A-LEVEL
APPLIED SCIENCE

SC05 – Choosing and Using Materials
Mark scheme

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Version: 1.0 Final

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this Mark Scheme are available from aqa.org.uk

Question 1

Question	Part & sub-part	Marking guidance	AO/Mark	Total Mark	Comment
1	(a)	a long chain molecule / a long chain of monomers / a long chain of repeating units	(1)(AO1)	**1**	NOT: 'a long chain <u>of</u> molecules'
1	(b)	Any 2 from • non-biodegradable / don't decay / don't rot • give off <u>poisonous</u> fumes (or <u>greenhouse gases</u>) when burnt • more landfill space needed (for disposal) • uses up crude oil / uses up a valuable resource / comes from a non-renewable source / low reserves of oil	(2)(AO1)	**2**	NOT: just CO_2 NOT: crude oil will run out
1	(c)	In order polypropene forms strong fibres (1) + (1) polystyrene can be expanded into foam (1) + (1) perspex does not easily shatter / transparent (1) + (1)	(3)(AO1) (3)(AO2)	**6**	use list principle for the property mark
1	(d)(i)	they have low melting points / polymers are easy to mould (when hot)	(1)(AO1)	**1**	Accept 'easily melted' NOT: 'can be melted'
1	(d)(ii)	(a lot of) electricity / energy is needed <u>to melt the polymer</u>	(1)(AO2)	**1**	

Total 11 marks

Question 2

Question	Part & sub-part	Marking guidance	AO/Mark	Total Mark	Comment
2	(a)(i)	axes in correct place with suitable scales and labelled (name and units) (1) all 7 points plotted correctly (± half a small square) (1) line of best fit [straight line up to point(44,4), curve thereafter] (1)	(3)(AO2)	**3**	
2	(a)(ii)	the graph shows force against length, not force against extension / the length of the spring cannot be zero / the unloaded length of the spring is 20 mm	(1)(AO1)	**1**	
2	(a)(iii)	extension is (directly) proportional to the load / strain is proportional to stress	(1)(AO1)	**1**	
2	(a)(iv)	0 – 4 (N) length of spring (or extension) increases in even steps / uniformly / constantly / increases by 6mm each time / straight line graph	(1)(AO2) (1)(AO1)	**2**	
2	(a)(v)	read from candidate's graph (3.6 to 3.8 N)	(1)(AO1)	**1**	
2	(b)(i)	8 (cm)	(1)(AO2)	**1**	
2	(b)(ii)	14 (cm)	(1)(AO2)	**1**	

Total 10 marks

Question 3

Question	Part & sub-part	Marking guidance	AO/Mark	Total Mark	Comment
3	(a)	**polypropylene** max. **3** marks • dries quickly • does not gain weight easily (when wet) • lightweight • will not fade / can be bright colours / colours will not run • hard wearing / strong / does not rip easily • easier to clean **polyester** max. **3** marks • dries quickly • lightweight • will not fade / can be bright colours / colours will not run • hard wearing / strong / does not rip easily **wool** max. **2** marks • absorbs sweat • lightweight **cotton** max. **1** mark • absorbs sweat	(3)(AO2)	**3**	Look for explanation – not just properties copied from the table
3	(b)	material C (1) it has lowest thermal conductivity (1) so will conduct heat away from the hand slowest (1)	(2)(AO1) (1)(AO2)	**3**	

Total 6 marks

Question 4

Question	Part & sub-part	Marking guidance	AO/Mark	Total Mark	Comment
4	(a)	can withstand high crushing / squashing forces	(1)(AO1)	**1**	
4	(b)	• a sensible set up which will compress mortar (1) • a method to increase compression (1) • a method to take a numerical measurement at point of failure (1) • carry out experiment on all 3 samples (1) • repeat (1) Example • place mortar in a G-clamp • tighten • count number of turns until mortar crumbles • repeat with other samples • repeat experiment Example • place a weight on top of mortar • add weights one at a time • count weights added when mortar crumbles • repeat with other samples • repeat experiment	(5)(AO3)	**5**	
4	(c)(i)	can withstand only low stretching / pulling forces	(1)(AO1)	**1**	
4	(c)(ii)	steel reinforcing	(1)(AO1)	**1**	

Question 4 cont'd

Question	Part & sub-part	Marking guidance	AO/Mark	Total Mark	Comment
4	(c)(iii)	density = mass ÷ volume = 45 ÷ (0.60 × 0.60 × 0.05) = 45 ÷ 0.018 = 2500 = 2.5×10^3 kg m^{-3} 2 marks for correct answer 1 mark for unit (accept kg / m^3)	(2)(AO2) (1)(AO1)	**3**	1 compensation mark for either • correct value for volume or • correct formula / substitution
4	(c)(iv)	• example of composite material (1) • correct use of named composite (1) Examples • carbon fibre in fishing rods / golf clubs / tennis racquets / racing cars • laminated glass in car windows • reinforced glass in door windows • plywood / chipboard in furniture • GRP (fibreglass) in boat hulls / canoes / surf boards etc	(2)(AO1)	**2**	

Total 13 marks

Question 5

Question	Part & sub-part	Marking guidance	AO/Mark	Total Mark	Comment
5	(a)	In order • maximum stress / force material can withstand (before fracture) • can be hammered / pressed / beaten / rolled into shape • can be drawn out into wires(or pipes) / deforms plastically	(3)(AO1)	**3**	Not simply 'can be shaped'
5	(b)	• electrons are delocalised / free in structure / sea of electrons • electrons can move as a current / can move when a pd is applied / can transfer energy	(2)(AO1)	**2**	
5	(c)	it is unreactive	(1)(AO1)	**1**	NOT: 'low reactivity'
5	(d)	a rock containing metal compounds / metal oxide (in a quantity) making it economical to extract the metal	(1)(AO1) (1)(AO1)	**2**	
5	(e)	electrolysis	(1)(AO1)	**1**	Accept description of electrolysis
5	(g)	it needs electricity to extract it / can only be obtained using electrolysis / more difficult to extract	(1)(AO1)	**1**	

Total 10 marks

Question 6

Question	Part & sub-part	Marking guidance	AO/Mark	Total Mark	Comment
6	(a)(i)	<table><tr><td></td><td></td><td></td></tr><tr><td></td><td>✓</td><td></td></tr><tr><td></td><td></td><td>✓</td></tr><tr><td></td><td>✓</td><td></td></tr></table> all 3 ticks correct for 2 marks. 1 mark for 2 correct ticks.	(2)(AO1)	**2**	
6	(a)(ii)	• in brass there is more space between atoms • because of presence of different sized atoms	(2)(AO1)	**2**	
6	(b)	• heat to high temperature / heat strongly • cool quickly / cool in oil / cool in water	(2)(AO1)	**2**	
6	(c)(i)	• heat to high temperature / heat strongly • cool slowly / allow to cool / cool in air / controlled cooling	(2)(AO1)	**2**	
6	(c)(ii)	less brittle	(1)(AO1)	**1**	
6	(d)(i)	non-crystalline / irregular arrangement of particles	(1)(AO1)	**1**	

Question 6 cont'd

6	(d)(ii)	• example of ceramic material (1) • correct use of named ceramic (1) Examples • pottery / china — cups, saucers, plates etc • alumina (aluminium oxide) — lining for furnaces • clay — pottery / brick / tiles • brick — building	(2)(AO1)	**2**	

6	(e)	molecules aligned	(1)(AO1)	**1**	

Total 13 marks

Question 7

Question	Part & sub-part	Marking guidance	AO/Mark	Total Mark	Comment
7	(a)(i)	stress = force ÷ cross-sectional area	(1)(AO1)	**1**	NOT: F/A
7	(a)(ii)	strain = change in length (extension) ÷ original length	(1)(AO1)	**1**	
7	(a)(iii)	a ratio of two lengths / idea that the units cancel out	(1)(AO1)	**1**	Not just 'a ratio'
7	(b)(i)	material Q does not show plastic deformation / only shows elastic deformation	(1)(AO2) (1)(AO1)	**2**	
7	(b)(ii)	material P gradient (or slope) is largest / line is steepest / for a particular value of stress, the strain is smallest / for a particular value of strain, the stress is largest	(1)(AO2) (1)(AO1)	**2**	
7	(c)	area increases by a factor of 1.5 (1.23 ÷ 0.82) therefore force increases by a factor of 1.5 force = 240 × 1.5 = 360 (N) 2 marks for correct answer	(2)(AO2)	**2**	1 compensation mark for an indication that force increases by 1.5 (1.23 ÷ 0.82)
7	(d)(i)	man made / not natural	(1)(AO1)	**1**	
7	(d)(ii)	does not return to original length / shape (when force is removed) / material is permanently deformed	(1)(AO1)	**1**	
7	(e)(i)	force = stress × area = $2 \times 10^{8} \times 1.32 \times 10^{-6}$ = 2.64×10^{2} = 264 (N) 2 marks for correct answer	(2)(AO2)	**2**	1 compensation mark for correct formula / substitution

Question 7 cont'd

Question	Part & sub-part	Marking guidance	AO/Mark	Total Mark	Comment
7	(e)(ii)	strain = stress ÷ Young modulus = $1.25 \times 10^{8} \div 1.4 \times 10^{11}$ = 8.9×10^{-4} (2) extension = strain × original length = $8.9 \times 10^{-4} \times 0.5$ = 4.45×10^{-4} (m) (2) allow ecf from strain calculation	(4)(AO2)	**4**	for each part give 1 compensation mark for correct formula / substitution

Total 17 marks

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	TOTAL
AO1	**7**	**4**	**2**	**6**	**10**	**13**	**7**	**49**
AO2	**4**	**6**	**4**	**2**	**0**	**0**	**10**	**26**
AO3	**0**	**0**	**0**	**5**	**0**	**0**	**0**	**5**
TOTAL	**11**	**10**	**6**	**13**	**10**	**13**	**17**	**80**