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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 – June series

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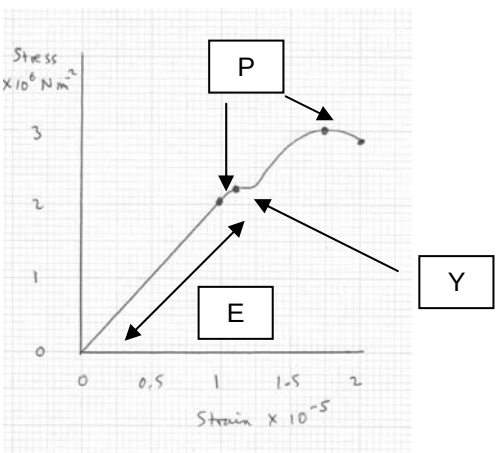
Question 1

(a)	Each material correctly linked to its property AND a correct use stated = 1 mark *Please note:* The question refers to applications in a building Material – Aluminium Property – Good electrical conductor, fairly low density and will not rust Suggested use – Window frames, doors, guttering, pipes, suspended ceilings. Reject: electrical applications Material – Concrete Property – Highly compressive strength and easily made on-site Suggested use – Floors, walls, blocks, bricks, foundations, and paving Material – Glass Property – High tensile strength but brittle and cracks easily Suggested use – Windows Material – Steel Property – High tensile strength but corrodes easily Suggested use – Joints, lintels, beams, girders. Reject: vague answers such as 'structure'	(4) (AO1)	**4**
(b)(i)	Concrete is weak in tension/ crumbles or cracks easily/ for strength/for reinforcement *Reject:* for support	(1) (AO1)	**1**
(ii)	Easier to bend (into curves)/ more flexible	(1) (AO1)	**1**
(c)(i)	C pointing to topside of main floor (Allow C anywhere above the reinforcing rod)	(1) (AO2)	**1**
(ii)	These are the parts that are in <u>tension</u>	(1) (AO2)	**1**
(iii)	ADVANTAGE: Lighter to handle, easier to work or fit, renewable resource, can be cut, sawn, nailed etc., can look more aesthetically pleasing DISADVANTAGE: Needs to be protected from rot, not as strong (for any given size)	(1) (AO1) (1) (AO1)	**2**
(d)(i)	The longer the joist, the bigger the (cross-sectional) area needed	(1) (AO2)	**1**
(ii)	Any two from: (Stress is Force/Area), so to <u>keep the stress the same</u> for any given force, The <u>total area must be the same</u>. If <u>fewer joists are used</u>, the area of each one must be greater in order to keep the total area and therefore the stress the same.	(2) (AO2)	**2**

Total Mark: 13

Question 2

(a)(i)	Stiff materials have a high value of Young's modulus/inflexible/ resistant to bending	(1) (AO1)	**1**
(ii)	Ductile materials can be drawn out into a wire	(1) (AO1)	**1**
(iii)	Tensile strength is the stretching force required to <u>break</u> the wire/how hard or difficult it is to break or snap the wire	(1) (AO1)	**1**
(b)(i)	Stress is Force/Area	(1) (AO1)	**1**
(ii)	Strain is extension/original length	(1) (AO1)	**1**
(c)(i)	E labelled at any point on the linear section (i.e. up to strain = 1.05×10^{-5}) 	(1) (AO1)	**1**
(ii)	P labelled anywhere between the points shown (i.e. strain > 1.05×10^{-5})	(1) (AO1)	**1**
(iii)	Y labelled at yield point (i.e. strain = $1.25 \times 10^{-5} \pm 1$ square)	(1) (AO1)	**1**
(d)(i)	Material will return to its original shape/ length/ size (when the deforming force is released)	(1) (AO1)	**1**
(ii)	Material fails to return to its original shape/ length/ size (when the deforming force is released)/ it has a permanent set	(1) (AO1)	**1**
(iii)	The point at which (elongation) changes from elastic to plastic	(1) (AO1)	**1**
(e)	Young's modulus = stress/strain OR $1 \times 10^{6} \div 0.5 \times 10^{-5}$ $= 2 \times 10^{11}$ (correct numerical answer with no working = 2marks) Nm^{-2} (Accept Pa)	(1) (AO2) (1) (AO2) (1) (AO1)	**3**
(f)(i)	Graph A	(1) (AO2)	**1**
(ii)	Graph D	(1) (AO2)	**1**

(g)	Any five of the following points: Fixed load is there to ensure that the control wire is straight Variable load stretches the wire under test, Micrometer adjusted until spirit level shows level, Original length of test wire measured, Diameter of test wire measured, Cross-sectional area of test wire calculated, More weights added to variable load, This causes the test wire to stretch, Micrometer readjusted to make spirit level show level again, Difference in micrometer reading shows extension of wire, Measure extension of wire, Strain calculated from extension/original length, Stress calculated from load/cross-sectional area of wire, Young's modulus (stiffness) calculated from stress/strain	(5) (AO1)	**5**

Total Mark: 21

Question 3

(a)(i)	a material composed of more than one type of material (bonded) together *Accept:* a mixture of different materials	(1) (AO1)	**1**
(ii)	Wood/ hull is lighter weight/ easier to work/ low density/does not rust Composite is easier to shape or bend/ stronger	(1) (AO2) (1) (AO2)	**2**
(iii)	Makes the hull waterproof/ prevents rotting	(1) (AO2)	**1**
(b)(i)	A mixture that contains at least one metal (allow a mixture of metals)	(1) (AO1)	**1**
(ii)	harder/ stronger/ more resistant to corrosion/more durable *Reject:* does not rust	(1) (AO2)	**1**
(c)(i)	Cubic	(1) (AO1)	**1**
(ii)	The heat (of warming it up)	(1) (AO1)	**1**
(iii)	Spectacle frames	(1) (AO1)	**1**

Total Mark: 9

Question 4

(a)(i)	Suitable scale on both axes (*N.B.* candidates may choose not to plot the value for single glass) Points plotted correctly (Allow 1 plotting error; points should be ± 1 square) Correct line drawn (May be best fit, or dot-to-dot)	(1) (AO1) (1) (AO1) (1) (AO1)	**3**
(ii)	U-value decreases with width of air gap (or converse) but levels out	(1) (AO2) (1) (AO2)	**2**
(b)(i)	Any sensible answer relating to greater or smaller: thermal conductivity/ heat flow/ thermal insulation	(1) (AO1)	**1**
(ii)	Any one from: Temperature difference between inside and outside Width of air gap Type of glass Area/size of window	(1) (AO2)	**1**
(c)	Advantage: better thermal insulation/ doesn't need painting/less liable to rot/ longer lasting/ Disadvantage: difficult to repair/ may warp/ colour may fade/aesthetically unpleasing/ non-renewable resource	(1) (AO1) (1) (AO1)	**2**

Total Mark: 9

Question 5

(a)(i)	Flexible/ transparent/ waterproof/ resistant to corrosion/ solid/soft/ weak/ easily deformed/ it is an insulator *Accept:* low melting point	(1) (AO1)	**1**
(ii)	Wrapping/ bags	(1) (AO1)	**1**
(iii)	CH_2=CHC1 (NB Structural formula must be completely correct) *Reject*: structural formula for the polymer. *Accept:* C_2H_3Cl	(1) (AO1)	**1**
(iv)	Isoprene	(1) (AO1)	**1**
(b)(i)	Double Covalent	(1) (AO1) (1) (AO1)	**2**
(ii)	Bond breaks (to enable carbon atoms to join together in a chain)	(1) (AO1)	**1**
(c)	Sample B (no mark for choosing the correct sample) evidence of crystalline structure/ <u>regular</u> arrangement/pattern *Accept:* reference to cross links	(1) (AO2)	**1**
(d)	Idea that sulphur atoms prevent the chains from tangling up/sulphur atoms cross link the chains	(1) (AO1)	**1**
(e)	Initially when force is applied, the chains simply straighten out/bond angles simply rotating/extension increases/rubber stretches then becomes much harder to stretch/ trying to move atoms apart (N.B. The marks may be awarded either for describing the graph or for explaining in terms of atoms)	(1) (AO2) (1) (AO2)	**2**

(f)	Polymers usually have lower density than metals/ easy to make and fabricate/coating different parts of the polymer could produce a material where some parts conduct and others insulate/no corrosion problems	(1) (AO1)	**1**

Total Mark: 12

Question 6

(a)	Invar	(1) (AO1)	**1**
(b)	0.051 OR 0.00051 Cm OR m (unit must match correct numerical answer)	(1) (AO2) (1) (AO2)	**2**
(c)	Any two from: (As temperature rises,) copper tube expands But the invar doesn't Therefore gap closes (and less gas allowed through)	(2) (AO2)	**2**

Total Mark: 5

Question 7

(a)	Any three from: Type A has much thicker insulation (or converse) Type B has much thicker conductor/ more conductors (or converse) High voltage needs a lot of insulation to prevent sparking High current needs thick wire to prevent overheating	(3) (AO1)	**3**
(b)	Any eight from: Measure length of wire Measured with a metre rule Measure diameter of wire Measured with a micrometer screw gauge/ vernier callipers Area calculated (from $\pi r^{2)}$ Measure current through wire Measured with an ammeter Measure p.d. (accept voltage) across wire Measured with a voltmeter Measure/ monitor temperature Measured with a thermocouple Calculate resistance (from R=V/I) Compare result with manufacturer	(8) (AO3)	**8**

Total Mark: 11