

PHYSICS



EXAM QUESTION PACK

P1.1 THE PARTICLE MODEL

SCORE

/43

PERCENTAGE

%

STEMUP

These questions belong to OCR, not to us.

The examination questions, mark schemes and examiner comments in this pack were written and published by OCR. They are past assessment materials, reproduced here so that students can revise from them.

What we do not own

STEMUP is not affiliated with OCR and does not own, and makes no claim to own, any of the question, mark scheme or examiner report material in this pack. OCR has not endorsed, approved or been involved in the production of it. OCR and the qualification titles used here belong to their respective owners and appear for identification only.

Where to find the originals

OCR publishes its past papers, mark schemes and examiner reports. Always check the current specification at ocr.org.uk before you revise, because content and wording can change between series.

If you hold the rights to any material in this pack and would like it amended or removed, contact admin@stemup.co.uk and we will act on it.

Gateway Physics A (9-1)

The particle model

Please note that you may see slight differences between this paper and the original.

Candidates answer on the Question paper.

OCR supplied materials:

Additional resources may be supplied with this paper.

Other materials required:

- Pencil
- Ruler (cm/mm)

Duration: Not set

Candidate forename		Candidate surname								
Centre number						Candidate number				

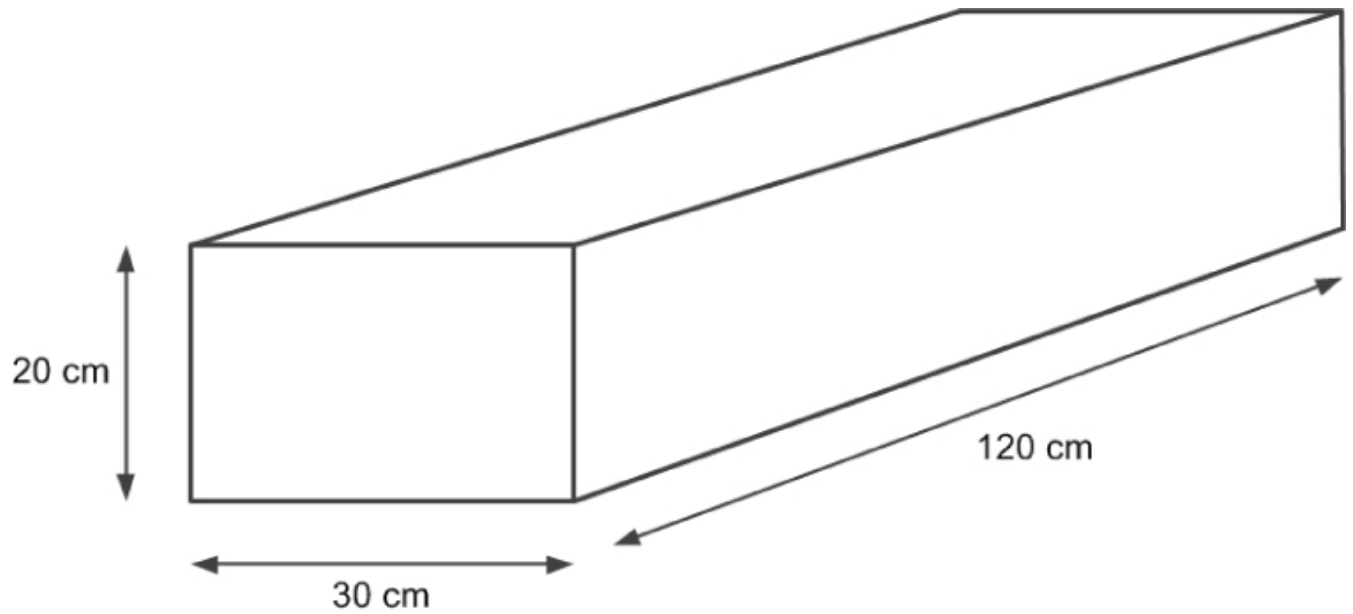
INSTRUCTIONS TO CANDIDATES

- 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, unless your teacher tells you otherwise.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Where space is provided below the question, please write your answer there.
- You may use additional paper, or a specific Answer sheet if one is provided, but you must clearly show your candidate number, centre number and question number(s).

INFORMATION FOR CANDIDATES

- The quality of written communication is assessed in questions marked with either a pencil or an asterisk. In History and Geography a *Quality of extended response* question is marked with an asterisk, while a pencil is used for questions in which *Spelling, punctuation and grammar and the use of specialist terminology* is assessed.
- 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 **43**.
- The total number of marks may take into account some 'either/or' question choices.

- 1 Wood has a density of 180 kg/m^3 .



Calculate the mass of this piece of wood.

Show your working and give the units.

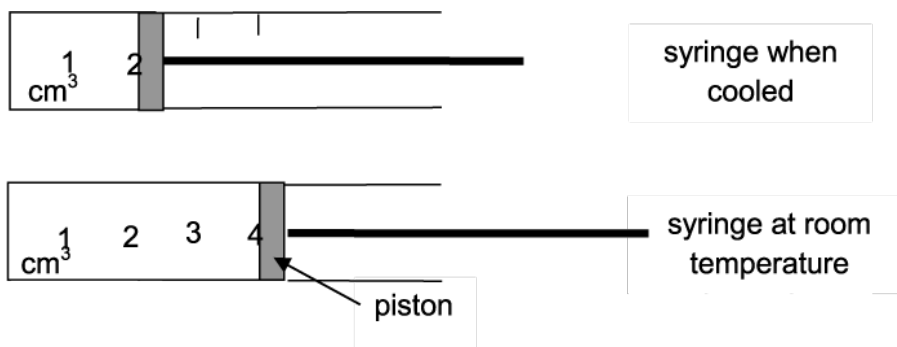
answer: _____ units: _____

[6]

- 2 A graduated syringe contains air.

It is put in a freezer to cool it down.

When it is removed from the freezer the piston has moved inwards.



The density of the air in the syringe when cooled is 2.4 kg/m^3 .

What was the density of the air at room temperature?

- A 0.6 kg/m^3
- B 1.2 kg/m^3
- C 2.4 kg/m^3
- D 4.8 kg/m^3

Your answer

[1]

- 3 A piece of metal has a volume of $2.0 \times 10^{-5} \text{ m}^3$.

The density of it is $8.0 \times 10^3 \text{ kg/m}^3$.

What is its mass?

- A $2.5 \times 10^{-3} \text{ kg}$
- B $4.0 \times 10^{-2} \text{ kg}$
- C $1.6 \times 10^{-1} \text{ kg}$
- D $1.6 \times 10^3 \text{ kg}$

Your answer

[1]

4(a) Roxanne investigates the density of different materials.

She calculates the density using this equation:

density (in g/cm³) = $\frac{\text{mass}}{\text{volume}}$

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

Calculate the density of glass.

answer ----- g / cm³

[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.

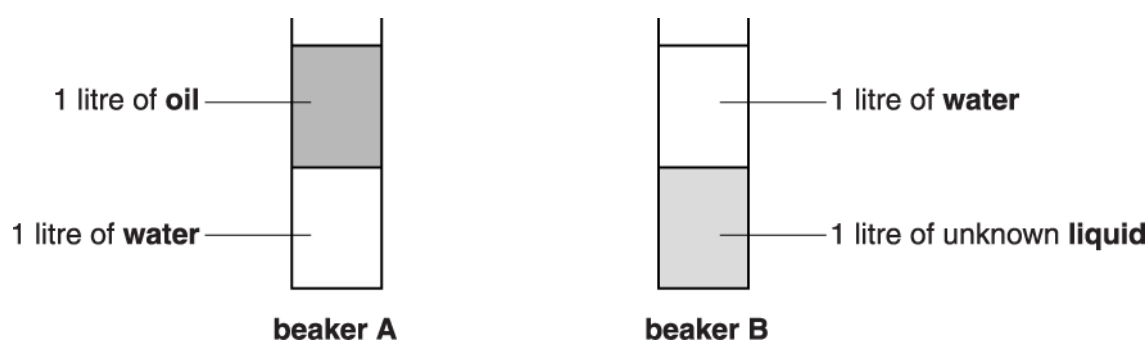
She puts one litre of oil into beaker **A**.

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.



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

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

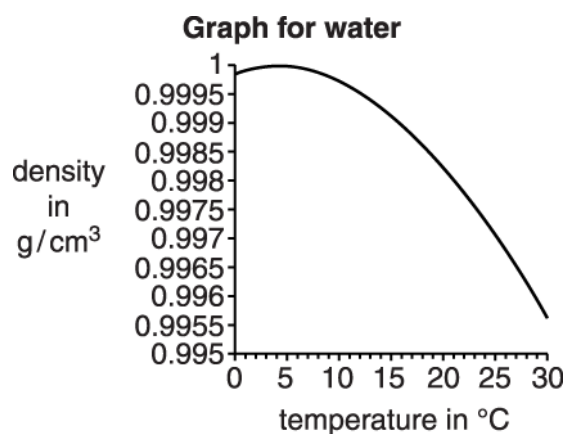
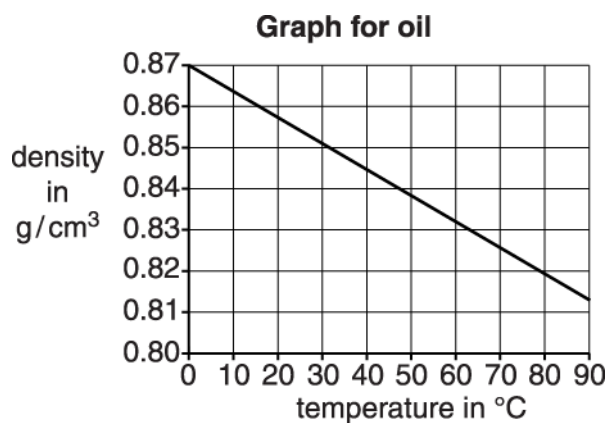
[3]

(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.

-----[2]

5 Atomic models have changed over time.

Old atomic model – Atoms are a positive mass with negative electrons fixed in it.

Current atomic model – Atoms are made from protons, neutrons and electrons.
Protons and neutrons are in a central nucleus surrounded by a cloud of electrons.

(i) Write down **two** differences between these models.

1 -----

2 -----

[2]

(ii) Why did the atomic model change?

[2]

6 The atomic model has changed over time.

Why did the model need to change over time?

- A Models only have a finite lifetime
- B Computers were invented
- C The older models could not explain new evidence
- D Peer review

Your answer

[1]

7 A radio wave has a wavelength of 100 m. It has a speed of 3×10^8 m/s.

Use the equation: Wave speed = Frequency $\times$ Wavelength

Calculate the frequency of the wave.

- A 3 MHz
- B 30 MHz
- C 300 MHz
- D 3000 MHz

Your answer

[1]

8 What is the typical diameter of an atom?

A $1.0 \times 10^{-15} \text{ m}$

B $1.0 \times 10^{-10} \text{ m}$

C $1.0 \text{ }\mu\text{m}$

D 1.0 mm

Your answer

[1]

9 A liquid has a volume of 0.01 m^3 and a mass of 12 kg .

What is the density of the liquid?

Use the equation: $\text{density} = \text{mass} \div \text{volume}$

A 0.12 kg / m^3

B 12 kg / m^3

C 120 kg / m^3

D 1200 kg / m^3

Your answer

[1]

10 Different states of matter have different densities.

Which of the following shows the states of matter in density order, starting with the lowest density?

- A Solid – liquid – gas
- B Solid – gas – liquid
- C Gas – liquid – solid
- D Liquid – gas – solid

Your answer

[1]

11 An object has a volume of 1.5 m^3 and a mass of 3.0 kg .

What is the density of the object?

Use the equation: density = mass $\div$ volume

- A 0.5 kg/m^3
- B 2.0 kg/m^3
- C 4.5 kg/m^3
- D 6.0 kg/m^3

Your answer

[1]

12 A student investigates what happens when she heats a beaker of water.

	The temperature increases	The state changes	The energy stored in the water changes
A	✓	✓	✓
B	✓	x	x
C	x	✓	x
D	x	x	✓

Which row in the table describes what **could** happen when the water is heated?

Your answer

[1]

13(a) A student uses a ruler to determine the volume of a cube, **A**. The length of one side of the cube is 0.100 m.

(i) Calculate the volume of cube **A**.

Volume of cube **A** = ... m³ [2]

(ii) Cube **B** has the same volume as cube **A**.

The mass of cube **B** is ten times greater than the mass of cube **A**.

Compare the density of cube **B** with cube **A**.

Use the equation for density to help your explanation.

----- [2]

(b) Give **one** reason why a solid is more dense than a gas.

----- [1]

14 What is the typical size for a small molecule?

- A 0.1 cm
- B 0.1 km
- C 0.1 m
- D 0.1 nm

Your answer

[1]

15(a) Complete the sentences about an atom.

Use words from the list.

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

Atom	Electrons	Negatively	Neutrons
Nucleus	Orbits	Positively	Protons

An atom has a charged nucleus surrounded by
charged electrons.

The nucleus contains protons and

Almost all of the mass of an atom is in the

[4]

(b)

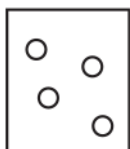
- (i) A swimming pool contains 9970 kg of water in 10 m³.

Calculate the density of water.

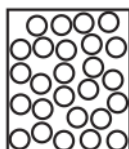
Use the equation: density = mass ÷ volume

Density = ... kg / m³ [1]

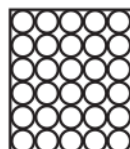
- (ii) The diagrams, A, B and C, show the particles in three states of matter.



A



B



C

Write the letters in the boxes to give the correct order of density, from **most** to **least** dense.

Most dense —————→ **Least dense**



[1]

- (iii) Explain why you chose the order in (ii).

----- [1]

END OF QUESTION PAPER

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
1			Conversion of cm to m (1) Calculation of volume: $0.2 \times 0.3 \times 1.2 = 0.072 \text{ m}^3$ (1) Re-arrangement of formula for mass (1) Substitution: 180×0.072 (1) Answer: 13 (1) Units: kg (1)	6	ALLOW 12.96
			Total	6	
2			B	1	
			Total	1	
3			C	1	
			Total	1	
4	a		1.9(333) (g/cm ³)	1	Examiner's Comments This calculation was mostly correct.
	b		2.7 (g) [2] BUT if answer is incorrect then 0.9 x 3 scores [1]	2	Examiner's Comments This calculation was mostly correct.
	c		Mark explanation only B is heaviest [0] Unknown liquid is denser than water [1] Unknown liquid is denser than oil [1] and is liquid X [1]	3	If answer is A then it is still possible to gain up to 2 marks If no clear reference to density of water or oil is made then allow unknown liquid is heavier than oil / water [1] Examiner's Comments Most chose beaker B as the response and went on to select liquid X [1]. Better answers also described the unknown liquid as denser than water [1] and oil [1].

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	d	i	Oil (linear) reduction in density with increasing temperature / ORA [1]	1	Examiner's Comments Most chose beaker B as the response and went on to select liquid X [1]. Better answers also described the unknown liquid as denser than water [1] and oil [1].
		ii	Water density rises up to 5° and then falls (non-linearly) as temperature increases AW [1]	1	Eg. water's maximum density is at 5°C [1] Allow 3°C – 6°C tolerance Examiner's Comments Most answers restricted their descriptions of the graph to the portion after 60C. This meant they missed out the key points of density rising to a peak at 5 or 6°C and then falling with increased temperature.
		iii	Any two from: Ice (at 0°C) is less dense (than water at 0°C) [1] Density of water increases up to 5°C [1] (Idea that) water warmer as depth increases [1]	2	e.g. 'warmest water at the bottom' scores [1] Examiner's Comments In this question most stated that ice floated on water as its density is lower than water. Very few realised the water's temperature increased with depth.
			Total	10	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
5		i	Any two from: The old model has no protons / ORA ✓ The old model has no neutrons / ORA ✓ There is no nucleus in the old model / ORA ✓ The electrons are in fixed positions in the old model / ORA ✓ The positive particles are in a nucleus in the current model ✓ The negative particles/electrons are outside / surround the nucleus in the current model ✓	2 (AO2 × 1.1)	<u>Examiner's Comments</u>  Misconception It is important to be clear which model/view point/thing the candidate is writing about in these type of question. Candidates will not be credited when they expect the examiner to interpret what their answer implies. It is better to state clearly "the old model." rather than "one of the models ..." A number of candidates read the first statement about the old atomic model as implying that atoms had a positive charge. Several candidates did not achieve both marks because they were not clear about which model they were talking about.
		ii	Any two from: new evidence ✓ more experiments completed ✓ previous model couldn't explain new observations ✓	2 (AO2 × 1.1)	ALLOW mention of Rutherford, Geiger/Marsden <u>Examiner's Comments</u> Most candidates recognised the role of Rutherford/Geiger/Marsden which was expected. Several candidates mentioned Niels Bohr and/or John Dalton, which was unexpected in this context.
			Total	4	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
6			C ✓	1 (AO1.1)	Examiner's Comments The great majority of candidates gave the correct answer C.
			Total	1	
7			A ✓	1 (AO 2.2)	Examiner's Comments This was the most challenging question in Section A. The most common response was distractor D, where candidates multiplied the numbers together rather than dividing wave speed by wavelength.  AfL For these type of questions candidates should be encouraged to insert the numbers into the equation. When they do this they will see that the equation needs to be rearranged. Alternatively, candidates could rearrange the equation so that the unknown quantity is on the left-hand side of the equal sign.
			Total	1	
8			B ✓	1 (AO1.1)	Examiner's Comments The majority of the candidates correctly recalled the diameter of the atom. A small but significant number of candidates incorrectly chose response A.
			Total	1	
9			D ✓	1 (AO2.1)	Examiner's Comments Most candidates correctly substituted the numbers into the given equation.
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
10			C ✓	1 (AO2.1)	Examiner's Comments Candidates knew the order in which the states needed to be put. Option A is the correct answer. Option D was a common misunderstanding where candidates had not placed the states of matter '...in density order, starting with the lowest density.'
			Total	1	
11			B ✓	1 (AO2.1)	
			Total	1	
12			A	1 (AO2.1)	
			Total	1	
13	a	i	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = $0.001 / 1 \times 10^{-3} \text{ (m}^3\text{)}$ award 2 marks $0.1 \times 0.1 \times 0.1 \checkmark$ $= 0.001 / 1 \times 10^{-3} \text{ (m}^3\text{)} \checkmark$	2 (AO2x2.2)	
		ii	Density = mass/volume / density is proportional to mass ✓ (Cube B has 10 x mass of cube A, so) density of cube B is 10 x density of cube A ✓	2 (AO1.2) (AO2.2)	ALLOW density is 10 times larger ALLOW numerical values used to show density of cube B is 10 x density of cube A
	b		Particles (in solid) are close(r) together / (more) compact / ORA / AW✓	1 (AO1.1)	Assume answer refers to a solid unless indicated otherwise
			Total	5	
14			D	1 (AO1.1)	
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
15	a		Positively ✓ Negatively ✓ Neutrons ✓ Nucleus ✓	4 (AO1.1 x 4)	
	b	i	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 997 (kg/m ³) award 2 marks 9970 ÷ 10 ✓ = 997 (kg/m ³) ✓	2 (AO 2.1) (AO 2.1)	
		ii	C B A	1 (AO1.1)	Correct order only
		iii	Any one from: C has more/the most particles (for the same volume) ✓ A has fewer/the least particles (for the same volume) ✓	1 (AO 1.1)	ALLOW C has particles closest together/least spread out/most tightly packed ALLOW A has particles furthest apart/most spread out/least tightly packed ALLOW correct identification of C = solid, (B = liquid,) A = gas
			Total	8	