Version 1.0: 0207

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Applied Science 8771/8773/8776/8779

SC05 Choosing and Using Materials

Mark Scheme

2007 examination - January 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.

Set and published by the Assessment and Qualifications Alliance.

The Assessment and Qualifications Alliance (AQA) is a company limited by guarantee registered in England and Wales (company number 3644723) and a registered charity (registered charity number 1073334).
Registered address: AQA, Devas Street, Manchester M15 6EX
Dr Michael Cresswell Director General

Question 1

(a)	Any **two** reasons with explanations Reason: Blocks are larger than bricks/ lower density than bricks Explanation: Therefore less handling/ quicker construction/ fewer blocks Reason: Blocks have lower thermal conductivity Explanation: Therefore less heat lost from house Reason: Blocks have lower density Explanation: Lighter to carry Read each reason + explanation together and award up to two marks Do NOT allow references to cost	(1) (1)	**4**
(b)(i)	0.01	(1)	**1**
(ii)	Mass = density x volume OR mass = 700 x 0.01 Correct equation or substitution = 7 correct answer Allow error carried forward for volume from (b)(ii) Correct answer with no working = 2 Correct working with wring answer =1 Correct answer with wrong working = 0	(1) (1)	**2**
(c)(i)	C pointing to top section of beam Allow anywhere above the rod T pointing to bottom section of beam Allow anywhere below the rod	(1) (1)	**2**
(ii)	Concrete cracks unless reinforced / concrete is weak in tension Accept concrete is brittle Do NOT allow “to make stronger”	(1)	**1**
(iii)	Concrete is weaker in tension than in compression	(1)	**1**
(iv)	Stronger / less liable to bend or buckle/ uses less steel	(1)	**1**
(d)(i)	0.005	(1)	**1**

(ii)	Concrete: *Advantage*: can be poured on site / strong in compression Do NOT allow reference to cost *Disadvantage:* column would need to be large diameter / large mass involved/ concrete difficult to drill into for fixings / cracks / brittle Hardwood: *Advantage:* renewable resource / easy to work *Disadvantage*: susceptible to rot etc / may twist or split / low strength / large cross-section needed Do NOT allow "low density" Mild steel: *Advantage*: very strong (in compression or tension) / smaller cross-section needed *Disadvantage:* difficult to work / may buckle / needs cladding otherwise / aesthetically unpleasing / may corrode / high density	(1) (1) (1) (1) (1) (1)	**6**

Total Mark: 19

Question 2

(a)(i)	$\frac{\text{Force}}{\text{Area}}$	(1)	**1**
(ii)	$\frac{\text{Extension}}{\text{Original length}}$	(1)	**1**
(b)	Youngs modulus = $\frac{\text{stress}}{\text{strain}}$	(1)	**1**
(c)(i)	E anywhere on first linear section	(1)	**1**
(ii)	P showing any section after the first linear section	(1)	**1**
(iii)	Y pointing to the first peak	(1)	**1**
(d)(i)	• x axis correctly scaled • y axis correctly scaled and units labelled • points plotted correctly to within ± 1 mm allow one plotting error • suitable line drawn Allow line of best fit that treats the last point as anomalous and ignores it	(1) (1) (1) (1)	**4**
(ii)	Elastic limit labelled Allow between strain of 17.5 and 18 (independent of line drawn)	(1)	**1**
(iii)	Area = $\frac{\text{Force}}{\text{Stress}}$ or $\frac{50}{20 \times 10^6}$ Correct equation or substitution Area = 2.5 x 10^{-6} Correct answer Allow e.c.f. if not converted from MN m^2 Correct unit	 (1) (1) (1)	**3**

Total Mark: 14

Question 3

(a)	Metallic (bonding)	(1)	**1**
(b)	Stress applied and yielding occurring = 3 Stress applied and elastic strain produced = 2 Stress removed leaving permanent deformation = 4 No stress applied = 1 All 4 in correct order 2 or 3 correct = 1 1 correct = 0	(2)	**2**
(c)(i)	A mixture that contains at least one metal Accept a mixture of metals	(1)	**1**
(ii)	Diagram to show tin atoms between copper atoms Different atoms must be labelled	(1)	**1**
(iii)	Annealing / work hardening Accept oil or water quenching	(1)	**1**
(d)(i)	Tendency to fracture under sudden impact / cracks easily / cracks when hit	(1)	**1**
(ii)	• Force is concentrated in a smaller area • Idea of crack propagation starting at deformity	(1) (1)	**2**
(e)	Any seven from the following: *(i) Measurements:* – mass/weight of centre punch – thickness of metal sheet – height of drop – diameter/depth of dent *(ii) Instruments:* – ruler – (vernier) callipers – microscope – balance – micrometer screw gauge *(iii) Fair test:* – same thickness of sheet – same mass/weight of punch – same drop height Do NOT allow “keep everything the same” *(iv) Results:* – compare depth/diameter of dents – sheet with the bigger dent is less resistant – idea of repeating – reason for repeating, e.g. improved reliability	(7)	**7**

Total Mark: 16

Question 4

(a)	Any **TWO** from the following, 1 mark each – density – stiffness/ flexibility/ brittleness – elasticity – toughness – Young's modulus – Strength Do NOT accept "light" Allow "not brittle"	(1) (1)	**2**
(b)	Cost / durability / corrosion / fabrication		**1**
(c)(i)	Strands drawn parallel to each other		**1**
(ii)	Increased strength/ more tension possible		**1**

Total Mark: 5

Question 5

(a)(i)	Has no regular pattern	(1)	**1**
(ii)	Porcelain / pottery / china Do NOT accept clay	(1)	**1**
(b)(i)	Length and cross-sectional area	(1)	**1**
(ii)	For each part accept either one reason (1 mark) with associated explanation (1 mark) OR accept two reasons for 1 mark each *Cable not made entirely from steel:* • conductivity too low • so not a good electrical conductor accept: • density too high • therefore cable very heavy/ might sag too much *Cable not made entirely from aluminium:* • tensile strength too low • therefore cable might break accept: • cost of aluminium too high • therefore cable too expensive	(1) (1)	**4**
(iii)	• Idea of increase in length when wire gets hot • Need to allow for expansion/contraction with temperature	(1) (1)	**2**

Total Mark: 9

Question 6

(a)(i)	Material that is a combination of two or more materials	(1)	**1**
(ii)	Has a high value of Young's modulus Accept inflexible	(1)	**1**
(iii)	Will resist high force before fracture	(1)	**1**
(b)	Thermoplastics can be remoulded by heating / thermosetting plastics cannot	(1)	**1**
(c)(i)	*C-O:* • single • covalent Independent marks *C=O:* Double (bond) Allow 'covalent' once in either part	 (1) (1) (1)	**3**
(ii)	• Double bonds can be broken • Cross-link chains attached	(1) (1)	**2**
(iii)	No opportunity to attach cross links Accept idea of no double bonds	(1)	**1**
(d)(i)	Indefinite shelf life / good toughness / no chemical reaction required / low cost of manufacture / cheaper to produce	(1)	**1**
(ii)	Good chemical resistance / no need for high temperatures in production / can fabricate larger items	(1)	**1**
(e)	To add strength	(1)	**1**
(f)	Positive gradient shown	(1)	**1**
(g)	If Polysulphone chosen, any 3 marks from: – no need for extended cure cycles – cheaper production costs – simplified quality control procedures – no need for great strength – resistant to chemicals – If Carbon fibre chose, any 3 marks from: – low density – high strength – high stiffness No marks for stating material chosen	(3)	**3**

Total Mark: 17