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General Certificate of Education (A-level) Applied
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Applied Science SC05

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Unit 5: Choosing and Using Materials

Final

Mark Scheme

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Question 1

1(a)(i)	Diagram 1.	(1) (AO1)	**1**
1(a)(ii)	The object is in the air / the object is in water in the other diagrams / other readings will be less than the weight in air / gravity is only force on it.	(1) (AO1)	**1**
1(b)(i)	Diagrams 1 and 2 (in any order).	(1) (AO1)	**1**
1(b)(ii)	The object must be fully submerged.	(1) (AO1)	**1**
1(b)(iii)	12 (cm^3)	(1) (AO1)	**1**
1(b)(iv)	(Measuring cylinder is) too full / reads 97 (cm^3) – for 1 mark. BUT: Submerged object would take reading above 100 (cm^3) where there are no markings / water overflows – scores 2 marks.	(1) (AO2) (1) (AO2)	**2**
1(c)(i)	Measure the dimensions of the object. Multiply length x breadth x height.	(1) (AO1) (1) (AO1)	**2**
1(c)(ii)	Density = mass ÷ volume = 1.35 ÷ 5 x 10^{-4} = 2.7 x 10^3 kgm^{-3} (2700 kgm^{-3}) 2 marks for correct answer (Allow 1 compensation mark for correct formula or substitution). 1 mark for correct units (allow kg/m^3).	(1) (AO2) (1) (AO2) (1) (AO1)	**3**

Total Mark: 12

Question 2

2(a)(i)	Force required to break (or snap) / how difficult it is to break (or snap).	(1) (AO1)	**1**
2(a)(ii)	Any 2 from: 1. (Strength) is a property of the material (not specimen). 2. (Strength) is independent of dimensions (of specimen). 3. Breaking force depends on dimensions (of specimen). 4. (Breaking stress) takes cross-sectional area into account. Allow stress = force ÷ cross-sectional area.	(1) (AO2) (1) (AO2)	**2**
2(b)	Wood/oak.	(1) (AO1)	**1**
2(c)(i)	Made of more than one material.	(1) (AO1)	**1**
2(c)(ii)	To gain the properties of each material (not just stronger) / better (or improved properties / desired properties.	(1) (AO1)	**1**
2(c)(iii)	Laminate box ticked.	(1) (AO1)	**1**
2(d)	Manmade / not natural.	(1) (AO1)	**1**
2(e)	Irregular / non-crystalline.	(1) (AO1)	**1**
2(f)	Arrow pointing to the bottom of the shelf. The arrow must be clearly pointing to the bottom part of the shelf, anywhere along its length.	(1) (AO1)	**1**

Total Mark 10

Question 3

3(a)	Axes drawn in correct place and labelled. Suitable scales and units. All 5 points plotted correctly (± 1/2 a small square). Straight line through origin.	(1) (AO2) (1) (AO2) (1) (AO2) (1) (AO2)	**4**
3(b)(i)	As force increases so does the extension (or converse) – for 1 mark. BUT Extension is directly proportional to force (or WTTE) – for 2 marks.	(1) (AO2) (1) (AO2)	**2**
3(b)(ii)	2.9(cm) Accept answers from 2.8 to 3.0 – read from the graph.	(1) (AO1)	**1**
3(b)(iii)	Beyond elastic limit / for large loads there will not be a linear relationship (OWTTE) / plastic deformation will occur with large loads.	(1) (AO2)	**1**
3(c)(i)	(Metal) spring.	(1) (AO1)	**1**
3(c)(ii)	Any 2 from: Straight line indicates spring (or wire). Extensions are too great for a wire. Wire would require much greater force to produce extensions shown. Any other reason why it might be a spring.	 (1) (AO1) (1) (AO1)	**2**

Total Mark: 11

Question 4

4(a)	Heat resistant.	(1) (AO1)	**1**
4(b)	Hard wearing / chemically unreactive.	(1) (AO1)	**1**
4(c)	In order: A sharing (of a pair) of electrons. Force of attraction between ions. Can withstand large crushing / squashing forces. Fractures / shatters / snaps /cracks / only deforms elastically / no (or little) plastic deformation.	 (1) (AO1) (1) (AO1) (1) (AO1) (1) (AO1)	**4**
4(d)	No free electrons / no delocalised electrons / no free ions.	(1) (AO2)	**1**
4(e)(i)	(Tensile) force ÷ weight.	(1) (AO1)	**1**
4(e)(ii)	Articles will have a low weight. (Accept light)	(1) (AO1)	**1**
4(f)	It does not have any grain boundaries (to reflect light back).	(1) (AO2)	**1**

Total Mark: 10

Question 5

5(a)(i)	In any order: Good conductor of electricity. (Accept ductile) Low density.	(1) (AO1) (1) (AO1)	**2**
5(a)(ii)	Stronger. Must be a comparison i.e. stronger, not just strong.	(1) (AO1)	**1**
5(a)(iii)	A mixture of elements including at least one metal. Accept a mixture of metals. (Do not accept metals being 'joined' or 'combined' or 'bonded')	(1) (AO1)	**1**
5(b)	Made up of long chain molecules / a long chain molecule / a long chain of monomers. NOT A long chain of molecules.	(1) (AO1)	**1**
5(c)	Row 1 increase increase no change Row 2 decrease decrease no change Row 3 increase increase no change Accept correct alternative answers for increase (goes up, gets higher), decrease (goes down, gets lower) and no change (stays the same). For each row – 2 marks for all 3 answers correct 1 mark for 2 answers correct	(1) (AO1) (1) (AO1) (1) (AO1) (1) (AO1) (1) (AO1) (1) (AO1)	**6**
5(d)	In order: A D B	(1) (AO1) (1) (AO1) (1) (AO1)	**3**

Total Mark: 14

Question 6

6(a)(i)	Stiff materials are inflexible / rigid / difficult to bend / have a high value of Young's modulus.	(1) (AO1)	**1**
6(a)(ii)	Can be drawn out into wires (or pipes) / shows both elastic and plastic behaviour.	(1) (AO1)	**1**
6(b)(i)	Stress = force ÷ cross-sectional area.	(1) (AO1)	**1**
6(b)(ii)	Strain = extension ÷ original length.	(1) (AO1)	**1**
6(b)(iii)	Strain is a ratio of two lengths / idea that the units cancel out.	(1) (AO1)	**1**
6(c)(i)	Stress = 10×10^9 (from graph) Force = stress x area $= 10 \times 10^9 \times 4.5 \times 10^{-3}$ $= 4.5 \times 10^7$ (N) 3 marks for correct answer. 2 compensation marks for: • 10×10^9 • Force = stress x area / correct substitution / allow compensation mark for stress = force ÷ area if not given in (b)(i).	(1) (AO2) (1) (AO2) (1) (AO2)	**3**
6(c)(ii)	Young modulus = stress ÷ strain. $= 10 \times 10^9 \div 4 \times 10^{-2}$ (or any other correct figures from graph) $= 2.5 \times 10^{11}$ Nm^{-2} 2 marks for correct answer (1 compensation mark for correct formula or substitution). 1 mark for correct unit (also accept N/m^2 or Pa).	(1) (AO2) (1) (AO2) (1) (AO1)	**3**
6(d)	Tensile strength / density / elasticity.	(1) (AO1)	**1**

Total Mark: 12

Question 7

7(a)	The 5 points underlined must be listed by the candidate. 3 additional marks for any three of the other points. 1. Measure length of steel pipe 2. Using a ruler. 3. Take initial temperature reading. 4. Turn micrometer until it touches the pipe. 5. Take micrometer reading. 6. Unscrew micrometer. 7. Pass steam through pipe. 8. Once steam has been emerging for several minutes. 9. Turn micrometer until it touches the pipe. 10. Take new micrometer reading. 11. Repeat micrometer reading after a further few minutes. to make sure expansion is complete. 12. Take final temperature reading. 13. Subtract micrometer readings to obtain expansion. 14. Subtract temperature readings to obtain rise in temperature.	(5) (AO3) (3) (AO3)	**8**

7(b)	X = platinum. Y = aluminium. If correct metals are named but the wrong way round – give 1 mark.	(1) (AO2) (1) (AO2)	**2**

7(c)	Coefficient of linear expansion of brass is higher than that for steel.	(1) (AO2)	**1**

Total Mark: 11

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