Version 1.0

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Applied Science 8771/8773/8776/8779

SC05 Choosing and Using Materials

Mark Scheme

2006 examination – June series

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 meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting 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 candidates' 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.

Unit SC05 – Choosing and Using Materials

Question 1

(a)(i)	Description of how sample is secured Description of how sample is loaded Load until sample breaks Suitable diagram may also be acceptable mark accordingly	(1)(AO3) (1)(AO3) (1)(AO3)	**3**
(ii)	Force (don't accept weight alone) Accept F for force N for Newton's Area Accept A M^2	(1)(AO3) (1)(AO3)	**2**
(iii)	Repeat (measurements e.g. from the same batch) ensure area of aluminium is equal for all tests or any suitable answer such as identical conditions (fair test alone not an acceptable answer)	(1)(AO3) (1)(AO3)	**2**
(b)	Any 2 of: longer/stretched(deformed not acceptable) narrower/thinner 'necking' plastic deformation breaks Don't accept smaller	 (1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1)	**2**
(c)(i)	D (accept C-D) don't accept C alone Region where aluminium behaves elastically Accept elastic/linear/area of proportionality Don't accept straight line/unchanged C (accept B-C) E – F or F alone or E-G Breaking point failure or fracture point Accept any word which indicates breaking such as snap	(1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1)	**5**
(ii)	If stress is removed then the sample returns to its original length/size/shape/not deformed structure Don't accept almost back to original length/shape (still) elastic – 1 mark	(1)(AO1) (1)(AO1)	**2**
(iii)	Elastic limit has not been exceeded or Sample or material is still elastic or Hooke's law (still obeyed) Accept answers which refer to the fact that permanent deformation hasn't occurred or Hysteresis a Area of proportionality	(1)(AO1)	**1**

Total Mark: 17

Question 2

(a)(i)	Annealing	(1)(AO1)	**1**
(ii)	Heated (any reference to heating) to below its melting point Heating till it melts – only 1 mark for heating Cooled (slowly) don't accept rapid cooling/quenching	(1)(AO1) (1)(AO1) (1)(AO1)	**3**
(b)(i)	Can be pulled or drawn into wires Allow can be formed more easily into different shapes/formed/easy to work – don't accept moulded Can withstand plastic deformation	(1)(AO1)	**1**
(ii)	Mark in response to answer to (i) don't award the same marking point in (i) and (ii) The material is easy to work Less energy is required/other suitable answer Accept reference to cost only if qualified	 (1)(AO1) (1)(AO1)	**2**
(iii)	The (micro)structure is crystalline/crystals Don't accept molecules, penalised once only The layers can flow over each other/dislocations movement/atoms can flow/slip into gaps Re-arrangement will cause shape to be changed easily/can be lengthened	(1)(AO1) (1)(AO1) (1)(AO1)	**3**
(c)(i)	Polymer/plastic coating/coat with metal (low reactivity/non toxic) Name appropriate metal e.g. AL, Zn	 (1)(AO1)	**1**
(ii)	Resistive to chemicals or oxidisation or an acceptable comment (water/corrosion/rusting) Don't accept air/environment/content of can	(1)(AO1)	**1**
(iii)	E.g. water corrosion or oxidisation will weaken The steel strength reduced or lowered/less strong/more brittle Accept any suitable mechanical property	(1)(AO1)	**1**
(d)(i)	Reducing the thickness/acceptable answer/less material used thinner pieces? Don't accept answers to heat	 (1)(AO2)	**1**
(ii)	Reducing the time or temperature (within reason) Recycling heat/heat exchangers –any other acceptable comments	(1)(AO2)	**1**

Total Mark: 15

Question 3

(a)	Amorphous – non crystalline	(1)(AO1)	**1**
(b)(i)	Covalent	(1)(AO1)	**1**
(ii)	High melting temperature, high temp form of material? Reference to Silicon Dioxide being a fine powder/powdered form	(1)(AO1)	**1**
(c)	$D = M/V$ 2700 / 1.1 (indication that correct formula is known) = 2454, or 2500 kg/m^3 or 2.5×10^3 kg/m^3 Accept answers within the range Correct answer alone 2 marks, correct unit 1 mark Accept calculations in g/cm^3 1 compensation mark for correct substitution/correct unit accept rounded or unrounded?	(1)(AO2) (2)(AO2)	**3**
(d)(i)	Strong/good in compression/poor in tension/brittle Low ductility not malleable (any suitable mechanical property – don't accept toughness as in stem of question) Creep/flow/stiffness	(1)(AO1)	**1**
(ii)	Transparent/medium/high density/insulator/allow resistance to most chemicals/allow reference to melting/boiling points	(1)(AO1)	**1**
(e)	Any 2 from: The stress builds up at the tip of the crack the crack widens material eventually fails Or suitably illustrated diagram (for 2 marks) Diagram to show that cracks are increasing in length/grows/wider etc	(1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1)	**2**
(f)(i)	Thermal toughening or tempering (sintering)	(1)(AO1)	**1**
(ii)	Heated to high temperature (melted)/heat strongly Cooled rapidly depending process mentioned If cooled only then no mark	(1)(AO1) (1)(AO1)	**2**
(iii)	Any 3 from 6: The surface is placed in compression cracks are closed as a result of tension underneath glass does not produce 'sharp pieces' when it fails Glass fails in a safer way/won't shatter Glass is tougher/ been toughened Ignore reference to objects hitting windscreen unless directly linked to points above	(1)(AO2) (1)(AO2) (1)(AO2) (1)(AO2) (1)(AO2) (1)(AO2)	**3**

Total Mark: 17

Question 4

(a)(i)	Composite or fibres or named fibrous materials	(1)(AO1)	**1**
(ii)	Protect the fibre (from damage) and aids the bonding/adhesion of the fibres	(1)(AO2) (1)(AO2)	**2**
(b)	Any 2 from 4: Low density (accept lightweight) High strength or stiffness Flexible Resistance to chemicals High resistivity (electrical)	 (1)(AO2) (1)(AO2) (1)(AO2) (1)(AO2) (1)(AO2)	**2**
(c)(i)	Point A – Tension (tensile strength)	(1)(AO1)	**1**
(ii)	Point B – Compression (compressive strength)	(1)(AO1)	**1**
(d)	Any 2 of 3: The main stress will be along the length of the rod (longitudinal) More stiffness required in this direction (compared to transverse reference made to surface area) Because of the weight of the fish	 (1)(AO2) (1)(AO2) (1)(AO2)	**2**
(e)	Carbon/graphite is a conductive material/conducts electricity/good conductor/conductor Risk of electric shock/may touch cable	(1)(AO2) (1)(AO2)	**2**
(f)(i)	Rod B	(1)(AO2)	**1**
(ii)	Comparison must be made with the other rods not selected Statements which are relevant and comparative: Cost is not as cheap as but glass it has a better cost to stiffness ratio It has the lowest density which is favourable in terms of handling It has the lowest strength but this a low requirement	 (1)(AO2) (1)(AO2) (1)(AO2)	**3**

Total Mark: 15

Question 5

(a)(i)	Polymer	(1)(AO1)	**1**
(ii)	long (chain)	(1)(AO1)	**1**
(b)(i)	Any 2 of 4 from: Reduction in weight Promotional value Energy saving Aid or enhance athletes performance	 (1)(AO1) (1)(AO1) (1)(AO1) (1)(AO1)	**2**
(ii)	Any 2 from: Hard wearing tough Weather proof (accept water proof/resistance to chemicals) Flexible	 (1)(AO1) (1)(AO1) (1)(AO1)	**2**
(c)(i)	Any suitable material named E.g. polythene, acrylic, pvc, polypropylene etc No polycarbonates	(1)(AO1)	**1**

(ii)	Can be re-melted/reused and processed again and again Heating softens or even melts	(1)(AO1)	**1**
(d)(i)	Any 2 from: Strength increases Increases in direction of drawing/alignment Or a suitable supporting diagram	 (1)(AO1) (1)(AO1) (1)(AO1)	**2**
(ii)	Any 2 from: Chemical reaction occurs in thermoset Strong bonds (form between polymer chains) cross linking	 (1)(AO1) (1)(AO1) (1)(AO1)	**2**
(e)(i)	Stress: the force per unit CSA of material Material/or formula used stress = $\frac{F}{CSA}$ Or accept Force/Area Strain: change in length/original length or formula used (porportional increase\in length owtte) Or how much a material bends/compresses in relation to force added	 (1)(AO1) (1)(AO1)	**2**
(ii)	Correct formula used – stress/strain Correct calculation used 7/0.05 = 140.00 or 7 x 10^3 / 0.05 Correct units kN/mm^2 N/mm^2(kPA or PA) Correct answer alone 2 marks Correct unit alone 1 mark	(1)(AO1) (1)(AO2) (1)(AO2)	**3**

Total Mark: 17

Paper Total: 80