Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education

Life and Health Sciences

Assessment Unit AS 5

assessing

Material Science

[SZ051]

Assessment

MARK SCHEME

General Marking Instructions

Introduction

Mark schemes are published to assist teachers and students in their preparation for examinations. Through the mark schemes teachers and students will be able to see what examiners are looking for in response to questions and exactly where the marks have been awarded. The publishing of the mark schemes may help to show that examiners are not concerned about finding out what a student does not know but rather with rewarding students for what they do know.

The Purpose of Mark Schemes

Examination papers are set and revised by teams of examiners and revisers appointed by the Council. The teams of examiners and revisers include experienced teachers who are familiar with the level and standards expected of students in schools and colleges.

The job of the examiners is to set the questions and the mark schemes; and the job of the revisers is to review the questions and mark schemes commenting on a large range of issues about which they must be satisfied before the question papers and mark schemes are finalised.

The questions and the mark schemes are developed in association with each other so that the issues of differentiation and positive achievement can be addressed right from the start. Mark schemes, therefore, are regarded as part of an integral process which begins with the setting of questions and ends with the marking of the examination.

The main purpose of the mark scheme is to provide a uniform basis for the marking process so that all the markers are following exactly the same instructions and making the same judgements in so far as this is possible. Before marking begins a standardising meeting is held where all the markers are briefed using the mark scheme and samples of the students' work in the form of scripts. Consideration is also given at this stage to any comments on the operational papers received from teachers and their organisations. During this meeting, and up to and including the end of the marking, there is provision for amendments to be made to the mark scheme. What is published represents this final form of the mark scheme.

It is important to recognise that in some cases there may well be other correct responses which are equally acceptable to those published: the mark scheme can only cover those responses which emerged in the examination. There may also be instances where certain judgements may have to be left to the experience of the examiner, for example, where there is no absolute correct response – all teachers will be familiar with making such judgements.

The abbreviation 'ecf' stands for 'error carried forward'.

					AVAILABLE MARKS
1	**(a)**	Diagram correctly labelled; *Wire*, *marker*, *pulley*, *mass*/*load*/*weight* [½] each (round up)		[2]	
	(b)	**(i)** Correct length shown from blocks fixed end to marker (**and** labelled L)		[1]	
		(ii) 2 m (2.0 m) (if more than one answer circled, -1)		[1]	
	(c)	Metre rule – Length	[1]		
		Ruler/Metre Stick/Travelling Microscope – Extension	[1]		
		Micrometer Screw Gauge – Diameter	[1]	[3]	
	(d)	E = stress/strain	[1]		
		E = F/A ÷ ΔL/L **or** Stress = F/A and Strain = ΔL/L	[1]	[2]	9
2	**(a)**	E = $2 \times 10^8/1.7 \times 10^{-3}$ (any correct points from straight line) ([1] for each value **with correct power**)	[2]		
		E = 1.18×10^{11} {range 1.17–1.2 × 10^{11}}	[1]		
		Units: Pa or Nm^{-2} (independent marking for units)	[1]	[4]	
	(b)	C.S.A = $\pi d^2/4$ or $= \pi r^2$	[1]		
		$= \pi (1.32 \times 10^{-3})^2/4$			
		$= 1.37 \times 10^{-6}$ (m^2)	[1]		
		Stress = Force/Area	[1]		
		$= 320/1.37 \times 10^{-6}$ (allow ecf for area)	[1]		
		$= 2.34 \times 10^8$ (Pa)	[1]	[5]	9
3	**(a)**	**(i)** A material made from two or more different materials		[1]	
		(ii) Gain the properties of each material/improved properties		[1]	
	(b)	Metal Composite Polymer Ceramic/polymer [1] each		[4]	
	(c)	**(i)** Particles have no pattern/arrangement/no structure		[1]	
		(ii) A regular/ordered arrangement of particles		[1]	
	(d)				

Particle	**Number**	**Location**		
proton	11	nucleus	[1]	
electron	10	outside nucleus/ orbit/ in shells	[1]	[2]

	(e)	Thermoset – has side cross links (which stop polymer molecules from lining up regularly) Thermoplastic – no cross links (so polymer molecules line up regularly) [both for 1]			
		Thermoset – structure is not crystalline/has no regular arrangement Thermoplastic – structure is crystalline/has a regular arrangement of particles (<u>both</u> for [1])		[2]	12

				AVAILABLE MARKS
4	**(a)**	**(i)**	Tin [1]	
		(ii)	Alloy [1]	
		(iii)	Iron and Carbon [1]	
	(b)		• Colour/appearance – alloys must retain distinctive colours/do not easily tarnish in air • Soft-to allow designs to be stamped into coin surfaces. • Hardness – Wear resistant – for long term use • Recyclability – able to recycle the alloy • Antibacterial characteristics – Bacteria doesn't multiply • Corrosion resistance – to ensure minimal material losses over the lifetime of coins • Security – producing coins that are difficult to counterfeit; ease of use accepted by vending machines. • non-allergenic – no risk of allergy [1] each for factors; max [2] [1] each for reason; max [2] [4]	
	(c)			

copper and **zinc** [1]	**iron** and **chromium** [1]
yellow-gold [1]	silver-grey
musical instruments	**cutlery/cookware/medical equipment** [1] (Any sensible suggestion)

[4]

	(d)	**(i)**	A process which softens metal/so they can be cut/shaped more easily/allows material to bend when pressure is applied [1]	
		(ii)	Any **two** from: • heated • above recrystallisation temperature • cooled slowly • to below recrystallisation temperature [2]	14
5	**(a)**	**(i)**	BENEFITS – Any **two** • Material reuse through use of nanotechnology to repair/extend life of equipment • Pharmaceutical creations • Link to precision manufacturing improving a range of products which can be produced [2] • Other valid benefits acceptable	
		(ii)	RISKS – Any **two** • Weapons including miniature explosives linked to potential to change nature of modern warfare/Terrorism • Surveillance technology – reduces personal freedom • nanopollutants/nanotoxicology • Other valid risks acceptable [2]	

						AVAILABLE MARKS
	(b)	**(i)**	Sheet of graphene curved into a closed cylinder		[1]	
		(ii)	high electrical conductivity/high thermal conductivity/very high tensile strength/lightweight/low density/very elastic Any **two**		[2]	7
6	**(a)**	**(i)**	A material in which the property can change when there is a change to surroundings		[1]	
		(ii)	Stress produces voltage/current [1] voltage/current creates strain [1]		[2]	
	(b)	**(i)**	Thermochromatic materials Change colour with change in temperature	[1] [1]	[2]	
		(ii)	Shape memory alloy (SMA) As the brace warms up, it returns to its designed shape	[1] [1]	[2]	7
7	**(a)**	**(i)**	$V = 5.0 \times 2.0 \times 5.0 = 50\ (cm^3)$ Mass = Density × Volume Mass = 19.32 × 50 (allow ecf. for Volume) Mass = 966 g = 0.966 kg (candidates value of mass correct to 3 sf)	[1] [1] [1] [1] [1]	[5]	
		(ii)	19.32 ($g\,cm^{-3}$)		[1]	
	(b)		Gold: $V = m/\rho = 125/19.32 = 6.47\,cm^3$ Platinum: $V = m/\rho = 125/21.45 = 5.83\,cm^3$ Difference in volume = $6.47 - 5.83 = 0.64\,cm^3$ (at least 2 dp) **or** candidates values for gold and platinum correctly subtracted, to at least 2 dp.	[1] [1] [1]	[3]	9

AVAILABLE MARKS

8 (a) Indicative content

- Price – affordable for homeowner
- Thermal conductivity – measure of the ability of the material to conduct heat
- Stiffness – ease of fitting and laying pipes in awkward areas
- Corrosion – water will be running through these pipes so need to be as corrosion resistant as possible to prevent needing repaired/to last long
- Factor – any valid factor
- with reason
  e.g. ability to accommodate water as it freezes/withstands high pressure – so pipes don't burst easily in winter due to freezing/as spec – environmental considerations/quality required/demand/regulations
- Candidate's choice **and** valid reason for their choice

Response	Marks
Candidates describe clearly 5 or more of the points shown in the indicative content. There is widespread and accurate use of appropriate scientific terminology. Presentation, spelling, punctuation and grammar are excellent. They use the most appropriate form and style of writing. Relevant material is organised with clarity and coherence.	**[5]–[6]**
Candidates describe clearly 3 or 4 of the points shown in the indicative content. There is good reference of scientific terminology. Presentation, spelling, punctuation and grammar are sufficiently competent to make meaning clear. They use an appropriate form and style of writing. There is some attempt to organise material.	**[3]–[4]**
Candidates identify clearly 1 or 2 of the points shown in the indicative content. There is limited reference of scientific terminology. Presentation, spelling, punctuation and grammar may contain some errors. The form and style are of a satisfactory standard. There is only a limited attempt to organise material.	**[1]–[2]**
Response is not worthy of credit	**[0]**

[6]

(b) Any **two** from:
To reduce heat loss from domestic heating pipes
To prevent freezing of domestic water supply pipes
Ease of use
Cost. [2] 8

Total **75**