OCR
Oxford Cambridge and RSA

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

F

J259/01 Breadth in physics (Foundation Tier)

Sample Question Paper

Date – Morning/Afternoon

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 with a range of different weights hung on it.

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

……

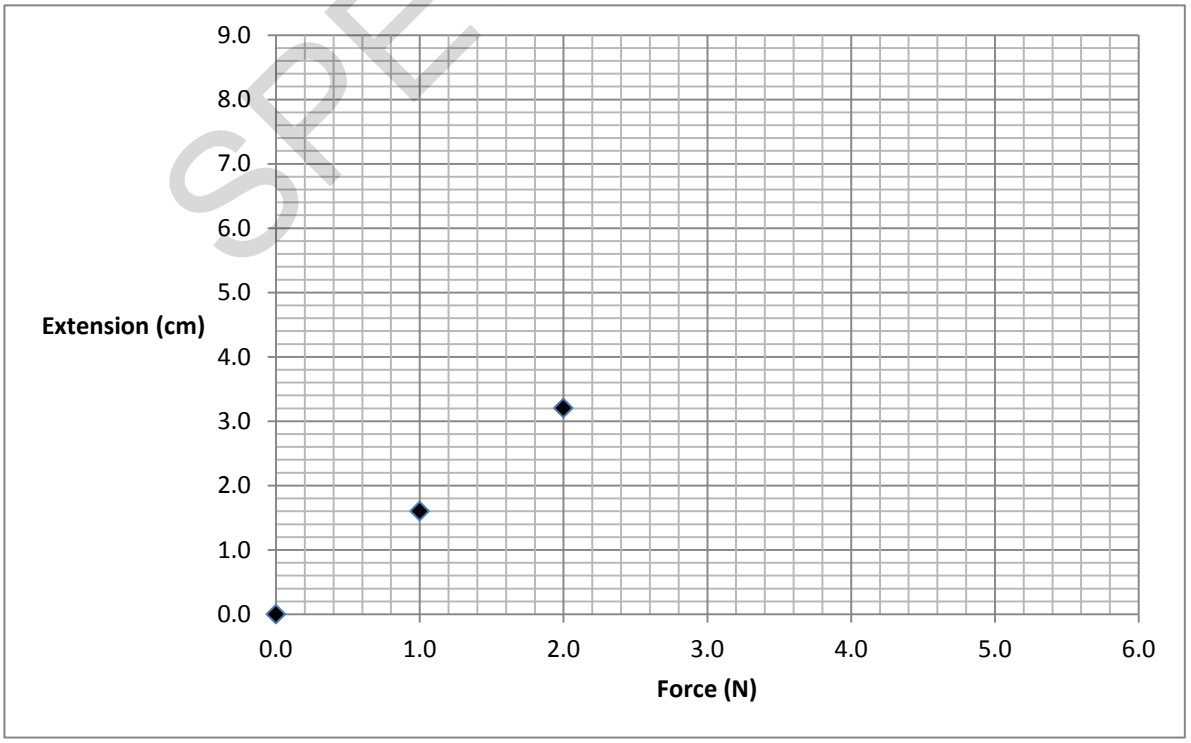
…… **[1]**

(b) They collect the following results.

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

Circle the outlier in the results for extension. **[1]**

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



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

(d) Using the data, calculate the spring constant of the spring when the force is 4.0 N.

Force exerted = extension x 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?

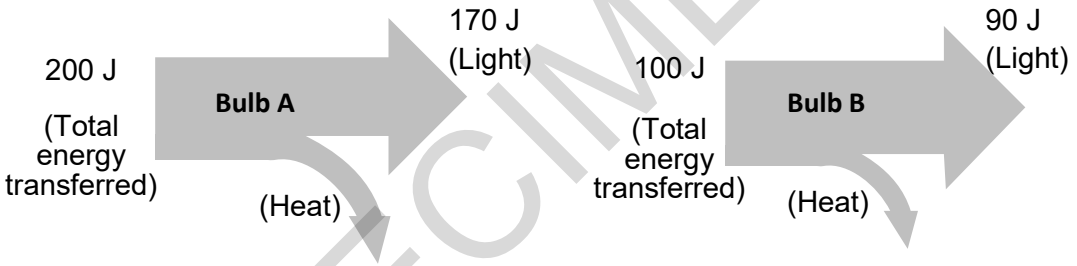
Put ticks (✓) in the boxes next to the **two** correct answers.

its power rating	☐
the frequency of the mains supply	☐
how much it cost to buy	☐
the cost of one unit of electricity	☐
how long 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** of the following conclusions can be made from these diagrams?

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

Bulb B produces 10 J by heating for every 100 J of energy transferred by the electric current.	☐
Bulb A is more efficient.	☐
Both bulbs transfer more energy by lighting than heating.	☐
The bulbs do not waste any energy.	☐
Bulb B will not last as long as bulb A.	☐

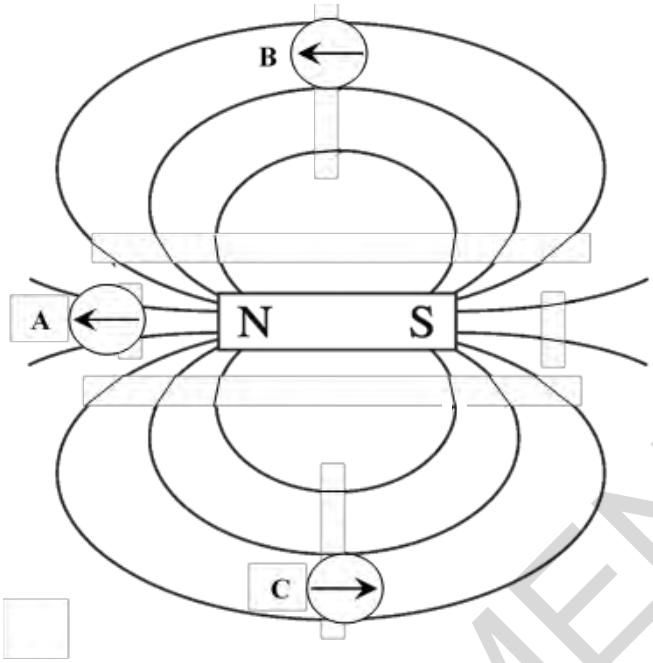
[2]

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

……% **[3]**

3 Two students are investigating magnets and electromagnets.

(a) They use three plotting compasses to examine the magnetic field around a bar magnet.



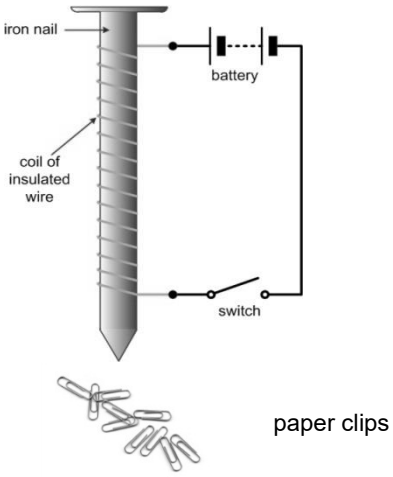
(i) Which of the plotting compasses, **A, B** or **C**, is faulty and pointing in the wrong direction?

…….. **[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	**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	**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.

…….. **[1]**

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

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

……

……

…….. **[2]**

4 Here is a list of waves:

Infrared

Microwaves

Sound

Ultraviolet

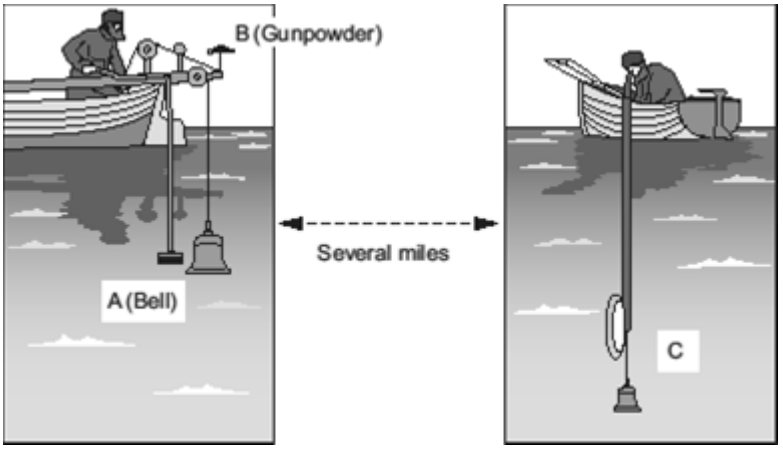
X-rays

(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 picked up several miles away (**C**).

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

……

…… **[2]**

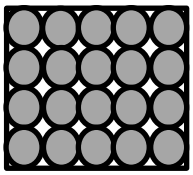
(b) The flash from the gunpowder was seen before the sound of the explosion was heard. Explain why this happened in terms of the speed that sound and light travel.

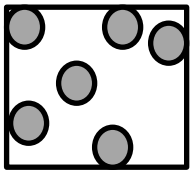
……

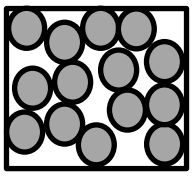
…… **[1]**

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

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.

nucleus positive electrons protons neutrons negative

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:

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

Outline 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 1000** of them developed a further cancer within 15 years as a result of the treatment.

Calculate approximately how many cancer patients involved in this study developed a further cancer within 15 years of treatment. Use the data given above in your answer.

…….. **[2]**

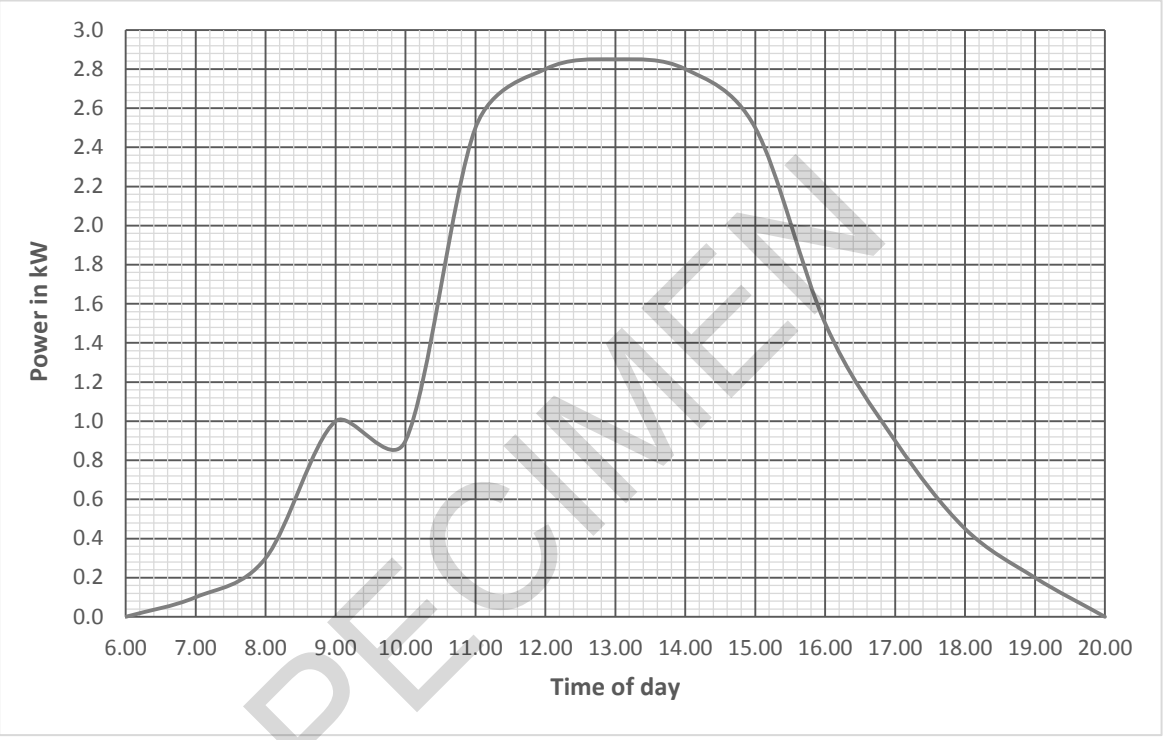
7 **(a)** Write down the difference between a renewable and a non-renewable energy resource.

……..……..

…… **[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.



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

……kW **[1]**

(c) The output from the solar panel is d.c. This needs converting to the correct a.c. voltage for the household.

(i) What is the correct voltage and frequency of the UK mains 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.

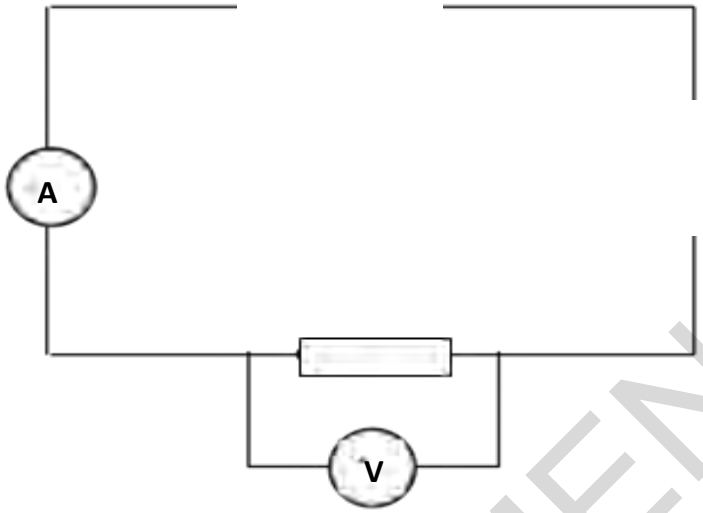
Name an energy resource for a power station that **does not** have a boiler.

…… **[1]**

8

(a) Melanie is learning about electric charge in circuits.

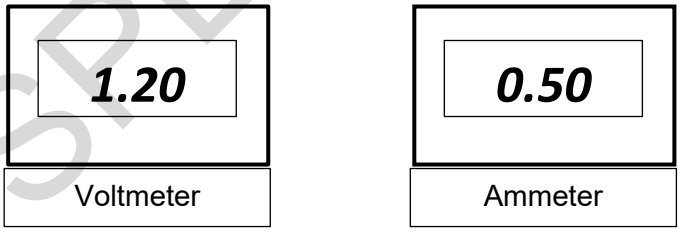
This is an incomplete circuit showing a resistor, a voltmeter and an ammeter.



(i) Complete the diagram, using the correct symbols, by adding a switch and a single cell or battery.

[1]

Melanie switches the circuit on and watches the voltmeter and ammeter readings carefully for **30 seconds.** She notices that both readings remain steady as shown below.



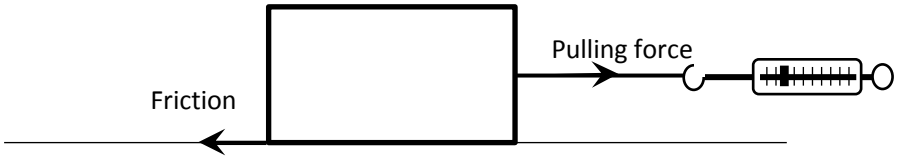
(ii) Calculate the quantity of electrical charge (in C) which flows through the resistor in 0.5 minutes.

……..C **[3]**

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

……..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 amount of work done by this force on the block as it is pulled 30 cm along the surface in 5 seconds.

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

……..J **[3]**

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

Use straight lines below 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 Molly 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 below.

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

(a) For which **two** cars is the amount of work done the same?

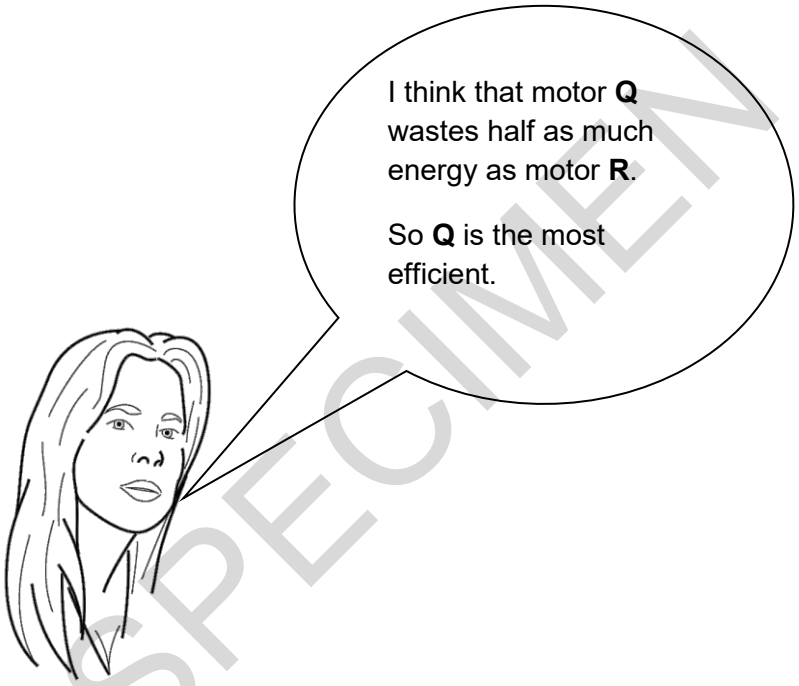
Show your working.

cars ……**and** …… **[2]**

(b) In another experiment to look at work done, Molly uses different electric motors to lift a large mass 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	2 000	1 920



Molly'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.

difference= .....W **[3]**

11 (a) (i) Define density.

……

…… **[1]**

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

Calculate its density.

…… kg/m^3 **[2]**

(b) Georgina 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.

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

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

Georgina concludes that the density of both the solid and the liquid affects whether it floats or sinks.

Use the data to justify Georgina's conclusion.

……

……

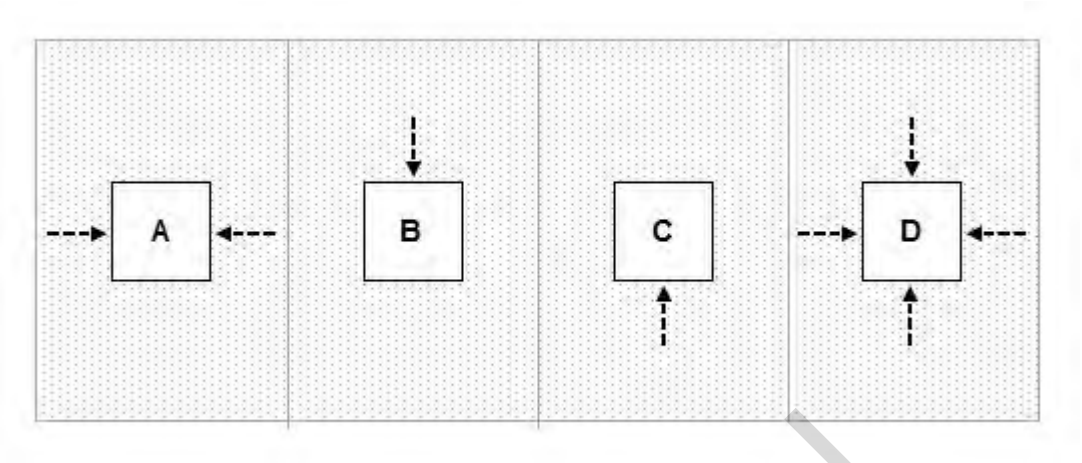
……

……

…… **[2]**

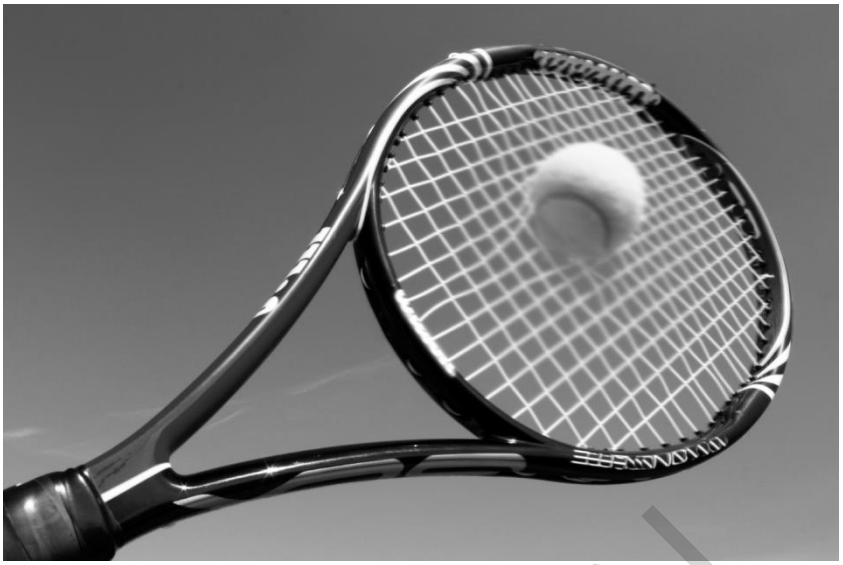
(c) A solid block is immersed in a liquid.

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



…….. **[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 following 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
It 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 0.06 kg and travels at a speed of 51 m/s.

Calculate the kinetic energy of the ball.

……..J **[3]**

(c) Calculate the weight in Newtons of the tennis ball. Gravitational field strength = 10 N/kg.

……N **[3]**

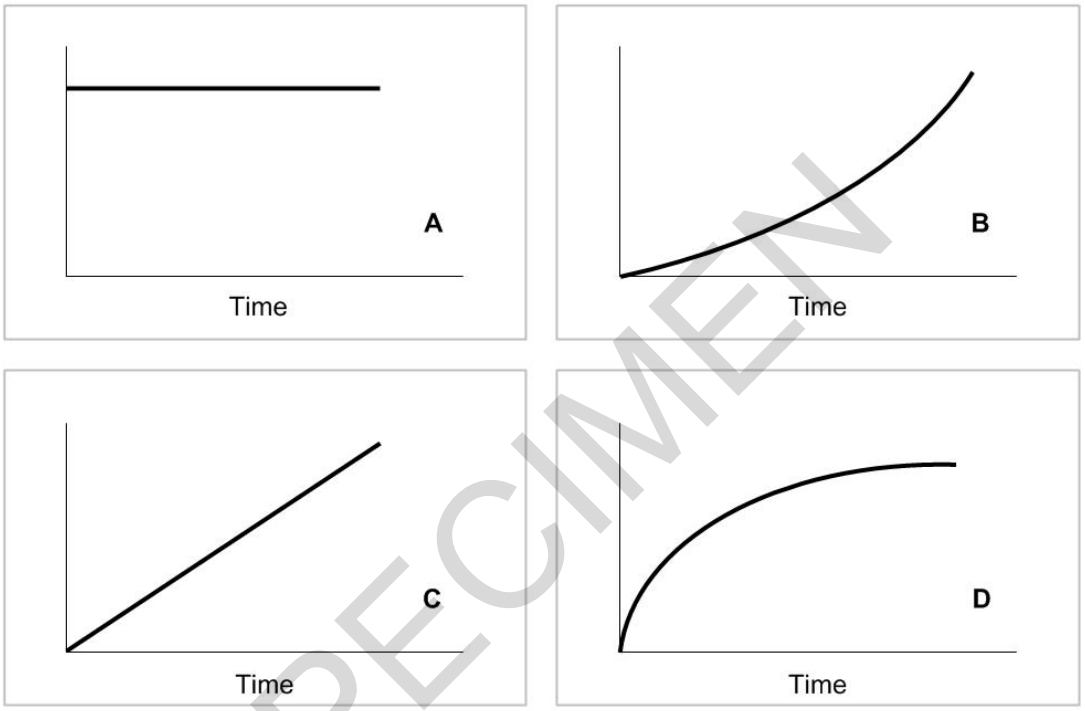
13 **(a)** A coin is dropped to the floor.

(i) Which of the graphs below, **A, B, C** or **D**, represents the distance time graph of the coin dropping?

…….. **[1]**

(ii) Which of the graphs below, **A, B, C** or **D,** represents the speed time graph of the coin dropping?

…….. **[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

……m/s **[3]**

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

……

……

…… **[3]**

END OF QUESTION PAPER

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