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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

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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 = 2.5×10^{-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