A-LEVEL
Applied Science
SC05 Choosing and Using Materials
Mark scheme

8770
June 2016

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	Answers	Additional Comments/Guidance	Mark
1(a)(i)	Nylon / Perspex		1
1(a)(ii)	Brick / glass		1
1(a)(iii)	• (An alloy is) a mixture of elements in which at least one is a metal. • bronze / stainless steel	Accept 'a mixture of metals'.	1 1
1(a)(iv)	• Made of more than one material • GRP / concrete		1 1
1(a)(v)	One of: • to gain the properties of each material • better (or improved) properties • desired properties	NOT: just 'stronger'	1
1(a)(vi)	Man-made / not natural		1
1(b)	Irregular structure / non-crystalline	Accept 'without shape'	1
1(c)	Expensive	NOT: 'cost' alone	1
Total			**10**

2(a)(i)	<table><tr><th>Material</th><th>HTS</th><th>HCS</th></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><tr><td></td><td>✓</td><td></td></tr></table>	All 4 correct = 2 marks. 3 correct = 1 mark. 1/2 correct = 0 marks	2
2(a)(ii)	Flexible		1
2(b)(i)	• Axes in correct place with suitable scales and labelled (name and units) • All 7 points plotted correctly (± half a small square) • Straight line of best fit passing through the origin		1 1 1
2(b)(ii)	1.8 N or as read from candidate's graph		1
2(b)(iii)	• Tensile strength is (directly) proportional to cross-sectional area. • Straight line graph that passes through the origin	Accept a mathematical statement indicating proportionality, e.g. if CSA doubles so does the tensile strength. A simple statement such as 'tensile strength increases as CSA increases' gains 0 marks. Do not accept 'positive correlation' unless qualified.	1 1
2(c)	One of: • stiffness / flexibility • brittleness • ductility • malleability • elasticity • plasticity • hardness • toughness		1
Total			**10**

3(a)(i)	Material **A** Any 2 from: • highest thermal conductivity • highest electrical conductivity • highest density	 Accept largest instead of highest Must be a superlative	1 2
3(a)(ii)	Material **D** Any 2 from: • lowest thermal conductivity • lowest electrical conductivity • lowest tensile strength	 Accept smallest instead of lowest Must be a superlative	1 2
3(b)	• Rate of flow of heat per unit area per unit temperature gradient or • Heat conducted per second ÷ (cross-sectional area × temperature gradient)		1
3(c)	In any order: • length • **cross-sectional** area		 1 1
3(d)(i)	(Density is) mass per unit volume	Accept : density = mass ÷ volume	1
3(d)(ii)	Volume = mass ÷ density = $(1.61 \times 10^{-2}) \div (2.30 \times 10^{3})$ = 7.0×10^{-6} m^3 = 7.0 cm^3 So Y = 75 + 7 = 82 (cm^3)	Correct answer with or without working gains all 3 marks. Correct formula / substitution gains 1 compensation mark Correct answer of 7 gains 2 compensation marks Max 2 compensation marks	2 1
Total			**13**

4(a)(i)	Covalent (bonding)	NOT: 'convalent'	1
4(a)(ii)	Electrons are shared (between atoms)	Accept correct statement about ionic bonding if 'ionic' is given as answer in 4(a)(i)	1
4(a)(iii)	Double (covalent) bond / C=C		1
4(b)	In any order: • softness • flexibility	Both correct for mark	1
4(c)	• Diffuse / leak out of / escape from products • Get into food / air / soil / people eat contaminated food / breathe contaminated air / touch contaminated soil		1 1
4(d)	• Plasticiser molecules get between polymer chains / push chains further apart • Reduces the forces(of attraction) / strength of bonds **between** the polymer chains • So **less energy** is needed to separate / slide the polymer chains		1 1 1
4(e)	• Plasticisers diffuse / move nearer to the surface / escape from the polymer • So there is **less plasticiser** (between the polymer chains) to modify the properties / so the chains move closer together	Allow description of a property change e.g. there is **less plasticiser** so plastic becomes less flexible / brittle	1 1
Total			**11**

5(a)	Regular / ordered arrangement of particles		1
5(b)(i)	Can be drawn out into wires(or pipes) / shows (both elastic and) plastic deformation (or behaviour)		1
5(b)(ii)	• In iron the layers / atoms can slide past each other • The different sized atoms / irregular structure (of steel) • Prevents the layers / atoms sliding past each other (as easily)	The 2nd marking point can be obtained from a diagram	1 1 1
5(c)(i)	Difficult to dent / scratch / wear away	Allow resistant to deformation	1
5(c)(ii)	One of: • lasts longer / won't wear away as easily / more durable • does not blunt so easily • keeps its cutting edge • gives a cleaner cut • gives a more accurate cut	Ignore reference to 'hardness'	1
5(d)	**Procedure / Measurements** • Place tube above metal sample • Drop punch down tube • Measure height of drop • with a ruler • Measure diameter / depth of dent • with Vernier callipers / travelling microscope • Repeat with second sample **Validity** • Same drop height / always drop from top of tube • Same thickness of metal sheet • Use same centre punch each time • Same surface under sample **Repeatability** • Repeat with each sample and average results **Results** • Sheet with smaller (average) dent is harder	Any 4 from procedure / measurements section Accept 'drop punch from top of tube' Any 2 from validity section Both 'repeat' and 'average' needed for mark Accept converse	4 2 1 1
Total			**15**

6(a)(i)	Aluminium		1
6(a)(ii)	(Steel has the) same coefficient of linear expansion (as concrete)		1
6(a)(iii)	Inc. in length = coefficient × orig. length × temp. rise. = 0.00002 × 0.5 × 70 = 0.0007 m / 0.7 mm	Correct numerical answer gains 2 marks. 1 compensation mark for correct formula / substitution. 1 mark for correct unit matching numerical answer.	2 1
6(b)(i)	Brass (no mark). • the higher the coefficient the greater the expansion / brass expands more than iron • the outside of the curve is longer.		1 1
6(b)(ii)	Diagram of a curved strip with brass labelled on the inside of the curve / iron labelled on the outside of the curve.	Accept an unlabelled diagram with the outside of the curve shaded **and** the inside of the curve unshaded	1
Total			**8**

7(a)	One of: • stiff / high YM so does not stretch (too far under stress) • tough / not brittle so does not break / snap easily • elastic so returns to original length (when unstressed) • flexible to bend around pulley	1 mark for property + 1 mark for explanation. Explanation must be linked to the property. Do not allow 'stiffness' / 'YM' / 'toughness' unless qualified. NOT: 'strong / hard / ductile / malleable / durable'	2
7(b)(i)	Strain is change in length divided by original length	Accept 'extension' for 'change in length' Accept answer written as a formula	1
7(b)(ii)	Stress is force divided by **cross-sectional** area	Accept answer written as a formula	1
7(b)(iii)	Young modulus is stress divided by strain	Accept answer written as a formula	1
7(c)	CSA = force ÷ stress $= (5.4 \times 10^{4}) \div (1.1 \times 10^{8})$ $= 4.9 \times 10^{-4}\ m^2$	2 marks for correct answer. 1 compensation mark for correct formula / substitution. 1 mark for correct unit.	3
7(d)(i)	Strain = stress ÷ YM $= (1.1 \times 10^{8}) \div (2.1 \times 10^{11})$ $= 5.2 \times 10^{-4}$	2 marks for correct answer. 1 compensation mark for correct formula / substitution.	2
7(d)(ii)	Extension = strain × orig. length $= (5.2 \times 10^{-4}) \times 650$ $= 3.4 \times 10^{-1}$ (m) = 0.34(m)	2 marks for correct answer. 1 compensation mark for correct formula / substitution. Allow ecf from 7(d)(i)	2
7(e)	One of: • to avoid getting near to plastic or permanent deformation (in cable) • to avoid getting near to permanently changing length (of cable) • to stay well below elastic limit	NOT:' so cable does not break / snap' NOT: 'for safety'	1
Total			**13**