OCR
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GCSE (9–1) Physics B (Twenty First Century Science) F

J259/01 Breadth in physics (Foundation Tier)

Sample Question Paper

Date – Morning/Afternoon

Version 2.1

Time allowed: 1 hour 45 minutes

You must have:
- a ruler
- the Data Sheet

You may use:
- a scientific or graphical calculator

First name									
Last name									
Centre number						Candidate number				

INSTRUCTIONS
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided.
- Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION
- The total mark for this paper is **90**.
- The marks for each question are shown in brackets **[ ]**.
- This document consists of **24** pages.

Answer **all** the questions.

1 Two students are investigating springs and forces.

(a) They measure how much a steel spring stretches when different weights are hung on it.

State **one** safety precaution the pupils should take when completing this experiment.

.....

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

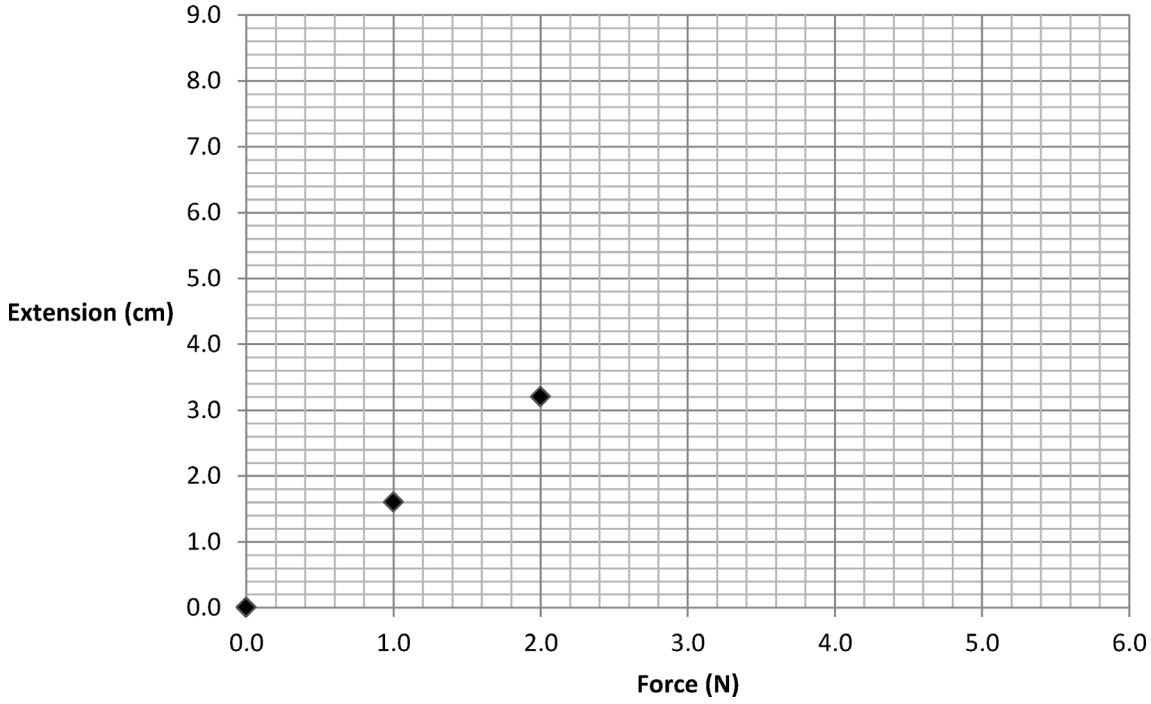
(b) They collect the results listed in **Table 1.1**.

Force (N)	Extension (cm)
0.0	0.0
1.0	1.6
2.0	3.2
3.0	6.0
4.0	6.4
5.0	8.0

Table 1.1

Circle the possible anomaly in the results for extension. **[1]**

(c) They start to plot a graph of their results.



Plot the remaining points, **ignoring the anomaly**, and draw a line of best fit. **[3]**

(d) Using the results in **Table 1.1**, calculate the spring constant of the spring when the force is 4.0 N.

Force = extension × spring constant

Spring constant = ... N/m **[4]**

2 The demand for energy in the home keeps increasing.

(a) What does the **amount** of energy transferred electrically by an appliance depend upon?

Put ticks (?) in the boxes next to the **two** correct answers.

How much it cost to buy ☐

Its power rating ☐

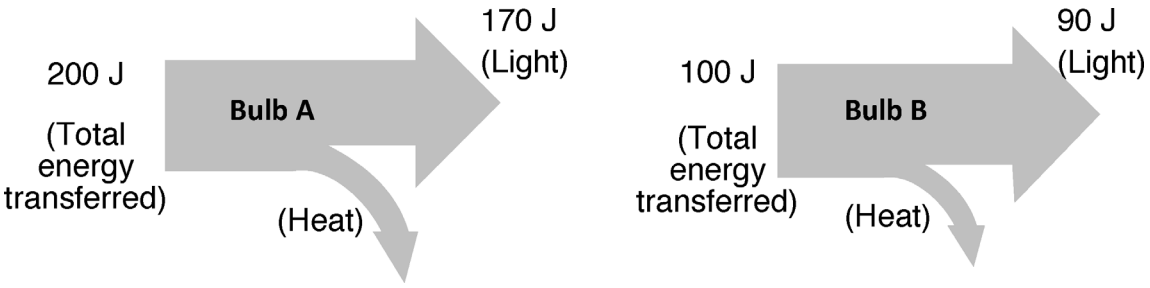
The cost of one unit of electricity ☐

The frequency of the mains supply ☐

The time it is used for ☐ **[2]**

(b) Look at these Sankey diagrams for two different energy efficient bulbs.

(The diagrams are **not** drawn to scale.)



(i) Which **two** conclusions can be made from these diagrams?

Put ticks (✓) in the boxes next to the **two** correct answers.

Both bulbs transfer more energy by lighting than heating. ☐

Bulb **A** is more efficient. ☐

Bulb **B** produces 10 J by heating for every 100 J of energy transferred by the electric current. ☐

Bulb **B** will **not** last as long as bulb **A**. ☐

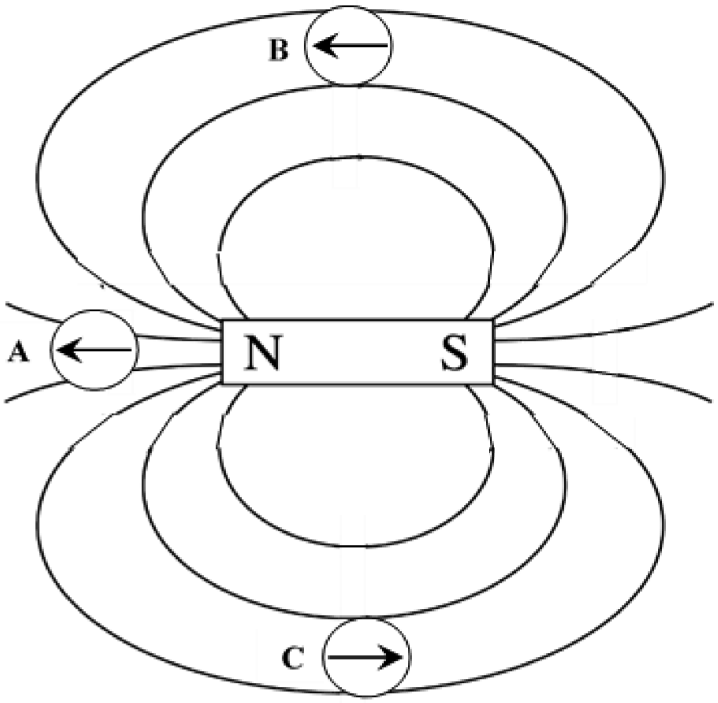
The bulbs do **not** waste any energy. ☐ **[2]**

(ii) Calculate the efficiency of bulb **A** as a percentage.

Efficiency = ... % **[3]**

3 Two students are investigating magnets and electromagnets.

(a) They use three plotting compasses (**A**, **B** and **C**) to examine the magnetic field around a bar magnet.



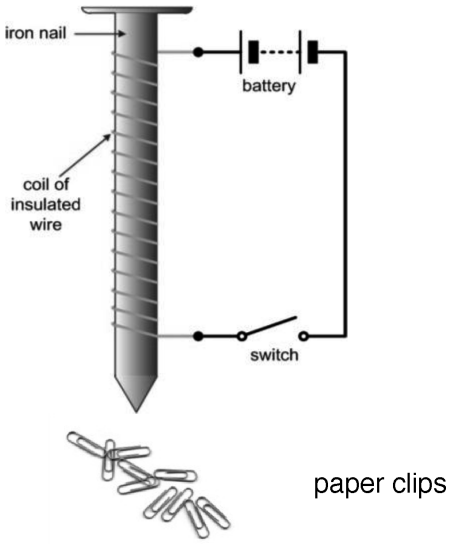
(i) Which plotting compass (**A, B** or **C**) is faulty and pointing in the wrong direction?

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

(ii) At which **ONE** of the three positions (**A, B** or **C**) will the bar magnet's field be the **strongest**?

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

(b) They set up the apparatus below to test a simple electromagnet.



(i) The students decided to change **one** factor and see how it affected the strength of the electromagnet.

They both repeated their tests. Here are their results.

	Number of paper clips attracted	
Number of turns in coil	**Test 1**	**Test 2**
0	0	0
10	6	5
20	13	14
30	22	20
Student **A**'s results		

	Number of paper clips attracted	
Number of turns in coil	**Test 1**	**Test 2**
0	0	0
10	2	4
20	5	9
30	11	17
Student **B**'s results		

Student **B** used heavier paper clips.

In student **B**'s experiment, calculate the mean for the number of paper clips attracted when **30 turns** were used.

Mean = ... **[1]**

(ii) Which student, **A** or **B**, has collected better quality valid data?

Give **two** reasons to support your answer.

.....

.....

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

4 Here is a list of waves:

Infrared

Microwaves

Sound

Ultraviolet

X-rays

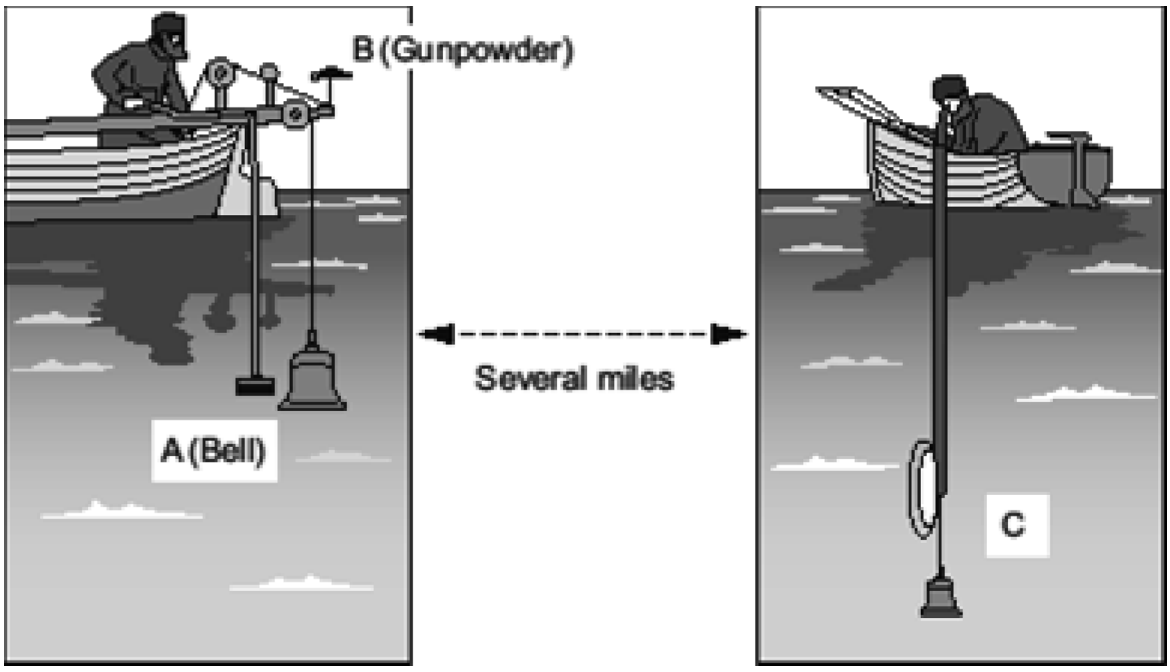
(a) Use waves from the list to answer the following questions.

You may use each wave once, more than once or not at all.

(i) Which wave is **not** in the electromagnetic spectrum? ..... **[1]**

(ii) Which wave can be used to find metal objects in a suitcase?..... **[1]**

5 **(a)** Nearly 200 years ago, an underwater bell was used to find the speed of sound under water in Lake Geneva, Switzerland.



- The bell (**A**) was struck and the gunpowder (**B**) ignited at the same time.
- The flash from the gunpowder and the sound from the bell were detected several miles away (**C**).

What **two** measurements need to be taken in this experiment to calculate the speed of sound under water?

1 .....

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

(b) The flash from the gunpowder was seen before the sound from the bell was heard.

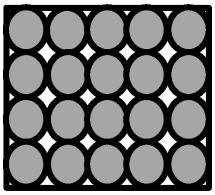
Explain why this happened in terms of the speed that sound and light travel.

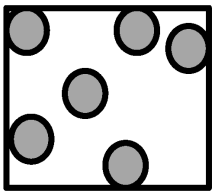
.....

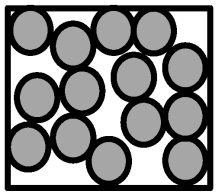
..... **[1]**

(c) (i) Below are diagrams showing the particle arrangements in solids, liquids and gases.

Draw lines to match the diagram to the correct label.







Gas
Liquid
Solid

[2]

(ii) Sound waves travel through materials by making the particles in the material vibrate.

Use this idea and your knowledge of the particle model of matter to explain why sound travels much faster through water than through air.

.....

.....

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

6 In 1913, Niels Bohr suggested a new model of the atom.

This model has been further developed over time.

(a) Complete the following sentences. Use words from the list.

electrons negative neutrons nucleus positive protons

In the modern model of the atom, the mass of the atom is concentrated in the

.....

This central part of the atom is made up of particles called .....and

..... and has an overall ..... charge. **[4]**

(b) The element iodine has many **isotopes**.

A nucleus of the stable isotope of iodine can be represented as:

$$^{127}_{53}\mathrm{I}$$

What is the difference between the nuclei of two isotopes of the same element.

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

(c) Radioactive isotopes are widely used in medicine to treat cancer. Some people are concerned that using radiotherapy treatment for cancer may itself cause a second cancer.

In a recent study of over 600 000 cancer patients who had been treated with radiotherapy, it was found that about **5 in 1 000** of them developed a further cancer within 15 years as a result of the treatment.

Calculate the number of cancer patients in this study that developed a further cancer within 15 years of treatment.

Use the data above in your answer.

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

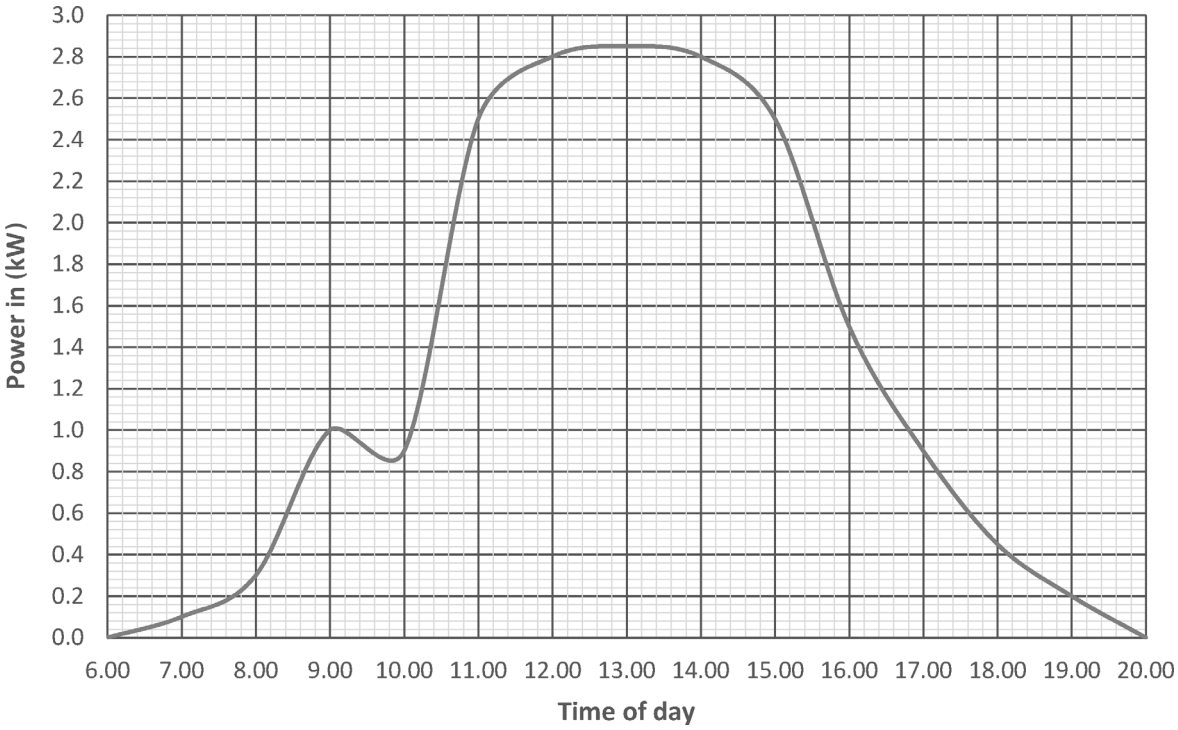
7 (a) What is the difference between a renewable and a non-renewable energy resource?

.....

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

(b) More and more homes are having solar panels fitted to reduce household electricity bills.

The graph shows how the power output from a solar panel varies during a typical summer day.



Using the graph, estimate the mean power output **between 11:00 and 15:00 hours**.

Mean power output = ... kW **[1]**

(c) The output from the solar panel is d.c.

This needs converting to the correct a.c. voltage for the household to use the electricity.

(i) What is the correct voltage and frequency of the UK mains electricity supply?

Put a (ring) around the **two** correct values.

Voltage			**Frequency**		
110 V	**230 V**	**360 V**	**30 Hz**	**40 Hz**	**50 Hz**

[2]

(ii) In the National Grid, what is the name of the device used to change the supply voltage before and after transmission?

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

(d) A new power station is being built in your town.

The table gives some information about three different types of power station.

Type of power station	Efficiency (%)	Cost per kWh in pence	Environmental factors
Wind	34	4 to 5.5	May damage local wildlife, e.g. birds
Nuclear	35	2 to 2.5	Produces radioactive waste
Gas	38	2 to 3	Produces carbon dioxide

Which type of power station would you recommend building?

Use information from the table to decide.

Explain your choice.

.....

.....

.....

.....

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

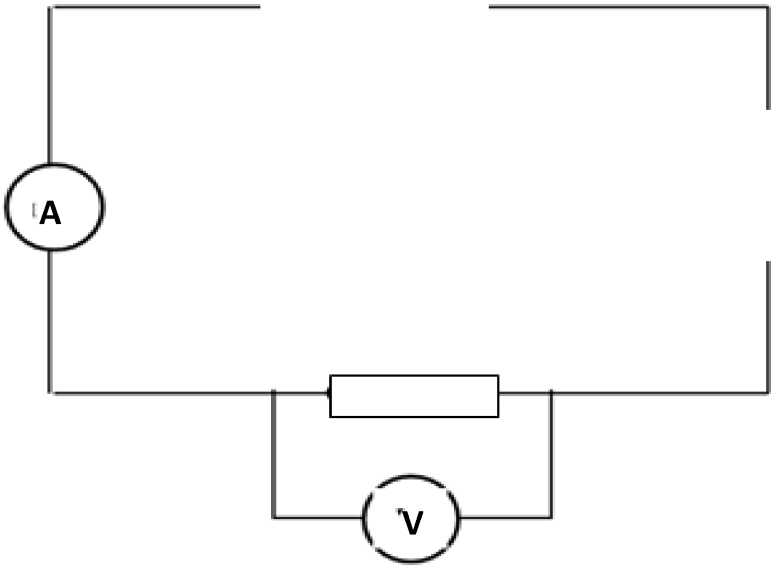
(e) Some power stations include boilers where the steam is used to turn a turbine.

Name an energy resource for a power station that does **not** have a boiler.

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

8 **(a)** Eve is learning about electric charge in circuits.

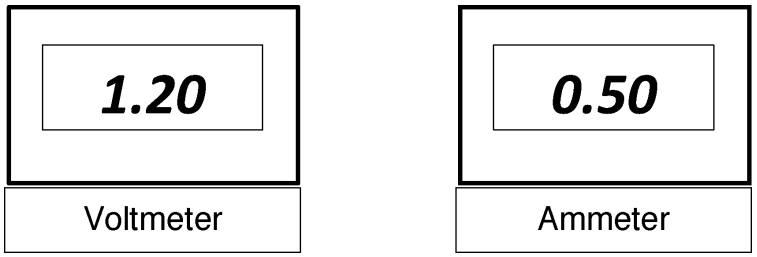
The diagram is an incomplete circuit showing a resistor, a voltmeter and an ammeter.



(i) The diagram needs a switch and a single cell or battery.

Complete the diagram, using the correct symbols. **[1]**

Eve switches the circuit on and watches the voltmeter and ammeter readings carefully for **0.5 minutes**. She notices that both readings remain steady as shown below.



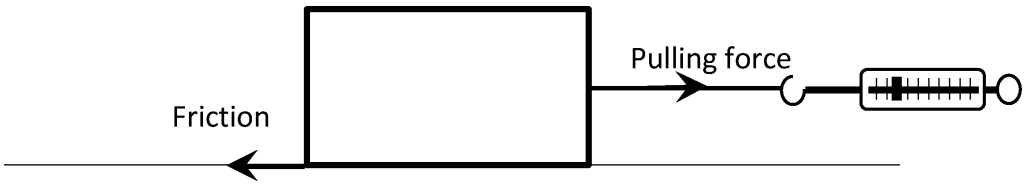
(ii) Calculate the electric charge (in C) which flows through the resistor in 0.5 minutes.

Electric charge = ... C **[3]**

(iii) Calculate the resistance of the resistor in the circuit.

Resistance = ... Ω **[3]**

9 **(a)** This is an incomplete force diagram showing a block being slowly pulled horizontally along a flat surface.



(i) On the diagram **draw and label** arrows to represent the force of gravity and the reaction force (both acting on the block). **[2]**

(ii) The block is pulled with a force of 4 N.

Calculate the work done by this force on the block as it is pulled 30 cm along the surface for 5 seconds.

Work done = force × distance moved in the direction of the force.

Work done = ... J **[3]**

(iii) Originally the block was pulled at a steady speed. The pulling force is then changed.

Use lines to link each '**statement**' about the pulling and friction forces to the '**effect**' these new forces have on the motion of the block.

Statement	**Effect**
	… the block will continue to move at a steady speed.
The pulling force is smaller than the friction force …	…the block will speed up.
The pulling force is greater than the friction force …	… the block will slow down.
The pulling force is equal to the friction force …	… the block will stand still.
	… the block will move to the left.

[3]

10 Nina pulls toy cars along the floor in a laboratory.

She measures the force and distance moved each time.

Her results are shown in the table.

Toy car	Pulling force (N)	Distance moved (m)
A	10	2
B	5	6
C	4	5
D	2	7

(a) Which **two** cars do the same amount of work?

Show your working.

Car …… and Car ..... **[2]**

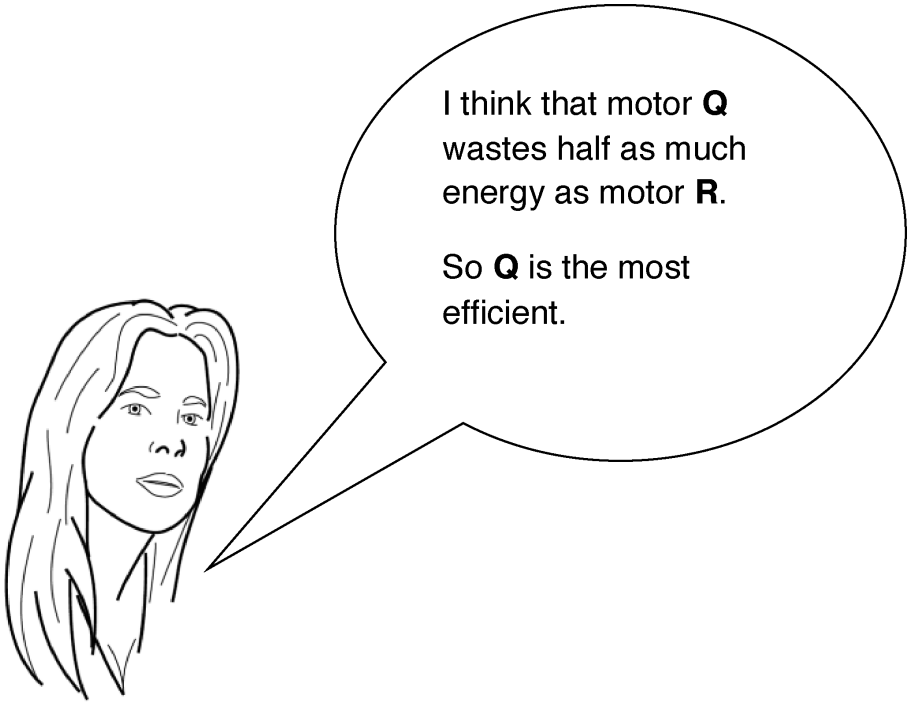
(b) Nina does another experiment to investigate work done.

Nina uses two different electric motors (**Q** and **R**) to lift a large mass. She wants to find out which motor is the most efficient.

She measures the input electrical energy and the work done on the mass.

Look at the table of her results.

Electric motor	Input energy (J)	Output energy (J)
Q	800	760
R	2000	1920



Nina's statement is partly correct and partly wrong.

Use the data in the table above and calculations to explain why.

.....

.....

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

(c) Motor **R** takes 20 seconds to lift the mass.

Calculate the **difference** between the input and output power of motor **R**.

Difference = ... W **[3]**

11 **(a)** **(i)** Define density.

.....

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

(ii) A 3.0 m^3 volume of air has a mass of 3.9 kg.

Calculate the density of the air.

Density = ... kg/m^3 **[2]**

(b) Layla does an experiment to test the hypothesis:

'the reason why a solid floats or sinks in a liquid depends upon both the density of the solid and the density of the liquid'.

She was given blocks of rubber and wood and bottles of maple syrup and baby oil.

The table shows the densities of the four materials.

Material	Density (g/cm^3)
Rubber	1.52
Wood	0.85
Maple Syrup	1.37
Baby Oil	0.80

Layla's results are shown below.

Material	Floats in Maple Syrup	Floats in Baby Oil
Rubber	No	No
Wood	Yes	No

Layla concludes that the density of both the solid and the liquid affect whether the solid floats or sinks.

Use the data to justify Layla's conclusion.

.....

.....

.....

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

(c) A solid block is immersed in a liquid.

Which diagram, **A**, **B**, **C** or **D**, best shows the **direction** of all the force(s) on the solid caused by the liquid pressure?

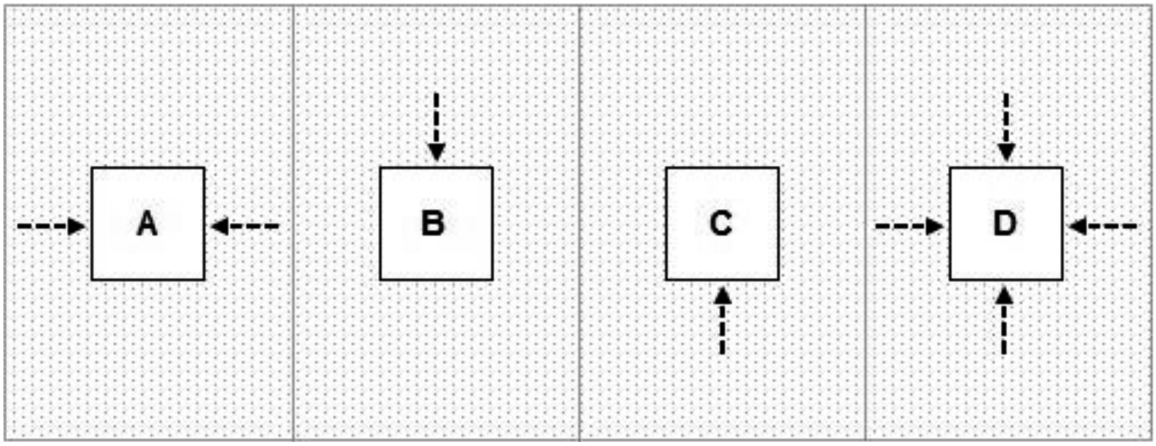
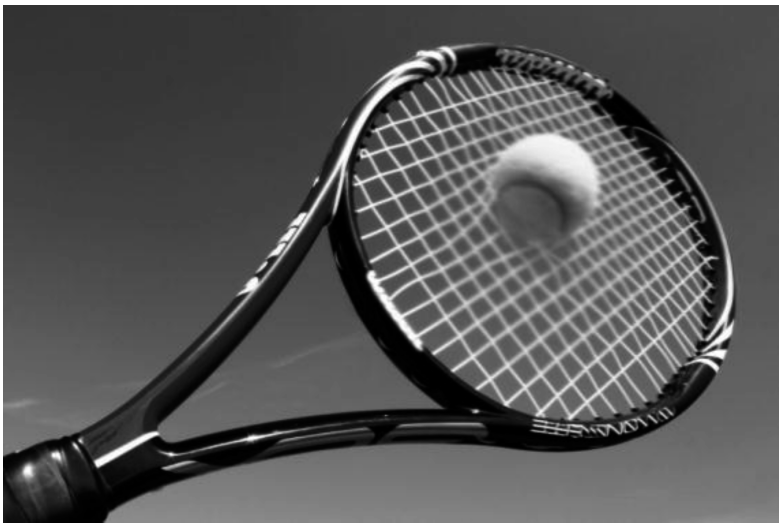


Diagram:..... **[1]**

12 This is a picture of a tennis ball being hit.



(a) The racket exerts an average force of 1000 N on the tennis ball.

Complete the table to show whether each statement about the average force exerted **by** the tennis ball **on** the racket is **true** or **false**.

Put ticks (✓) in the correct boxes.

	True	**False**
The average force is a vector quantity		
The average force acts in the same direction as the ball is moving		
The average force equals 1000 N		
The average force depends upon the weight of the ball		

[2]

(b) The tennis ball has a mass of 0.060 kg and travels at a speed of 51 m/s.

Calculate the kinetic energy of the ball.

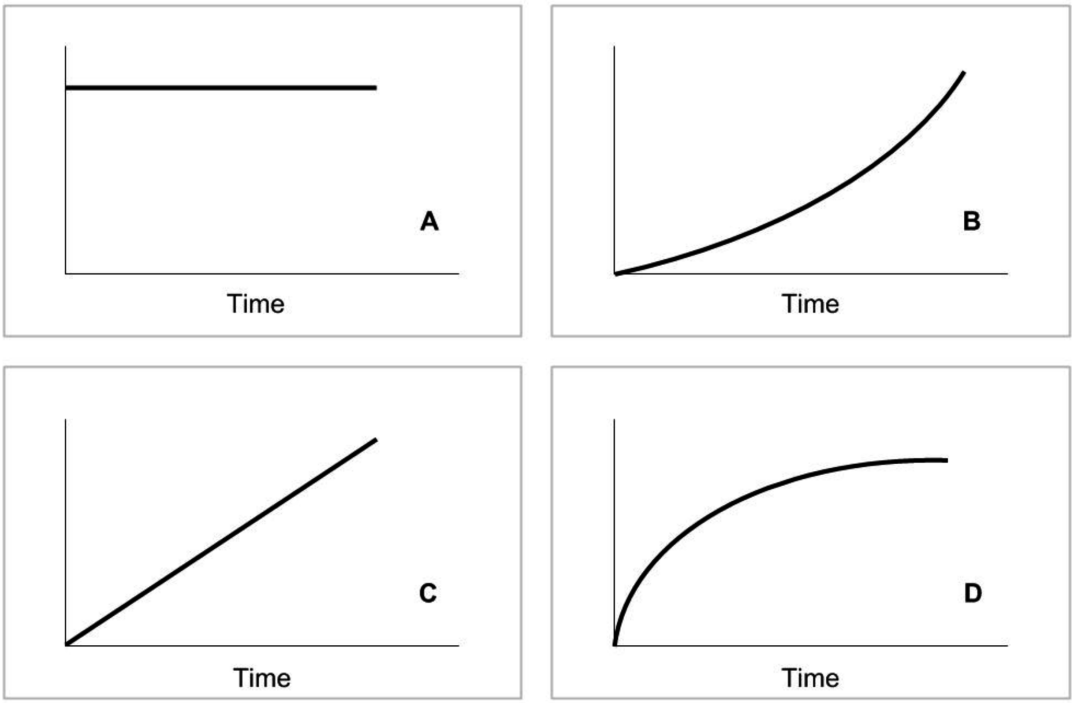
Kinetic energy = ... J **[3]**

(c) Calculate the weight (in newtons) of the tennis ball.

- Gravitational field strength = 10 N/kg.

Weight = ... N **[3]**

13 **(a)** A coin is dropped to the floor.



(i) Which graph represents the distance–time graph of the coin dropping?

Graph:..... **[1]**

(ii) Which graphs represent the speed–time graph of the coin dropping?

Graph:..... **[1]**

(b) The coin falls through a distance of 150 cm in a time of 0.8 seconds.

Calculate the average speed at which the coin falls.

Speed = distance ÷ time

Average speed = ... m/s **[3]**

(c) Explain the **difference** between vectors and scalars as it applies to velocity and speed.

.....

.....

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

END OF QUESTION PAPER