| Name | Register Number | Class |
|---|---|---|
| | | |

# MACPHERSON SECONDARY SCHOOL

**SCIENCE (PHYSICS/CHEMISTRY)** **5076/1**
**SCIENCE (PHYSICS/BIOLOGY)** **5077/1**
PAPER 1 Multiple Choice
**AUGUST 2016** **1 hour**

**PRELIMINARY EXAMINATION**
**SECONDARY FOUR EXPRESS / FIVE NORMAL (ACADEMIC)**

**READ THESE INSTRUCTIONS FIRST**

**Do not open this booklet until you are told to do so.**

Write your name, class and register number on top of this page and on any separate answer paper used.

There are twenty questions in 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.

Any rough working should be done in this booklet.

Take g = 10 m/s$^2$ and weight of 1 kg mass = 10 N

**At the end of the examination :**
Hand in the Optical Mark Sheet separately.





**1** The following statements are about motion.

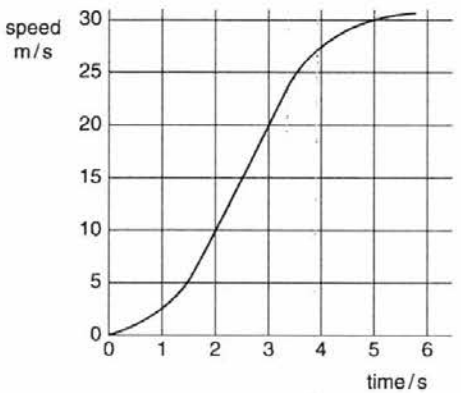
**(I)** A plane flies due North for 500 km.
**(II)** A runner's average speed in a race around a track is 5 m/s.
**(III)** A caterpillar crawls at 5 mm/s in a straight line towards a leaf.
**(IV)** A tourist travels 500 km on a journey.

Which statements describe vector quantities?

**A** **(I)** and **(II)**
**B** **(I)** and **(III)**
**C** **(II)** and **(III)**
**D** **(II)** and **(IV)**

**2** The graph shows the speed of a car as it accelerates from rest.

During part of this time the acceleration is uniform.




What is the size of this uniform acceleration?

**A** 5 m/s$^2$
**B** 6 m/s$^2$
**C** 10 m/s$^2$
**D** 20 m/s$^2$

3 A steel ball is released just below the surface of thick oil in a cylinder.

During the first few centimetres of travel, what is the acceleration of the ball?

A constant and equal to 10 $m/s^2$

B constant but less than 10 $m/s^2$

C decreasing

D increasing

4 What apparatus is needed to determine the density of a regularly-shaped block?

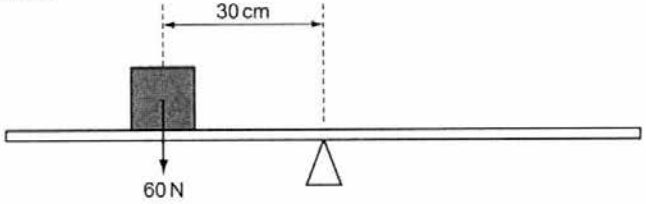
A a balance and a ruler

B a balance and a weighing scale

C a measuring cylinder and a ruler

D a measuring cylinder and a beaker

5 A uniform beam is balanced at its midpoint. An object is placed on the beam, as shown.




Which force will rebalance the beam?

A 30 N acting upwards, 60 cm to the left of the midpoint

B 30 N acting upwards, 60 cm to the right of the midpoint

C 45 N acting downwards, 45 cm to the right of the midpoint

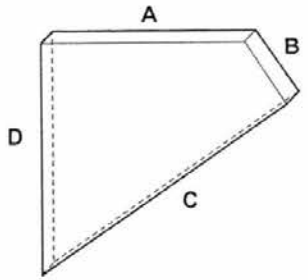
D 90 N acting downwards, 20 cm to the left of the midpoint





6 The diagram shows a thick sheet of glass.

Which edge must it stand on to cause the greatest pressure?




7 A worker is lifting boxes of identical weight from the ground onto a moving belt. At first, it takes him 2 s to lift each box. Later in the day, it takes him 3 s.

Which statement is correct?

A Later in the day, less work is done in lifting each box.

B Later in the day, more work is done in lifting each box.

C Later in the day, less power is developed in lifting each box.

D Later in the day, more power is developed in lifting each box.

8 What happens to the molecules when the temperature of a gas rises at constant volume?

A The molecules expand and the gas becomes less dense.

B The molecules move closer together.

C The molecules move with greater average speed.

D The molecules exert smaller forces on one another as they collide more often.

9 A rod of metal is heated at one end.

Which statement best describes the conduction of heat through the metal?

A Atoms move from the hot end and hit electrons at the cold end.
B Atoms vibrate and hit atoms at the cold end.
C Free electrons move from the hot end and hit atoms further along the rod.
D Free electrons vibrate and pass energy to free electrons further along the rod.

10 Bubbles are seen forming rapidly in water and the temperature of the water remains constant.

Which of the following statements best describe what happens?

A The particles of the water are moving further apart.
B The particles of the water are moving faster.
C The particles of the water are moving faster and further apart.
D The particles of the water are moving slower and closer together.

11 Which is the best description of the speed of a water wave?

A the distance between one wave crest and the next
B the distance between the crest of a wave and a trough
C the distance that a particle of water moves up and down in one second
D the distance that a wavefront moves along the surface in one second

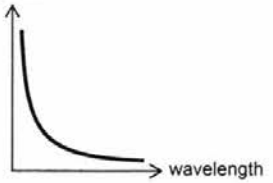
12 What causes refraction when light travels from air into glass?

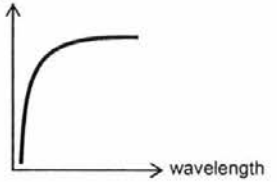
A The amplitude of the light waves changes.
B The colour of the light changes.
C The frequency of the light waves changes.
D The speed of the light changes.

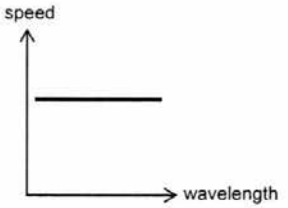


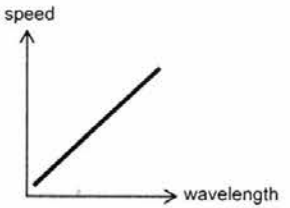


13 Which of the following shows the relationship between the speed and the wavelength of the electromagnetic waves in vacuum?

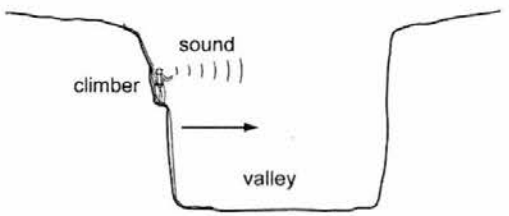
A



B



C



D



14 To estimate the width of a valley, a climber starts a stopwatch as he shouts. He hears an echo from the opposite side of the valley after 1.0 s.




The sound travels at 340 m/s.

What is the width of the valley?

A 85 m B 170 m C 340 m D 680 m

**15** A polythene rod repels an inflated balloon hanging from a nylon thread.

What charges must the rod and the balloon carry?

**A** The rod and the balloon carry opposite charges.

**B** The rod and the balloon carry like charges.

**C** The rod is charged but the balloon is not.

**D** The balloon is charged but the rod is not.

**16** Which of the following is equivalent to one coulomb?

**A** one ampere second

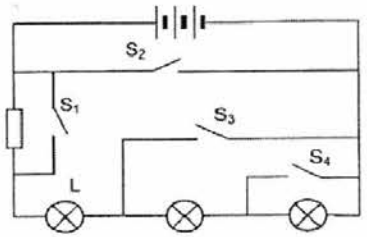
**B** one ampere per volt

**C** one volt ampere

**D** one volt per ampere

**17** In the circuit diagram below, there are four switches.

Assuming none of the lamps will 'blow', which switches must be closed in order for lamp **L** to be as bright as possible?




**A** $S_1$ and $S_2$

**B** $S_2$ and $S_3$

**C** $S_2$ and $S_4$

**D** $S_1$ and $S_3$





**18** The power of an electric iron is 1.2 kW.

What is the maximum quantity of energy, in joules, that can be transformed by the iron in one hour?

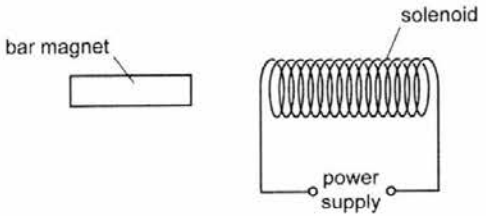
**A** 72 J

**B** 4320 J

**C** 72 000 J

**D** 4 320 000 J

**19** A solenoid carrying a current is used to demagnetise a bar magnet.

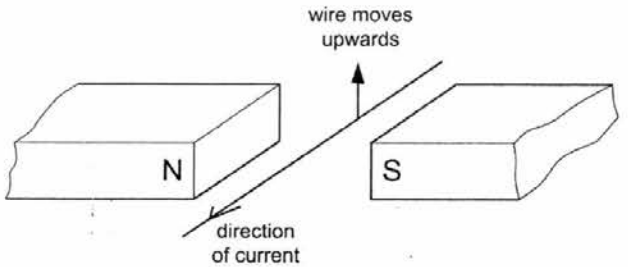



Which conditions achieve demagnetisation?

| | current through solenoid | movement of bar magnet |
|---|---|---|
| **A** | a.c. | around the solenoid quickly |
| **B** | a.c. | through the solenoid slowly |
| **C** | d.c. | around the solenoid quickly |
| **D** | d.c. | through the solenoid slowly |

**20** A student carries out an experiment to see the effect of a magnetic field on a wire carrying a current.

The wire moves upwards as shown.




What should the student do to make the wire move downwards?

**A** change the direction of the current

**B** move the poles of the magnet closer together

**C** send a smaller current through the wire

**D** use a stronger magnet

| Name | Register Number | Class |
|---|---|---|
| | | |

# MACPHERSON SECONDARY SCHOOL

**SCIENCE (PHYSICS/CHEMISTRY)** **5076/2**
**SCIENCE (PHYSICS/BIOLOGY)** **5077/2**
PAPER 2 PHYSICS
**AUGUST 2016** 1 hour 15 minutes

**PRELIMINARY EXAMINATION 2**
**SECONDARY FOUR EXPRESS / FIVE NORMAL (ACADEMIC)**

**READ THESE INSTRUCTIONS FIRST**

**Do not open this booklet until you are told to do so.**

Write your name, class and register number on top of this page and on any separate answer paper used.

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

**Section B**
Answer any two questions.
Write your answers in the spaces provided.
At the end of the examination,
1. fasten all separate answer paper (if any) securely to the answer booklet;
2. enter the numbers of the Section B questions you have answered on the answer booklet.

Take g = 10 m/s$^2$ and weight of 1 kg mass = 10 N

**At the end of the examination :**
Fasten any separate answer paper used securely to the question paper.

| For Examiner's Use | | |
|---|---|---|
| Section A | | |
| Section B | | |
| | | |
| TOTAL | | |

This question paper consists of **15** printed pages including this page.

**[Turn over**



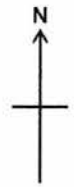
## Section A (45 Marks)

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

**1** A journey consists of two displacements: the first is 500 m in a northerly direction and the second is 200 m in an easterly direction.

**(a)** In the space below draw, to scale, a vector diagram of these displacements.

State the scale of your diagram.
On your diagram, show the two displacements and the resultant displacement.
Determine the size (magnitude) and direction of the resultant displacement.




scale = .....

size = .....

direction = ..... [3]

**(b)** Another journey covers a distance of 700 m. Describe how it is possible that this journey has no resultant displacement.

.....

..... [1]

2 A rock from space is travelling in a straight line at high speed when it enters the Earth's atmosphere. Fig. 2.1 is the speed-time graph for the rock from time $t = 0$ to time $t = 50$ s.

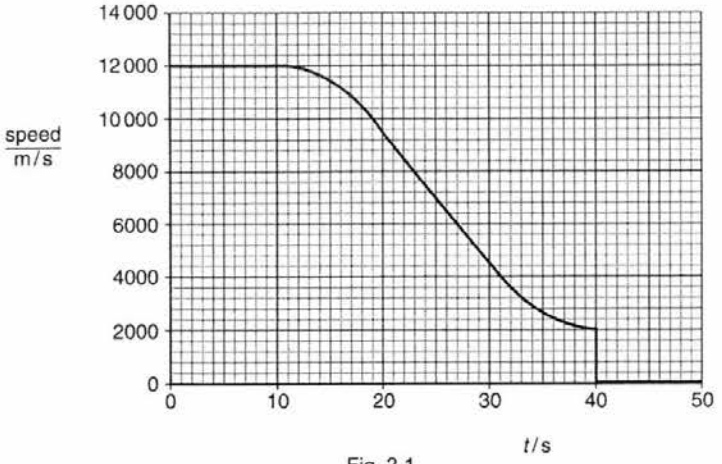



Fig. 2.1

**(a)** On Fig. 2.1, mark

- a letter **X**, where the rock is moving with a constant speed,
- a letter **Y**, where the rock has a uniform deceleration,
- a letter **Z**, where the rock has a non-uniform deceleration. [3]

**(b)** At time $t = 25$ s, the mass of the rock is 8.4 kg.
For the time $t = 25$ s, determine

**(i)** the size of the acceleration of the rock,

acceleration = ..... [2]

**(ii)** the size of the resultant force on the rock.

force = ..... [2]





3 Fig. 3.1 shows a device for punching holes in a piece of paper. A person applies a force $F$ at the end of the arm. Just before the hole is made in the paper, the arm is at rest.

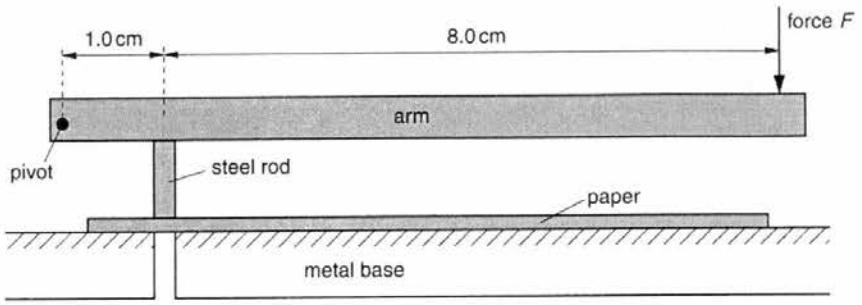



Fig. 3.1

**(a)** Just before the hole is made, the force upwards on the steel rod is 7.2 N.

Calculate the value of F. Use the distances marked on Fig. 3.1.

F = ..... [2]

**(b)** The steel rod pushes the paper into the hole in the metal base with a force of 7.2 N.

The end of the steel rod has an area of $2.8 \times 10^{-5}$ m$^2$.

Calculate the pressure exerted on the paper.
State the formula that you use in your calculation.

pressure = ..... [2]

4 Fig. 4.1 shows a girl standing in front of a shop window made of thick glass. The front surface **A** of the glass and the back surface **B** are marked. She sees the reflection of her shoes in surface **A**.

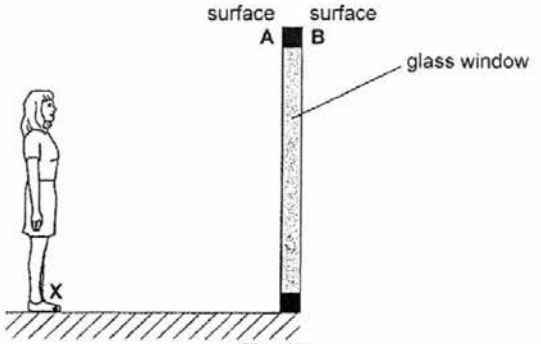



Fig. 4.1

**(a)** **(i)** On Fig. 4.1, draw a ray of light from point **X**, reflected by surface **A**, to the girl's eye. [1]

**(ii)** On Fig. 4.1, mark the angle of incidence of the ray at surface **A**. Label this angle **i**. [1]

**(b)** Only some of the light is reflected by surface **A**. Most of the light refracts into the glass. Fig. 4.2 shows a ray of light in air, before it enters the glass. A protractor is also shown.

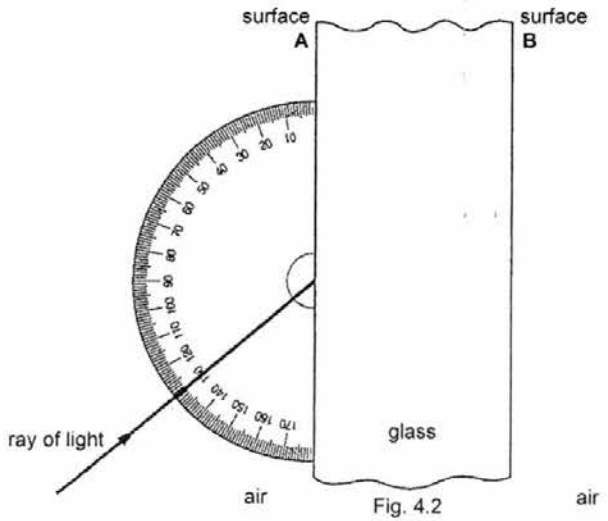



Fig. 4.2

The refractive index of the glass is 1.5.





**(i)** For the ray in Fig. 4.2, calculate the angle of refraction in the glass.

angle = ..... [3]

**(ii)** On Fig. 4.2, draw the ray of light as it passes through the glass and emerges into the air on the other side. [1]

5 The diagram below shows two small plastic spheres **P** and **Q** made from different materials.


Sphere **P** has a negative charge while sphere **Q** is uncharged. After rubbing sphere **Q** with a cloth, the two spheres are found to attract each other.

**(a)** Suggest why the two plastic spheres attract each other.

.....

.....

..... [2]

**(b)** 100 spheres **P**, each of charge 1 C, are moved between two points in 20 s.

Calculate the amount of current generated.

current = ..... [2]

6 A sound wave, travelling in air, approaches a solid barrier with a gap in the middle. Fig. 6.1 represents the compressions and rarefactions of the sound wave. The compressions are labelled **A**, **B** and **C**.

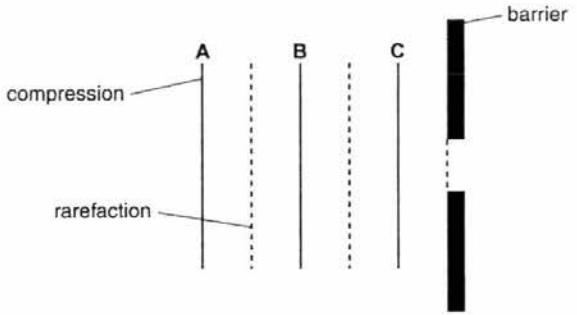



Fig. 6.1

**(a)** State how a compression differs from a rarefaction.

.....

..... [1]

**(b)** The speed of sound in air is 340 m/s. The frequency of the sound is 850 Hz.

For this wave, determine

**(i)** the wavelength,

wavelength = ..... [2]

**(ii)** the time that elapses before compression **A** reaches the barrier.

time = ..... [2]

**(c)** Sound waves can also travel in water.
State how the speed of sound in water compares with the speed of sound in air.

..... [1]





7 Fig. 7.1 shows an electrical circuit containing a 12 V power supply and a number of resistors.

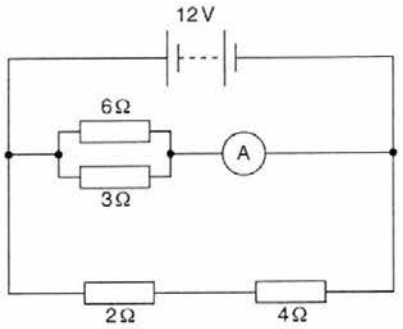



Fig. 7.1

**(a)** Calculate the combined resistance of

**(i)** the 2 Ω and 4 Ω resistors in series,

resistance = ..... [1]

**(ii)** the 3 Ω and 6 Ω resistors in parallel.

resistance = ..... [2]

**(b)** Calculate the reading of the ammeter in Fig. 7.1.

ammeter reading = ..... [2]

**(c)** Determine the potential difference across the 4 Ω resistor.

p.d. = ..... [2]

8 Fig. 8.1 shows a coil of wire wrapped around a plastic tube. Inside the tube are two pieces of soft iron. When the switch is closed, the compass needles point in the direction of the magnetic field produced at each position. You may ignore the magnetic field of the Earth in this question.

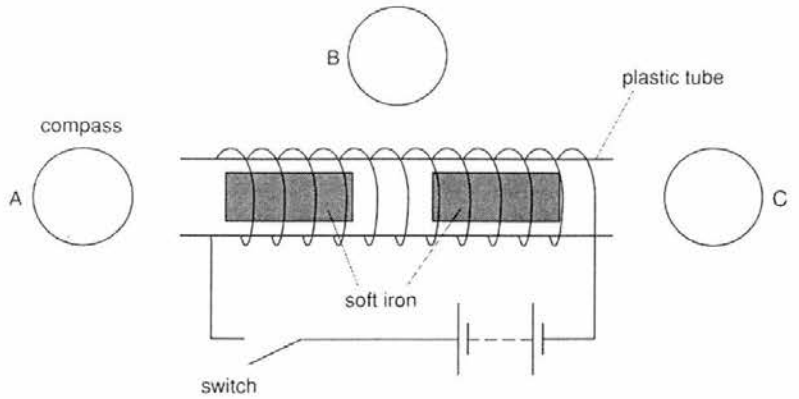



Fig. 8.1

**(a)** On Fig. 8.1 mark arrows, in compasses **A**, **B** and **C**, to show the direction of the magnetic field at each position after the switch has been closed. [2]

**(b)** When the switch is closed, the two pieces of soft iron in the tube become magnets and move.

**(i)** On Fig. 8.1, mark the poles formed on each piece of soft iron. [1]

**(ii)** State and explain how the pieces of iron move.

.....

.....

..... [2]

**(c)** State the effect on the magnetic field of

**(i)** reversing the direction of the current,

.....

..... [1]

**(ii)** reducing the size of the current.

.....

..... [1]





## Section B (20 Marks)

Answer any **two** questions from this section.

9 **(a)** Fig. 9.1 shows apparatus that demonstrates how a coin and a piece of paper fall from rest under gravity.

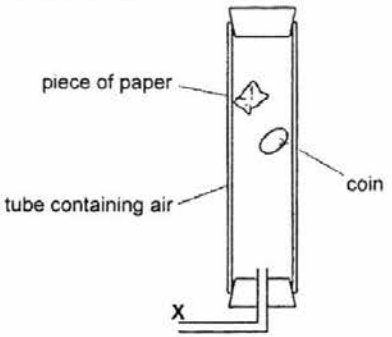



Fig. 9.1

**(i)** State the initial value of the acceleration of the coin as it falls from rest.

..... [1]

**(ii)** The coin and paper are at the positions shown in Fig. 9.1.

Explain, in terms of the forces acting, why

**(1)** the paper falls with constant speed,

.....

.....

..... [1]

**(2)** the coin still accelerates.

.....

.....

..... [1]

**(iii)** A vacuum pump is connected to **X** and the air in the tube is removed.
The coin and paper fall differently in a vacuum from the way they fall in air.

State two of these differences.

(1) .....

.....

(2) .....

..... [2]

**(b)** It is commonly said that oil floats on water "because it weighs less than water".

State what is meant by the terms "weight" and "density" and hence, rewrite the statement correctly.

.....

.....

.....[3]

**(c)** Calculate the volume of oil of density 800 kg/m$^3$ and mass 2240 g.

volume = ..... [2]





**10** A wind turbine uses a renewable energy source to generate electricity.

**(a)** State one disadvantage of using wind turbines to produce a high proportion of the electricity in Singapore.

.....

..... [1]

**(b)** Fig. 10.1 shows how the power output of a wind turbine varies with wind speed.

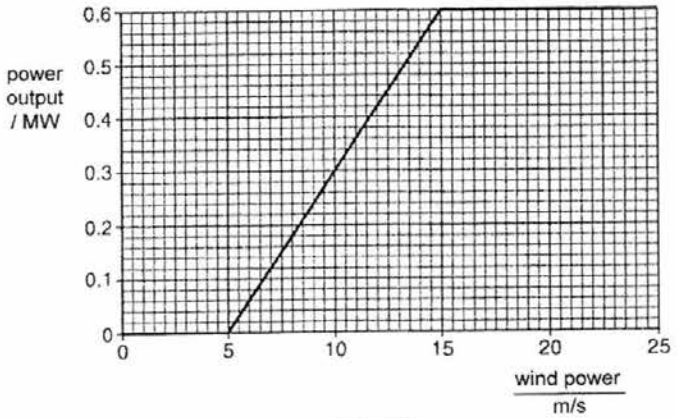



Fig. 10.1

**(i)** Using Fig. 10.1, describe how the power output varies with the wind speed.

.....

.....

.....

.....

..... [3]

**(ii)** The wind speed is recorded at one minute intervals, as shown in Fig. 10.2.

| time / min | wind speed / m/s |
|---|---|
| 0 | 2 |
| 1 | 3 |
| 2 | 16 |
| 3 | 16 |
| 4 | 0 |
| 5 | 10 |

Fig 10.2

Using the date in Fig. 10.1 and Fig. 10.2 to estimate the total energy produced in the five minute interval. Give your answer in joules.

energy = ..... J [3]

**(iii)** Explain why your answer to **(ii)** is only an estimate.

.....

..... [1]

**(c)** A wind turbine produces an alternating voltage of 600 V. Electric cables connect the wind turbine to houses some distance away.

Energy is wasted within the cables.

State and explain one method to reduce the amount of energy that is wasted.

.....

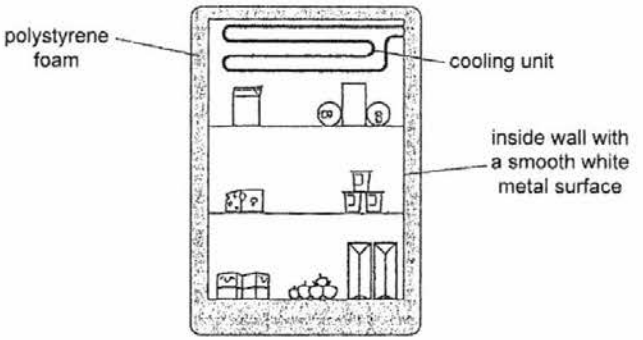
.....

..... [2]





**11** **(a)** The figure below shows a refrigerator. The refrigerator walls are made of smooth white metal with a layer of polystyrene foam between the inside and outside walls.




**(i)** Describe how polystyrene foam insulates the refrigerator.

.....

.....

.....

..... [2]

**(ii)** Explain how the cooling unit at the top cools all the contents of the refrigerator.

.....

.....

.....

.....

..... [2]

**(iii)** The inside wall radiates a small amount of thermal energy (infra-red radiation).

State how the colour of the surface affects the amount of energy radiated.

.....

..... [1]

**(b)** The ultra-violet region of the electromagnetic spectrum contains two sections, UVA and UVB. The wavelength range of UVA radiation is from 320 nm to 400 nm and the wavelength range of UVB radiation is from 280 nm to 320 nm.

**(i)** UVA radiation is used in sunbeds.
Suggest why the amount of ultra-violet radiation used is carefully limited.

.....

..... [1]

**(ii)** Calculate the lowest frequency of UVA and UVB radiation.
The speed of light is $3.0 \times 10^8$ m/s.

UVA frequency = .....

UVB frequency = ..... [3]

**(iii)** State the name of another region of the electromagnetic spectrum with a frequency higher than that of UVB radiation.

..... [1]

## 2016 Sec 4 Express / 5 N(A) Prelim 2 Paper 1 Answer Key

| | |
|---|---|
| 1. | B |
| 2. | C |
| 3. | C |
| 4. | A |
| 5. | A |
| 6. | B |
| 7. | C |
| 8. | C |
| 9. | C |
| 10. | A |
| 11. | D |
| 12. | D |
| 13. | C |
| 14. | B |
| 15. | B |
| 16. | A |
| 17. | D |
| 18. | D |
| 19. | B |
| 20. | A |



## Section A (45 Marks)

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

1 A journey consists of two displacements: the first is 500 m in a northerly direction and the second is 200 m in an easterly direction.

**(a)** In the space below draw, to scale, a vector diagram of these displacements.

State the scale of your diagram.
On your diagram, show the two displacements and the resultant displacement.
Determine the size (magnitude) and direction of the resultant displacement.


- components shown on correct diagram with correct resultant (i.e. towards NE) and a scale given
- 540 (±10) m
- 22° ± 3° E of N with correct diagonal

scale = .....

size = .....

direction = ..... [3]

**(b)** Another journey covers a distance of 700 m. Describe how it is possible that this journey has no resultant displacement.

The journey ends at the starting point, ie returns in opposite direction.

..... [1]

2 A rock from space is travelling in a straight line at high speed when it enters the Earth's atmosphere. Fig. 2.1 is the speed-time graph for the rock from time $t = 0$ to time $t = 50$ s.

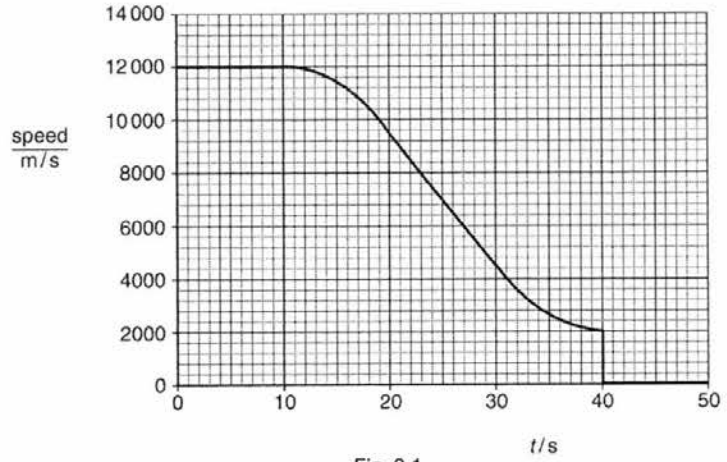



Fig. 2.1

**(a)** On Fig. 2.1, mark

- a letter **X**, where the rock is moving with a constant speed,
- a letter **Y**, where the rock has a uniform deceleration,
- a letter **Z**, where the rock has a non-uniform deceleration. [3]

1. X between t ≥0 and t < 10 s
2. Y between t > 20 s and t < 30 s
3. Z between t > 10 s and t < 20 s or between t > 30 s and t < 40 s

**(b)** At time $t = 25$ s, the mass of the rock is 8.4 kg.
For the time $t = 25$ s, determine

**(i)** the size of the acceleration of the rock,

selection of two values between 15 and 35 s,
$a = \Delta v / t = 500$ m/s$^2$

acceleration = ..... [2]

**(ii)** the size of the resultant force on the rock.

$F = ma = 8.4 \times 500 = 4200$ N

force = ..... [2]



3 Fig. 3.1 shows a device for punching holes in a piece of paper. A person applies a force $F$ at the end of the arm. Just before the hole is made in the paper, the arm is at rest.

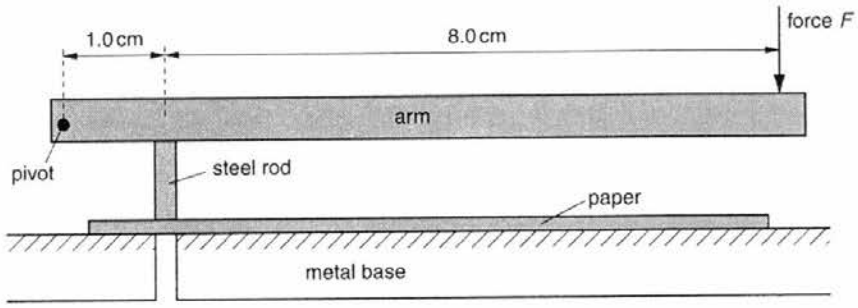



Fig. 3.1

**(a)** Just before the hole is made, the force upwards on the steel rod is 7.2 N.

Calculate the value of F. Use the distances marked on Fig. 3.1.

$7.2 \times 1 = F \times 9$

$F = 7.2 / 9 = 0.8$ N

F = ..... [2]

**(b)** The steel rod pushes the paper into the hole in the metal base with a force of 7.2 N.

The end of the steel rod has an area of $2.8 \times 10^{-5}$ m$^2$.

Calculate the pressure exerted on the paper.
State the formula that you use in your calculation.

P = F/A formula stated

$P = 7.2 / 2.8 \times 10^{-5} = 2.6 \times 10^5$ Pa ($2.57 \times 10^5$ Pa)

pressure = ..... [2]

4 Fig. 4.1 shows a girl standing in front of a shop window made of thick glass. The front surface **A** of the glass and the back surface **B** are marked. She sees the reflection of her shoes in surface **A**.

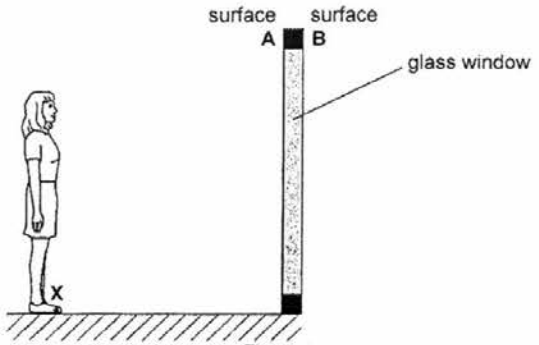
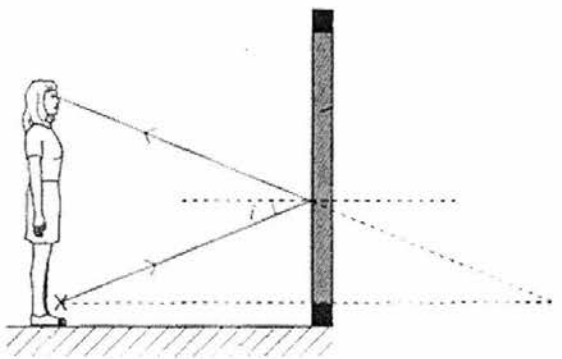



Fig. 4.1

**(a)** **(i)** On Fig. 4.1, draw a ray of light from point **X**, reflected by surface **A**, to the girl's eye. [1]

**(ii)** On Fig. 4.1, mark the angle of incidence of the ray at surface **A**. Label this angle **i**. [1]

(a) (i) and (ii)






**(b)** Only some of the light is reflected by surface **A**. Most of the light refracts into the glass. Fig. 4.2 shows a ray of light in air, before it enters the glass. A protractor is also shown.

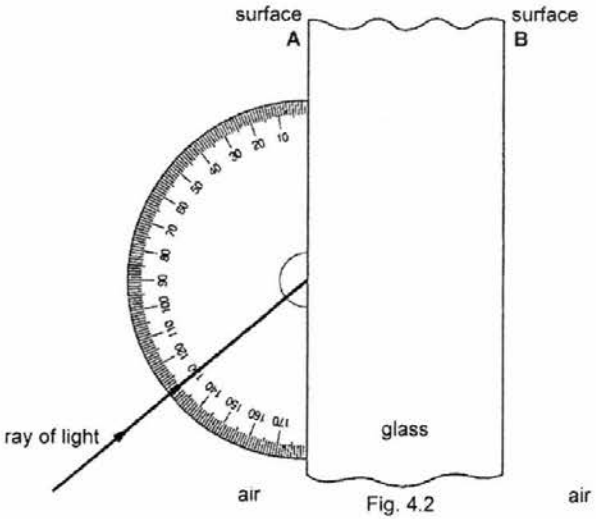



Fig. 4.2

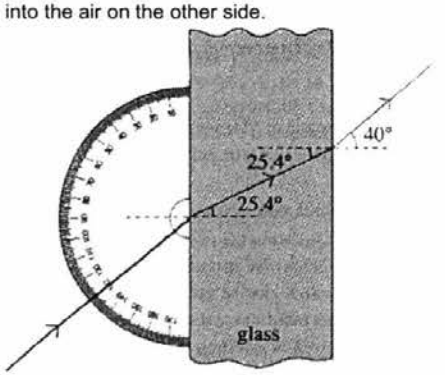
The refractive index of the glass is 1.5.

**(i)** For the ray in Fig. 4.2, calculate the angle of refraction in the glass.

measurement of i = 40°
n = sin i / sin r
sin r = sin 40° / 1.5
r = $\sin^{-1}$ (sin 40° / 1.5) = 25.4°

angle = ..... [3]

**(ii)** On Fig. 4.2, draw the ray of light as it passes through the glass and emerges into the air on the other side. [1]



5 The diagram below shows two small plastic spheres **P** and **Q** made from different materials.


Sphere **P** has a negative charge while sphere **Q** is uncharged. After rubbing sphere **Q** with a cloth, the two spheres are found to attract each other.

**(a)** Suggest why the two plastic spheres attract each other.

Q becomes positively charged after rubbing.
Unlike charges attract and thus the two spheres attract each other.
..... [2]

**(b)** 100 spheres **P**, each of charge 1 C, are moved between two points in 20 s.

Calculate the amount of current generated.

Current, I = Q / t
= (100 × 1) / 20
= 5 A

current = ..... [2]



6 A sound wave, travelling in air, approaches a solid barrier with a gap in the middle. Fig. 6.1 represents the compressions and rarefactions of the sound wave. The compressions are labelled **A**, **B** and **C**.

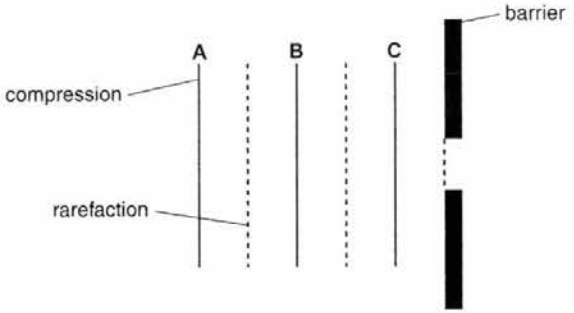



Fig. 6.1

**(a)** State how a compression differs from a rarefaction.

(in compressions) pressure higher or molecules / atoms / particles close(r) together / (more) tightly packed
..... [1]

**(b)** The speed of sound in air is 340 m/s. The frequency of the sound is 850 Hz.

For this wave, determine

**(i)** the wavelength,

$v = f \times \lambda$
$\lambda = v / f = 340 / 850 = 0.40$ m

wavelength = ..... [2]

**(ii)** the time that elapses before compression **A** reaches the barrier.

distance (of compression A from barrier) = $2.5 \times 0.40 = 1.0$ m
time (to reach barrier) = $1 / 340 = 2.9 \times 10^{-3}$ s or 2.9 ms

OR

$T = 1 / f = 1 / 850 = 1.2 \times 10^{-3}$
(moves 2.5 wavelengths:) time = $2.5 / 850 = 2.9 \times 10^{-3}$ s or 2.9 ms

time = ..... [2]

**(c)** Sound waves can also travel in water.
State how the speed of sound in water compares with the speed of sound in air.

speed in water greater or state that numerical value of speed is greater than 340 m/s
..... [1]

7 Fig. 7.1 shows an electrical circuit containing a 12 V power supply and a number of resistors.

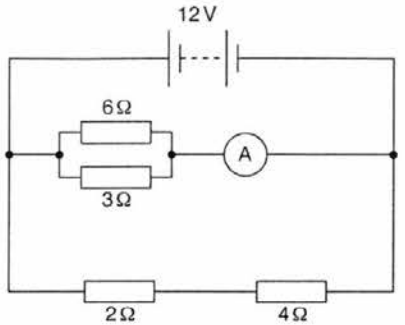



Fig. 7.1

**(a)** Calculate the combined resistance of

**(i)** the 2 Ω and 4 Ω resistors in series,

2 + 4 = 6 Ω

resistance = ..... [1]

**(ii)** the 3 Ω and 6 Ω resistors in parallel.

$1/R = 1/R_1 + 1/R_2$
R = 2 Ω

resistance = ..... [2]

**(b)** Calculate the reading of the ammeter in Fig. 7.1.

I = V/R = 6 A

ammeter reading = ..... [2]

**(c)** Determine the potential difference across the 4 Ω resistor.

I = V / R = 12 / 6 = 2 A
V = IR = 2 x 4 = 8 V

p.d. = ..... [2]



8 Fig. 8.1 shows a coil of wire wrapped around a plastic tube. Inside the tube are two pieces of soft iron. When the switch is closed, the compass needles point in the direction of the magnetic field produced at each position. You may ignore the magnetic field of the Earth in this question.

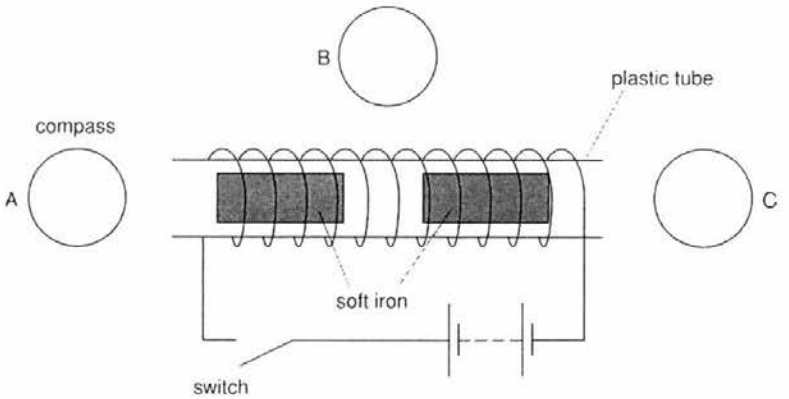



Fig. 8.1

**(a)** On Fig. 8.1 mark arrows, in compasses **A**, **B** and **C**, to show the direction of the magnetic field at each position after the switch has been closed. [2]

arrows in A and C to right
arrow in B to left [or right if both A and C to left]

**(b)** When the switch is closed, the two pieces of soft iron in the tube become magnets and move.

**(i)** On Fig. 8.1, mark the poles formed on each piece of soft iron. [1]

SNSN or [NSNS]

**(ii)** State and explain how the pieces of iron move.

Iron pieces attract / move together
attraction of opposite poles/unlike poles / S and N
..... [2]

**(c)** State the effect on the magnetic field of

**(i)** reversing the direction of the current,

opposite direction/reverses/poles change
..... [1]

**(ii)** reducing the size of the current.

weaker (field) or (iron) demagnetises
..... [1]

## Section B (20 Marks)

Answer any **two** questions from this section.

**9** **(a)** Fig. 9.1 shows apparatus that demonstrates how a coin and a piece of paper fall from rest under gravity.

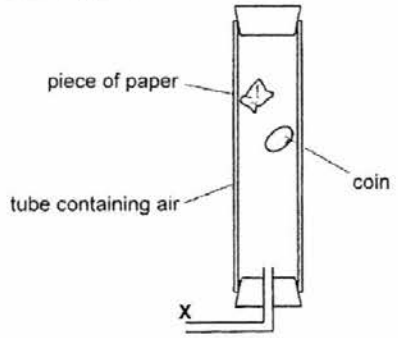



Fig. 9.1

**(i)** State the initial value of the acceleration of the coin as it falls from rest.

10 m/s$^2$

..... [1]

**(ii)** The coin and paper are at the positions shown in Fig. 9.1.

Explain, in terms of the forces acting, why

**(1)** the paper falls with constant speed,

At constant speed, the resultant force on the paper is 0 N as the magnitude of the paper's weight equals the magnitude of the force of air resistance.

..... [1]

**(2)** the coin still accelerates.

The weight of the coin is greater than the force of air resistance acting on it. Hence the coin still has a resultant downward force which causes it to accelerate downwards.

..... [1]



**(iii)** A vacuum pump is connected to **X** and the air in the tube is removed. The coin and paper fall differently in a vacuum from the way they fall in air.

State two of these differences.

(1) There is no air resistance acting on the coin and the paper and both will accelerate constantly at 10 m/s$^2$ downwards.

(2) Both the coin and the paper will reach the base of the tube at the same time regardless of their weight.

..... [2]

**(b)** It is commonly said that oil floats on water "because it weighs less than water".

State what is meant by the terms "weight" and "density" and hence, rewrite the statement correctly.

Weight is the gravitational force acting on an object whereas density is the mass per unit volume.
Oil floats on water because it is less dense than water.

.....[3]

**(c)** Calculate the volume of oil of density 800 kg/m$^3$ and mass 2240 g.

Density = mass / volume
Volume = mass / density
= 2.24 / 800 = 0.0028 m$^3$

volume = ..... [2]

**10** A wind turbine uses a renewable energy source to generate electricity.

**(a)** State one disadvantage of using wind turbines to produce a high proportion of the electricity in Singapore.

Wind cannot be controlled; hence it is an unreliable source of electrical energy.
Or If a high proportion of Singapore's electricity relies on wind turbines to generate electricity, if there are no winds, households, offices and industrial electrical supplies will be affected.

..... [1]

**(b)** Fig. 10.1 shows how the power output of a wind turbine varies with wind speed.

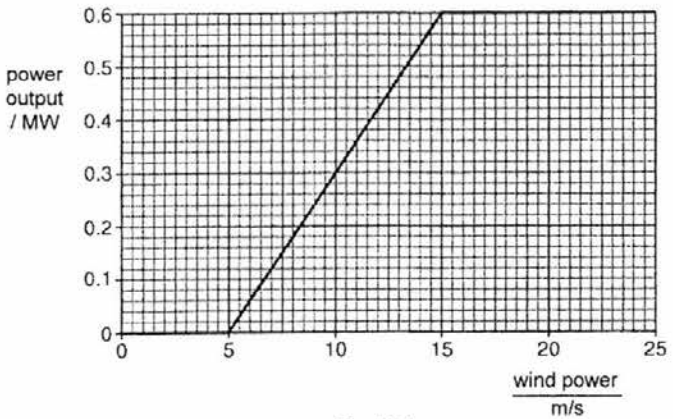



Fig. 10.1

**(i)** Using Fig. 10.1, describe how the power output varies with the wind speed.

For wind speeds of 0 m/s up to 5 m/s, the power output is 0 MW.
For wind speeds of 5 m/s to 15 m/s, the power output increases linearly from 0 MW for 5 m/s to 0.6 MW for l5 m/s.
For wind speeds of 15 m/s and higher, the power output remains constant at 0.6 MW.
Hence power output is maximum at 0.6 MW and remains unchanged for any further increase of wind speeds beyond 15 m/s.

..... [3]



**(ii)** The wind speed is recorded at one minute intervals, as shown in Fig. 10.2.

| time / min | wind speed / m/s |
|---|---|
| 0 | 2 |
| 1 | 3 |
| 2 | 16 |
| 3 | 16 |
| 4 | 0 |
| 5 | 10 |

Fig 10.2

Using the date in Fig. 10.1 and Fig. 10.2 to estimate the total energy produced in the five minute interval. Give your answer in joules.

Total energy = 0 + 0 + 36000000 + 36000000 + 0 + 18000000 = 90 000 000 J = **$9 \times 10^7$ J**

Explanation: When t = 0, wind speed = 2 m/s, power output = 0 MW → Energy = 0 J
When t = 1, wind speed = 3 m/s, power output = 0 MW → Energy = 0 J
When t = 2, wind speed = 16 m/s, power output = 0.6 MW → Energy = 36 000 000 J
When t = 3, wind speed = 16 m/s, power output = 0.6 MW → Energy = 36 000 000 J
When t = 4, wind speed = 0 m/s, power output = 0 MW → Energy = 0 J
When t = 5, wind speed = 10 m/s, power output = 0.3 MW → Energy = 18 000 000 J

energy = ..... J [3]

**(iii)** Explain why your answer to **(ii)** is only an estimate.

The calculations in (b)(ii) are based on the assumption that the wind speed is constant for the entire duration of the 5 minutes for each 1 min interval. However in real life, the wind speed can vary every second.

..... [1]

**(c)** A wind turbine produces an alternating voltage of 600 V. Electric cables connect the wind turbine to houses some distance away.

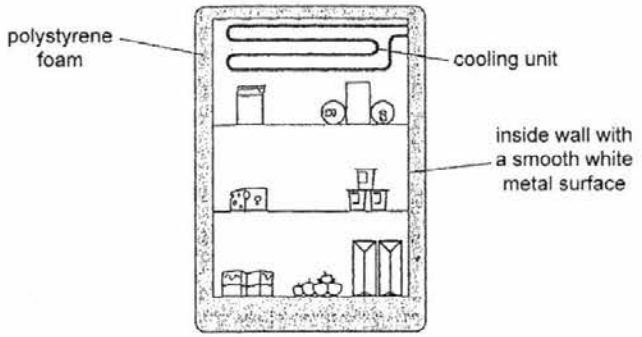
Energy is wasted within the cables.

State and explain one method to reduce the amount of energy that is wasted.

One method is to use thicker cables which have larger cross-sectional areas.
Since $R = \rho l/A$, R is inversely proportional to the cross-sectional area A, each thicker cable will have lower a resistance which will decrease the energy loss as heat.

..... [2]

11 (a) The figure below shows a refrigerator. The refrigerator walls are made of smooth white metal with a layer of polystyrene foam between the inside and outside walls.




**(i)** Describe how polystyrene foam insulates the refrigerator.

Polystyrene is a poor conductor of heat and is thus a good thermal insulating material.
The polystyrene walls will minimise the conduction of heat from the external surroundings into the refrigerator.
..... [2]

**(ii)** Explain how the cooling unit at the top cools all the contents of the refrigerator.

The air close to the cooling unit which has cooled down will sink down as the density of the air gets higher as the temperature drops; this will displace the less dense warm air which will rise up to the cooling unit.

Convection current is thus set up within the refrigerator.
..... [2]

**(iii)** The inside wall radiates a small amount of thermal energy (infra-red radiation).

State how the colour of the surface affects the amount of energy radiated.

White surfaces are poorer radiators and absorbers of heat from radiation compared to dark surfaces.
..... [1]



**(b)** The ultra-violet region of the electromagnetic spectrum contains two sections, UVA and UVB. The wavelength range of UVA radiation is from 320 nm to 400 nm and the wavelength range of UVB radiation is from 280 nm to 320 nm.

**(i)** UVA radiation is used in sunbeds.
Suggest why the amount of ultra-violet radiation used is carefully limited.

Ultra-violet radiation in large amount can cause skin cancer.
..... [1]

**(ii)** Calculate the lowest frequency of UVA and UVB radiation.
The speed of light is $3.0 \times 10^8$ m/s.

lowest frequency → longest wavelength

For UVA, $f = v / \lambda = 3.0 \times 10^8 / 400 \times 10^{-9} = \underline{7.50 \times 10^{14}\ Hz}$

For UVB, $f = v / \lambda = 3.0 \times 10^8 / 320 \times 10^{-9} = \underline{9.40 \times 10^{14}\ Hz}$

UVA frequency = .....

UVB frequency = ..... [3]

**(iii)** State the name of another region of the electromagnetic spectrum with a frequency higher than that of UVB radiation.

gamma rays
..... [1]