Version 1.0

General Certificate of Education (A-level) Applied
January 2012

Applied Science SC05

(Specification 8771/8773/8776/8777/8779)

Unit 5: Choosing and Using Materials

Final

Mark Scheme

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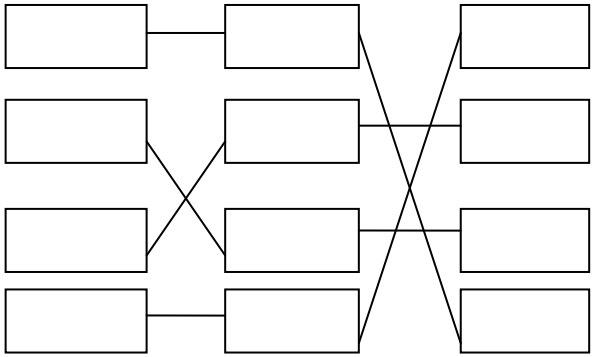
Question	Part	Sub-part	Marking guidance	AO	Mark	Comment
1	(a)		 All 4 **pairs** of lines correct = 3 marks, 3 or 2 correct = 2 marks, 1 correct = 1 mark	1 (AO1) 1 (AO1) 1 (AO1)	3	
1	(b)		In order : C B A	1(AO1) 1(AO1) 1(AO1)	**3**	

Total Marks: 6

2	(a)		Axes drawn in correct place and labelled (1) Suitable scales and units (1) All 6 points plotted correctly (1) (Allow half a small square latitude for each point) Straight line drawn through all 6 points and origin (1)	1(AO2) 1(AO2) 1(AO2) 1(AO2)	4	
2	(b)		Read off line of best fit (no units needed) 2·8	1(AO1)	1	
2	(c)		As cross-sectional area increases, breaking force increases (or converse) – 1 mark BUT – breaking force is directly proportional to cross-sectional area – 2 marks	1(AO2) 1(AO2)	2	

2	(d)	(i)	H It deforms plastically over the largest range	1(AO1) 1(AO2)	2	

2	(d)	(ii)	F It extends the least for a particular load / graph has largest gradient / graph is steepest	1(AO1) 1(AO2)	2	

2	(d)	(iii)	E It takes largest load before fracture	1(AO1) 1(AO2)	2	

Total Marks: 13

3	(a)		Malleable : can be hammered (or pressed) into shape (NOT: can be shaped) Brittle : Fractures / cracks / shatters / snaps / only deforms elastically / no (or little) plastic deformation	1(AO1) 1(AO1)	2	

3	(b)		Alloy	1(AO1)	1	

3	(c)		• In pure iron the layers / atoms can slide past each other • The carbon atoms / different sized atoms / irregular structure • Stops the layers / atoms from sliding past each other (as easily)	1(AO2) 1(AO2) 1(AO2)	3	

3	(d)	(i)	• Heat to <u>high</u> temperature / heat strongly • Cool <u>quickly</u> / cool in water / cool in oil	1(AO1) 1(AO1)	2	not ‘heat quickly’

3	(d)	(ii)	In any order: • Brittleness • Stiffness Accept: toughness, <u>tensile</u> strength, resistance to corrosion	1(AO1) 1(AO1)	2	

Total Marks: 10

4	(a)		Made up of long chain molecules / a long chain molecule (NOT a long chain <u>of</u> molecules) / a long chain of monomers	1(AO1)	1	
4	(b)		Irregular structure / non crystalline	1(AO1)	1	
4	(c)		Mark answers in pairs giving 1 mark for each correct pair. Within each pair the answers must be in the correct order i.e. • Density - mass • Tough - energy • Compressive - tensile	 1(AO1) 1(AO1) 1(AO1)	3	
4	(d)	(i)	In any order: • Less likely to break (or shatter) / safer / breaks into small pieces • Lower long term costs	 1(AO1) 1(AO1)	2	
4	(d)	(ii)	• Heat treated / annealed • Allowed to cool <u>slowly</u>	1(AO1) 1(AO1)	2	
4	(e)		Any 6 from: • Measure mass of object • Using a balance • Measure volume of object • Using displacement method (or a description) • Density = mass ÷ volume • Repeat • Take average	6 × (AO3)	6	

Total Marks: 15

5	(a)		They have diameters measured in nanometres	1(AO2)	1	
5	(b)		50 times (stronger)	1(AO1)	1	

5	(c)		In order: • Giant molecule • Inflexible / resistant to bending / rigidity / a stiff material has a high Young modulus • Maximum stress material can withstand (before fracture) / breaking stress • Material does not return to original length (or shape or size) when load is removed / material is <u>permanently</u> deformed	1(AO1) 1(AO1) 1(AO1) 1(AO1)	4	

5	(d)		Any 2 from: • Lighter / less weight / less mass • Stronger / greater tensile strength • Corrosion resistant / does not rust Accept 'easier to ride'	1(AO2) 1(AO2)	2	

5	(e)		In any order: • Nanotubes have a large surface area • Catalyst can be caged within the nanotube / reacting molecules cannot escape / more collisions between molecules	1(AO1) 1(AO1)	2	

Total Marks: 10

6	(a)	(i)	Can withstand high crushing / squashing forces	1(AO1)	1	

6	(a)	(ii)	Can withstand low stretching / pulling forces	1(AO1)	1	

6	(b)	(i)	Arrow pointing to the top of the beam	1(AO1)	1	

6	(b)	(ii)	The beam is in tension (in the lower part)	1(AO1)	1	

6	(c)	(i)	Any 3 from: • Wood needs painting (or protecting) • Wood will rot / decay (do not accept corrode) • Wood is not waterproof • Wood may warp / be damaged by weather • (hard)wood is heavier • depleting natural resources	1(AO1) 1(AO1) 1(AO1)	3	

6	(c)	(ii)	• (PVC) is a flexible material (1) • It needs to be rigid (to support glass) (1) BUT: makes it less flexible / makes it stiffer / to stop it bending = 2 marks	1(AO1) 1(AO1)	2	

6	(d)		Any 2 from: • Malleable • Unreactive / does not corrode • Waterproof • Easily cut (Ignore strong)	1(AO1) 1(AO1)	2	

6	(e)	(i)	62(%)	1(AO1)	1	

6	(e)	(ii)	108g of lead + 42g of tin - 2 marks for correct answer 1 compensation mark for : • 72% lead + 28% tin • or mass of lead = 72 × 150 ÷ 100 • or mass of tin = 28 × 150 ÷ 100	1(AO2) 1(AO2)	2	

Total Marks: 14

7	(a)		Stress = force ÷ cross-sectional area Strain = extension ÷ original length	1(AO1) 1(AO1)	**2**	

7	(b)	(i)	Using a (metre) rule / ruler / tape	1(AO3)	**1**	

7	(b)	(ii)	Suitable method for measuring extension e.g. • levelling micrometer and comparison wire • fixed scale and vernier • travelling microscope and marker / pointer (1 mark + 1 mark)	1(AO3) 1(AO3)	**2**	

7	(b)	(iii)	Elastic (no mark) Wire returns to original length (when load is removed)	1(AO1)	**1**	

7	(b)	(iv)	Obeys Hooke's Law (no mark) • force is directly proportional to extension or WTTE • examples of values given in support from the table	1(AO1) 1(AO2)	**2**	

7	(b)	(v)	Stress = $25 \div 1{\cdot}82 \times 10^{-7} = 1{\cdot}37 \times 10^{8}$ Strain = $1{\cdot}2 \times 10^{-3} \div 1{\cdot}73 = 6{\cdot}94 \times 10^{-4}$ Young modulus = stress ÷ strain $= 1{\cdot}37 \times 10^{8} \div 6{\cdot}94 \times 10^{-4}$ $= 1{\cdot}97 \times 10^{11}$ Nm^{-2} (Pa) 3 marks for correct answer (also accept $1{\cdot}98 \times 10^{11}$) 1 mark for unit (also accept N/m^2) 2 compensation marks as follows: • 1 mark for correct formula for Young modulus • plus 1 mark for correct value for either stress or strain • or 1 mark for correct substitution for either stress or strain	1(AO2) 1(AO2) 1(AO2) 1(AO1)	**4**	

Total Marks: 12