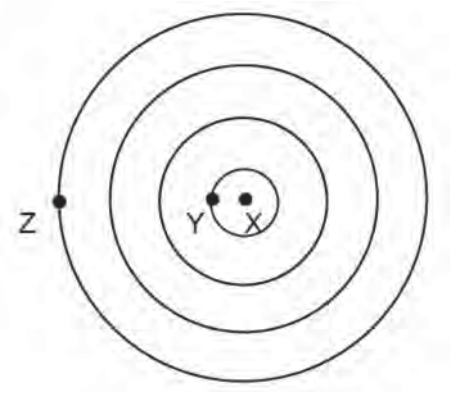
What is the final temperature of the mixture, assuming no heat is lost to the surroundings?

A 30 °C
B 50 °C
C 60 °C
D 70 °C

22 Which of the following changes in physical property **cannot** be used for temperature measurement?

A e.m.f. of a battery
B electrical resistance of a solid
C pressure of a gas
D volume of a liquid

23 The diagram shows circular wavefronts moving from X to Z as seen from the top.



The distance between Y and Z is 1.2 m and the frequency of the dipper at X is set at 15 Hz.

What is the speed of the wave?

A 4.5 m/s
B 6.0 m/s
C 12.5 m/s
D 18.0 m/s

24 A student makes three statements.

(1) All electromagnetic waves can travel in a vacuum and in air.
(2) All waves obey the laws of reflection but some waves do not obey the laws of refraction.
(3) Sound is a longitudinal wave which travels in a direction parallel to the direction of vibrations.

Which statements is/are **not** correct?

A Statement 1
B Statement 2
C Statements 1 & 2
D Statements 2 & 3

25 Statements 1 and 2 are about signals passing through an optical fibre of refractive index of 1.5.

Statement 1: The speed of the signal in the optical fibre is 2.0×10^8 m/s
Statement 2: There is less signal loss in the optical fibre than in a copper cable.

Which statements are correct?

A statement 1 only
B statement 2 only
C statement 1 and 2
D neither of the statements

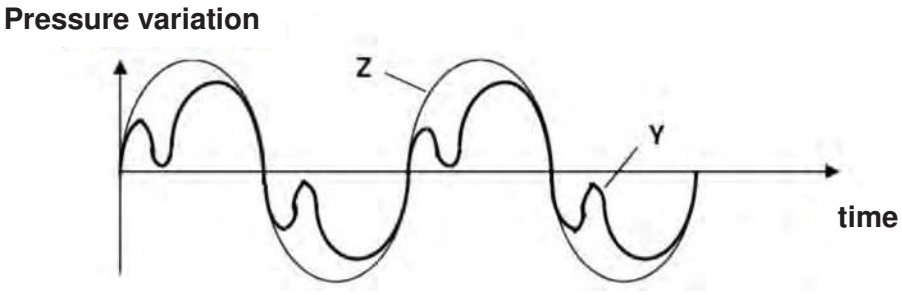
26 Which of the following is arranged in order of decreasing wavelength?

A microwaves, X-rays, visible light
B radio waves, ultraviolet rays, infra-red radiation
C radio waves, visible light, gamma rays
D ultraviolet rays, visible light, infra-red radiation

27 Which electromagnetic wave is most likely to cause structural damage to living cells and tissue?

A infra-red radiation
B microwaves
C radiowaves
D ultra-violet radiation

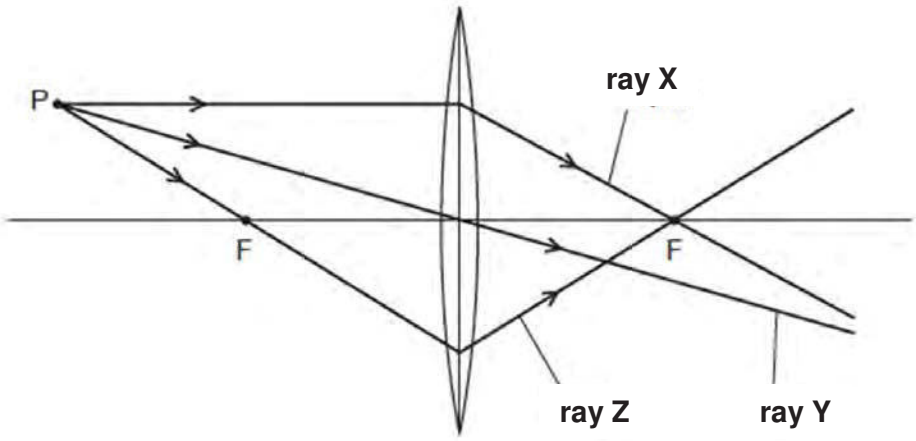
28 The diagram shows waveforms produced by a flute (Y) and turning fork (Z) played by two students.



How does the loudness and pitch of the sound from the turning fork Z compare to flute Y?

A The loudness of Y is lower but has the same pitch as compared to Z.
B Both Y and Z have the same pitch and loudness.
C The loudness of Y is higher and the pitch is lower as compared to Z.
D The loudness of Y is the same and the pitch is higher as compared to Z.

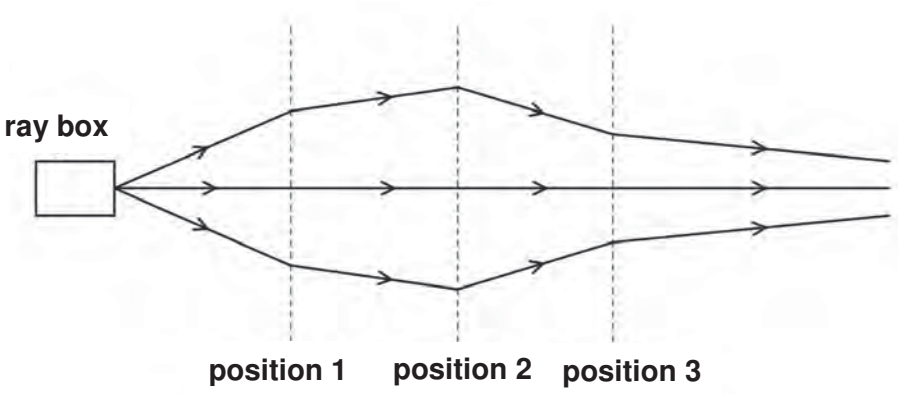
29 A student draws three rays of light from point P through a converging lens. Each point labelled F is a principal focus of the lens.



Which of the rays is/are drawn correctly?

A ray Y only
B ray Z only
C ray X and Y
D ray X and Z

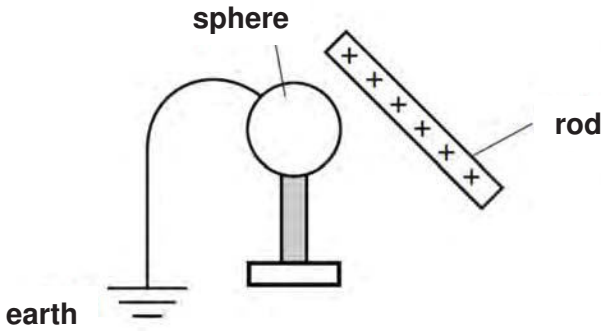
30 The rays of light from a ray-box pass through three lenses placed at positions 1, 2 and 3.



What type of lens is used at each position?

	position 1	position 2	position 3
A	converging	converging	converging
B	converging	converging	diverging
C	diverging	converging	diverging
D	diverging	diverging	converging

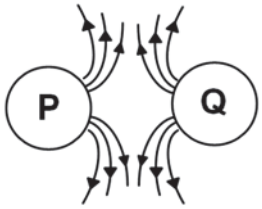
31 A positively charged rod is held close to an earthed metal sphere.



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

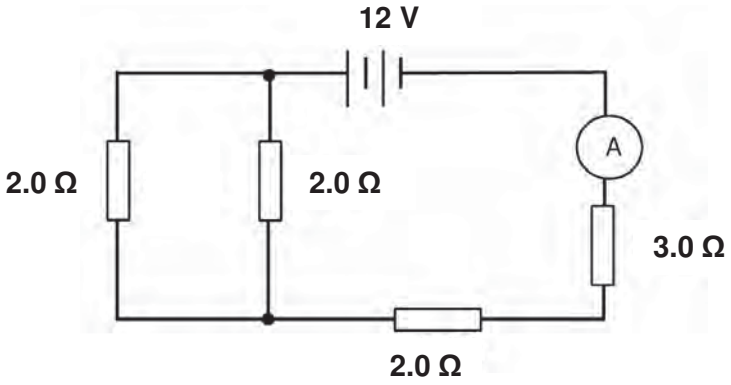
32 The figure below represents the electric field lines in the vicinity of two isolated electric charges, P and Q.



Which statement identifies the charges P and Q?

A Both P and Q are negative.
B Both P and Q are positive.
C P is positive and Q is negative.
D P is negative and Q is positive.

33 A circuit is set up in the diagram below.

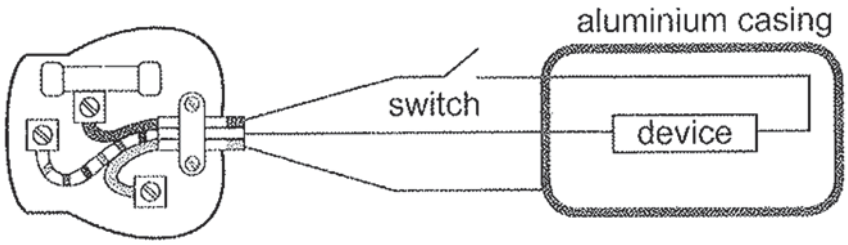


What is the ammeter reading in the circuit?

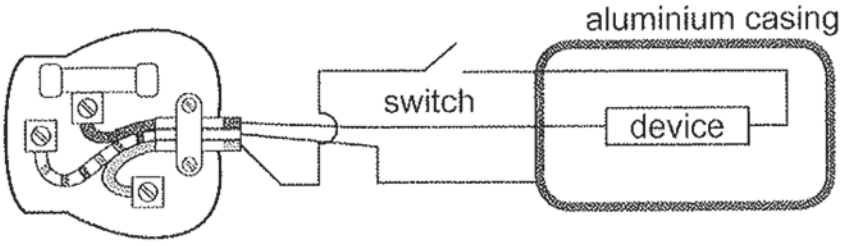
A 0.50 A
B 0.67 A
C 1.5 A
D 2.0 A

34 Which one of the following electrical appliances is correctly wired to a three-pin plug?

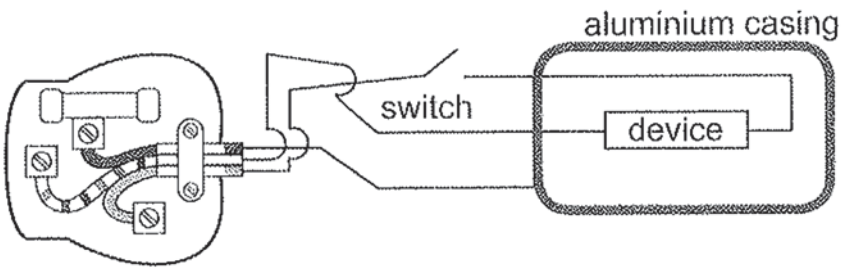
A



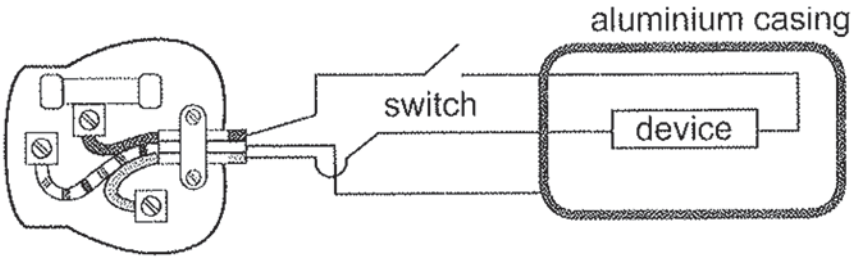
B



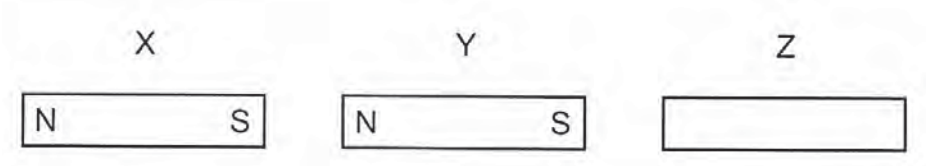
C



D



35 The diagram shows three bars placed in a line. X and Y are both magnets. Z is soft iron.

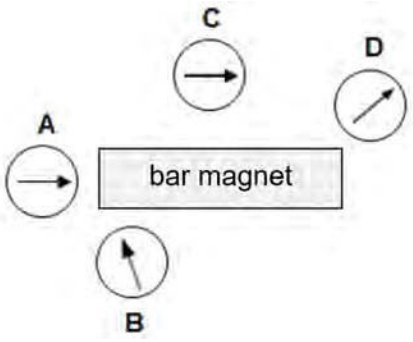


What are the magnetic forces on X and Z due to magnet Y?

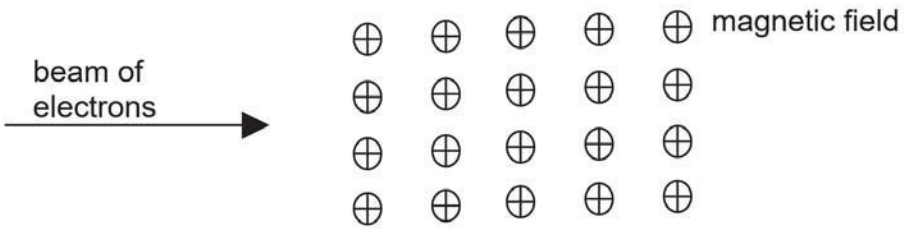
	force on X	force on Z
A	attraction	attraction
B	attraction	repulsion
C	repulsion	attraction
D	repulsion	repulsion

36 Four magnetic compasses are placed near a bar magnet as shown in the figure below.

Which compass is faulty?



37 The following figure shows a beam of electrons entering a magnetic field going into the paper.

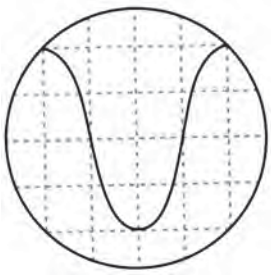


How will the beam of electrons be deflected?

A downwards
B into the paper
C upwards
D out of the paper

38 The diagram shows the trace obtained on the screen of an oscilloscope when a given signal is applied to the input terminals.

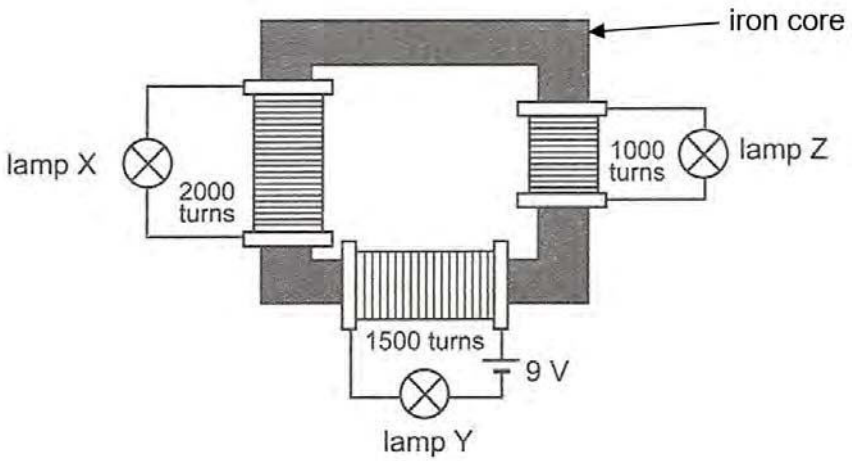
The time-base is set at 2.0 ms / div and the y-gain is set at 2.0 V / div.



Which of the following correctly represents the peak voltage and frequency of the signal?

	peak voltage / V	frequency / Hz
A	4.0	83.3
B	4.0	125
C	8.0	83.3
D	8.0	125

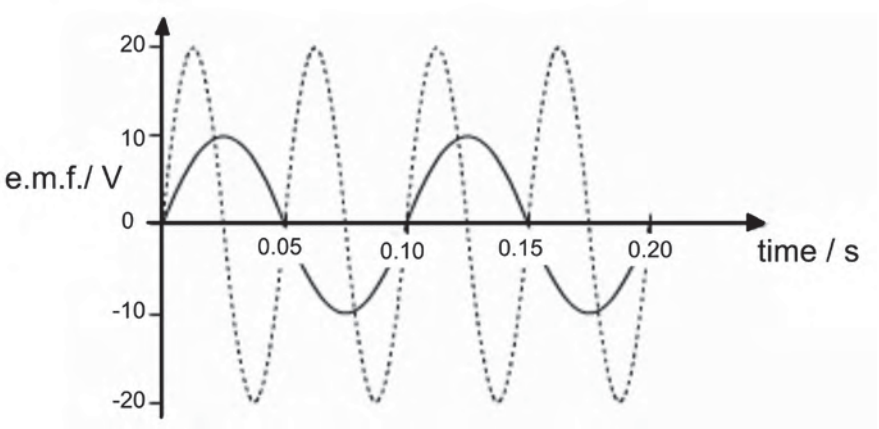
39 Three identical filament lamps, X, Y and Z, are connected to an iron core with multiple coils. The resistance of each lamp is 4.5 Ω and each requires a current of 2.0 A to light up normally.



What can be observed about the brightness of the three lamps?

	lamp X	lamp Y	lamp Z
A	dimmer than normal	normal brightness	brighter than normal
B	brighter than normal	normal brightness	dimmer than normal
C	not lit	normal brightness	not lit
D	not lit	not lit	not lit

40 In the graph shown, the solid curve shows how the e.m.f. produced by a simple a.c. generator varies with time. The dashed (dotted) curve is the output from the same generator after a modification has been made to the generator.



Which modification was made to produce the new output shown?

A The thickness of the coil was doubled.
B A split-ring commutator was added.
C The number of turns in the coil was doubled.
D The speed of rotation of the coil was doubled.

------ END OF PAPER ------

Class	Register Number	Name

Bukit Batok Secondary School
O-LEVEL PRELIMINARY EXAMINATION 2018
SECONDARY FOUR EXPRESS

PHYSICS **6091 / 02**
Paper 2 Theory 17 August 2018
0745 – 0930 hrs
1 hour 45 minutes

Candidates answer on the Question Paper.

Additional Materials: No additional materials needed

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 pen on both sides of the paper.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A
Answer **all** questions.

Section B
Answer **all** questions. Question **13** 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.

Take the gravitational field strength, *g* to be 10 N/kg where needed.

At the end of examination, fasten any separate answer paper to the Question Paper.
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 document consists of **19** printed pages (including this cover page).

Section A [50 marks]

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

1 An athlete uses an exercise machine, as shown in Fig. 1.1.

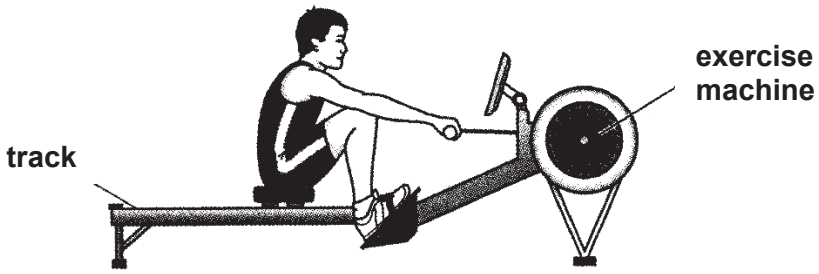


Fig. 1.1

The athlete moves forward and backwards along the track. As he pulls the handle, he moves backwards and the machine displays the force exerted by the handle. At the end of the track, he stops pulling and then returns to the position shown. This is one complete movement.

(a) An accurate value for the average power for one complete movement is obtained.

Describe what measurements are taken and how they are used to find the average power for one complete movement.

……

……

……

……

……

……[4]

(b) Forces act on the athlete as he exercises. Identify an action-reaction pair of forces.

……

……[1]

2 A student stands near the edge of a cliff. He throws a ball upwards, as shown in Fig. 2.1.

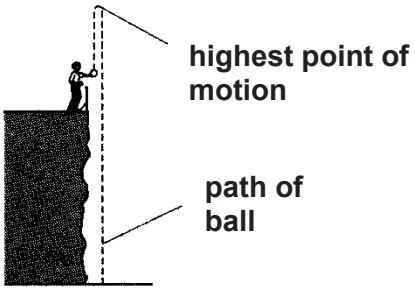


Fig. 2.1

The displacement-time graph for the first 1.0 s of motion is shown in Fig. 2.1. Air resistance is negligble in the first 1.0 s of motion.

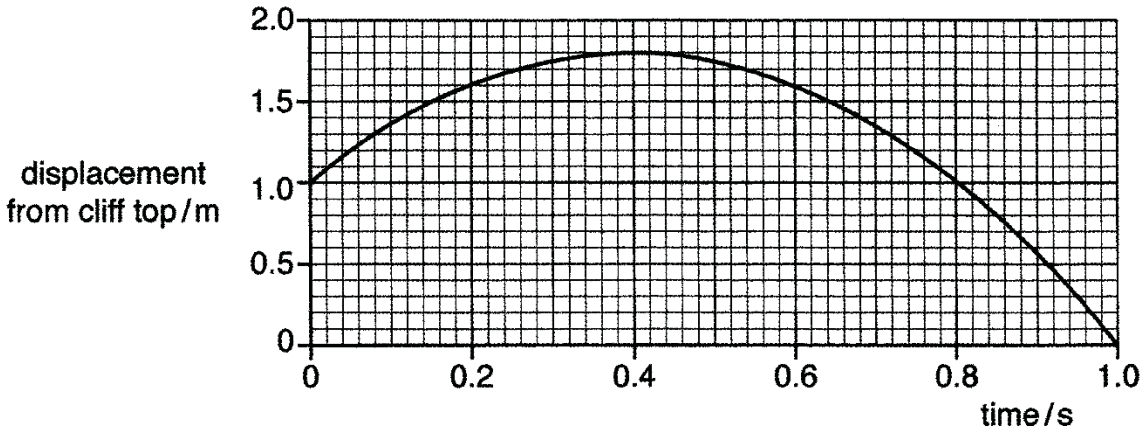


Fig. 2.1

(a) Estimate the average velocity of the ball from t = 0.8 s to 1.0 s

average velocity =…….…….. [2]

(b) The ball continues to fall after 1.0 s. The effect of air resistance becomes significant and the ball eventually reaches terminal velocity.

Describe how the velocity and acceleration of the ball changes as it reaches terminal velocity.

……..……..…….

……..……..…….

……..……..…….[2]

3 Fig. 3.1 shows a stationary piston in a cylinder. It consists of a piston on one end and is sealed on the other end.

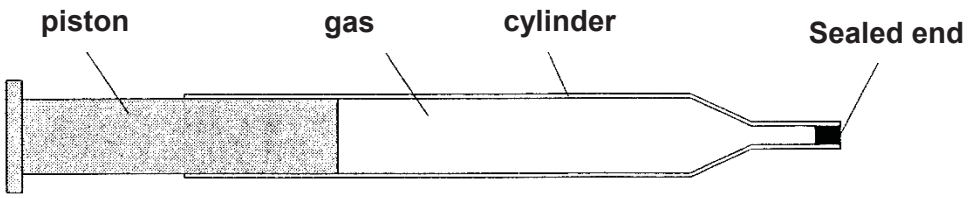


Fig. 3.1

The gas in the cylinder exerts the same pressure on the piston as it does on the sealed end.

(a) Using ideas about molecules, explain why the pressures are the same.

……

……

……[2]

(b) The piston is held in place and the cylinder is cooled. Temperature of the cylinder and gas dropped by 15 °C.

Using ideas about molecules, state and explain the change in pressure of the gas.

……

……

……

……[3]

4 Fig. 4.1 shows steam from a boiler passing through a turbine connected to a generator.
Steam passes through the turbine in the coiled copper tube and condenses in the condenser.
The internal energy of the seawater rises.

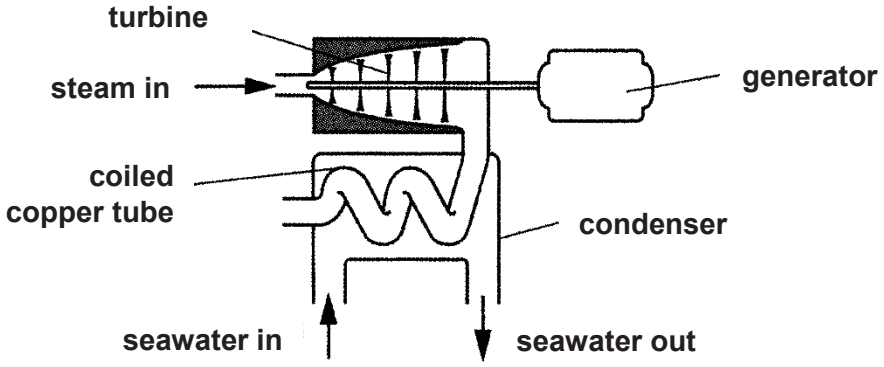


Fig. 4.1

(a) State the effect(s) of condensation of steam on the molecules of the seawater.

……

……

……

……[3]

(b) The seawater enters the condenser at a temperature of 30 °C, and leaves at a temperature of 64 °C. In a certain time, 265 MJ of thermal energy passes into the seawater.

The specific heat capacity of seawater is 3.9 kJ / (kg °C).

Calculate the mass of seawater that enters the condenser in this time.

mass =…….. [2]

5 Fig. 5.1 (drawn to scale) shows rays of light travelling in water from a light source **O**.

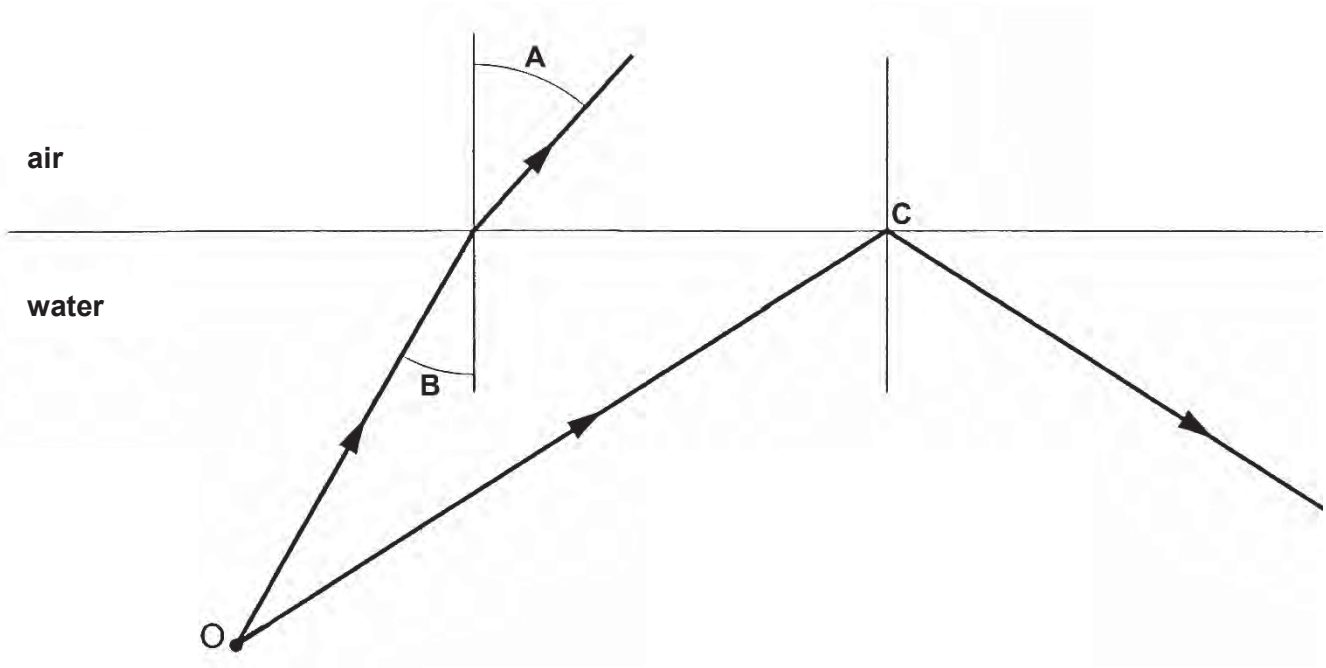


Fig. 5.1 (to scale)

(a) (i) Measure and write down the sizes of angles **A** and **B**.

angle **A** =…… & angle **B** =…… [1]

(ii) Hence, determine the refractive index of water.

refractive index =…… [2]

(b) Explain why the light ray does **not** escape from the water surface at point **C**.

……

……

……[2]

6 Some electrical components are easily damaged if electric charge is placed on them. They are often stored by placing them in contact with a conductor.

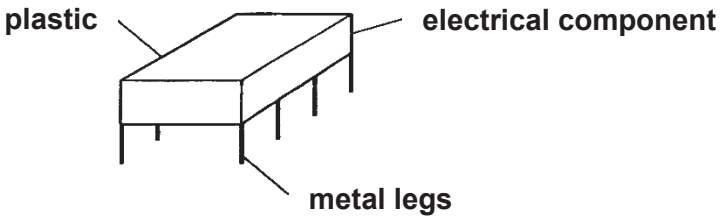


Fig. 6.1

(a) When the component shown in Fig. 6.1 is rubbed with a woollen cloth, the metal legs become negatively charged.

Explain how this happens.

……

……[1]

(b) Fig. 6.2 shows the negative charged metal legs placed near a piece of uncharged aluminium foil which rests on an insulator.

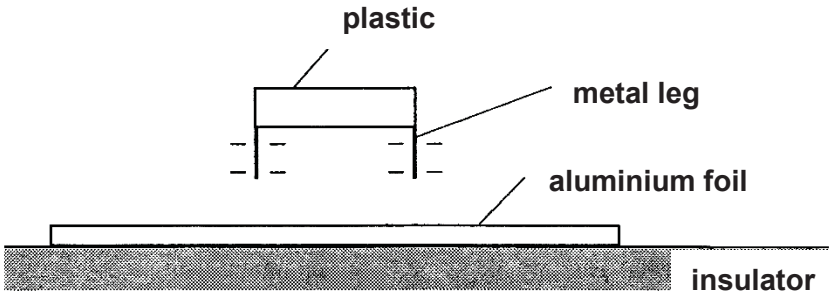


Fig. 6.2

Explain why the aluminium foil is attracted to and sticks to the metal legs.

……

……

……

……[2]

7 Fig. 7.1 shows a coil of wire connected by flexible leads to a switch and a battery.

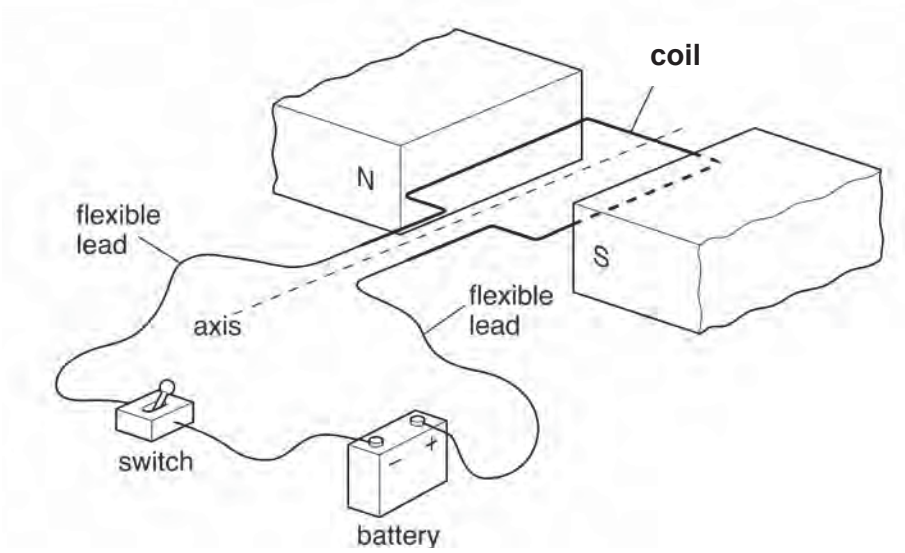


Fig. 7.1

The coil is placed between the poles of a permanent magnet and is free to turn about the axis.
When the switch is closed, forces due to the current act on the sides of the coil.
The coil starts to turn.

(a) **(i)** On Fig. 7.1, draw an arrow to show the direction of the force on the coil next to the N-pole of magnet. [1]

(ii) Explain how you obtained your answer.

……

……

……

……[3]

(b) The coil stops when it is vertical. Explain why the turning effect of the forces is zero at this position.

……

……[1]

(c) In order for the coil to rotate continuously, a split-ring commutator is connected between the battery and the coil.

Explain how the split-ring commutator enables the coil to rotate continuously.

……

……

……

……[2]

8 A student constructs a model of a circuit breaker using an unmagnetized steel core, as shown in Fig. 8.1. The distance from the stiff spring to the pivot is 25 cm. The iron arm can move freely about the pivot.

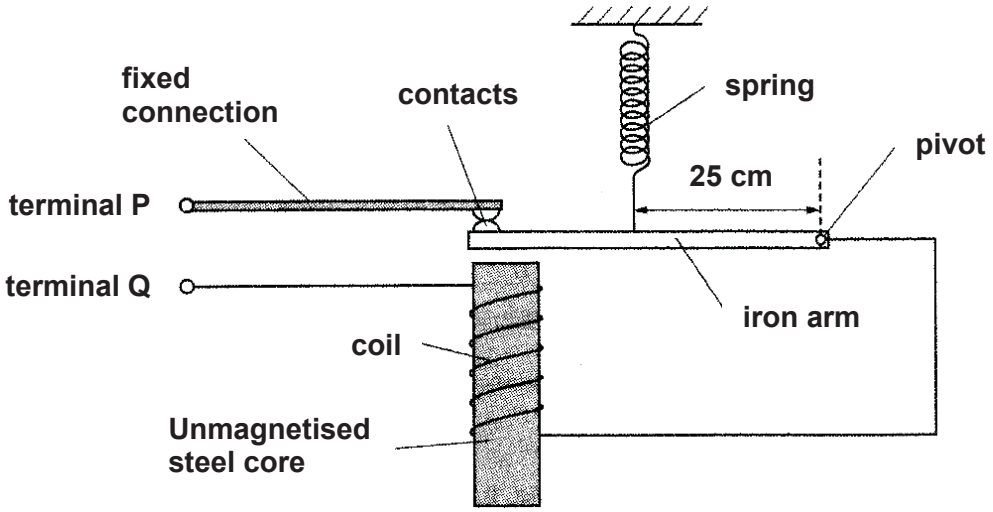


Fig. 8.1

(a) A current flowing from terminal **P** to terminal **Q** causes the contacts to separate. Explain why.

……

……

……

……[3]

(b) The student finds that his model can only be used once.

Suggest and explain **one** reason why.

……

……

……[2]

(c) Suggest and explain **one** modification such that the circuit breaker will be activated to work at a much larger current.

……

……

……

……[2]

9 Fig. 9.1 shows a circuit containing a 12 V filament lamp and a 12 V power supply.

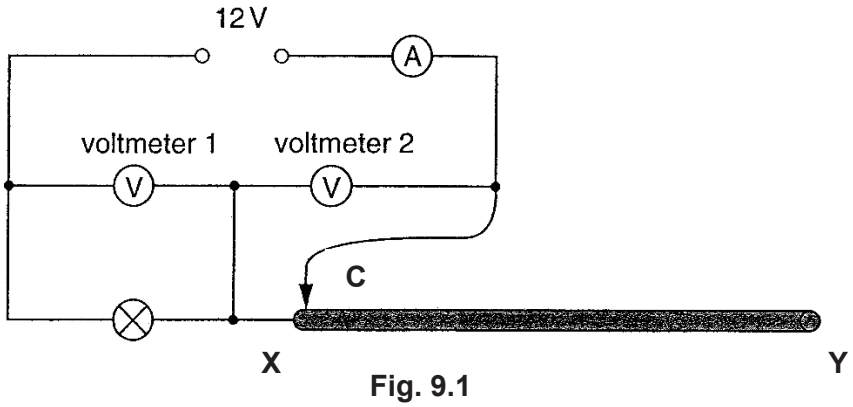


Fig. 9.1

The variable resistor **XY** is made from a long resistance metal wire. The sliding contact **C** moves along the wire from **X** to **Y**.

The wire **XY** obey Ohm's law.

(a) State what happens to the readings of the three meters as C moves from X to Y.
Give numerical values where possible.

voltmeter 1 ……..

……..…….

voltmeter 2 ……..……..

……..…….

ammeter ..……..……..

……..……..……[3]

(b) The variable resistor is adjusted so that the potential difference across the lamp is 4.0 V.
The current flowing through the lamp is 150 mA.

Determine the amount of charge that flows through the lamp in 5.0 minutes.

charge =……..…….. [2]

10 A straight length of copper wire lies horizontally between the poles of a U-shaped magnet. Fig. 10.1 shows the two ends of the wire connected to a very sensitive, centre-zero ammeter.

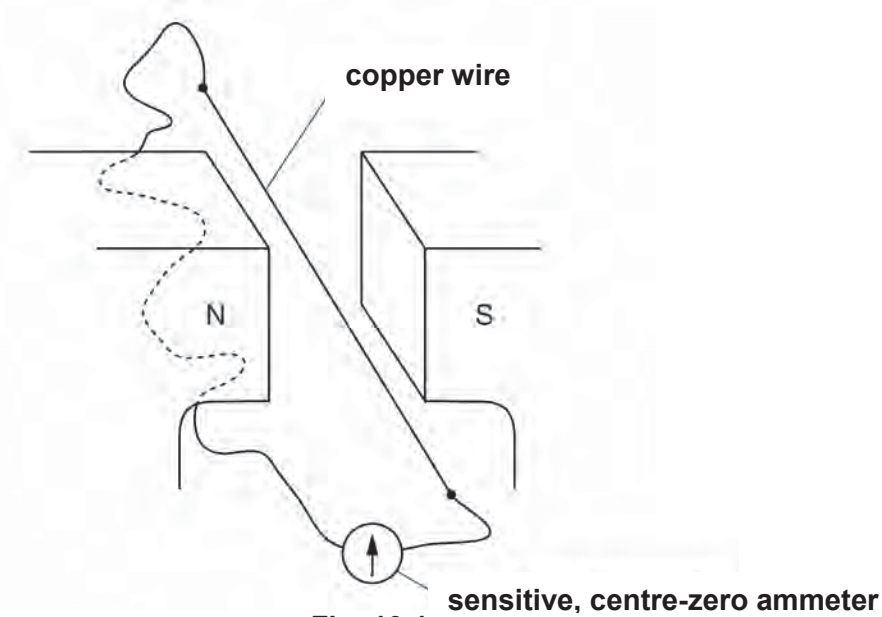


Fig. 10.1

The copper wire is moved upwards quickly between the two magnetic poles. The needle on the ammeter deflects momentarily.

(a) (i) Explain why the needle on the ammeter deflects.

.....

.....[1]

(ii) Draw an arrow on Fig. 10.1 to show the direction of current flowing in the part of copper wire between the two magnetic poles. [1]

(b) The wire is now moved downwards slowly between the two magnetic poles.

State what happens to the needle on the ammeter.

.....

.....[2]

Section B [30 marks]

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

Answer only one of the two alternative questions in **Question 13**.

11 A length of resistive wire is cut into two pieces **E** and **F**. Each piece of resistive wire is clamped, in turn, between two metal clips, as shown in Fig. 11.1. The length of wire between the clips is 0.7 cm for wire **E** and 2.0 cm for wire **F**.

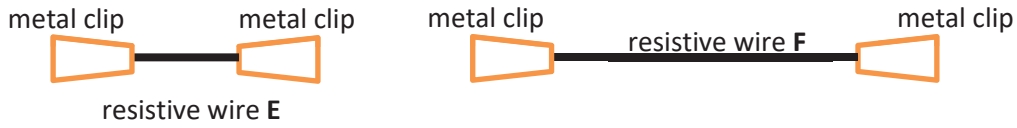


Fig. 11.1

(a) The potential difference (p.d.) across each wire is slowly increased. The p.d. is measured at various values of current. Fig. 11.2 shows the readings obtained.

	wire **E**	wire **F**
current / A	p.d. / V	p.d. / V
0	0	0
0.4	0.04	0.15
0.8	0.08	0.30
1.2	0.14	0.49
1.6	0.23	0.70
2.0	0.37	1.19
2.4	0.70	1.99
2.8	1.10	2.98
3.2	1.50	**not measurable**
3.6	**not measurable**	

Fig. 11.2

(i) Using data from Fig. 11.2, describe the relationship between the current and the p.d. across **E** for high currents.

.....

.....[1]

(ii) Given that the circuit is in working conditions, suggest why the p.d. is **not** measurable for wire **F** at a high current.

.....

.....

.....[1]

(iii) Determine the resistance of the resistive wire **E** when the current is 1.6 A

resistance =..... [1]

(iv) Draw and label a suitable electric circuit diagram of the experiment set up to get the readings of one of the resistive wires in Fig. 11.2. [3]

(v) In one experiment, both the wires and a 1.5 V dry cell were connected in series. Deduce the current flowing through the wire. Explain your answer.

.....

.....

.....

.....[2]

(b) The experiment is repeated with a strong wind blowing over the wires by the use of a table fan.

Fig. 11.3 shows the new readings obtained at selected currents.

	wire **E**	wire **F**
current / A	p.d. / V	p.d. / V
0.4	0.03	0.13
0.8	0.06	0.26

Fig. 11.3

(i) Suggest why the values of the p.d. at the same current in Fig. 11.3 are lower than that in Fig. 11.2.

.....

.....

.....[1]

(ii) Suggest one other difference that is seen for readings of p.d. at values of current greater than 0.8 A, as compared to those in Fig. 11.2.

.....

.....[1]

12 Fig. 12.1 shows the basic structure of a transformer.

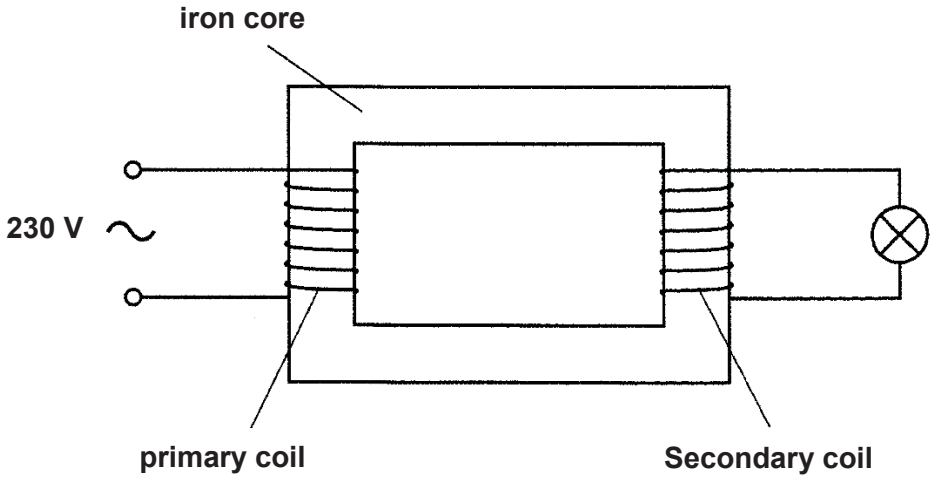


Fig. 12.1

An alternating voltage of 230 V is applied to the primary coil and a voltage is induced in the secondary coil. The secondary coil is connected to a lamp.

(a) Describe what is meant by an *alternating voltage*.

……

……[1]

(b) Suggest a reason for using an iron core in the transformer.

……

……[1]

(c) The primary coil has 2200 turns.

Calculate the smallest number of complete turns in the secondary coil that would give an induced voltage of at least 12 V in the secondary coil.

number of turns = …… [2]

(d) The transformer obeys the principle of conservation of energy. A student determines the input power and the output power of the transformer and calculates the efficiency of the transformer.

(i) State the principle of conservation of energy.

..……...……...……

..……...……...……

..……...……...……

..……...……...……[2]

(ii) The lamp is rated “12 V 1.2 A”. Calculate the current in the primary coil when the lamp works normally.

current = …… [2]

(iii) In reality, the primary coil has a current of 0.080 A.
Calculate the efficiency of the transformer.

efficiency = …… [2]

13 EITHER

A national springboard diver trains regularly. At the pool, he climbed up a flight of stairs with a total vertical height of 5.2 m to reach a springboard at the top in 16 seconds. Fig. 13.1 shows him ascending in the air during a jump.

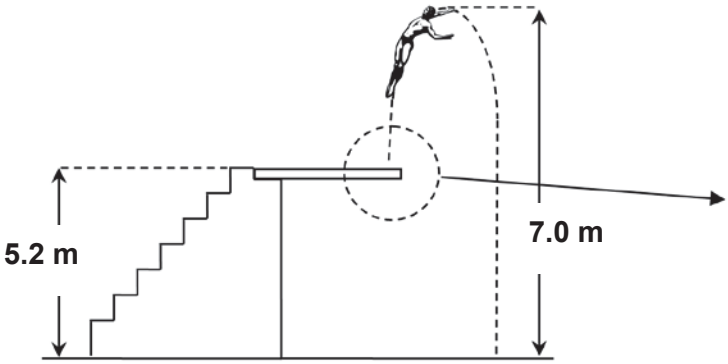


Fig. 13.1

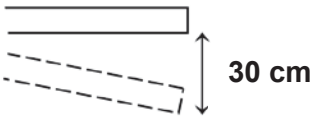


Fig. 13.2

(a) Describe the main energy change when the diver climbed up the flight of steps.

……

……[1]

(b) Given that the diver's weight is 620 N, find his average power during the climb.

average power = …… [2]

(c) The diver used the elastic springboard to propel himself and his centre of gravity reached a maximum height of 7.0 m from the surface of the water before plunging down.

Fig. 13.2 shows the springboard in action when it was used to propel the diver upwards at a certain speed. The springboard moved down a vertical distance of 30 cm during this instant, sprung back to horizontal position, and the diver left the springboard when it was horizontal.

(i) Determine the vertical speed at which the diver left the springboard.

vertical speed = …… [2]

(ii) Find the average upward force exerted by the springboard to propel the diver upwards.

average force = …… [2]

(d) Fig. 13.3 shows a dipper that will vibrate up and down vertically as the wheel turns, creating waves on a water surface. A direct current (d.c.) motor drives a wheel.

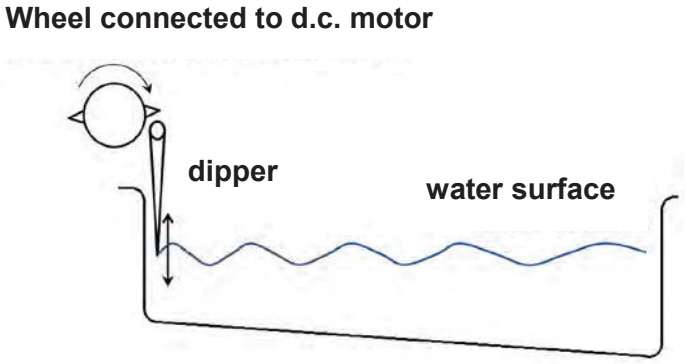


Fig. 13.3

(i) With reference to Fig. 13.3, explain what is meant by transverse wave motion.

……

……

……

……[2]

(ii) The wheel makes 240 revolutions every minute.

Determine the frequency of the vibration of the dipper.

frequency = …… [1]

OR

Fig. 13.4 shows an electric circuit made with a light-dependent resistor (LDR), and a variable resistor (rheostat) that is set to 3.0 kΩ. The potential divider is connected in series with a 12 V power supply and a voltmeter is connected across the LDR.

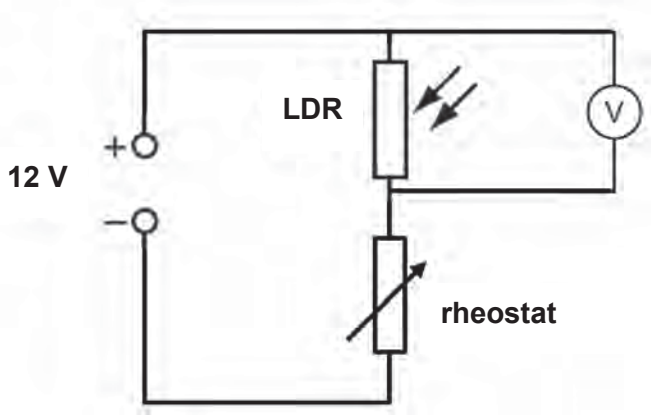


Fig. 13.4

During an experiment, a light was shone on the LDR and the resistance of the LDR was 1000 Ω.

(a) Define *electric current*.

……

……[1]

(b) Mark out with an arrow on Fig. 13.4, next to the power supply, the direction of conventional current flow. [1]

(c) Calculate

(i) the current in the circuit,

current = …… [2]

(ii) the reading shown on the voltmeter.

reading = …… [2]

(d) Describe and explain how the reading of the voltmeter would change when the light intensity decreases.

……

……

……

……[2]

(e) Describe and explain the effect of increasing the resistance of the rheostat.

……

……

……

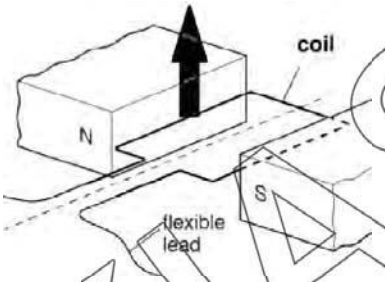
……[2]

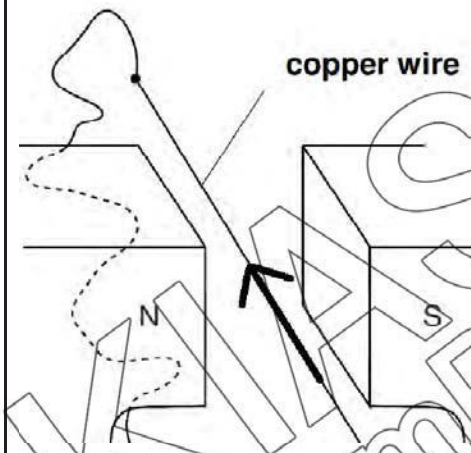
------ End of Paper ------

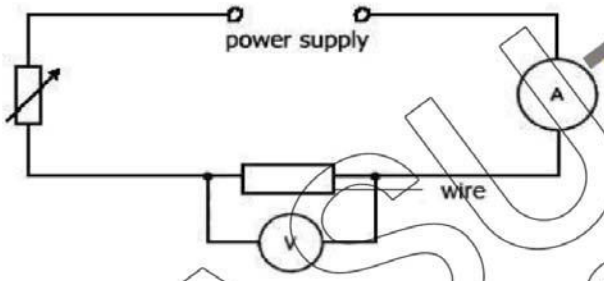
Q	ANSWER	Suggested Reason
1	**D**	Recall. 7 base quantities.
2	**C**	Most accurate method (average of few readings and precise instrument)
3	**D**	Distance travelled ÷ Time taken
4	**B**	Area under speed-time graph = ½ (20) (5.0) = 50.0 m. He reacted immediately. Taking into account negligible human reaction time, he would stop on the line.
5	**B**	Y is the highest point (momentarily at rest at highest point) To stop, speed should be zero.
6	**B**	For right angled triangle, tension = sqrt ($20^2 + 30^2$) = 36.1 N
7	**C**	Push – friction = m a and hence 40 – friction = 2.0 (5.0) Friction = 40 – 10 = 30 N
8	**C**	Recall. Inertia depends on mass.
9	**A**	Volume of bottle = mass / density = 680 / 13.6 = 50 cm^3 Density of P = mass / volume = 50 / 50 = 1.0 g/cm^3
10	**B**	Clockwise moments = anti-clockwise moments 10 (4.0) + 5.0 (1.0) = F (1.0) and hence F = 45 N
11	**B**	Recall. Weight acts through corner (edge) of base.
12	**A**	Recall. Pressure = Force / Area.
13	**B**	Recall. Manometer.
14	**C**	W = F d = 8.0 (6.0 x 5.0) = 240 J
15	**A**	P = F d / t = 600 x 10 / 20 = 300 W
16	**D**	Due to friction, energy is converted to heat and sound and dissipated away.
17	**B**	Pressure inside stays the same so when speed drops the rate of frequency increases due to smaller inner wall surface area.
18	**C**	Heat is lost from feet faster on floor tile due to smaller c and better conductor of heat.
19	**B**	Radiation through the air followed by conduction of heat through glass.
20	**D**	Q = m c Δθ = P t 2000 x 4.0 = 2.0 x c x (3 – 0) and hence, c = 1330 J/(kg °C) Q = m l_F = Pt 2000 x 3.0 = 2.0 x l_F and hence, l_F = 3000 J/kg
21	**A**	Heat gained by colder water = heat lost by hotter water 5.0 x c x (new temperature - 20) = 1.0 x c x (80 - new temperature) 5T - 100 = 80 – T and hence, 6T = 180 °C and so T = 30 °C
22	**A**	Recall. Thermometric property.
23	**B**	wavelength = 1.2/3 = 0.40 m v = f λ = 0.40 x 15 = 6.00 m/s
24	**B**	Statements 2 is incorrect. It can be refracted and reflected.
25	**C**	Speed in fibre = 2.0 x 10^8 m/s apply n = c/v.
26	**C**	Recall.
27	**D**	Recall. Higher frequency implies higher penetrating power and larger ionising power.
28	**A**	Recall. Smaller maximum value (smaller amplitude) and same period.
29	**C**	Ray X and Ray Y are correct.
30	**B**	Converge means rays go nearer after lens. Diverge means ray move farther apart after lens.
31	**A**	Electrons are attracted up from earth. Electrostatic induction.
32	**B**	Recall.
33	**D**	I = V / R = 12 / 6 = 2.0 A (effective resistance = 1 + 2 + 3 = 6 Ω)
34	**D**	Recall. Switch is along live wire. Earth wire touches metal casing.
35	**A**	Unlike poles attract. Z becomes an induced magnet that is attracted to Y.
36	**C**	Magnetic field lines go from right-hand-side pole to left-hand-side pole.
37	**A**	Apply fleming's left hand rule (conventional current to left)
38	**B**	Amplitude = max value of 2 boxes vertically. Frequency = 1 / 4 horizontal boxes.
39	**C**	Y is powered by the d.c. cell. X and Z do not lit due to no changing magnetic field (no a.c. supply).
40	**D**	Halved the period implies twice the frequency. Twice the amplitude implies twice the rate of cutting of magnetic flux (faraday's law)

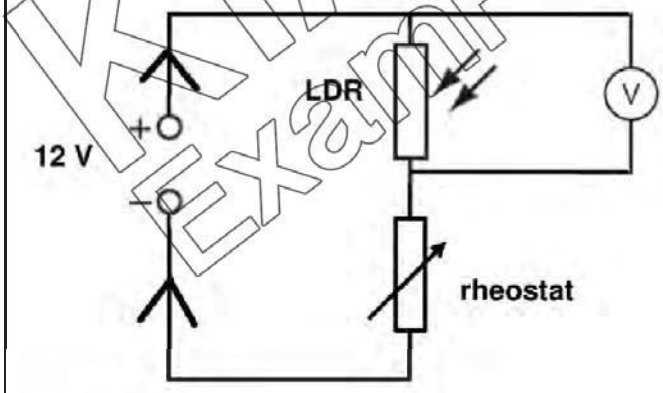
BUKIT BATOK SECONDARY SCHOOL
O-LEVEL PRELIMINARY EXAMINATION
PHYSICS 6091 PAPER 2 – SUGGESTED ANSWERS

Q	Suggested Answer
1a	• Record down force (using the force meter already on the machine) • Measure and record down distance = length of rope pulled (using measuring tape or metre rule) • Measure and record down time (using stopwatch) • Calculate Power = (Force x distance) / time • Repeat for another try to get another power reading and then calculate average *Overwhelming majority of candidates did not use instruments to make measurements.*
1b	• Pull on earth on him downwards & Pull by him on earth upwards with same size of force • Pull on man by rope to right & pull by man on rope to the left with same size of force **No marks if no direction mentioned** *Overwhelming majority of candidates did not mention direction and did not mention size.* *Majority of candidates mixed up the bodies involved.*
2a	Velocity = gradient of displacement-time graph = 0 – 1.0 / (1.0 – 0.8) = – 5.0 m/s (accept 5.0 m/s downwards) *Many candidates got the wrong answer of 5.0 m/s*
2c	• Velocity increases by less and less until it becomes constant • Acceleration decreases until it becomes zero *Large majority of candidates overly write.*
3a	• Randomly moving gas molecules hit on the inner wall randomly with equal probability • These collisions exert a force per unit area that is constant all along inner wall *Overwhelming majority of candidates answered same frequency as a condition.* *Majority of candidates are confused between intermolecular collisions and collisions against inner wall surfaces.*
3b	• Speed of gas molecules decrease and they move less vigorously • They hit inner walls with small force and less frequently • Smaller force exerted per unit area on inner walls (smaller pressure) *Most candidates did not mention molecules hitting the inner walls less hard (with less force).*
4a	• Molecules of seawater roll and slide faster • Molecules of seawater move more vigorously • Molecules of seawater move farther apart from each other *Large majority of candidates focused their answer on steam molecules losing heat instead of seawater molecules gaining heat. Some candidates wrote about heat transfer methods.*
4b	Q = m c Δθ 265 000 000 = m (3900) (64 – 30) mass = 1998.5 kg = 2000 kg *Many candidates could not convert 3.9k to 3900. Many candidates mistook 256 for 265.*
5a(i)	angle A = 42 ° and angle B = 30 ° (nearest degree for angle)

Q	Suggested Answer
5a(ii)	n = sin (large angle) / sin (smaller angle) = sin A / sin B = sin (42) / sin (30) = 1.34 (no units) *Candidates who wrote sin I / sin r could not score full credit as angle r is larger than angle i.*
5b	• Angle of incidence in water (optically denser medium) is larger than critical angle • Light is travelling from optically denser medium to optically less dense medium • Total internal reflection occurred and light reflects back into optically denser medium *The condition of light trying to move from optically denser to optically less dense medium is not mentioned.*
6a	Metal legs gained (surface) electrons from woollen cloth due to friction. *Large majority of candidates referred to negative charges.*
6b	• The force of attraction between the positive charges on Al and electrons on metals legs is larger than the force of repulsion between the electrons on Al and electrons on metal legs • As the positive charges on Al are now closer to the metal legs than the electrons of Al. • Upward force of attraction is larger than downward weight of Al foil as well *Very few candidates mentioned about the existence of both attraction and repulsion Fewer candidates went on to mention the weight of the Al foil.*
7a(i)	Vertically upwards on coil next to N-pole of magnet  *Candidates are reminded to draw the arrow on the coil using ruler.*
7a(ii)	• By Fleming's left hand rule, left middle finger points in direction of current • Left index finger points in direction of magnetic field lines from N-pole to S-pole • Left thumb points in direction of magnetic (Lorentz) force on coil upwards
7b	Force on coil acts through the pivot (M = F d, d = 0 m, M = 0 Nm) *Overwhelming majority of candidates are confused over the cutting of magnetic flux with moments (M = Fd).*
7c	• It reverses the direction of current in the coil every half a turn • Such that the force on coil nearest to N-pole of magnet is always upwards • It also prevents entangling of the external wires from power source during rotation *The idea of direction of force being reversed is not clearly expressed most of the time.*
8a	• Current in solenoid creates a strong electromagnet with N-pole at top of coil • Bottom left of iron arm is attracted downwards to the solenoid due to magnetic induction as it is now an induced S-pole • Anti-clockwise moment due to downward magnetic force of iron arm about pivot is more than clockwise moment due to upward force of spring about pivot *Overwhelming majority of candidates wrote very simplistic answers, omitting details.*

Q	Suggested Answer
8b	• Steel core becomes a permanent magnet that cannot be easily demagnetised. • Iron arm cannot move back up to close the contacts. • Current cannot flow as contacts stay open.
8c	**First point** Much larger current will create a much stronger electromagnet. Hence, we need to reduce the strength of the electromagnet. • Fewer turns of coil of solenoid so that the circuit breaker will not activate at a low current. • Larger distance (> 25 cm) of spring away from pivot for a larger moment to overcome.
9a	• Voltmeter 1 will change from decrease from initial 12 V • Voltmeter 2 will increase from initial 0 V • Ammeter will decrease from initial value *Overwhelming majority of candidates did not specify numbers (12 V, 0V) in their answers.*
9b	Q = I t = 0.15 (5.0 x 60) = 45.0 C (accept 45 C)
10a(i)	The copper wire experiences a temporary change in magnetic flux (of magnets) linked to it (per second), induced an e.m.f.
10a(ii)	Arrow drawn on wire in-between magnets INTO paper  *Very few candidates got the correct answer.*
10b	• Smaller size of momentary deflection • Deflection in the opposite direction (to the left)
11a(i)	The p.d. increases proportionally /uniformly / constantly / linearly as current increases
11a(ii)	• High current caused overheating of the wire ($P = I^2 R$ heating) and wire melted Overwhelming majority of candidates wrote that the voltmeter range is 0 to 3 V and hence could not measure more than 3 V. However, under working conditions, the voltmeter used would definitely be able to. The only exception is for a short-circuit fault (for ammeter) where the current would rise by a lot.
11a(iii)	R = V / I = 0.23 / 1.6 = 0.144 Ω (accept 0.14 Ω)

Q	Suggested Answer
11a(iv)	• Workable circuit to vary current and get p.d. (e.g. use of rheostat or potentiometer or variable power supply) • Correctly drawn circuit symbols and connections with ruler • Able to measure accurately current (ammeter) in wire and p.d. (voltmeter) across wire  **Accept either wire E or wire F** **Do not accept two wires connected in parallel** *Overwhelming majority of candidates did not use a rheostat. A sizeable number did not use ruler to draw straight lines.*
11a(iv)	• Approximately 2.0 A (same current for series connection) • Sum of p.d. in both wires in series is about 0.37 V + 1.19 V = approximately 1.5 V
11b(i)	• Strong wind causes cooling, reducing resistance and hence, by V = IR, reducing p.d. • Conduction of heat away from wire also leads to lower temperature
11b(ii)	• Fig 11.3 is now able to measure p.d. of currents previously not measurable in Fig. 11.2 • Fig. 11.3 shows smaller increase in p.d. as current is increased than Fig. 11.2
12a	• Positive and negative terminals switches position periodically • Size (magnitude) of voltage changes sinusoidally *Large majority of candidates confused current and voltage and mentioned about the changing direction of current flow.*
12b	• Increase the magnetic field strength by concentrating magnetic field lines inside it • Ensures good magnetic flux linkage between primary and secondary coil Overly broad answers such as increasing efficiency were rejected unless candidates went on to elaborate further on why efficiency went up.
12c	$N_S / N_P = V_S / V_P$ $N_S = 12 (2200) / 230$ = 114.8 = 115 turns
12d(i)	• Energy cannot be created nor destroyed. It changes from one form to another. • Total energy in a closed (isolated) system is fixed (constant) *Many candidates did not mention the 2nd point of total energy in a closed system being constant.*
12d(ii)	For 100% ideal transformer (zero loss), $I_s V_s = I_p V_p$ $I_p = (1.2 \times 12) / 230$ = 0.0626 A (accept 0.063 A)

Q	Suggested Answer
12d(iii)	Efficiency = useful output / total input = $I_s V_s \div I_p V_p$ = (1.2 x 12) ÷ (230 x 0.080) = 0.783 (accept 78.3 %) *Overwhelming majority of candidates compared the secondary coil current to the primary coil current.*
EITHER	**EITHER**
13a	Chemical energy → gravitational potential energy (initial and final forms) Kinetic energy → gravitational potential energy (during the run)
13b	P = F d / t = (620 x 5.2) / 16 = 202 W
13c(i)	Ignoring effects of air resistance, Loss in KE = Gain in GPE ½ m v^2 = m g Δh V = sqrt (2 x 10 x 1.8) = 6.00 m/s
13c(ii)	Work done by springboard on man = gain in GPE by man F x d = (620 x 1.8) F = 620 x 1.8 / 0.30 = 3720 N (accept 3700 N) *Overwhelming majority of candidates did not get this correct.*
13d(i)	• The water molecules vibrate vertically up and down, • Perpendicular to the propagation of wave (energy) from left to right
13d(ii)	F = number of vibrations in 1 second = 240 / 60 = 4.0 Hz
OR	**OR**
13a	Rate of flow of electric charge
13b	
13c(i)	I = V / R = 12 / (3000 + 1000) = 0.0030 A *Many candidates lost marks as they left their answer as 0.003 A.* *Candidates are reminded that 1 s.f. answers for calculations such as this is not allowed.*

Q	Suggested Answer
13c(ii)	V = IR = 1000 x 0.0030 = 3.00 V Many candidates lost marks as they left their answer as 3 V. *Candidates are reminded that 1 s.f. answers for calculations such as this is not allowed.*
13d	• Voltmeter reading will slowly increase. • Because $V_o = \frac{R_{LDR}}{R_{rheostat}+R_{LDR}} \times V_s$. When light intensity decreases, R_{LDR} increases and Voltage will increase accordingly to the formula *Candidates who did not use the potential divider principle mostly got it wrong as they wrongly assumed that the current would stay constant.*
13e	• **For bright situations, the p.d. across LDR is now smaller.** • **For dark situations, the p.d. across LDR is now smaller as well.** • It will make the circuit less sensitive/needs more changes in light intensity before voltmeter reading change • by increasing $R_{rheostat}$, R_{LDR} must change even more before the voltage will make the corresponding change. *Overwhelming majority of candidates did not know how to approach this question, focusing their answer on the decrease in voltmeter reading for a particular instance only.*