Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2019

Life and Health Sciences

Assessment Unit AS 5
assessing
Material Science

[SZ051]

FRIDAY 24 MAY, AFTERNOON

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.

					AVAILABLE MARKS
1	(a)	(i)	(A measure of the maximum) stretching **force** or tensile **stress** a material can withstand **before failure (breaking)**.	[1]	
		(ii)	**(**Ability of a material to deform (plastically)/how easily a material) can be bent, hammered etc.	[1]	
	(b)	(i)	Material Y – (For a given stress) there is a greater strain/it extends more/drawn out (into wire).	[1]	
		(ii)	Material X – steeper slope/steeper gradient.	[1]	4

2	(a)		x-axis labelled and unit: Extension/mm, x/mm, x/m	[1]	
			Appropriate scale on x-axis 100 N = 2 cm, 0.2 mm = 2 cm	[1]	
			5 or more points plotted correctly (±1 square) 3 or 4 correct plots gets [1] less than 3 correct plots gets [0]	[2]	
			Line of best fit	[1]	[5]
	(b)		Gradient = $\Delta y/\Delta x$	[1]	
			Converting mm to m	[1]	
			4.9×10^5 ($N\,m^{-1}$)	[1]	
			(Acceptable range for gradient 4.7×10^5 to 5.1×10^5) 4.9×10^2 earns [2] (accept 470–550)		[3]
	(c)		(C.S.A =) $\pi d^2/4$ (or equivalent)	[1]	
			$2.5(4) \times 10^{-6}$ (m^2)	[1]	[2]
	(d)		E = gradient × (L/A) [Accept (E =) $\frac{\text{stress}}{\text{strain}}$ or equivalent for 1 mark if no further]	[1]	
			Calculation: $4.9 \times 10^5 \times (1.2/2.54 \times 10^{-6})$ Allow ecf from **(b)** and **(c)**	[1]	
			Answer: 23×10^{10} (Pa)	[1]	
			(Acceptable range for Y.M. 22×10^{10} to 24×10^{10})		[3] 13

					AVAILABLE MARKS
3	(a)	(i)	(Sheet of) graphene [1] rolled into a cylinder [1]	[2]	
		(ii)	Any **two** from: • nitric oxide sensors • drug loading capacity/drug delivery/carry drugs/administer medicine • (selective) cancer cell destruction/cure cancer/treat cancer • bio stress sensors • glucose detection biosensors • scaffolding for tissue regeneration/bone grafts (2 × [1])	[2]	
		(iii)	Any **two** from: • Bioinert/don't react with the body/nontoxic/biotolerant/ chemically unreactive • small • loaded with various types of drugs • can be targeted • strong • electrically conducting (2 × [1])	[2]	
	(b)		4	[1]	
	(c)		Insulator/poor conductor/low conductivity or equivalent	[1]	
	(d)	(i)	n-type: excess of electrons/more e^- [1] p-type: deficiency of electrons [1]	[2]	
		(ii)	(Better) conductor/good conductor or equivalent	[1]	
	(e)		Positive	[1]	12
4	(a)		Any **two** from: High thermal conductivity/strong/hard wearing/tough to endure kitchen use/non-toxic/high resistance to thermal shock in order to withstand rapid changes in temp/withstand high temps/high melting point/unreactive/ doesn't deform/doesn't rust. (2 × [1])	[2]	
	(b)		Any **two** from: Lightweight/shatter resistant/easy to mould into desired shape/ cheaper/less brittle/less fragile (2 × [1])	[2]	4

AVAILABLE MARKS

5 **(a)** protons – positive – nucleus [1]
neutrons – neutral – nucleus [1]
electrons – negative – orbit nucleus/in shells [1] [3]

(b) **(i)** Thermoplastics – have no cross-links (tangled chains of long, thin molecules) [1]
Thermosetting – have cross links (long chain molecules joined by cross links) [1] [2]

(ii) Thermoplastic
Easily stretched/flexible/can be reshaped/remoulded [1]
Thermosetting
Strong/rigid/do not soften or melt/only shaped once/cannot be remoulded [1] [2]

(iii)

Use	**Thermoplastic**	**Thermoset**
Electrical insulation		✓
Plastic bottle	✓	

[1] for each correct tick [2] 9

6 **(a)** A mixture of two or more elements/materials/substances/metal [1]
One of which is a metal [1] [2]

(b)

Copper & Zinc		**Ornaments/door furniture (Musical) Instruments**
	Stainless Steel	
Nickel & Chromium		**Resistance wire Wire loop in flame test/ heating element**
	Steel	

[1] for each. Other uses acceptable. [6]

(c) **(i)** Super Invar [1]
Reason: lowest thermal expansion or allowing inaccuracies in time to be reduced [1] [2]

(ii) Rust free/water resistant/strength/hardness/hard wearing [1]

(d) Won't rust/less affected by heat than steel [1]
Fragile/expensive to make/breaks easily [1] [2] 13

AVAILABLE MARKS

7 (a) Indicative Content

- Biomaterial – material inserted into the body
- Bioactive
- (Bioactive) – a substance that interacts with tissue.
- Biotolerant
- (Biotolerant) – material is not rejected/toxins released are negligible.
- Bioinert
- (Bioinert) – do not initiate a response or interact when introduced into biological tissue. [6]

Response	Marks
Candidates describe clearly 5 or 6 of the points shown in the indicative content. There is widespread 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]

(b)

Smart Material	Example	Use
Photochromatic Material	**Security Markers**	**Materials change colour according to different lighting conditions.**
Shape Memory Alloy	**Spectacle Frames**	**easily deformed but regain original shape when warmed**
Thermochromatic Material	**Contact Thermometers**	**change colour as temperature changes**

[1] for each correct [6]

12

					AVAILABLE MARKS
8	**(a)**	88% of 28750 = 25300 (cm^3)		[1]	
	(b)	Mass = density × vol. or equivalent	[1]		
		8.94 × 25300 = 226182 (g)	[2]		
		Allow ecf from **(a)** Accept 226000/226200/226180		[3]	
	(c)	12% of 28750 = 3450 (cm^3)	[1]		
		Mass = 7.17 × 3450 = 24736.5 (g)			
		Allow ecf for volume	[1]		
		Masses Added: 226182 + 24736.5 = 250918.5 (g)	[1]		
		Allow ecf from **(b)** and mass of tin			
		Density = 250918.5/28750			
		Ans: 8.73 ($g\,cm^{-3}$)	[1]		
		Answer to 3 s.f.		[4]	8
				Total	**75**