YISHUN SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2021
SECONDARY 4 EXPRESS

CANDIDATE NAME

CLASS

INDEX NUMBER

PHYSICS
Paper 1   Multiple Choice

6091/01
27 August 2021
1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, class and index number on the Answer Sheet in the spaces provided.

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

Read the instructions on the Answer Sheet very carefully.

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

This document consists of **17** printed pages.
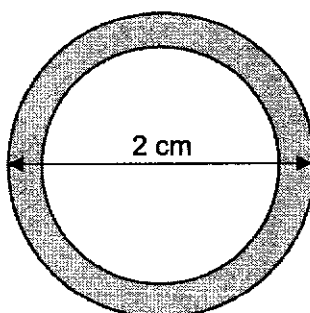
[Turn over

1   Which quantity is a vector quantity?

   A   density

   B   moment

   C   power

   D   pressure

2   What is the correct unit for the quantity shown?

	quantity	unit
A	latent heat	J
B	electromotive force	W
C	pressure	kg / m³
D	weight	kg

3   A length of copper pipe, of uniform cross-section and several metres long, carries water to a tap.
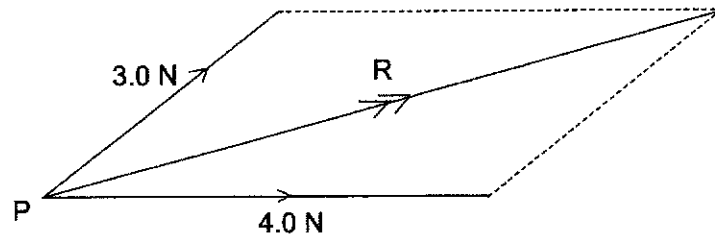

Measurements are taken to determine accurately the volume of copper in the pipe.

Which instruments are used?

   A   micrometer and vernier calipers

   B   micrometer and rule

   C   rule and tape

   D   tape and vernier calipers

3

4   The diagram shows the resultant R of a 3.0 N force and a 4.0 N force that act at a point P.

The angle between the 3.0 N force and the 4.0 N force can be any value from 0° to 90°.

Which value of R is **not** possible?

A   4.0 N   B   5.0 N   C   6.0 N   D   7.0 N

5   A skydiver is falling at terminal velocity.

Which row describes the acceleration of the skydiver and the velocity of the skydiver?

	acceleration of the skydiver	velocity of the skydiver
A	downwards	constant
B	downwards	zero
C	zero	constant
D	zero	zero

6   A stone is thrown from A and follows a parabolic path. The highest point of the path is B.
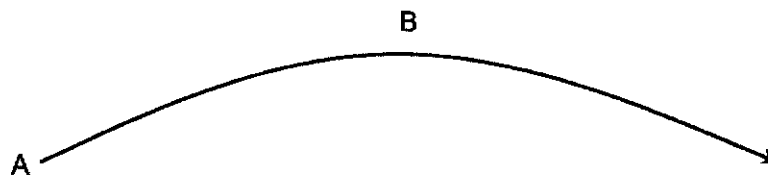
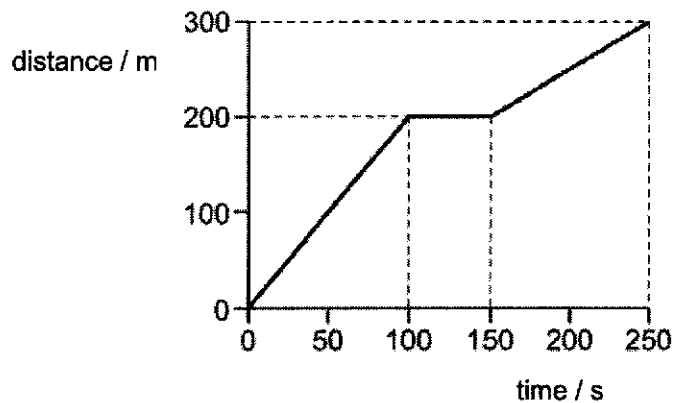Which statement is true about acceleration of free fall?

A   It is greatest at A.

B   It is greatest at B.

C   It is the same at A and B.

D   It is zero at B.

4

7 A cyclist takes a ride lasting 250 s.

The graph shows how the distance from the starting position varies with time.

What is his average speed for the whole journey?

| A | 1.0 m / s | B | 1.2 m / s | C | 1.4 m / s | D | 1.6 m / s |

8 A car of weight 11 000 N moves with constant velocity along a horizontal road. A driving force of 6000 N acts on the car.

What is the force opposing the motion of the car?

| A | 5000 N | B | 6000 N | C | 11 000 N | D | 17 000 N |

9 Which statement describes an object with the greatest inertia?

A a ball of mass 0.2 kg travelling at a constant velocity of 4.0 m/s

B a bullet of mass 4.2 g moving at a speed of 960 m/s

C a stationary car of mass 800 kg

D a student of mass 60 kg running 100 m race in 10 s

10 Two cylinders P and Q are made of iron.
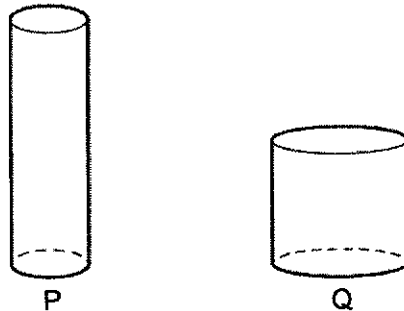
The height of P is twice the height of Q. The diameter of P is half the diameter of Q.

Which statement is correct?

A   The density of cylinder P is four times that of cylinder Q.

B   The density of cylinder P is twice that of cylinder Q.

C   The density of cylinder P is equal to that of cylinder Q.

D   The density of cylinder P is half that of cylinder Q.

11 A stationary block of wood of mass 5 kg is being pushed across a smooth horizontal surface by a constant horizontal force of 15 N through a distance of 7 m.
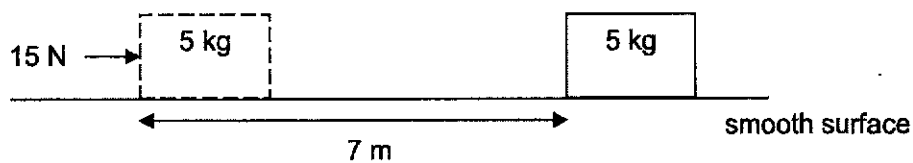
What is the speed of the block after moving through the distance of 7 m?

A   2.33 m/s   B   6.48 m/s   C   10.7 m/s   D   21.0 m/s

[Turn over

12 Four different electric motors have a power rating of 60 W. Under normal operating circumstances, the power outputs of the motor are shown in the table below.

Which electric motor has the highest efficiency?

motor	power output		
	sound energy	mechanical energy	heat energy
A	5 W	35 W	20 W
B	5 W	25 W	30 W
C	10 W	40 W	10 W
D	10 W	30 W	20 W

13 A student makes a model toy which balances on the end of a metal rod.

weight   weight

smooth surface
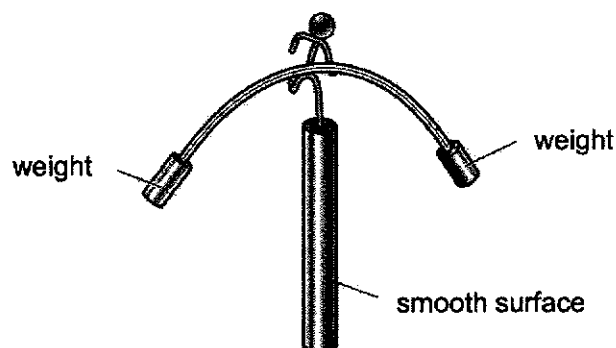
Why are the weights needed?

A   They increase the pressure on the rod.

B   They increase the weight of the model.

C   They lower the centre of gravity below the top of the rod.

D   They raise the centre of gravity above the top of the rod.

14 The mass of a non-uniform metre rule is 0.05 kg. Two forces, 1.0 N and 1.2 N, act on the metre rule at 0 cm and 100 cm respectively. The metre rule is in equilibrium when it is pivoted at its centre of gravity as shown.
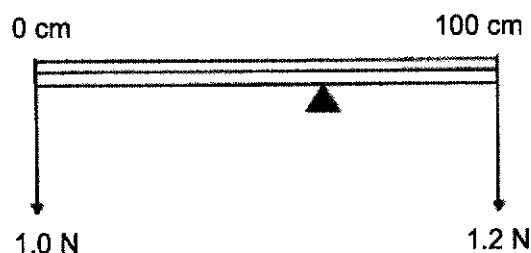
Where is the position of the centre of gravity of the metre-rule?

A at the 45.5 cm mark

B at the 50.0 cm mark

C at the 54.5 cm mark

D at the 83.3 cm mark

15 The diagram shows a hydraulic pump.
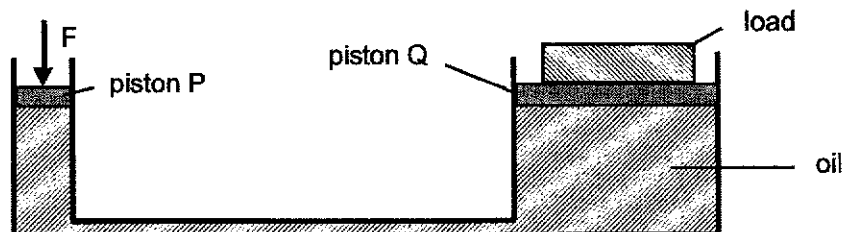
Which statement is true?

A The force F is greater than the weight of the load.

B The force F is the same as the weight of the load.

C The pressure on piston P is greater than the pressure on piston Q.

D The pressure on piston P is the same as the pressure on piston Q.

[Turn over

16 The diagram shows a simple barometer. The distance between P and R is 0.90 m and the distance between Q and R is 0.14 m. The density of mercury is 13 600 kg/m³ and the gravitational field strength g is 10 N/kg.
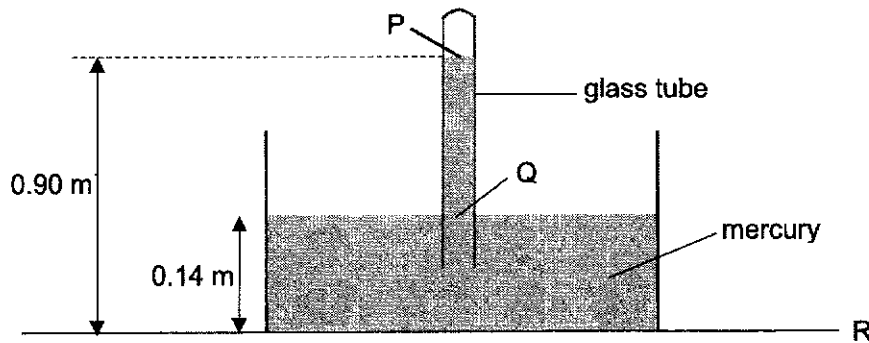
What is the pressure difference between points P and Q?

A   19 040 Pa

B   103 360 Pa

C   122 400 Pa

D   136 000 Pa

17 The diagrams show the same volume of water placed in 4 different containers.
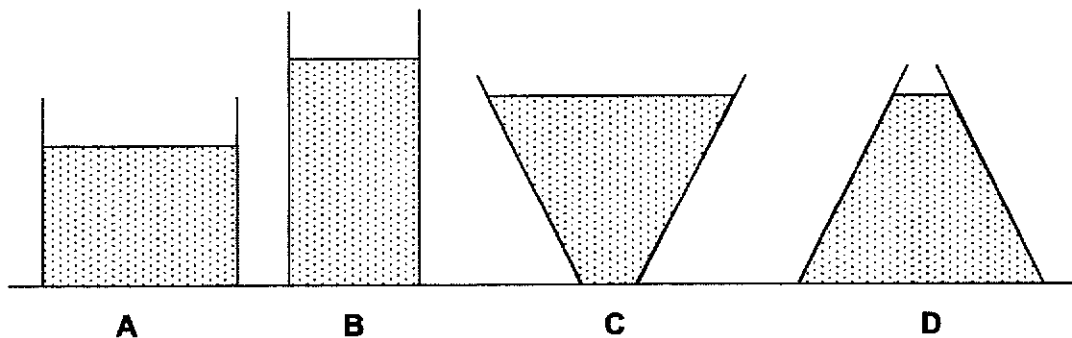
Which container will experience the greatest water pressure at the base?

18 Which statement explains the Brownian motion of smoke particles?

A convection currents in air

B collision between air molecules

C collision between smoke particle

D collisions on the smoke particles by the air molecules

19 The resistance of a wire is 25 Ω when it is placed in a cup of melting ice. At room temperature of 28 °C, its resistance is 38 Ω.

If the wire is placed in boiling water, what is the approximate value of its resistance?

A 28 Ω   **B** 46 Ω   **C** 71 Ω   **D** 152 Ω

20 Some gas is trapped in a closed container. The gas is cooled and the volume of the container is kept constant.

What happens to the gas molecules?

A They collide with the walls more often.

B They contract.

C They get closer together.

D They move more slowly.

21 Aluminium foils are commonly used to wrap sweet potatoes which are cooked in a barbecue fire.

How should the sweet potatoes be wrapped if the aluminium foil has one side that is more shiny than the other side?

A Dull side should be on the outside because it is a better absorber of radiation.

B Dull side should be on the outside because it is a better conductor.

C Shiny side should be on the outside because it is a better absorber of radiation.

D Shiny side should be on the outside because it is a better conductor.

[Turn over

22   Which statement is false?

   A   The angle of incidence on a rough surface is equal to the angle of reflection.

   B   The incident ray and the reflected ray always lie on the same plane.

   C   The image in a plane mirror is formed by two rays from the object.

   D   The speed an image moves away from a plane mirror is the same as the speed the object moves away from the same mirror.

23   An object O is placed in front of a plane mirror.
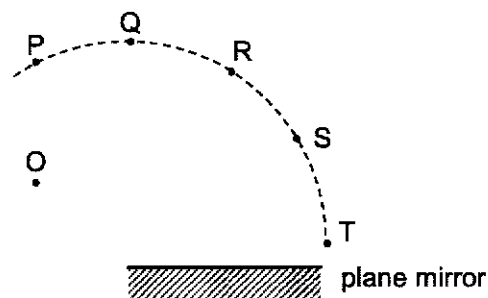
Where should an observer position himself so that he is able to see the image of **O** in the mirror?

   A   Between P and R only.

   B   Between Q and T only.

   C   Between R and S only.

   D   Between S and T only.

24   A student looks at the image of an object O using a periscope that consists of two plane mirrors.
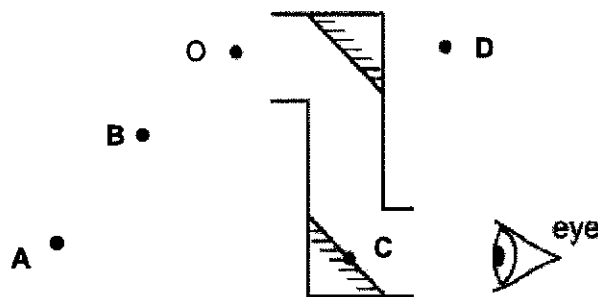
Where is the position of image O?

25 A ray of light travels through an air bubble in water.
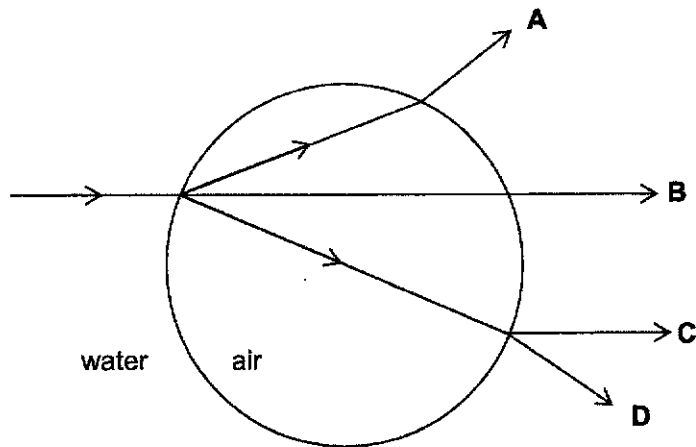
Which path of the ray of light is correct?

26 *I* is the image of object O formed by a thin converging lens.

The object O moves from the principal axis of the lens in the direction OP.
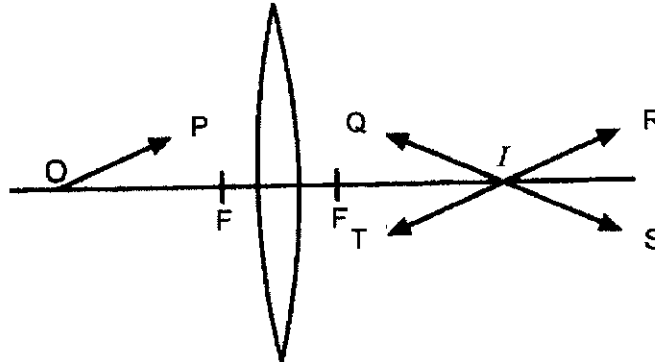
In what direction will the image move?

A   towards Q

B   towards R

C   towards S

D   towards T

[Turn over

27   The diagram shows circular water wavefronts moving from a point source P in a water tank. The source is vibrating at uniform frequency.
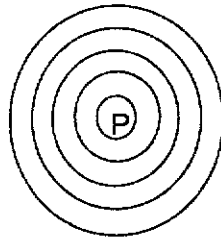
The point source is then set to vibrate with a gradually increasing frequency.

Which diagram shows the new resulting wavefronts?

A

B

C

D
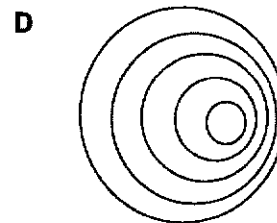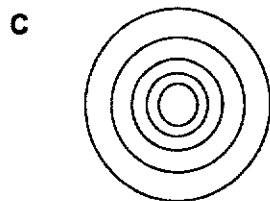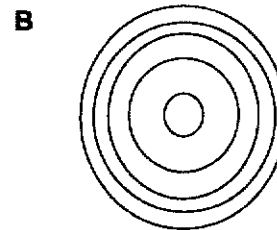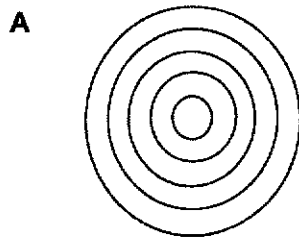
28   Which of the following components of the electromagnetic spectrum are placed in ascending order of frequency?

A   microwaves, infra-red rays, X-ray

B   ultraviolet rays, infra-red rays, radio waves

C   Gamma-rays, microwaves, visible light

D   radio waves, X-ray, ultraviolet rays

29 A series of compression and rarefactions of a sound wave is shown below.

What is the wavelength of the wave?
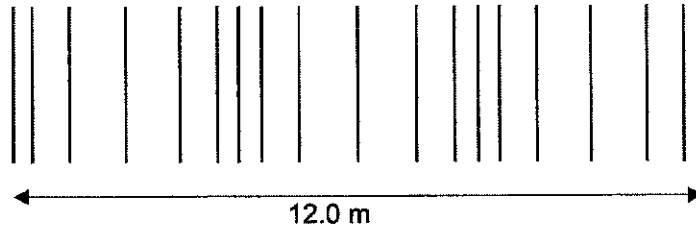
12.0 m

A 3.0 m

B 4.0 m

C 9.0 m

D 12.0 m

30 A negatively charged sphere is held with an insulating handle and brought near a metal plate.

galvanometer
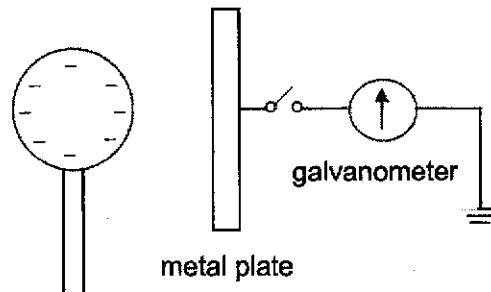
metal plate

Why does the galvanometer deflect momentarily when the switch is closed?

A   Electrons flows from Earth to the metal plate.

B   Electrons flows from metal plate to the Earth.

C   Protons flows from Earth to the metal plate.

D   Protons flows from metal plate to the Earth.

[Turn over

31 Three objects X, Y and Z are metal spheres, each on insulated stand.

Object X and Y experience a force of repulsion. Object X and Z experience a force of attraction.

Which set of charges cannot be correct?

	charge on X	charge on Y	charge on Z
A	positive	positive	negative
B	positive	positive	uncharged
C	negative	negative	positive
D	uncharged	uncharged	negative

32 When a p.d. across a bulb is 0.50 V, a current of 0.20 A flows through the bulb.

What is the work done to move 4.0 C of charge through the bulb?

A   0.80 J   B   1.0 J   C   2.0 J   D   8.0 J

33 Wire X and Y are two wires made of the same material such that wire Y is twice as thick and four times longer than wire X.

What is the ratio of resistance of X to the resistance of Y?

A   0.50   B   1.0   C   1.5   D   2.0

34 Which electrical component is an input transducer?

A   ammeter

B   bulb

C   thermistor

D   variable resistor

35 The circuit diagram shows some resistors connected to a 12 V battery.
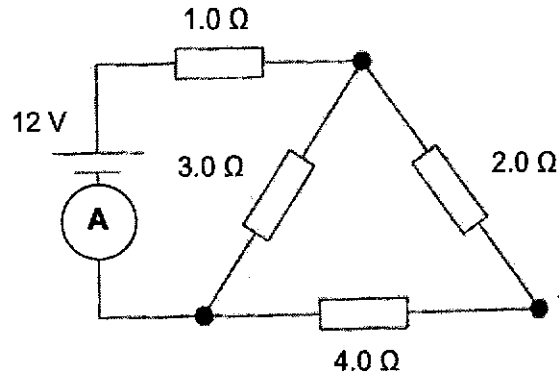
What is the reading on the ammeter?

A   1.0 A

B   3.0 A

C   4.0 A

D   12 A

36 A thermistor and LDR are connected to a constant voltage supply.

The temperature of the thermistor is increased but no other changes are made.

In which circuit will the voltmeter reading decrease?

A

B

C

D
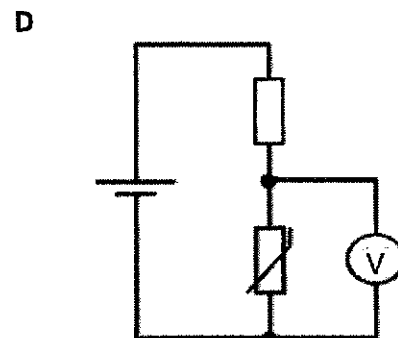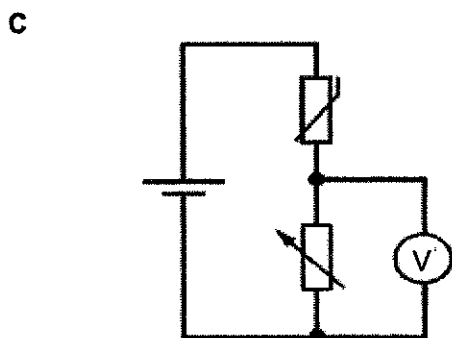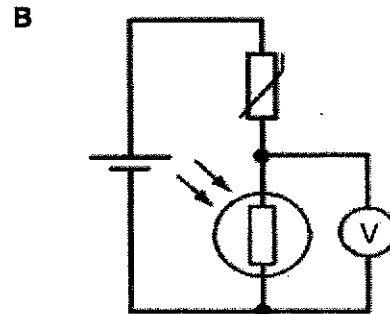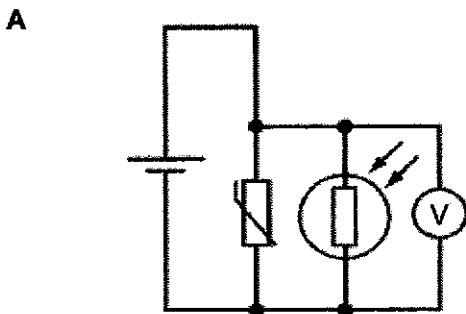
[Turn over

37 The following electrical appliances are connected in parallel to a 240 V power supply. The rating of the appliances and the duration of usage in one week is indicated in the table below.

appliance	rating	duration
fan	60 W	20 hours
television	150 W	30 minutes
fridge	250 W	everyday

What is the total cost of using the three appliances in one week if a unit of electricity costs $0.25?

A $10.82   B $43.28   C $173.12   D $1082

38 The diagram shows a plug that is wired wrongly. The appliance has an external metal casing.
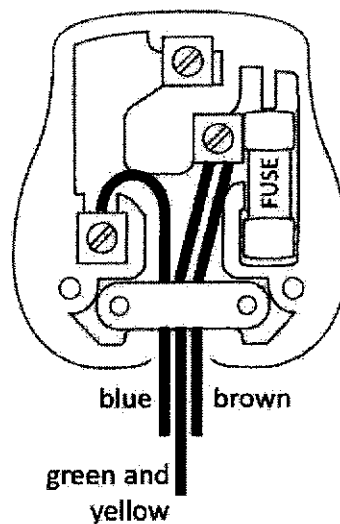
What will happen when the plug is used?

A   The appliance will continue to work without any danger to users.

B   The appliance will continue to work but the external metal casing is at high voltage.

C   The appliance will not work because the external metal casing is at high voltage and causes the fuse to melt.

D   The appliance will not work because there is a short circuit and causes the fuse to melt.

39   Which statement about the fuse is correct?

A   When a fuse is placed in the neutral wire, it will not melt when the current exceeds the fuse rating.

B   When a fuse is placed in the neutral wire, the current will still flow in the live wire if the fuse melts.

C   A fuse is not needed if the appliance has an external plastic casing.

D   A fuse disconnects the switch from the power supply if it is placed before the switch.

40   The diagram below shows a positive charge travelling towards an electric field.
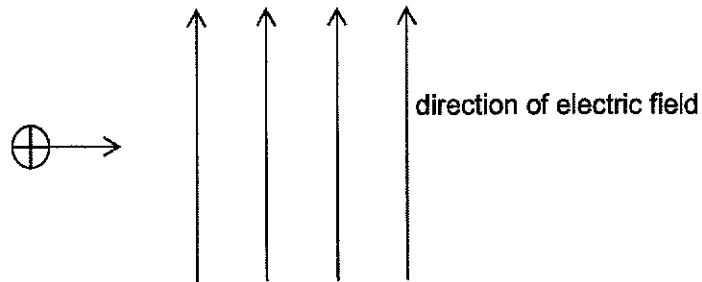
What is the direction the positive charge will move when it first enters the electric field?

A   into the paper

B   out of the paper

C   upwards

D   downwards

End of Paper

YISHUN SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2021
SECONDARY 4 EXPRESS

CANDIDATE NAME	

CLASS					INDEX NUMBER		

PHYSICS
Paper 2

6091/02
25 August 2021
1 hour 45 minutes

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

READ THESE INSTRUCTIONS FIRST

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

Section A
Answer all questions.

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

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

At the end of 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.

This document consists of **23** printed pages and **1** blank page.

[Turn over

2

Section A

Answer **all** questions in the spaces provided.

1   There is no atmosphere on the Moon.

An astronaut on the Moon drops a feather and a hammer from the same height at the same time. They both accelerate downwards at 1.6 m/s² and they hit the ground at the same time.

Both the feather and the hammer take 1.5 s to fall to the ground from rest.

(a)   Calculate the speed of the objects as they hit the ground.

speed = ... [2]

(b)   On Fig. 1.1, draw the speed-time graph for the fall. At the correct position on the y-axis, write the value of the speed at time t = 1.5 s.

Fig. 1.1

[1]

(c)   Using the speed-time graph in **(b)**, determine the height from which the objects are dropped.

height = ... [2]

2 Fig. 2.1 shows two uniform wooden blocks P and Q. Block Q weighs 6.0 N and is placed on top of block P.
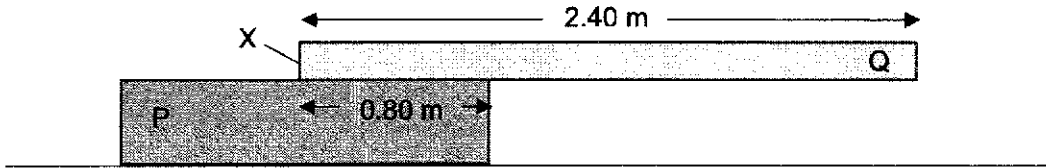
Fig. 2.1

(a) On Fig. 2.1, indicate the weight of the block Q with an arrow labelled "W".

[1]

(b) Predict and explain using moments, what happens to block Q after it is placed on block P.

....

....

.... [2]

(c) Determine the minimum downward force that should be applied at point X of block Q such that block Q is in equilibrium.

minimum force = ... [2]

[Turn over

4

3   (a)   Fig. 3.1 and Fig. 3.2 show two ways of using a laboratory retort stand to hold a flask of liquid.
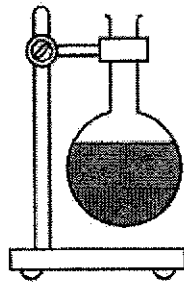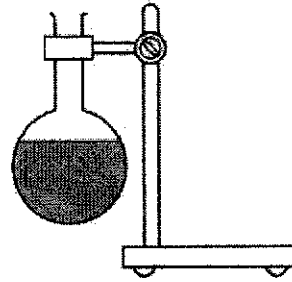
Fig. 3.1   Fig. 3.2

State and explain which arrangement is safer.

....

....

....

.... [2]

(b)   Some office filing cabinets have a mechanism that allows only one drawer to be opened at a time, as shown in Fig 3.3.
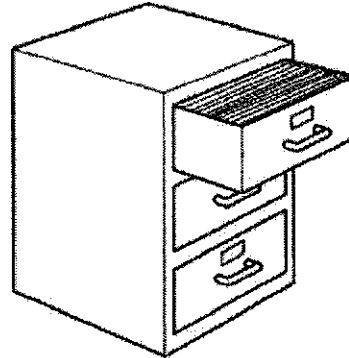
Fig. 3.3

Suggest why some filing cabinets have such mechanism.

....

....

....

.... [2]

4 The total mass of a wheelbarrow and its load is 90 kg. A worker pushes the wheelbarrow and load up a plank of length 2.0 m on to a platform, as shown in Fig. 4.1. The platform is at a height of 0.60 m above the ground.
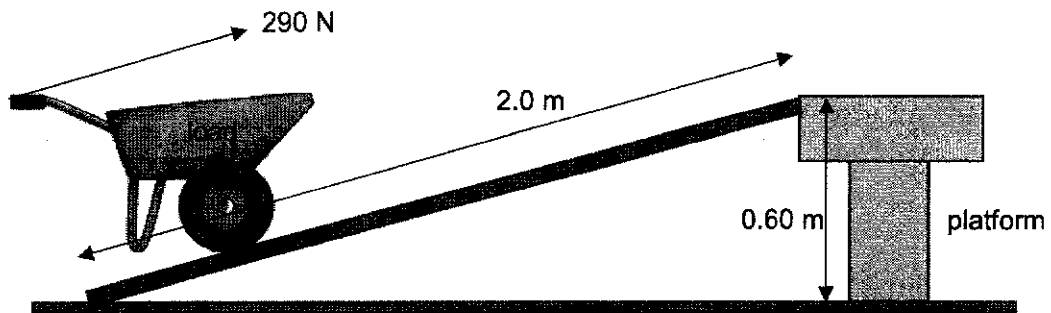
Fig. 4.1

The worker exerts a force of 290N on the wheelbarrow in the direction in which the wheelbarrow moves.

The gravitational field strength g is equal to 10N/kg.

(a) Calculate the gravitational potential energy gained by the wheelbarrow and its load.

energy = ... [2]

(b) Calculate the work done on the wheelbarrow by the worker.

work done = ... [2]

(c) Suggest one reason why the answer to **(a)** is not equal to the answer to **(b)**.

....

.... [1]

[Turn over

6

5   In many countries, solid salt is produced by trapping sea-water in large, shallow ponds and letting the water evaporate.

Fig. 5.1 shows salt being produced in this way.

Fig. 5.1

(a)   State two ways in which evaporation differs from boiling.

1. ....

....

2. ....

.... [2]

(b)   Explain why the temperature of the water drops when the water evaporates.

....

....

.... [2]

(c)   **(i)**   State why the ponds used in this process have large surface areas.

....

.... [1]

(ii)   State why this method of salt production does not work well in a country with a cold climate.

....

.... [1]

6   Fig. 6.1, not drawn to scale, shows a ray of light travelling in air before it enters a section of a glass block.
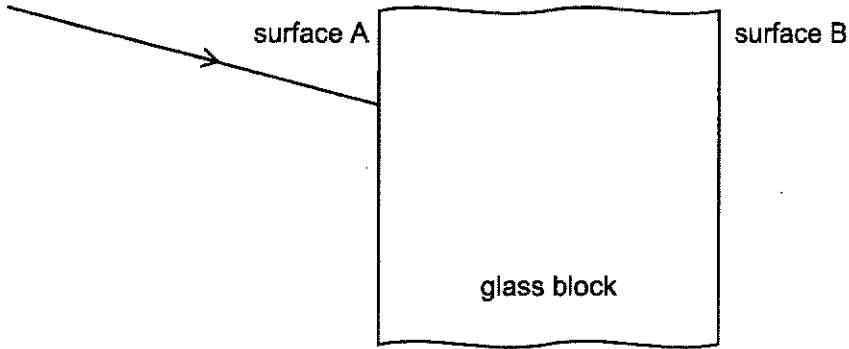
Fig. 6.1

The angle of incidence at surface A is 15° and the critical angle of the glass block is 42°.

(a)   Calculate the angle of refraction at surface A.

angle of refraction = ... [3]

(b)   Surface A is parallel to surface B.

Explain why the ray of light will never undergo total internal reflection at surface B.

....

....

....

.... [2]

[Turn over

8

(c) The glass block is rubbed with a cloth and it was discovered the area that is rubbed becomes positively charged.

(i) Explain why the area on the glass block that is rubbed becomes positively charged.

....

.... [1]

(ii) State and explain one way to discharge the net positive charges on the glass block.

....

....

.... [2]

7 Optical fibre uses total internal reflection of light to transmit signals at high speed. It is cheaper and lighter than cables.

State two other advantages of transmitting signals using optical fibre compared to cables.

....

....

.... [2]

8   Fig. 8.1 shows the virtual image of an object that is placed on the left side of a thin converging lens. The lens is not shown in Fig. 8.1.
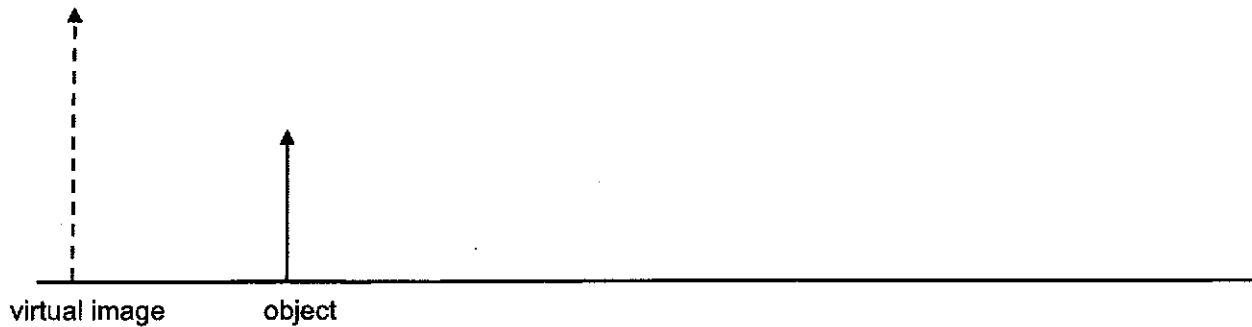
Fig. 8.1

(a)   On Fig. 8.1, draw two rays from the top of the object to locate the position of the lens and its focal point. Label the lens L and the focal point F.   [3]

(b)   The focal length of the lens is *f*.

Describe the changes in the size of the sharp image formed by the lens if the object is moved from 1.5*f* to 2.0*f*.

....

.... [1]

9   Fig. 9.1 shows a magnet hanging from a string. A metal key placed below the magnet and attached to a string, is attracted by the magnet.

string

N

S

string
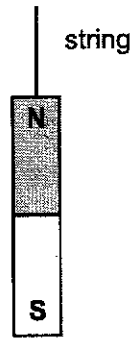
Fig. 9.1

(a)   The key becomes an induced magnet by the process of magnetic induction.

Explain what is meant by *magnetic induction*.

....

.... [1]

(b)   On Fig. 9.1, draw the magnetic field pattern in the space between the S-pole of the magnet and the top of the key.   [2]

(c)   Describe the force that is the part of the action-reaction pair with the weight of the key, and state the body on which it acts.

....

....

.... [2]

11

(d) The magnet is completely covered with iron foil.

Describe and explain what will happen to the key.

....

....

.... [2]

10 Fig. 10.1 shows a d.c. motor. The coil is able to rotate between a pair of magnets.
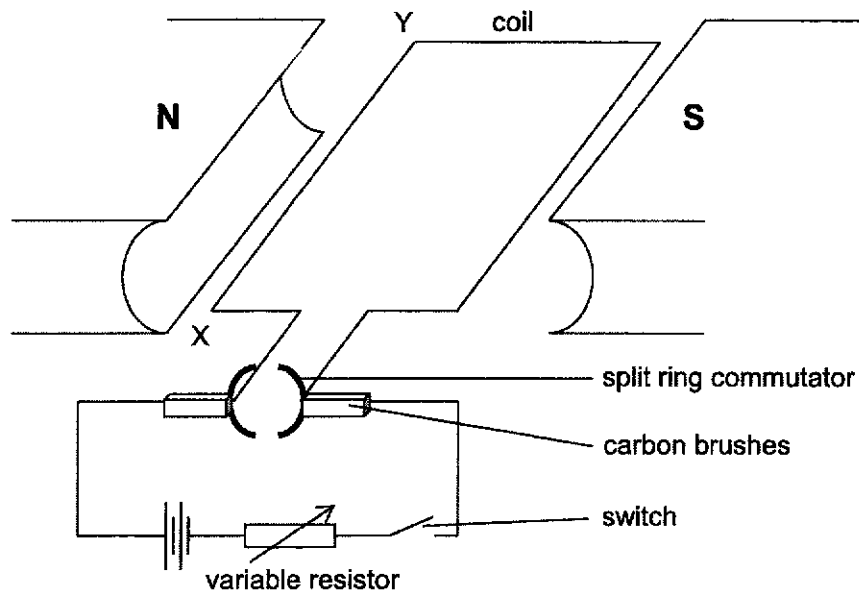
Fig. 10.1

(a) State the direction side XY of the coil will move when the switch is closed.

.... [1]

[Turn over

12

(b) Fig. 10.2 shows how the moment acting on the coil varies with time when the coil makes two complete rotations.
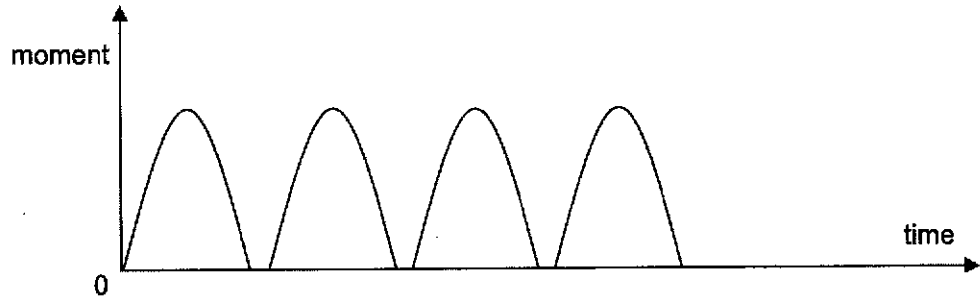
Fig. 10.2

(i) Explain why there is no moment for a short period of time as the coil rotates.

....

....

.... [1]

(ii) On Fig. 10.3, draw how the moment acting on the coil varies with time for two complete rotations when the resistance of the variable resistor is increased slowly. [2]
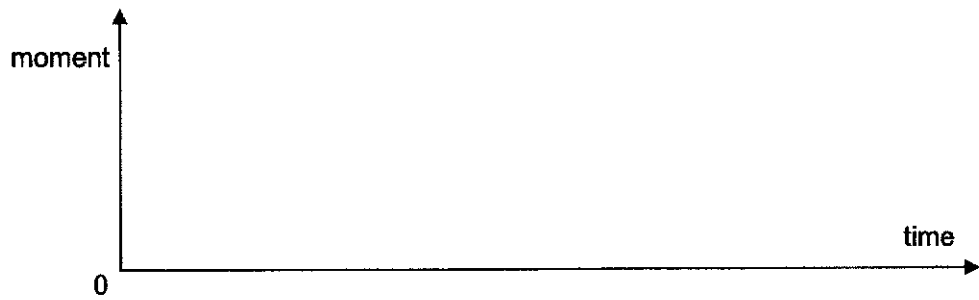

Fig. 10.3

13

BLANK

14

Section B

Answer **all** questions in this spaces provided.

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

11 Fig. 11.1 shows two resistance wires, P and Q, and a variable resistor connected to a dry cell. The dry cell has an e.m.f. of 2.0 V.

2.0 V

wire P

wire Q
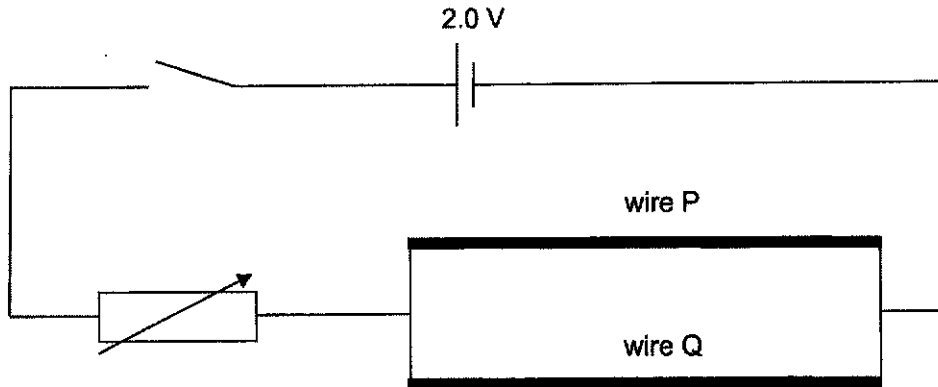
Fig. 11.1

When the switch is closed, the resistance of the variable resistor is gradually decreased. This increases the p.d. across the resistance wires.

Fig. 11.2 shows how the current in both wires changes as the p.d. across them are increased.

p.d. across wire P and Q / V	current in wire P / A	current in wire Q / A
0.20	0.10	0.20
0.40	0.20	0.40
0.60	0.30	0.60
0.80	0.40	0.80
1.00	0.49	1.00
1.20	0.57	1.20
1.40	0.63	1.40
1.60	0.68	1.58
1.80	0.70	1.73

Fig. 11.2

(a) Define the term *resistance*.

....

....

.... [1]

15

(b) Using the values in Fig. 11.2,

(i) state how the current changes in wire P as p.d. across it increases,

....

....

....

.... [2]

(ii) calculate the total power dissipated in the circuit when the p.d. across both wires is 0.20 V.

power = ... [2]

(iii) calculate the resistance of the variable resistor when the p.d. across both wires is 0.20 V.

resistance = ... [2]

[Turn over

16

(c) Fig. 11.3 shows the two resistance wires connected in series. The variable resistor is removed from the circuit.

2.0 V

Z

V

R   jockey   S

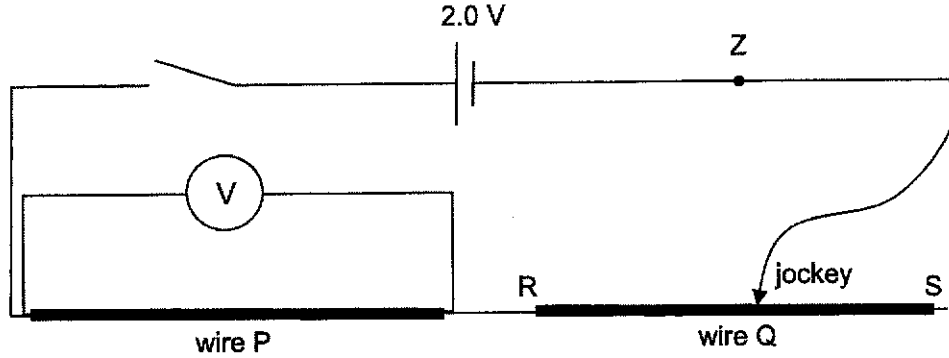wire P   wire Q

Fig. 11.3

When the switch is closed, the jockey is moved slowly along wire Q from R to S.

Describe the changes to the readings of the voltmeter, stating the magnitude where possible.

....

....

.... [2]

(d) A sensitive magnetic compass is placed above one of the connecting wires at Z in Fig. 11.3.

On Fig. 11.4, ignoring the Earth's magnetic field, draw the direction of the compass needle when the switch is closed.   [1]
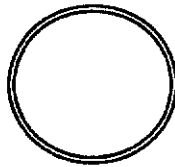
Fig. 11.4

12   Fig. 12.1 shows two hollow vertical glass tubes connected by a horizontal glass tube. There is an opening in the middle of the horizontal glass tube through which air can be removed. The tubes are immersed in liquid A and liquid B as shown and the height of the liquids in each tube is indicated as h_A and h_B.
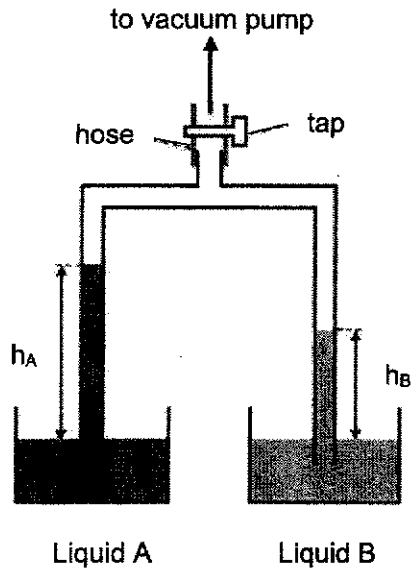

Fig. 12.1

(a)   State and explain what happens to the liquid levels in the tubes when more air is removed by the vacuum pump.

....

....

.... [2]

(b)   What causes the heights h_A and h_B to be different?

....

.... [1]

(c)   (i)   Mark a point in each of the liquid columns in the glass tubes that are at equal pressure. Label them P and Q.

[1]

(ii)   Explain why the two points are at equal pressure.

....

.... [1]

[Turn over

18

(d) Given that h_A = 75 cm and h_B = 69 cm, determine the ratio of the density of liquid A to liquid B.

ratio = ... [2]

(e) Liquid is commonly used in hydraulic systems to lift heavy weights. Such a system is used in the crane as shown in Fig. 12.2.
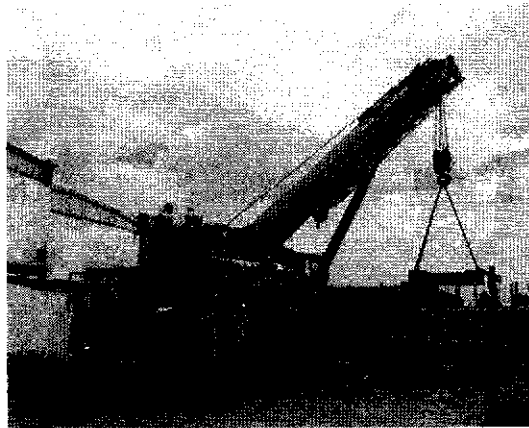

Fig. 12.2

(i) Explain why liquid is used in hydraulic systems.

....

....

.... [2]

(ii) Explain why water is not a good choice of liquid for hydraulic systems.

....

.... [1]

13   EITHER

Fig. 13.1 shows a boat using ultrasound to measure the depth of the seabed. Pulses of ultrasound are emitted from the transmitter and the echo is received by the detector.
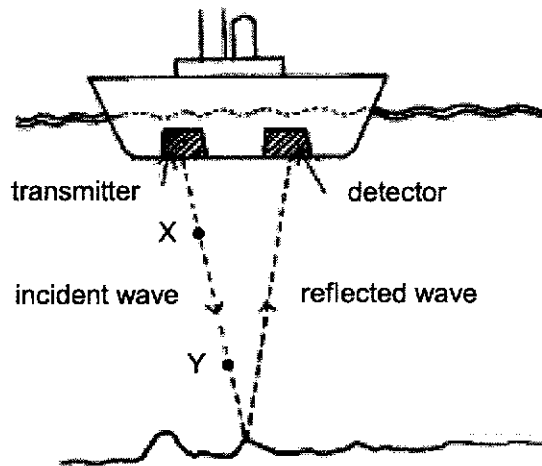

Fig. 13.1

The seawater particles vibrate as the ultrasound travels through the seawater. Fig. 13.2 shows the amplitude-time graphs of seawater particles at X and at Y.
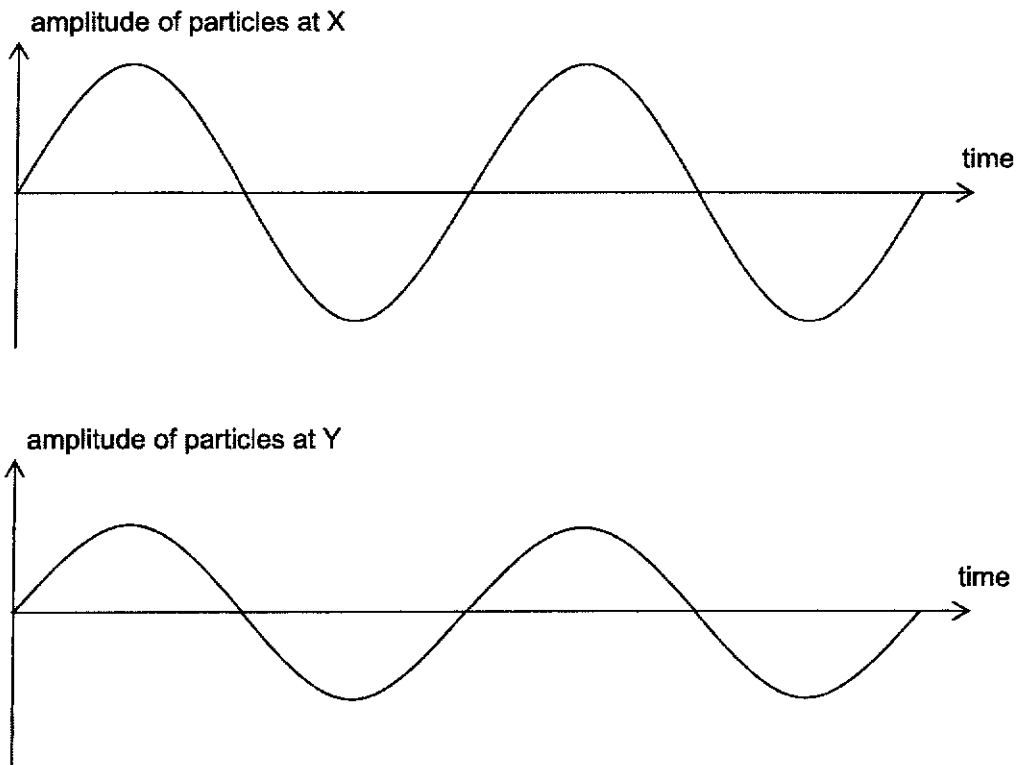

Fig. 13.2

[Turn over

20

(a) Explain what is ultrasound and state one other application of it.

....

.... [2]

(b) Explain the cause for the difference in the amplitude of the two graphs.

....

.... [1]

(c) When ultrasound hits the seabed, most of it is reflected and the rest travel into the seabed.

State the change, if any, to the following physical quantities of the ultrasound when they travel from seawater into the seabed.

frequency: ....

speed: ....

wavelength: ....
[2]

(d) The ship uses Global Positioning System (GPS) to track its location in the sea.

State which component in the electromagnetic spectrum is used in GPS?

.... [1]

(e) On a particular day, the sea is rough and the sea waves have an amplitude of 18.0 m. The boat takes 1.0 minute to move from the highest position to the lowest position.

(i) The sea waves and ultrasound require a medium for the transmission of energy.

State two other common properties of the two waves.

....

....

....

.... [2]

21

(ii)   If the speed of the sea waves is 1.5 km/h, calculate the wavelength of the sea waves.

wavelength = ... [2]

[Turn over

13   OR

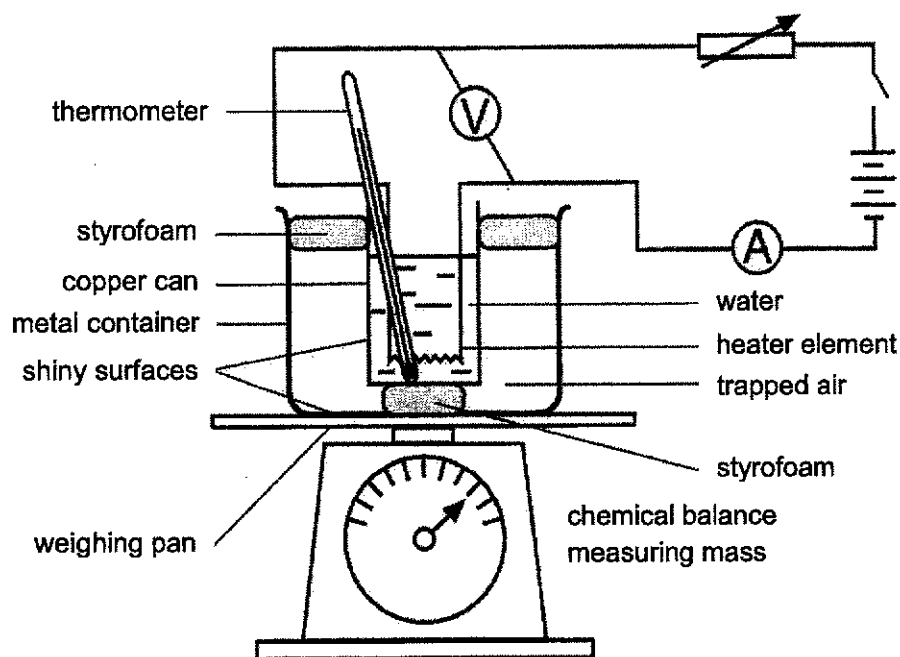Fig 12.5 shows a method of finding the specific heat capacity of water.

Fig. 13.5

The inner copper can has a mass of 400 g when empty. It contains 350 g of water.

The copper can has a specific heat capacity of 0.18 J / (g °C) and its outer surface is polished. The air between the copper can and the metal container is trapped by a layer of styrofoam.

The circuit of the heater is switched on continuously while the readings of the ammeter, the voltmeter, the thermometer and the chemical balance are recorded at regular time intervals.

23

The graphs of the total mass against time and the temperature against time have been plotted in Fig. 13.6 and Fig. 13.7 respectively.

total mass on weighing pan / g

temperature/°C
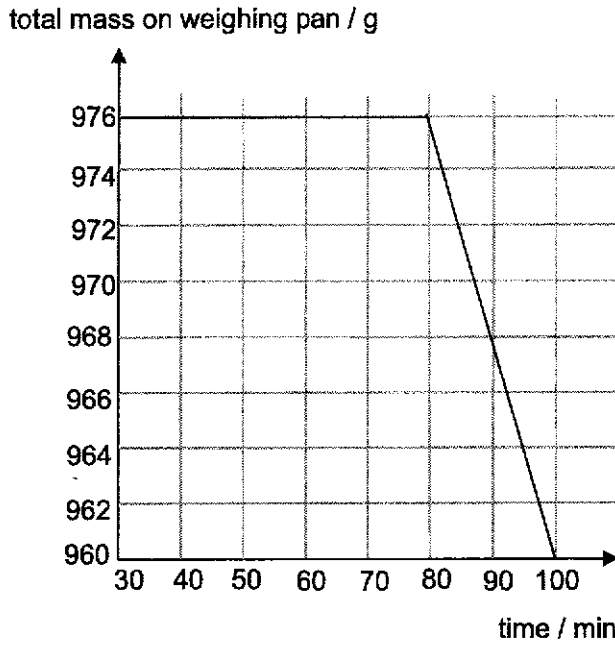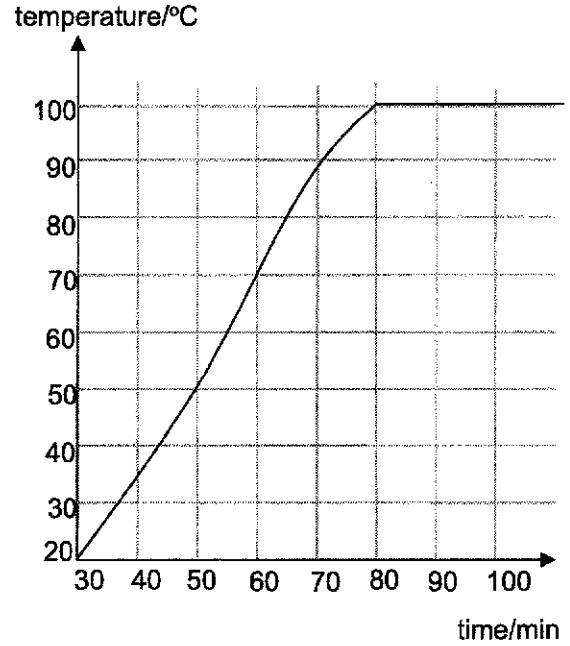
Fig. 13.6

Fig. 13.7

(a) Calculate the thermal energy gained by the copper can from t = 30 min to t = 60 min.

thermal energy gained = ... [2]

(b) Calculate the thermal energy emitted by the heater from t = 30 min to t = 60 min if the voltmeter and the ammeter readings are 14.0 V and 4.5 A constantly throughout the whole experiment.

thermal energy emitted = ... [2]

[Turn over

24

(c) Calculate the specific heat capacity of water using the results in **(a)** and **(b)**.

specific heat capacity = ... [2]

(d) Explain why answer to **(c)** is higher than the actual value.

....

.... [1]

(e) Explain why the temperature does not change from 80 min onwards.

....

.... [1]

(f) Calculate the specific latent heat of steam.

specific latent heat = ... [2]

End of Paper

Answers to Paper 1

Qn	Ans	Explanation
1	B	
2	A	Latent heat is the amount of energy absorbed or released during a phase change.
3	D	Calipers are needed to measure the diameter of the pipe. Tape is needed to measure the length as the pipe is several metres long.
4	A	Minimum value of R is 5N when the angle is 90°.
5	C	At terminal velocity, he is falling at constant velocity and zero acceleration.
6	C	Objects are subjected to the same gravitational acceleration (downwards) due to the earth's gravitational field.
7	B	Total distance / total time = 300 m / 250 s = 1.2 m/s
8	B	Since resultant force is zero, forces are balanced.
9	C	Inertia is only dependent on mass. The higher the mass, the larger the inertia.
10	C	Density is the same as both cylinders are of the same material (iron).
11	B	Work done = 15 x 7 = 105 J Since E_k = 105 J ½ x 5 x v² = 105 v = 6.48 m/s
12	C	The motor with the highest efficiency is the one which converts electrical energy into the most amount of useful energy (mechanical energy).
13	C	The lower the centre of gravity, the more stable the object. When the C.G. is below the top of the rod and when there is any slight displacement, the moment of the weight will cause the object to return to its original position.
14	C	$(100 - x)$ x 1.2 = 1 x x x = 54.5 cm
15	D	Input pressure is equal to output pressure in a hydraulic system.
16	B	(0.9 – 0.14) x 10 x 13600 = 103 360 Pa
17	B	Pressure in liquid depends on depth and not base area
18	D	Air molecules constantly collide with the smoke particles. Thus, the smoke particles keep moving in a random direction.
19	C	$(x – 25) / (38 – 25) = (100 – 0) / (28 – 0)$ x = 71.4 Ω
20	D	With lower temperature, the particles have lower kinetic energy.
21	A	Dull on the outside can absorb radiation at a faster rate and shiny on the inside can reflect the radiation to reduce the rate of loss of thermal energy to the surrounding.
22	C	Image in plane mirrors is formed by more than 2 rays. We normally draw 2 rays to locate the position of the image behind the mirror.
23	D	

24	A	
25	A	Light refracts away from the normal (drawn 90° to the boundary between 2 media) when it enters air and refracts towards the normal when it enters water.
26	C	As object moves towards the lens, the image moves further away from the lens. As object moves upwards, the image moves downwards.
27	C	Increasing frequency = decreasing wavelength. Hence the wavelength furthest from the source P must be longer than wavelength nearest to the source P.
28	A	
29	B	3 complete waves with total length 12.0 m
30	B	Some electrons in plate are repelled to the Earth until the metal plate is positively charged
31	D	X and Y must have the same charge to experience a repulsion. X and Z either have opposite charge or Z is uncharged to experience an attraction.
32	C	V = WD / Q WD = V × Q = 0.50 V × 4.0 C = 2.0 J
33	B	Y is twice as thick = cross sectional of Y is 4 times bigger, resistance of Y is 4 times smaller than X's. Y is four times longer, resistance of Y is 4 times larger than X's. Thus resistance of X is same as resistance of Y.
34	C	
35	C	Effective resistance in parallel = 2.0 Ω Total resistance = 3.0 Ω Current = 12 V / 3.0 Ω = 4.0 A
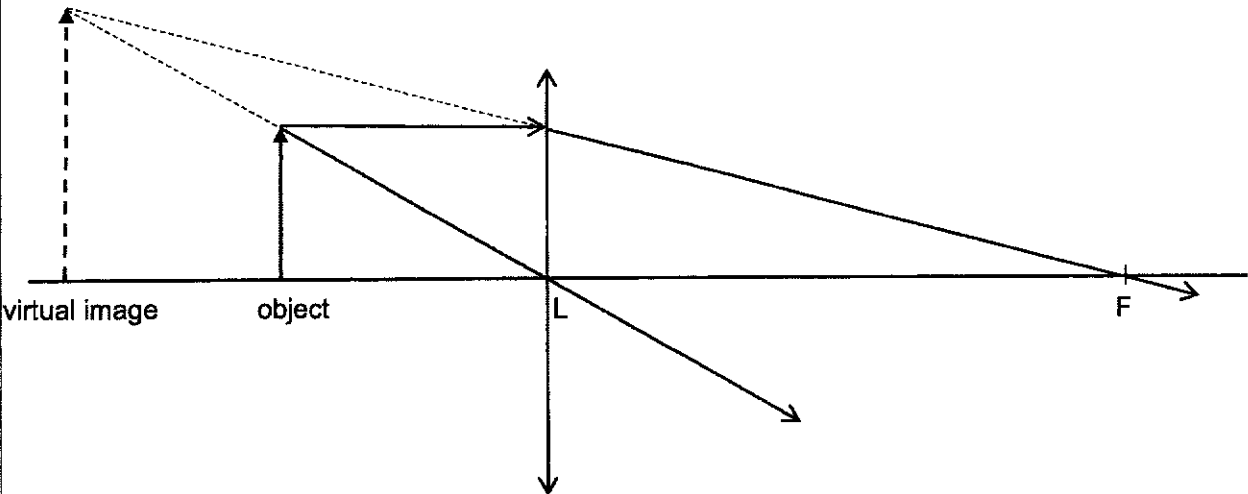
[Turn over

36	D	Increase in temperature will cause resistance of thermistor to decrease. In A, voltmeter measures emf of cell and reading is constant. In B and C, voltmeter reading will increase because p.d. across thermistor will decrease. In D, voltmeter reading will decrease because p.d. across thermistor will decrease.
37	A	Total energy used = (0.060 kW × 20 h) + (0.150 kW × 0.5 h) + (0.250 kW × 24 × 7 h) = 43.28 kWh Total cost = 43.28 kWh × $0.25/kWh = $10.82
38	B	Earth wire is connected to both metal casing and live terminal, not to Earth terminal. Hence the metal casing is at high voltage but no current will flow in the Earth wire since it is an open circuit until a user touches the casing. Normal current will still flow between live and neutral wire. So appliance will continue to work.
39	D	Current that exceeds the fuse rating will melt the fuse when it is placed in either live or neutral wire. This will stop current flowing in both wires. The fuse prevents appliances from overheating if current is too high which is not the function of the plastic casing.
40	C	Do not use Fleming's Left Hand Rule because the field is not a magnetic field but an electric field. Positive charges will move upwards.

Answers:

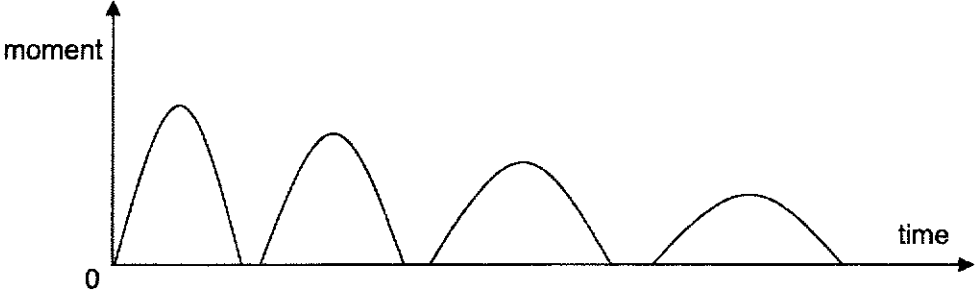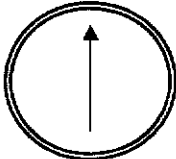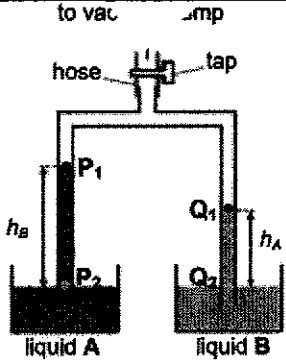| 1	(a)	1.6 × 1.5 [1] 2.4 m / s [1]
	(b)	2.4 marked on y-axis and straight line from (0, 0) to (1.5, 2.4) [1]
	(c)	0.5 x 2.4 x 1.5 or area under the graph mentioned / attempted [1] 1.8 m [1]
2	(a)	Weight drawn at the center of the block Q **and** labelled W [1]
	(b)	Q rotate clockwise [1] Due to clockwise moment about O due to the weight of Q. [1]
	(c)	For Q to be in equilibrium, taking moment about O, Total clockwise moment = total anti-clockwise moment 0.8 x F = 6 x 0.4 [1] F = 3.0 N [1]
3	(a)	Fig. 10.1 is safer [1] The centre of gravity of the flask is above the base or line of action of the weight of the set up passes through the base. [1]
	(b)	The weight of the drawer creates a clockwise moment that may topple the cabinet. / the centre of gravity may shift towards the right when the drawer is open. [1] Thus, by limiting the number of drawers to be opened will prevent the weight from being too big which cause a large clockwise moment. / prevent the shift of centre of gravity to be too far right and cause a large clockwise moment to topple the cabinets.[1]
4	(a)	g.p.e. = 90 × 10 × 0.60 [1] = 540 J [1]
	(b)	W.D. = 290 x 2.0 [1] = 580 J [1]
	(c)	work done against friction [1]
5	(a)	any two from: [2] only occurs at the surface / no bubbles produced occurs at any temperature produces cooling
	(b)	fast(est) molecules / molecules with great(est kinetic) energy escape [1] or slow(est) molecules / molecules with small(est kinetic) energy remain (average) speed of remaining molecules decreases [1] or molecules gain (kinetic) energy and escape
	(c)	(i)	rate of evaporation increases (with increasing area) [1]
		(ii)	rate of evaporation decreases with decreasing temperature or takes too much time [1]
6	(a)	refractive index = sin 90° / sin 42° = 1.49 [1 + 1] sin 15° / sin r = 1.49 r = 10.0° [1]
	(b)	The angle of incidence at surface B is equal to the angle of refraction at surface A. [1] The angle of incidence at surface A will not be bigger than 90° thus angle of refraction at surface A is less critical angle. [1]

[Turn over

	(c)	(i)	Friction due to rubbing removes some electrons from surface of the glass block (and transfer to the cloth). [1]
		(ii)	Place near a fire / flame [1] The flame will ionise the air particles in the air. Negative ions will be attracted to the positively charged area and neutralise it. [1]

7	Less degradation of signal during transmission [1] multiple signals can be sent at the same time [1]

8	
(a)	See above. Correct two rays with arrows and dotted construction lines drawn. [1] Correct position and label of lens L. [1] Correct position and label of focal point F. [1]
(b)	Image size decreases until it is the same size as object at 2.0f. [1]

27
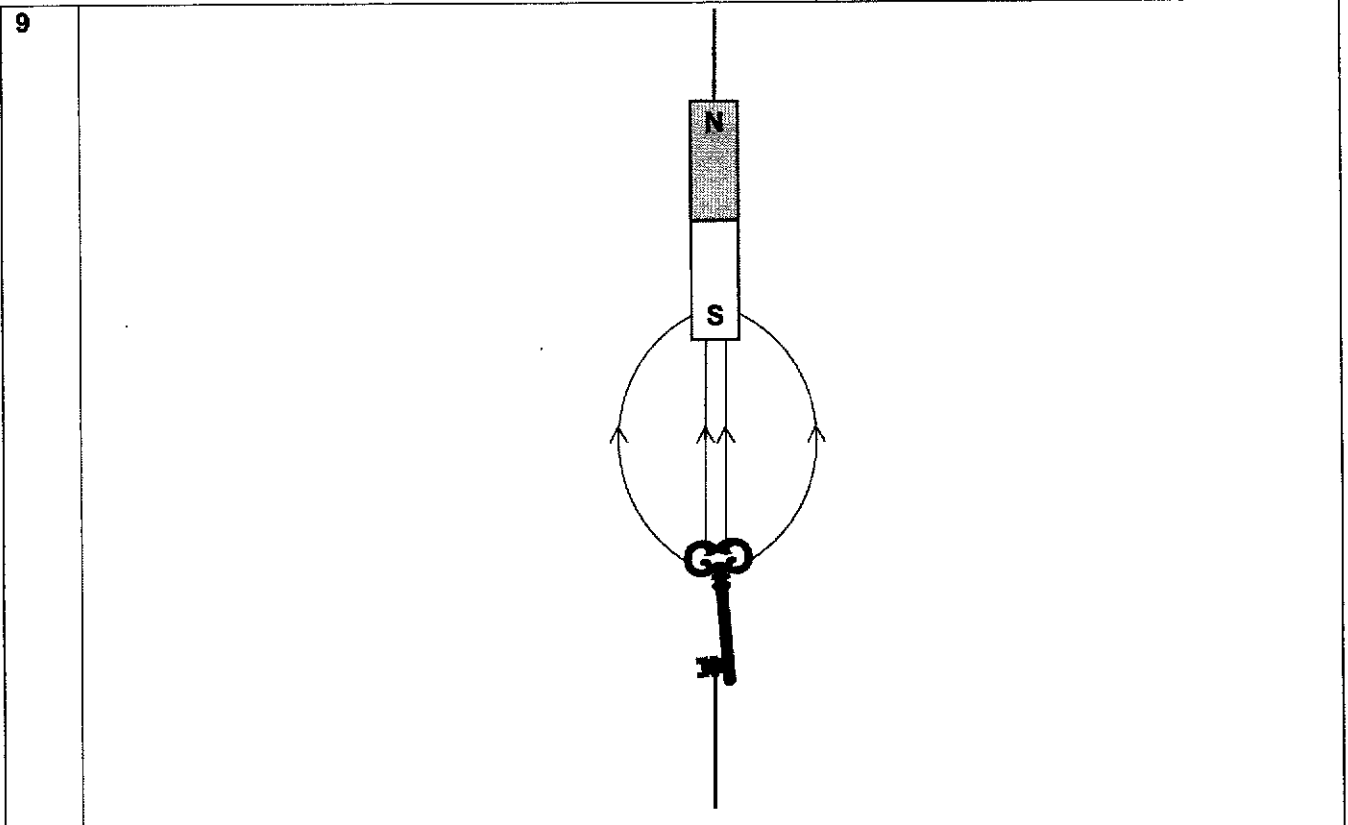
9		
	(a)	The process where a magnetic material becomes a magnet when it is placed close to or in contact with a magnet. [1]
	(b)	See above. Correct shape with minimal 2 straight field lines and 2 curve field lines [1] and correct direction [1]
	(c)	The force that the key acts on Earth [1] Direction of the force is acting upwards / opposite to its weight Magnitude is the same as its weight [1]
	(d)	The key will drop to the ground / not attracted by the magnet. [1] The iron sheet shield the surrounding from the magnetic field of the magnet or magnetic field lines are concentrated within the iron foil. [1]
10	**(a)**	Down [1]
	(b)	**(i)** When the coil is vertical, there is no contact between brushes and split ring. There is no current in the coil. [1]

		(ii)	 Decreasing amplitude [1] increasing period of rotation [1] Short period of time with no moments must be present.
11	**(a)**		Ratio of the p.d. across the resistor to the current flowing through it. [1]
	(b)	**(i)**	from 0.20 V to 0.80 V, current increases at a uniform rate [1] from 1.00 V to 1.60 V, current increases at a decreasing rate [1]
		(ii)	power = current × voltage = (0.20 A + 0.10 A) × 2.0 V [1] = 0.60 W [1]
		(ii)	resistance = p.d. / current = p.d. across resistor / current through resistor = [2.0 V - 0.20 V] / [0.10 A + 0.20 A] [1] = 6.0 Ω [1]
	(c)		Initial voltmeter reading is 2.0 V [1] The voltmeter reading will decrease [1]
	(d)		[1]
12	**(a)**		Both level of liquid rise up.[1] This is due to the difference between the atmospheric pressure and the pressure of the trapped gas above the liquid in the tube.[1]
	(b)		The difference in density of the liquid A and B.[1]
	(c)	**(i)**	 P1 with Q1 or P2 with Q2[1]

		(ii)	For P1Q1, gas pressure acts equally at all points of the tubes. [1] or For P2Q2, Both points are at the same level as the liquid surface of the tanks containing liquid A and B. Thus, since the liquid surface of the tank experiences atmospheric pressure, P2 and Q2 will also experience atmospheric pressure.
	(d)		Ratio = 75 / 69 [1] = 0.92 [1]
	(e)	(i)	Liquid are not compressible. [1] Pressure is transmitted equally throughout an enclosed liquid. [1]
		(ii)	Water evaporates easily. [1] or Water cause rusting or Water tension may cause air bubbles.

13	EITHER		
	(a)		Sound of frequency higher than 20 kHz [1] Use to check on health of foetus. [1]
	(b)		The energy is lower at Y because as sound propagates, it diverges and the energy at Y is lower. [1]
	(c)		frequency: remains the same speed: increases wavelength: increases all correct [2] two correct [1]
	(d)		Radio waves or microwaves [1]
	(e)	(i)	They obey laws of reflection or obey laws of refraction or they carry no electric charge [1 + 1]
		(ii)	frequency = 1 / 2 min = 1 / 120 s = 0.00833 s speed = 1.5 km / h = 0.417 m/s [both 1] wavelength = speed / frequency = 50 m [1]
13	OR		
	(a)		Q_{copper} = mcT = 400 x 0.18 x (70 – 20) [1] = 3600 J [1]
	(b)		Energy = VIt = 14 x 4.5 x 30 x 60 [1] = 1.13×10^5 J [1]
	(c)		Q_{Total} = Q_{water} + Q_{copper} Q_{water} = 1.13×10^5 + 3600 [1]

[Turn over

30

		$(350)(c_{water})(70 - 20)$ = 109 800 = $6.27 \ J \ / \ (g \ °C)$ [1]
	(d)	Thermal energy lost to the surrounding is not being accounted for. [1]
	(e)	It reaches boiling point of water. [1]
	(f)	m_{steam} = 976 – 960 = 16g Q_{total} = ml_v $(14)(14.5)(20 \times 60)$ = $16 \times l_v$ l_v = 4725 J/g