

- (a)** Scientists have ideas about where the Earth's atmosphere and oceans came from. They think that:
1. The atmosphere formed from gases that came out of volcanoes.
 2. More than 4400 million years ago, water vapour from volcanoes condensed to form the oceans, leaving other gases in the air.

How does the data in the table and the graph support these ideas?

[3]

- (i) Explain the changes to the percentages of oxygen and carbon dioxide in the atmosphere shown on the graph.

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- (ii) The percentages of oxygen and carbon dioxide have stayed approximately the same since 500 million years ago.

Explain why.

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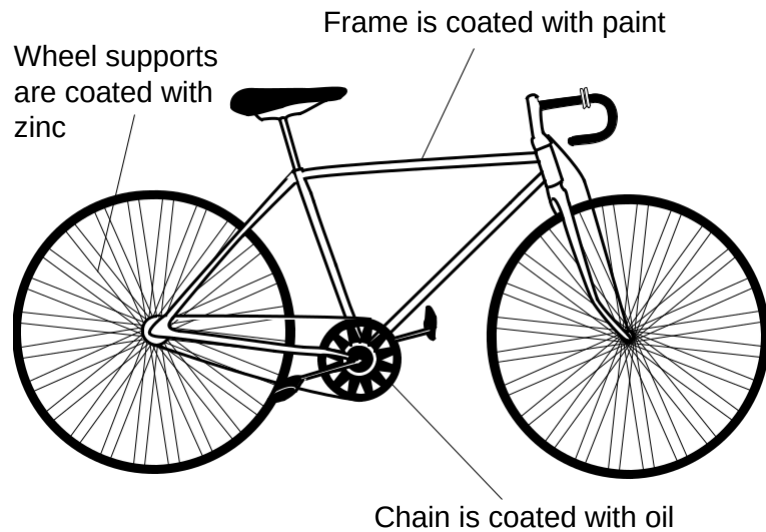
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.....

..... [2]

- (c)* Different parts of a bike are each made from different steel alloys. Each of the alloys contains mainly iron.

The diagram shows the different methods to prevent corrosion that are used on each part of the bike.



Explain how each of the coatings used on the bike prevent corrosion and discuss how effective the coatings are if they become damaged.

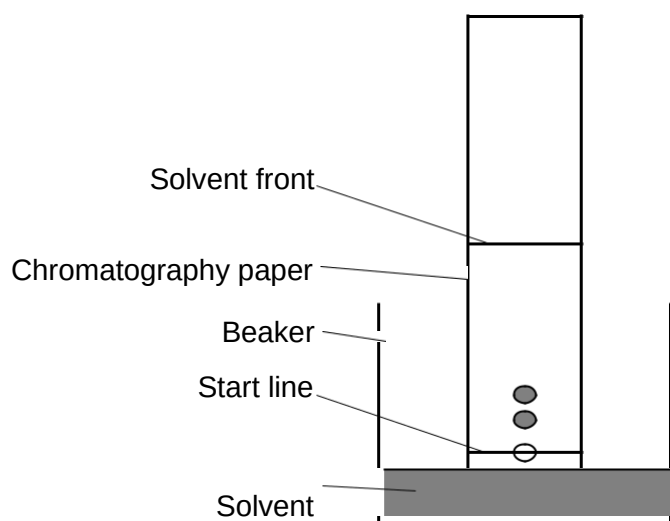
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[6]

- (c) The scientist uses paper chromatography to separate the substances in one of their medicines.

They use water as a solvent.

The diagram shows their results.



- (i) Identify the stationary phase and the mobile phase in their experiment.

Stationary phase

Mobile phase

[2]

- (ii) Use ideas about solubility to explain why the substances separate.

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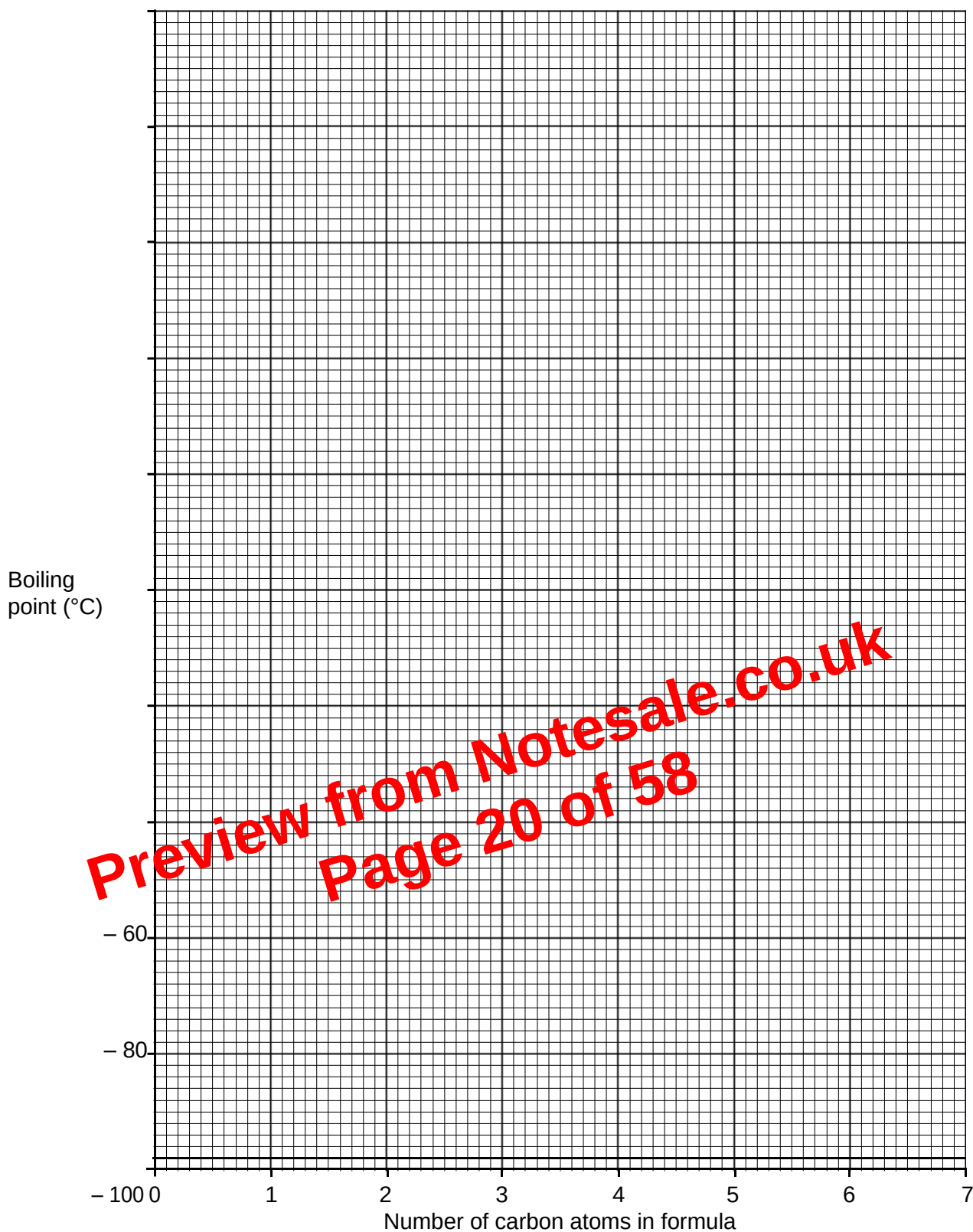
..... [2]

- (iii) The scientist wants to improve the chromatography experiment.

Suggest **one** way they can increase the separation of the substances.

.....

..... [1]



[3]

(ii) Use your graph to estimate the boiling point of propane, C₃H₈.

Boiling point of propane = °C [1]

- (b) The scientist concludes that recycling PET bottles reduces harm to the environment despite its use of energy.

Suggest **two** reasons why recycling PET bottles reduces harm to the environment.

- 1
- 2 [2]

- (c) The fabric at the end of the process is used for different products.

Two of the products made from the fabric are padded jackets and insulation for houses.

Suggest why the life cycle assessments of these two products are different.

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-
- [2]

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10. For answers marked by levels of response:

Read through the whole answer from start to finish, using the Level descriptors to help you decide whether it is a strong or weak answer. The indicative scientific content in the Guidance column indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance. Using a 'best-fit' approach based on the skills and science content evidenced within the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer.

Once the level is located, award the higher or lower mark:

The higher mark should be awarded where the *Level descriptor* has been evidenced and all aspects of the communication statement (in italics) have been met.

The lower mark should be awarded where the *level descriptor* has been evidenced but aspects of the communication statement (in italics) are missing.

In summary,

The skills and science content determines the level.

The communication statement determines the mark within a

level. Level of response questions on this paper are **5c** and **8**

Question			Answer	Marks	AO element	Guidance
4	(a)		Atmosphere formation: (early) atmosphere <u>and</u> volcano gases contain carbon dioxide and nitrogen and hydrogen / volcano gases contain the same gases present in the atmosphere ✓ (graph) (early) atmosphere <u>and</u> volcanoes gases contain <u>more</u> carbon dioxide than other gases (hydrogen and nitrogen) ✓ Ocean formation: there are large amounts/92% of water vapour in volcano gases but not in the early atmosphere ✓	3	3.1a 2 x 3.1b	Note: For all MPs answer must refer to <u>both</u> (early) atmosphere ('the graph') <u>and</u> volcanoes ('the table') IGNORE references to oxygen / photosynthesis / respiration / development of the atmosphere / comparison to composition of atmosphere <u>today</u> ALLOW carbon dioxide has the second highest percentage composition in volcano gases and the highest in the (early) atmosphere AW
	(b)	(i)	plants appeared/carbon dioxide dissolves in the oceans ✓ carbon dioxide has fallen and oxygen has increased ✓ photosynthesis uses carbon dioxide and/or produces oxygen ✓	3	2.1 2 x 1.1	Plants=algae/phytoplankton/photosynthetic organisms/photosynthetic bacteria /cyanobacteria ALLOW 2 marks (MP2 and MP3) for photosynthesis uses carbon dioxide and produces oxygen IGNORE correct references to respiration DO NOT ALLOW MP3 if stated that respiration produces oxygen / uses carbon dioxide
		(ii)	animals (and plants) use oxygen (for respiration) ✓ rate of oxygen and/or carbon dioxide being used up is equal to the rate of production / same amount of carbon dioxide and/or oxygen is produced and used ✓	2	1.1 2.1	IGNORE 'equilibrium' ALLOW rate of photosynthesis = rate of respiration

Question			Answer	Marks	AO element	Guidance
5	(a)		improved properties / harder / stronger / more corrosion resistant ✓	1	1.1	IGNORE more malleable/ductile/melting point/brittleness/hardwearing/durability/takes more weight ALLOW does not rust
	(b)	(i)	Shows $(97.8/0.12) = 815$ (which is more than 800) ✓	1	1.2	ALLOW $800 \times 0.12 = 96\%$ (which is less than 97.8%) OR ratio is 800:0.98 (which is less than one)
		(ii)	mole ratio is smaller because iron has a higher relative atomic mass / carbon has a lower relative atomic mass / quote 56 or 55.8 and 12 ✓✓	2	2.1	ALLOW for 1 mark: (relative) atomic mass of iron (56 or 55.8) and carbon (12) are different ALLOW mass number DO NOT ALLOW molecular mass / M_r / relative formula mass / RFM