OCR

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Thursday 19 June 2014 – Afternoon

GCSE GATEWAY SCIENCE
PHYSICS B

B752/02 Physics modules P4, P5, P6 (Higher Tier)

Candidates answer on the Question Paper.
A calculator may be used for this paper.

OCR supplied materials:
None

Other materials required:
- Pencil
- Ruler (cm/mm)

Duration: 1 hour 30 minutes

B752/02

12670543 09

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- The quality of written communication is assessed in questions marked with a pencil (✎).
- A list of equations can be found on page 2.
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **85**.
- This document consists of **32** pages. Any blank pages are indicated.

EQUATIONS

energy = mass × specific heat capacity × temperature change

energy = mass × specific latent heat

$$\text{efficiency} = \frac{\text{useful energy output } (\times 100\%)}{\text{total energy input}}$$

wave speed = frequency × wavelength

power = voltage × current

energy supplied = power × time

$$\text{average speed} = \frac{\text{distance}}{\text{time}}$$

distance = average speed × time

$$s = \frac{(u + v)}{2} \times t$$

$$\text{acceleration} = \frac{\text{change in speed}}{\text{time taken}}$$

force = mass × acceleration

weight = mass × gravitational field strength

work done = force × distance

$$\text{power} = \frac{\text{work done}}{\text{time}}$$

power = force × speed

$$KE = \frac{1}{2}mv^2$$

momentum = mass × velocity

$$\text{force} = \frac{\text{change in momentum}}{\text{time}}$$

GPE = mgh

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

$v = u + at$

$v^2 = u^2 + 2as$

$s = ut + \frac{1}{2}at^2$

$m_1u_1 + m_2u_2 = (m_1 + m_2)v$

$$\text{refractive index} = \frac{\text{speed of light in vacuum}}{\text{speed of light in medium}}$$

$$\text{magnification} = \frac{\text{image size}}{\text{object size}}$$

$I_e = I_b + I_c$

$$\frac{\text{voltage across primary coil}}{\text{voltage across secondary coil}} = \frac{\text{number of primary turns}}{\text{number of secondary turns}}$$

power loss = $(\text{current})^2 \times \text{resistance}$

$V_pI_p = V_sI_s$

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Question 1 begins on page 4

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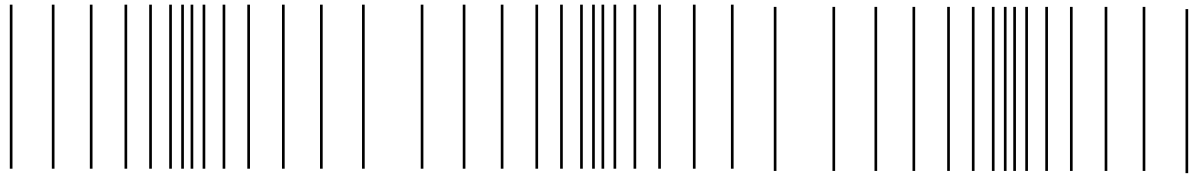
Answer **all** the questions.

SECTION A – Module P4

1 This question is about waves.

(a) Look at the diagram of a longitudinal wave.



(i) Use the diagram to describe a compression.

.....

..... **[1]**

(ii) Two types of waves are longitudinal and transverse.

The particles in these waves move in different ways.

Compare the movement of particles in longitudinal and transverse waves.

You may use labelled diagrams in your answer.

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..... **[3]**

(b) The frequency of an ultrasound wave is 25 000 Hz.

Can humans hear this ultrasound?

.....

Explain your answer.

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[2]

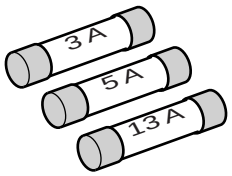
[Total: 6]

2 Sheree researches fuses in electrical plugs.

She finds the information below.

Choosing the correct fuse

The three main sizes of fuse are 3 amps, 5 amps and 13 amps.



You must use the correct fuse for your appliance.

Sheree has an electric drill with a power rating of 750W.

It is plugged into the 230V mains.

There is no fault with the drill but the fuse wire in the plug melts when she switches the drill on.

Sheree decides to use a different fuse.

Use calculations to explain why the original fuse wire melts, and explain which size fuse is the safest to use if the drill develops a fault.

The quality of written communication will be assessed in your answer to this question.

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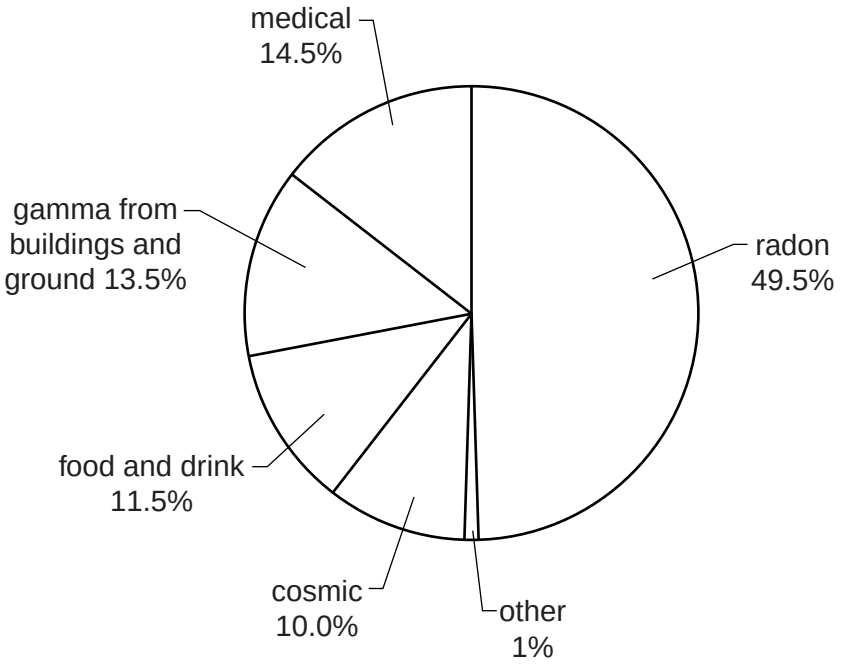
..... **[6]**

[Total: 6]

3 This question is about sources of background radiation in the UK.

(a) The chart shows the average percentage contributions from different sources.



The percentage radiation from each source is different for each person in the UK.

Write down **two** reasons for this difference.

.....

.....

.....

..... **[2]**

(b) Teams of scientists monitor sources of background radiation in different areas of the UK.

Why is it important for all the teams of scientists to publish their findings each year?

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.....

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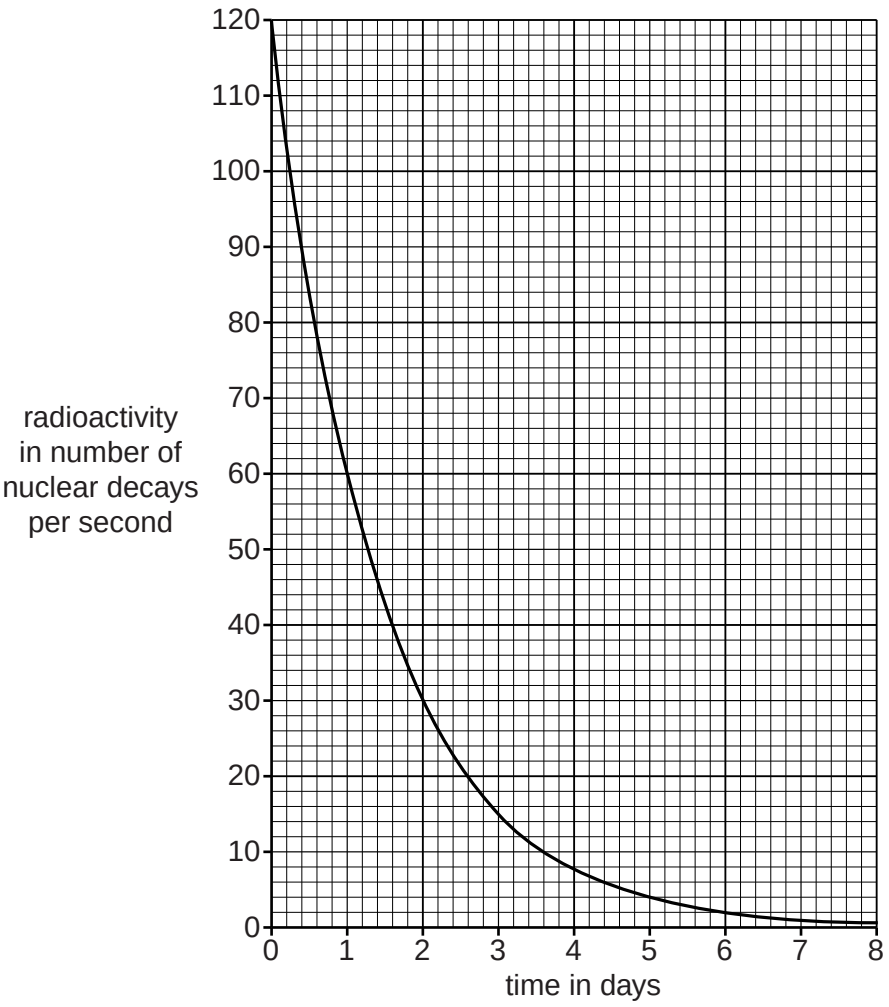
..... **[2]**

[Total: 4]

4 Medical radioisotopes use radioactive elements.

Radioactivity is measured by the number of nuclear decays per second.

Look at the graph showing the radioactive decay of element **A**.



(a) (i) What happens to the radioactivity of element **A** between day 1 and day 2?

.....

..... **[2]**

(ii) Doctor Hanif compares radioactive element **A** with radioactive element **B**.

Both elements start with the same radioactivity of 120 nuclear decays per second.

Element **B** has a **longer** half-life.

Draw a line on the graph to show the decay of element **B**. **[1]**

(b) Technetium-99 can be used to make a medical radioisotope.

When technetium-99 decays it emits beta radiation.

Complete the nuclear equation for this decay.

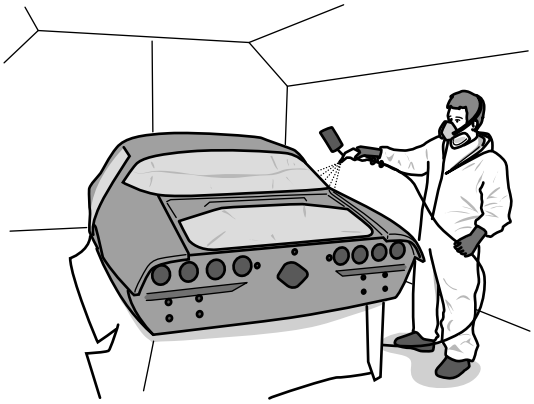
$$^{99}_{43}\text{Tc} \rightarrow {}^{\ldots\ldots}_{\ldots\ldots}\text{Ru} + {}^{\ldots\ldots}_{\ldots\ldots}\beta$$

[2]

[Total: 5]

Question 5 begins on page 10

5 Electrostatics can be useful for paint spraying.



(a) Complete the sentences to describe electrostatic paint spraying.

The paint gun is charged.

The paint particles are all given the same ..... .

This makes the paint particles in the spray ..... .

The car is charged oppositely to the paint particles.

This causes the paint particles to be ..... .

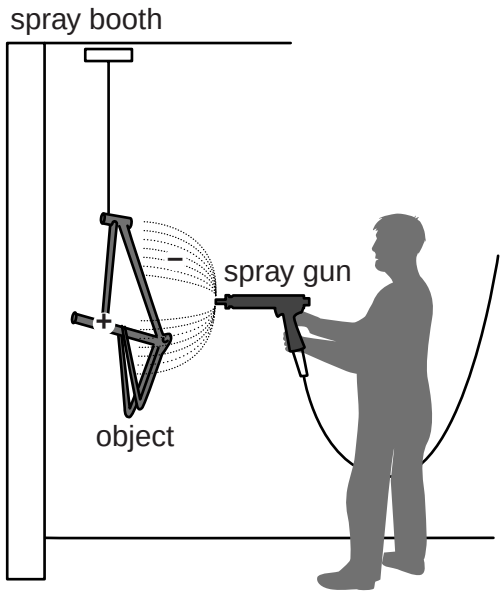
Two advantages of using electrostatics for paint spraying are .....

..... and ..... .

[3]

(b) During electrostatic paint spraying electrons are transferred.

Look at the diagram of an object being paint sprayed.



Describe where electrons are gained and lost in this process.

In your answer, write about the direction of electron transfer.

.....

..... **[1]**

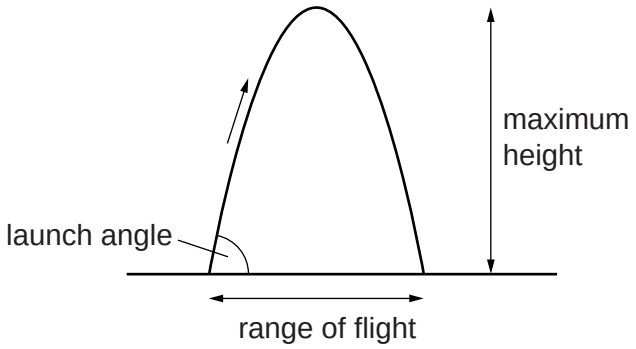
[Total: 4]

SECTION B – Module P5

6 Jia makes a model air rocket in school.

She measures the maximum height and the range of flight for different launch angles.

Look at the diagram.



Look at Jia's results.

Launch angle in degrees	Maximum height reached in m	Range of flight in m
30	1.2	8.7
45	2.5	10.0
60	3.7	8.7
75	4.7	5.0

(a) Use the data to describe how the launch angle affects the range of flight of the rocket.

.....

.....

..... **[2]**

(b) Jia tests one more launch angle.

This angle gives the rocket its greatest maximum height.

Suggest the launch angle she used in this test.

..... degrees **[1]**

(c) Jia's rocket is a projectile and it follows a path.

If there is very little air resistance, the projectile path is very predictable.

(i) Name the **shape** of the path followed by Jia's rocket.

..... **[1]**

(ii) How does the force of gravity affect the vertical velocity **and** vertical acceleration as the rocket rises?

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..... **[2]**

(iii) How does the force of gravity affect the horizontal velocity of the rocket?

.....

..... **[1]**

[Total: 7]

Question 7 begins on page 14

7 Real rockets can carry satellites into space and put them in orbit around Earth.

Two types of satellite orbit are

- low polar orbit
- geostationary orbit.

(a) TV satellites are in geostationary orbit.

What is meant by a geostationary orbit and why is this orbit chosen for satellites transmitting TV signals?

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..... **[3]**

(b) Low polar satellites can be used to take aerial photographs of storm clouds.

These photographs can be updated about every 90 minutes.

(i) Explain why this satellite cannot take photographs of these storm clouds more often than this.

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..... **[1]**

(ii) A **low polar** satellite travels at a different speed to a **geostationary** satellite.

Compare the speeds of the two satellites and explain this difference using ideas about forces.

No calculations are required in your answer.

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..... **[3]**

[Total: 7]

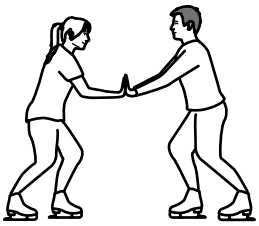
8 Nina and Matt like to ice skate.

Nina and Matt start from rest and hold each other's hands.

Then they push each other and move apart.

Look at the diagrams below.

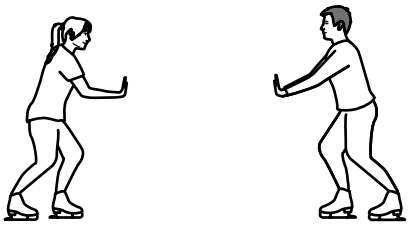
before



Nina
mass = 60 kg
velocity = 0 m/s

Matt
mass = 100 kg
velocity = 0 m/s

after



Nina
mass = 60 kg
velocity = −5 m/s

Matt
mass = 100 kg
velocity = 3 m/s

Explain why Nina and Matt move apart at different velocities.

Use the data and ideas about forces and momentum in your answer.

The quality of written communication will be assessed in your answer to this question.

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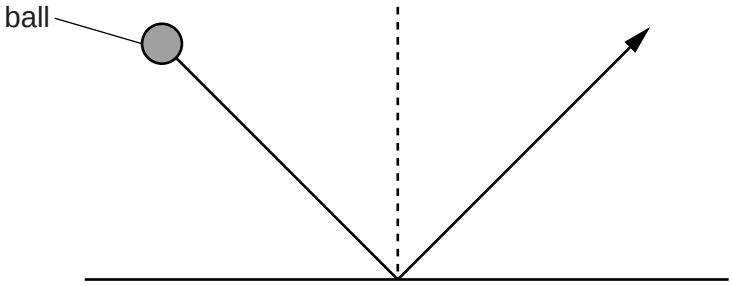
..... **[6]**

[Total: 6]

9 In the 1600s two scientists, Newton and Huygens, had different theories about light.

(a) Newton had a particle model which explained reflection.

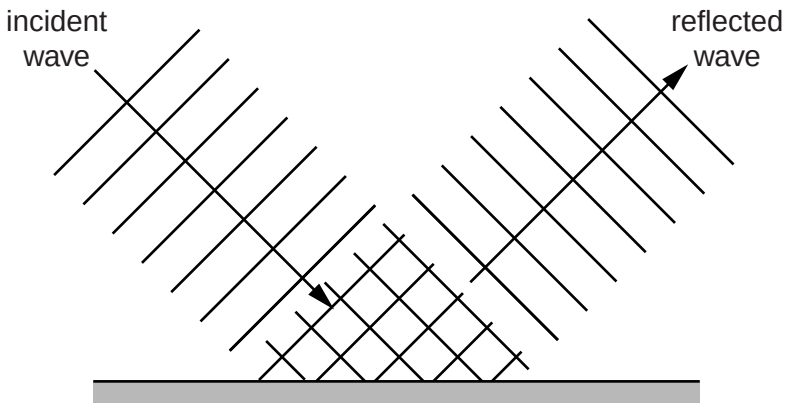
Look at the diagram.



'A ball (particle) hits the surface and bounces off at the same angle'.

Huygens' wave model also explained reflection.

Look at the diagram.



How does Huygens' wave model explain the reflection of light?

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..... **[1]**

(b) Diffraction and interference experiments started to change scientists' confidence in particle and wave models.

The particle theory lost support and the wave theory gained support.

Explain why.

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..... **[2]**

(c) Use the wave model to explain constructive and destructive interference.

Diagrams may be used to help explain your answer.

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..... **[2]**

[Total: 5]

SECTION C – Module P6

10 Symbols are used to represent electronic components.

(a) Look at the two different electronic components.

LDR **thermistor**

For each component, describe what causes the resistance to change **and** how the resistance changes.

LDR .....

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Thermistor .....

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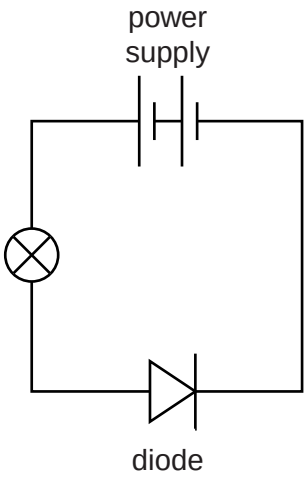
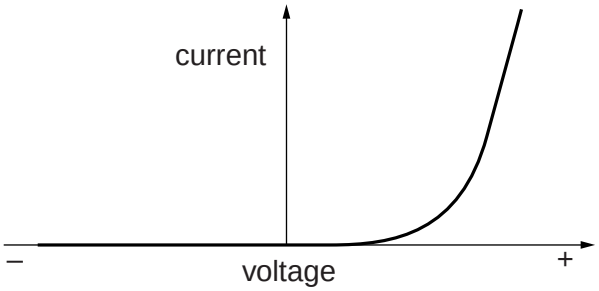
[2]

(b) The diagram shows a circuit with a silicon diode.



Look at the current-voltage graph for this diode.



Use the graph to explain why the current passes through this diode.

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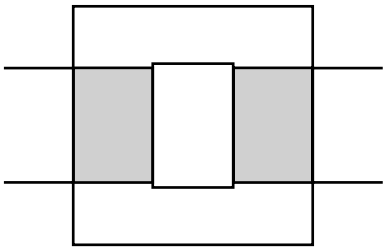
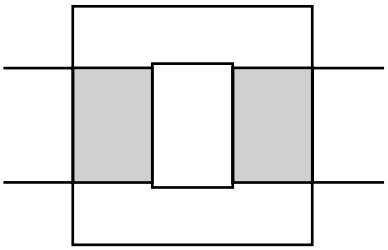
..... **[2]**

[Total: 4]

11 This question is about transformers.

Look at the information about two different transformers.

	 **transformer A**	 **transformer B**
Type of core	iron	iron
Number of primary turns	500	1000
Number of secondary turns	1000	500
Input voltage	20 volts AC	20 volts AC

Write about the similarities and differences between transformer **A** and transformer **B**.

Include information about how the transformers work, their construction and their output voltages.

The quality of written communication will be assessed in your answer to this question.

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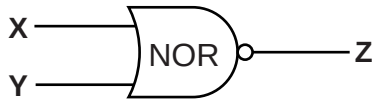
..... **[6]**

[Total: 6]

12 Many electronic devices contain logic gates.

(a) One type of logic gate is a NOR gate.

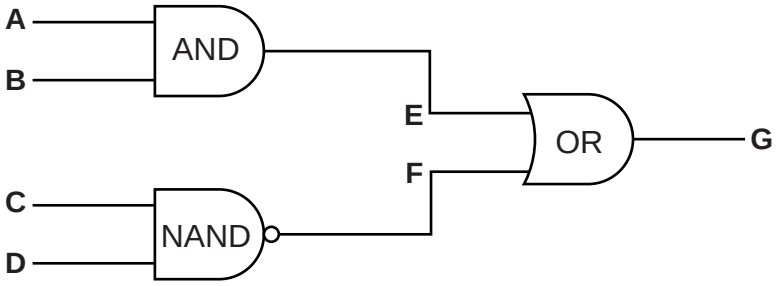


Complete the truth table for a NOR gate

X	Y	Z
0	0	
0	1	
	0	

[2]

(b) Logic gates can be combined together.



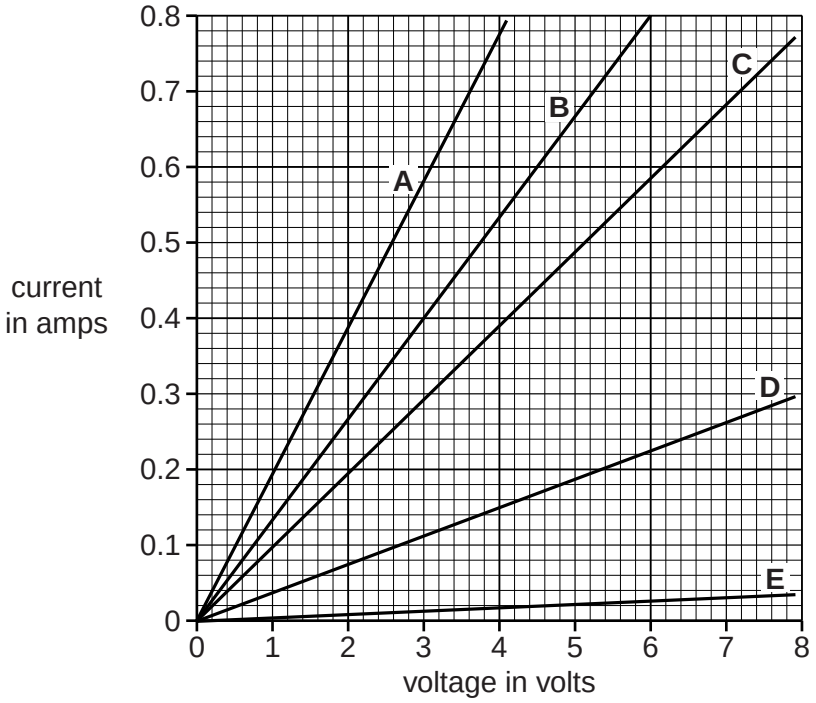
Look at part of the truth table for this combination of gates.

A	B	C	D	E	F	G
0	0	0	0			
0	1	1	0			
1	0	0	0			
1	1	1	1			

Complete the missing spaces in this truth table. **[2]**

[Total: 4]

13 George draws a current-voltage graph for five different ohmic conductors.



(a) Calculate the resistance of conductor **B**.

.....

.....

resistance ..... ohms **[2]**

(b) All the ohmic conductors are made from the same material.

They have the same cross sectional area.

They are all different lengths.

Use the graph to write down the letter of the conductor with the longest length.

answer .....

Explain your answer.

.....

.....

.....

[2]

(c) George investigates a metal filament bulb.

George tries to explain how the resistance changes when the bulb is switched on. He uses the model below.

Current in a conductor is the flow of charge carriers called protons.

The charge carriers collide with the atoms (ions) in the conductor.

This makes the atoms vibrate less which

- **causes an increase in collisions, decreasing the resistance**
- **increases the temperature of the conductor.**

George has made **three** mistakes in his model.

State the **three** mistakes he has made and write down the corrections.

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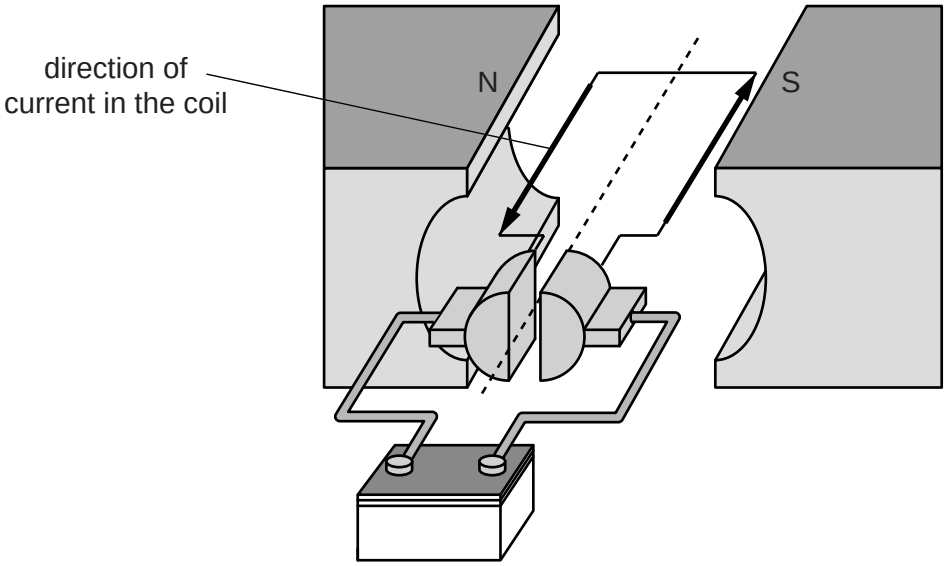
..... **[2]**

[Total: 6]

Question 14 begins on page 24

14 DC electric motors are used in many different appliances.

(a) Look at the diagram of a DC motor.



Use Fleming's Left Hand rule to predict if the coil will spin **clockwise** (↻) or **anti-clockwise** (↺) in the following arrangements.

The motor is set up as shown in the diagram. It will spin ..... .

The current is reversed. It will now spin ..... .

With the current still reversed, the north and south poles are also reversed.

It will now spin ..... .

[1]

(b) Many motors have different speed settings.

(i) Suggest how the **same** motor can be made to have different speed settings.

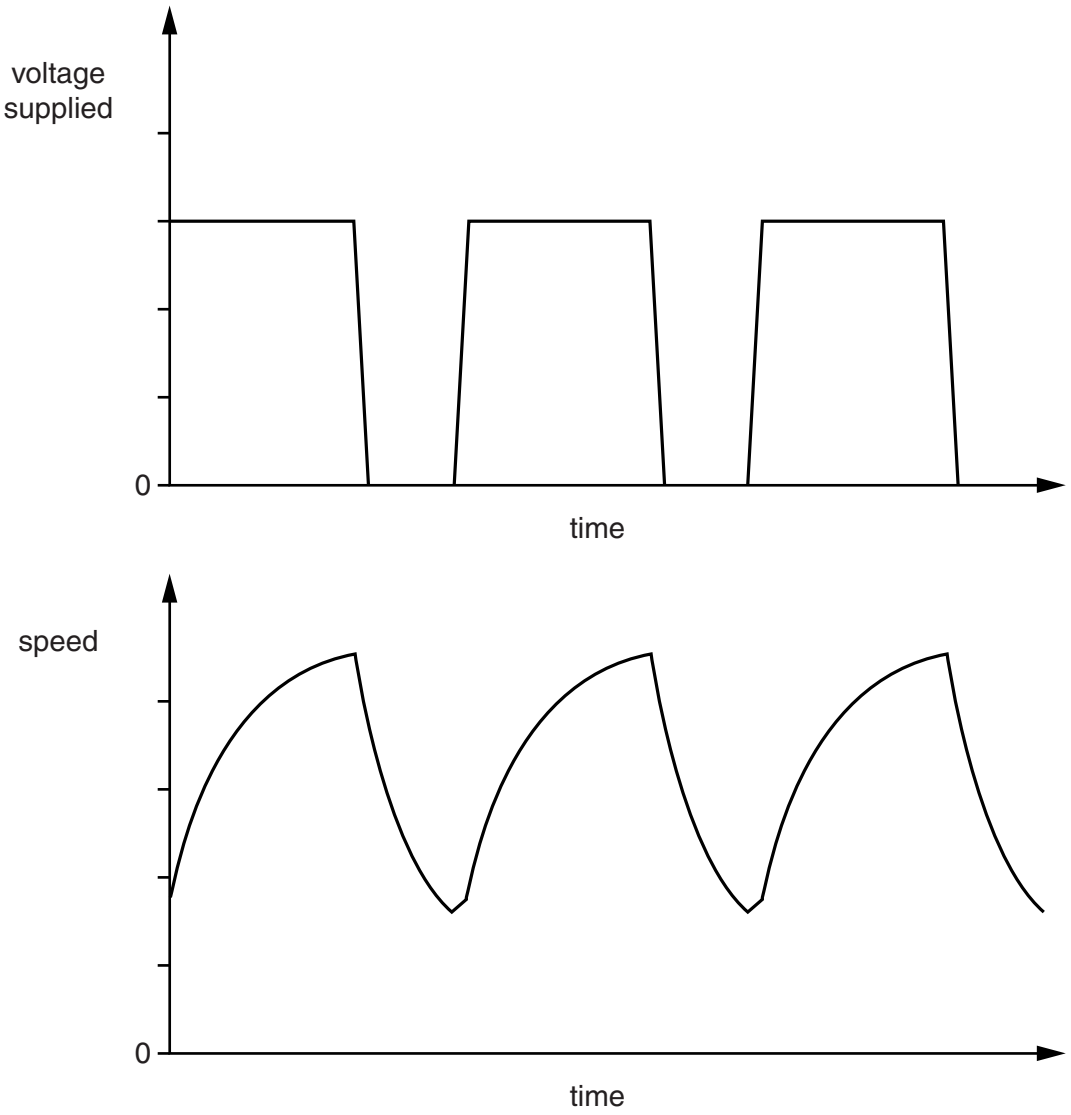
.....

..... **[1]**

(ii) Look at the data on the graphs.

They show how the voltage supplied and the speed of the motor are related.

The supply voltage is switched on **and** off regularly.



Describe what happens to the speed of the motor as the voltage is regularly switched on and off.

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..... **[2]**

(iii) Suggest how the speed of the motor will vary if the supply voltage is switched on and off more frequently.

.....

..... **[1]**

[Total: 5]

SECTION D

15 Roxanne investigates the density of different materials.

She calculates the density using this equation:

$$\textbf{density (in g/cm}^3\textbf{)} = \frac{\textbf{mass}}{\textbf{volume}}$$

Look at her results.

Material	State	Volume in cm^3	Mass in g	Density in g/cm^3
Water	liquid	1.0	1.0	1.0
Glass	solid	3.0	5.8	
Liquid X	liquid	1.0	1.2	1.2
Oil	liquid	3.0		0.9
Liquid Y	liquid	1.0	0.7	0.7
Liquid Z	liquid	1.0	0.8	0.8

(a) Calculate the density of glass.

.....

.....

answer ..... g/cm^3 **[1]**

(b) Roxanne has lost the measurement for the mass of oil.

Calculate the mass of oil.

.....

.....

answer ..... g **[2]**

(c) Roxanne experiments with different liquids from the table.

She has two identical beakers and puts one litre of water into each of them.

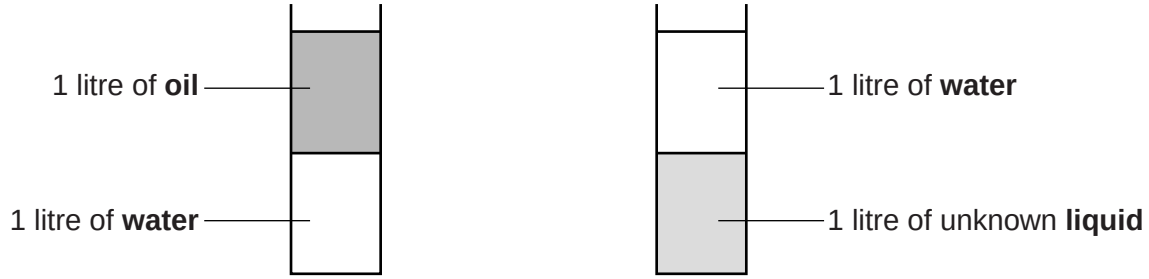
She puts one litre of oil into beaker **A**.

The oil floats on the water because of their densities.

Roxanne puts one litre of another of the liquids into beaker **B**.

The liquids do **not** mix together.

Look at the diagrams.



beaker A **beaker B**

Which beaker of liquids is heavier, **A** or **B**?

.....

Explain your answer and suggest which liquid from the table is the **unknown liquid**.

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[3]

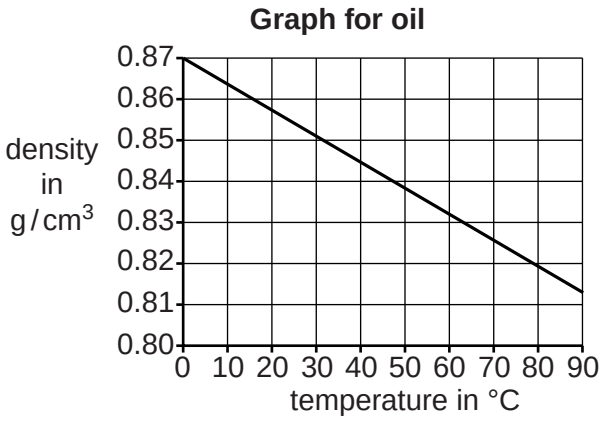
Turn over for the remainder of question 15

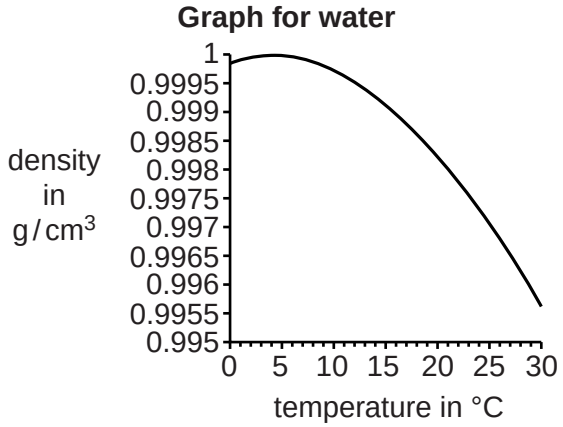
(d) The state of water is affected by temperature.

Water freezes and becomes ice at 0 °C.

The density of liquids is also affected by temperature.

Look at the graphs for oil and water.





(i) Describe how the density varies with temperature for **oil**.

.....

.....

..... **[1]**

(ii) Describe how the density varies with temperature for **water**.

.....

.....

..... **[1]**

(iii) Water freezes at 0 °C and ice floats on water. The density of ice is 0.92 g / cm^3 at 0 °C.

Use the data in the graph for water to explain why ice floats on water, and suggest how this protects fish at the bottoms of lakes which have frozen over.

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..... **[2]**

[Total: 10]

END OF QUESTION PAPER

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