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

Applied Science   **SC05**

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

Unit 5: Choosing and Using Materials

Final

Mark Scheme

Mark schemes are prepared by the Principal Examiner 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 examiners 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 examiner understands and applies it in the same correct way. As preparation for standardisation each examiner 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, examiners encounter unusual answers which have not been raised they are required to refer these to the Principal Examiner.

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.

Question	Part & subpart	Marking guidance	AO/Mark	Total Mark	Comment
1	(a)(i)	Ceramic (fibre)	(1) (AO1)	1	
1	(a)(ii)	Insulator / poor conductor of heat / high mp / heat resistant	(1) (AO1)	1	Accept 'fire proof'
1	(b)(i)	Copper	(1) (AO1)	1	
1	(b)(ii)	Conductor / does not rust / high melting point (melts at 1083°C)	(1) (AO1)	1	Accept 'ductile or malleable'
1	(c)(i)	Can be hammered (or pressed or beaten or rolled) into shape	(1) (AO1)	1	NOT: can be shaped
1	(c)(ii)	Can be drawn out into wires (or pipes) / deforms plastically	(1) (AO1)	1	
1	(c)(iii)	• Electrons are delocalised / free in structure / sea of electrons • Electrons can move in an organised way (or WTTE) / electrons carry the charge through the material	(1) (AO1) (1) (AO1)	2	
1	(d)	Tick in box next to hard	(1) (AO1)	1	
2	(a)(i)	Tiles	(1) (AO1)	1	
2	(a)(ii)	Plastic (liner)	(1) (AO1)	1	
2	(a)(iii)	Concrete / reinforced concrete	(1) (AO1)	1	
2	(b)	It reinforces the concrete / makes the concrete stronger / gives support to the concrete / concrete breaks less easily	(1) (AO1)	1	
2	(c)(i)	A mixture of <u>elements</u> including at least one metal	(1) (AO1)	1	Accept 'a mixture of metals'
2	(c)(ii)	• In iron the layers / atoms can slide past each other • The different sized atoms / irregular structure (of steel) • Prevents the layers / atoms from sliding past each other (as easily)	(1) (AO1) (1) (AO1) (1) (AO1)	3	The second marking point can be obtained from a diagram

2	(d)(i)	Decomposes / decays / rots	(1) (AO1)	1	
2	(d)(ii)	Do not decompose / take up space in landfill / harms animals	(1) (AO1)	1	Ignore pollution / damages environment / difficult to recycle
2	(d)(iii)	In any order: • Not biodegradable / does not decompose (or decay or rot) • Not affected by sunlight	(1) (AO2) (1) (AO2)	2	
2	(d)(iv)	Plastic C In any order • Won't go soft / not affected by high temperatures • Not flammable	(1) (AO2) (1) (AO2) (1) (AO2)	3	Ignore biodegradable If all 4 properties of plastic C are listed then 1 mark maximum
3	(a)	The extension is (directly) proportional to the force applied (OWTTE)	(1) (AO1)	1	
3	(b)(i)	Arrow pointing to straight line section of graph (to the left of point A)	(1) (AO1)	1	
3	(b)(ii)	Arrow pointing to curved section of graph (to the right of point A)	(1) (AO1)	1	
3	(b)(iii)	Elastic limit	(1) (AO1)	1	
3	(c)(i)	Will return to original shape / length / size (when force is removed) / extension is proportional to load	(1) (AO1)	1	
3	(c)(ii)	Will not return to original shape / length / size (when force is removed) / is permanently deformed	(1) (AO1)	1	
3	(d)(i)	19(cm)	(1) (AO2)	1	
3	(d)(ii)	35(g)	(1) (AO2)	1	

3	(e)(i)	One mark for each of the following points. • Measure the length of the spring • Using the metre rule • Add a 100g mass and measure the length (or extension) of the spring • Repeat increasing the mass by 100g each time • Measure the length (or extension) of the spring with only the rock sample attached • Plot a graph of mass against length (or extension) • Read off the mass corresponding to the length (or extension) due to the rock sample OR for 2 marks (replacing the last 2 points) mass of rock sample = $\dfrac{\text{extension of spring due to rock sample}}{\text{extension of spring due to known mass (M)}} \times M$	(1) (AO3) (1) (AO3) (1) (AO3) (1) (AO3) (1) (AO3) (1) (AO3) (1) (AO3)	7	For 5 marks maximum • Measure length of spring • Using a metre rule • Measure length (or extension) of spring with rock sample attached • Add 100g and measure length (or extension) • Continue adding masses until length (or extension) equals that produced by rock sample
3	(e)(ii)	Any 2 of the following • Clamp the base of the stand to the bench / place a heavy weight on the base of the stand • Lower the clamp • (Adjust the clamp) so that spring is nearer the stand • (Rotate the clamp or stand) so that the spring is over the bench	(1) (AO3) (1) (AO3)	2	
3	(f)	Density = mass ÷ volume Volume = mass ÷ density = $0{\cdot}355 \div 3{\cdot}69 \times 10^3$ $\qquad\qquad\qquad = 9{\cdot}62 \times 10^{-5}\,m^3$ (or 96.2cm^3) 2 marks for correct answer 1 compensation mark for correct formula / rearrangement / substitution 1 mark for unit	(1) (AO2) (1) (AO2) (1) (AO1)	3	
4	(a)	In order: • Man made / not natural • A long chain molecule / a long chain of monomers / a long chain of repeating units • Regular arrangement of particles • Hard wearing / long lasting	(1) (AO1) (1) (AO1) (1) (AO1) (1) (AO1)	4	NOT: A long chain of molecules

4	(b)	Allows water <u>vapour</u> / <u>sweat</u> to pass through	(1) (AO1)	**1**	

4	(c)(i)	Propene	(1) (AO1)	**1**	Accept C_3H_6

4	(c)(ii)	Correct structure of propene drawn	(1) (AO1)	**1**	
4	(d)(i)	Covalent	(1) (AO1)	**1**	

4	(d)(ii)	Electrons are shared	(1) (AO1)	**1**	If ionic is given in (d)(i) allow 'electrons are transferred'

4	(e)	The <u>double</u> (covalent) bond / C=C	(1) (AO1)	**1**	

4	(f)	In any order: • Traps air • Reflects infrared radiation	(1) (AO1) (1) (AO1)	**2**	

5		<u>Stronger</u> • Canoes / boat hulls / caravans / surfboards / skateboards = GRP (fibre glass) • Fishing rods = carbon fibre • Crash helmets / riot shields / bus shelter windows / telephone box windows / spectacle lenses = polycarbonate	(1) (AO2) (1) (AO2)	**2**	In each case give 1 mark for the product and 1 mark for the modern material. Accept other valid responses A correct product on its own scores 1 mark but a name of material on its own does not score

5		<u>Safer</u> • Crash helmets / riot shields / spectacle lenses / eye protectors / machine guards = polycarbonate • Safety clothing e.g. jackets worn by firemen, policemen, soldiers = Kevlar	(1) (AO2) (1) (AO2)	**2**	In each case give 1 mark for the product and 1 mark for the modern material. Accept other valid responses A correct product on its own scores 1 mark but a name of material on its own does not score

5		Easier to use Non-stick coating on pans = Teflon (PTFE)	(1) (AO2) (1) (AO2)	2	In each case give 1 mark for the product and 1 mark for the modern material. Accept other valid responses A correct product on its own scores 1 mark but a name of material on its own does not score
5		Weight reduction • Tennis racquet = carbon fibre • Canoes / boat hulls / surfboards = GRP (fibre glass) • Car wheels = aluminium alloys	(1) (AO2) (1) (AO2)	2	In each case give 1 mark for the product and 1 mark for the modern material. Accept other valid responses A correct product on its own scores 1 mark but a name of material on its own does not score
6	(a)(i)	Inflexible / resists bending / rigid / high value of Young modulus	(1) (AO1)	1	
6	(a)(ii)	Stretching force needed to break (or snap or fracture) the wire / how difficult it is to break (or snap or fracture) the wire	(1) (AO1)	1	
6	(b)(i)	Stress = force ÷ cross-sectional area	(1) (AO1)	1	
6	(b)(ii)	Strain = change in length (extension) ÷ original length	(1) (AO1)	1	
6	(b)(iii)	Strain is a ratio of two lengths / idea that the units cancel each other out	(1) (AO1)	1	
6	(b)(iv)	• All nine points plotted correctly ±1 small square • Straight line through origin up to stress = $4 \cdot 7 \times 10^7$ and a curved line that lies close to data points thereafter	(1) (AO2) (1) (AO2)	2	

6	(b)(v)	Young modulus = stress ÷ strain
		  • Using values of stress and strain taken from the table (up to stress = $4·7 \times 10^7$) the answer is $9·0 \times 10^9$
		  • OR. A correct answer obtained from values of stress and strain read from the straight line section of the candidates graph
		2 marks for correct answer (1 compensation mark for correct formula / substitution)
		1 mark for correct unit - Nm^{-2} or Pa
			(1) (AO2)
			(1) (AO2)
			(1) (AO1)
				3	Accept $9·1 \times 10^9$
					
					Accept N/m^2

6	(c)	Area = force ÷ stress = $6500 ÷ 3·6 \times 10^7 = 1·81 \times 10^{-4}$ m^2 2 marks for correct answer (1 compensation mark for correct formula / substitution) 1 mark for unit	(1) (AO2) (1) (AO2) (1) (AO1)	**3**	Accept a correctly calculated answer based on the candidate's reading of stress from his graph at strain = $4·0 \times 10^{-3}$

6	(d)	• Material C • Smallest gradient / least steep line / for any value of stress it has the largest value of strain / for any value of strain it has the smallest value of stress	(1) (AO1) (1) (AO1)	**2**	

6	(e)	Malleability / ductility / density	(1) (AO1)	**1**	