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**General Certificate of Education  
June 2010**

**APPLIED SCIENCE**

**SC05**

**Unit 5      Choosing and Using Materials**

***Mark Scheme***

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**Question 1**

		(1) (AO1) (1) (AO1) (1) (AO1) (1) (AO1)	<b>4</b>
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**Total Mark: 4**

**Question 2**

	In order B D C	(1) (AO1) (1) (AO1) (1) (AO1)	<b>3</b>
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**Total Mark: 3**

**Question 3**

(a)	Ceramic Any 2 from medium density, brittle, waterproof, does not corrode, can crack when heated strongly, heat resistant.	(1) (AO1) (1) (AO1) (1) (AO1)	<b>3</b>
(b)(i)	Made up of more than one material.	(1) (AO1)	<b>1</b>
(b)(ii)	To gain properties of each material / better (or improved) properties / desired properties (not just 'stronger')	(1) (AO1)	<b>1</b>
(c)(i)	Accept stainless steel or marble or ceramic (no mark) with valid reason (1 mark)	(1) (AO2)	<b>1</b>
(c)(ii)	Stainless steel (no mark) with valid reason (1 mark)	(1) (AO2)	<b>1</b>
(c)(iii)	MDF (no mark) Accept stainless steel with valid reason (1 mark)	(1) (AO2)	<b>1</b>
(d)(i)	Alloy	(1) (AO1)	<b>1</b>
(d)(ii)	72.7 (Accept 73)	(1) (AO2)	<b>1</b>
(d)(iii)	1.8 ecf from (d)(ii) kg	(1) (AO2) (1) (AO1)	<b>2</b>
(d)(iv)	0.16 (cm) (Accept 0.2) 3 marks for correct answer. 2 compensation marks for any 2 of the following: <ul style="list-style-type: none"> <li>• <math>D = M / V</math></li> <li>• <math>V = M / D</math></li> <li>• <math>V = 2500 / 7.7</math></li> <li>• <math>V = 324.7</math> (Accept 325)</li> <li>• Thickness = <math>324.7 (325) / 2000</math></li> </ul>	(1) (AO2) (1) (AO2) (1) (AO2)	<b>3</b>
(d)(v)	It rusts / corrodes	(1) (AO1)	<b>1</b>
(e)	Ionic (Accept covalent)	(1) (AO1)	<b>1</b>

**Total Mark: 17****Question 4**

(a)	1 mark each Synthetic - man made / not natural. High tensile strength - can withstand high <u>stretching</u> forces. Brittle - shatters / snaps / fractures / cracks / only deforms elastically / no (or little) plastic deformation. Polymer - a long chain molecule (not a long chain 'of molecules') / a long chain of monomers / a long chain of repeating units. Crystalline - a regular arrangement of particles	(1) (AO1) (1) (AO1) (1) (AO1) (1) (AO1) (1) (AO1)	<b>5</b>
(b)	Nitrogen and oxygen / N and O. (Both are needed)	(1)(AO1)	<b>1</b>
(c)	Double covalent	(1)(AO1) (1)(AO1)	<b>2</b>
(d)	Crystalline structure (of polymer chains) / parallel polymer chains Hydrogen bonding (between chains) / description of H-bonding in Kevlar	(1)(AO1) (1)(AO1)	<b>2</b>
(e)	Resistant to water / resistant to acids / low density	(1)(AO1)	<b>1</b>
(f)(i)	Stress = force ÷ cross-sectional area	(1)(AO1)	<b>1</b>

(f)(ii)	0.0155 (accept 0.015 or 0.016 or 0.02) 2 marks for correct answer. 1 compensation mark for strain = extension / original length or strain = 0.017 / 1.1 or strain = 1.7 / 110	(1) (AO2) (1) (AO2)	<b>2</b>
(f)(iii)	$1.29 \times 10^{11} \text{ Nm}^{-2} \text{ (Pa)}$ (accept $1.25 \times 10^{11}$ or $1.33 \times 10^{11}$ or $1.0 \times 10^{11}$ ) / ecf from (f)(ii) 2 marks for correct answer, 1 mark for correct units. 1 compensation mark for either correct formula for Young Modulus or correct substitution.	(1) (AO2) (1) (AO2) (1) (AO1)	<b>3</b>

**Total Mark: 17****Question 5**

(a)	Rate of flow of heat per unit area per unit temp. gradient. OR Heat conducted per second divided by (cross-sectional area $\times$ temp. gradient).	(1) (AO1)	<b>1</b>
(b)	Axes drawn in correct place and labelled Suitable scales and units All 5 points plotted correctly (allow half a square latitude for each point) Smooth curve drawn through 4 points but omitting point (700, 180) i.e. point for metal 2.	(1) (AO2) (1) (AO2) (1) (AO2) (1) (AO2)	<b>4</b>
(c)(i)	Read off line of best fit (no units needed)	(1) (AO1)	<b>1</b>
(c)(ii)	As thermal conductivity increases, specific heat capacity decreases. (or converse)	(1) (AO2)	<b>1</b>
(c)(iii)	Metal 2.	(1) (AO1)	<b>1</b>
(d)	Low. (no mark) Heat cannot travel through <u>frame</u> easily. Less heat is lost to the surroundings / room stays warmer.	(1) (AO2) (1) (AO2)	<b>2</b>
(e)	Plastic has a <u>lower</u> thermal conductivity than metal Accept: plastic is an insulator of <u>heat</u> / plastic does not transfer heat as quickly as metal.	(1) (AO1)	<b>1</b>

**Total Mark: 11****Question 6**

(a)	Deformation is permanent / does not return to original length (or shape) / atoms do not return to original position.	(1) (AO1)	<b>1</b>
(b)(i)	Dislocation / atom missing / vacancy	(1) (AO1)	<b>1</b>
(b)(ii)	Malleability / ductility	(1) (AO1)	<b>1</b>
(b)(iii)	Dislocation moved to the right New bonding of atoms correct.	(1) (AO1) (1) (AO1)	<b>2</b>
(c)(i)	(The extra atom) stops the movement of dislocations / stops layers (or atoms) sliding	(1) (AO1)	<b>1</b>
(c)(ii)	Alloying	(1) (AO1)	<b>1</b>
(d)(i)	Similarity : both processes involve heating (and cooling)	(1) (AO1)	<b>1</b>
(d)(ii)	Differences : Q.H. – cool rapidly / cool in water or oil A. - cool slowly / cool in air / allow to cool / controlled cooling	(1) (AO1) (1) (AO1)	<b>2</b>

**Total Mark: 10**

**Question 7**

(a)	Elastic limit	(1) (AO1)	1
(b)(i)	An arrow (E) pointing to the curve to the left of X	(1) (AO1)	1
(b)(ii)	An arrow (P) pointing to the curve to the right of X	(1) (AO1)	1
(c)	Stiffness / Young modulus	(1) (AO1)	1
(d)	Steeper line / larger gradient More force required to produce same extension / same force produces less extension Elastic limit at a larger force	(1) (AO2) (1) (AO2) (1) (AO2)	3
(e)(i)	Tension / tensile force	(1) (AO1)	1
(e)(ii)	2.5 (N)	(1) (AO2)	1
(e)(iii)	Any value from 4.1 to 4.9 (N) inclusive	(1) (AO2)	1
(f)	Measure current through wire (not measure 'amps') Measure potential difference (voltage) across wire (not measure 'volts') Repeat experiment with the other two wires  Then a maximum of 5 from the following <ul style="list-style-type: none"> <li>• connect wire to (variable) power supply</li> <li>• (current) measured with an ammeter (accept multimeter)</li> <li>• (pd) measured with a voltmeter (accept multimeter)</li> <li>• repeat using different values of current (or voltage)</li> <li>• take an average value of the conductance</li> <li>• plot a graph of current against pd (voltage)</li> <li>• calculate the gradient</li> </ul> (Allow a correct circuit diagram to give the marks for: power supply, ammeter and voltmeter)	(1) (AO3)  (1) (AO3) (1) (AO3)             (5) (AO3)	8

**Total Mark: 18**