



Rewarding Learning

**ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2017**

Life and Health Sciences

Assessment Unit AS 5

assessing

Material Science

[SZ051]

WEDNESDAY 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.

1	(i) diamond	[1]
	(ii) square (based)/pyramid 136° sight of 136° ($\pm 2^\circ$)	[1] [1]
	(iii) time applied 10–15 s	[1]
	(iv) N/m ² or N/cm ² or N/mm ² (accept Pa) or Nm ⁻² or Ncm ⁻² or Nmm ⁻² or VH or vh or kgf/m ² or dph	[1]
2	(i) Stress, $\sigma = F/A$ (A =) πr^2 (or $\pi d^2/4$) $A = \pi (0.14 \times 10^{-3})^2$ (or $\pi (0.28 \times 10^{-3})^2/4 = 6.16 \times 10^{-8} \text{ (m}^2)$) Stress, $\sigma = 5.50/6.16 \times 10^{-8} (= 8.93 \times 10^7 \text{ Nm}^{-2})$ 10 ⁿ error penalised once only	[1] [1] [1] [1]
	(ii) (Strain) = extension/original length = 1.53/2000 = 7.65×10^{-4} (no units) penalise units (-1) 10 ⁿ error penalise	[1] [1] [1]
	(iii) Young Modulus = stress/strain = $8.93 \times 10^7 / 7.65 \times 10^{-4}$ {ecf for strain from (ii), but not } [1] = 1.17×10^{11} {stress (given in (i) in question)} [1] Nm ⁻² [ecf for unit] [1]	[1] [1] [1]
	(iv) L: limit of proportionality or Hooke's Law (obeyed) up to L force \propto extension or stress \propto strain E: elastic (limit) or up to E wire returns to original length when force (or stress) removed Y: yield point or beyond this point small increases in force (or stress) give large increases in length (or extension or strain) or plastic (deformation)	[1] [1] [1] [1]

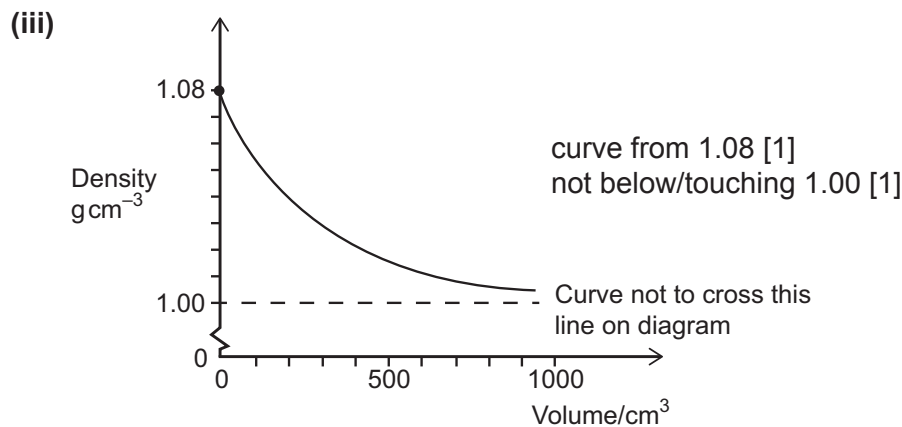
AVAILABLE
MARKS

5

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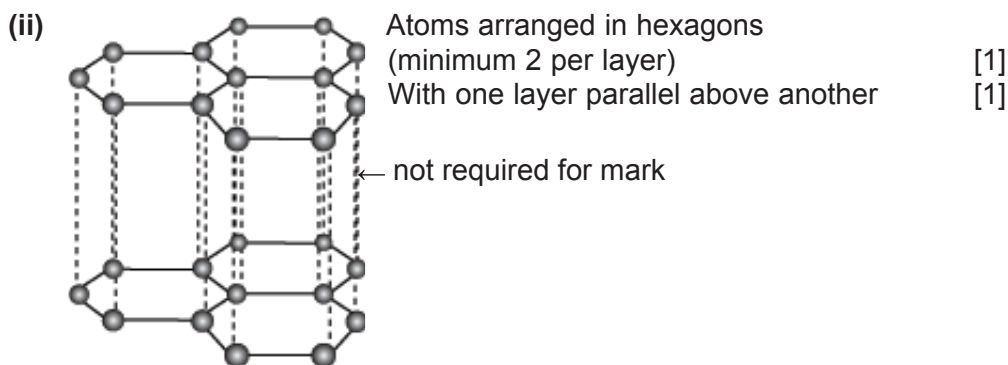
- 3 (i) (Mass of solution =) Density \times volume (or equivalent) [1]
 $= 1.08 \times 500$ [1]
 $= 540$ (g) [1]
 So mass of salt = 40 (g) [1]

- (ii) If volume to be added is x cm³, mass to be added is x grams [1]
 Density of new solution = 1.04 = $(540 + x)/(500 + x)$ {ecf for 540 from (i)} [1]
 $500 \times 1.04 + 1.04x = 540 + x$ [1]
 $x = 20/0.04 = 500$ cm³ [1]



10

- 4 (a) (i) Carbon (accept C) [1]



- (iii) Graphene is a one atom thick layer (or one layer thick) of graphite (accept converse argument) [1]

- (b) (i) (Sheet of graphene curved into) a (closed) cylinder [1]

- (ii) Any **two** (1 mark each) from:
 Non-toxic,
 high drug loading capacity,
 good (cell) penetration quality/small
 can respond to near infrared light
 can respond to presence of nitrogen oxide
 can target specific site or not harming healthy cells
 unreactive [2]

7

5 Indicative Content

- alloy is a mixture of 2 or more elements
- of which one (at least) is a metal
- to anneal it heat the alloy
- to a high temperature or to above its recrystallisation temperature
- allow the alloy to cool (slowly) (to below its recrystallisation temperature)
- annealing makes the alloy easier to cut
- and easier to shape (work)/malleable/ductile

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 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 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]

6

- 6 (a) A material that is suitable for introduction into living tissue [1]
- (b) Bioinert materials are ones that:
- Do not release toxins [1]
 - Are not rejected by the body or tissue accepts it [1]
 - Do not interact with biological tissue/inside body
- (Any 2 points from 3)**
- (c) (i) Bioactive materials are those which interact with or cause a (chemical/biological) response when in contact with living tissue [1]
- (ii) Between 1 and 100 nm [1]
- (d) Material: (oxidised) titanium, zirconium or other suitable materials
Any **two** from:
still strong
resistant to corrosion (in biological fluids)
biotolerant [3]

8

7 (a) Upper arrow – (free) electron } [1] for both
 Lower arrow – atom or ion } [1]

(b) (i) 2, 8, 4 (Inner circle – 2, middle circle – 8, outer circle – 4)
 – ignore location of electrons on the circle [1]

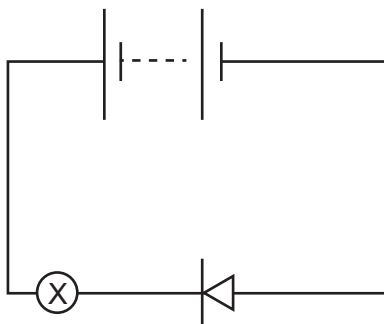
(ii) No free/delocalised electrons [1]
 Outer electrons involved in bonding with other silicon atoms [1]

(iii)

	n-type silicon	p-type silicon	
Negative electrons	✓		[1]
Positive holes		✓	[1]
Negative holes			

(iv) Phosphorus **or** arsenic **or** antimony **or** bismuth (Group V element) [1]

(c) (i) Lamp, battery and diode in series (all symbols correct) [1]
 Diode arrow pointing towards positive of cell [1]



(ii) Holes in p-type material pulled away from depletion layer [1]
 Electrons in n-type material pulled away from depletion layer [1]
 Depletion layer widens (**or** virtual battery pd increases **or** battery bias prevents flow of majority carriers through the depletion layer) [1]

AVAILABLE MARKS

- 8 (a) (i) (A polymer is) a large molecule, or macromolecule composed of many repeated subunits **or** chain of monomers or string of monomers (NOT a long chain molecule) [1]
- (ii) Response to heat
- Thermosets (are polymers/materials) strengthen while being heated, or cannot be successfully remoulded **or** reheated after their initial heat-forming. [1]
 - Thermoplastics (soften when heated and harden or strengthen after cooling, so they) **or** can be successfully remoulded or reheated after their initial heat-forming. [1]
- Molecular structure
- Thermosets have cross-links (between polymer chains) [1]
 - Thermoplastics have no cross-links [1]
- (b) (i) Any **two** (1 mark each) from:
 Chemically unreactive with sewage/water resistant/
 won't leak
 Does not rot decompose
 Long-lasting or durable or hardwearing
 Easy to join with other pipes
 Smooth inner surface reduces pumping costs
or other valid response, e.g. strong, will not rust or
 stiff or lightweight } DO NOT ALLOW high m.p. or cheap [2]
- (ii) Any **two** (1 mark each) from:
 Clothing/Footwear
 Floor-covering
 Internal ceilings
 Shower curtains
 Medical bags or lunch bag or bin bag or bottles
or other valid response/hosepipe/OHP film/cling film/shrink wrap/
 laptop buttons or insulation on wires [2]
- (c) (i) Any **two** (1 mark each) from:
 (Tactile) touchpads
 Touch switches or touch screen
 Force/Pressure sensors or iPhones/smart phones/screen on phone
 Motor speed controllers
or other valid response, e.g. thin laptop buttons [2]
- (ii) Squeeze it/Apply pressure to it [1]
- (iii) Shape Memory Alloy or SMA [1]

Total

AVAILABLE MARKS

13

75