



Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2017

Centre Number

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Candidate Number

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Life and Health Sciences

Assessment Unit AS 5
assessing
Material Science



SZ051

[SZ051]

WEDNESDAY 24 MAY, AFTERNOON

TIME

1 hour 30 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

Answer **all eight** questions.

Write your answers in the spaces provided in this question paper.

INFORMATION FOR CANDIDATES

The total mark for this paper is 75.

Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

You may use an electronic calculator.

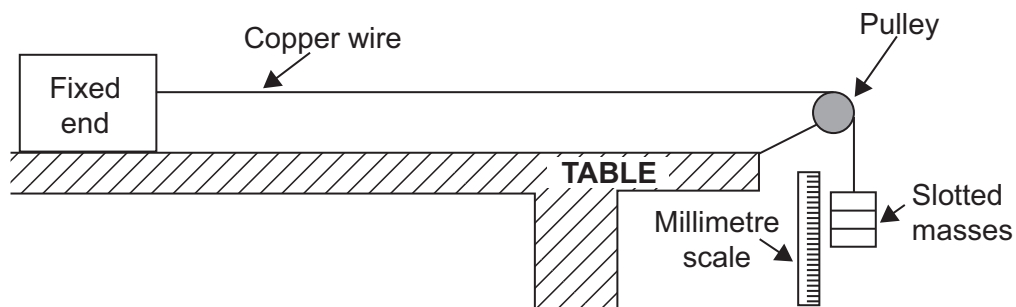
Quality of written communication will be assessed in Question 5.

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	

Total Marks	
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- 2 An unstretched copper wire is 2.00 m long and has a diameter of 0.28 mm. A student carries out an investigation on this wire to determine its Young Modulus. The student finds that a force of 5.50 N causes the wire to extend by 1.53 mm.



Source: Principal Examiner

Fig. 2.1

- (i) Show **clearly** how it can be deduced that when the force in the wire is 5.50 N, the stress is approximately $8.93 \times 10^7 \text{ N m}^{-2}$.

[4]

- (ii) Calculate the strain in the wire.

You are advised to show your working.

Strain = _____ [3]

Examiner Only	
Marks	Remark

3 A laboratory has a supply of salt water solution of density 1.08 g cm^{-3} .

The density of pure water is 1.00 g cm^{-3} .



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Fig. 3.1

- (i) Calculate the mass of salt present in 500 cm^3 of salt water solution of density 1.08 g cm^{-3} .

You may assume that there is no change in the volume of the solution when salt is added to water.

You are advised to show your working.

Mass of salt = _____ g [4]

Examiner Only

Marks

Remark

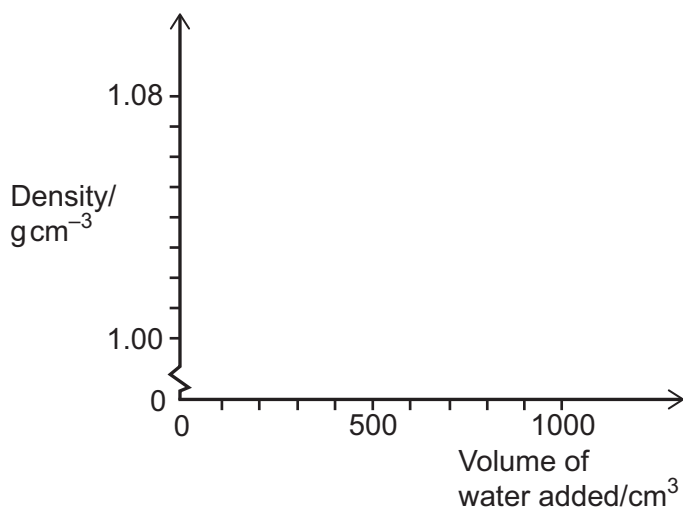
- (ii) A technician is asked to prepare a solution of salt water of density 1.04 g cm^{-3} .
The technician does this by adding pure water to a 500 cm^3 sample of the salt water of density 1.08 g cm^{-3} .

Calculate how much additional pure water the technician must add, assuming the density of pure water is 1.00 g cm^{-3} .

You are advised to show your working.

Volume = _____ cm^3 [4]

- (iii) Complete the graph below to illustrate how the density of the solution changes as increasing amounts of pure water are added to the solution.



[2]

Examiner Only	
Marks	Remark

5 Alloys are sometimes prepared through the process of annealing.

State what is meant by an alloy and describe the process of annealing.
Explain the benefits of the annealing process.

You will be assessed on the quality of your written communication.

Meaning of an **alloy**

Process of annealing

Explanation of benefits

[6]

Examiner Only	
Marks	Remark

- 7 Metals are generally excellent conductors of electricity. This is due to the way that the particles within a metal are arranged. Fig 7.1 below shows a simplified particle diagram for a metal.

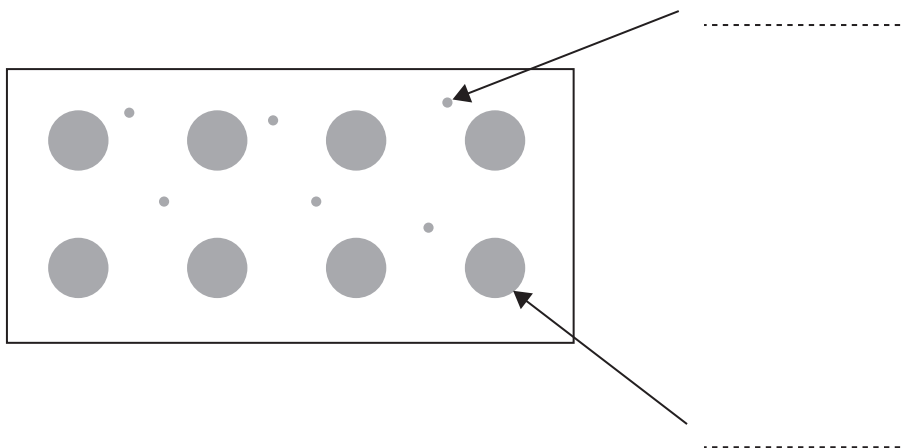


Fig. 7.1

(a) Complete Fig 7.1 to identify the particles. [1]

(b) A neutral silicon atom has 14 electrons in total.

(i) Complete Fig 7.2 below to show the electronic arrangement of the silicon atom. Each electron should be represented as a dot in the appropriate shell. [1]

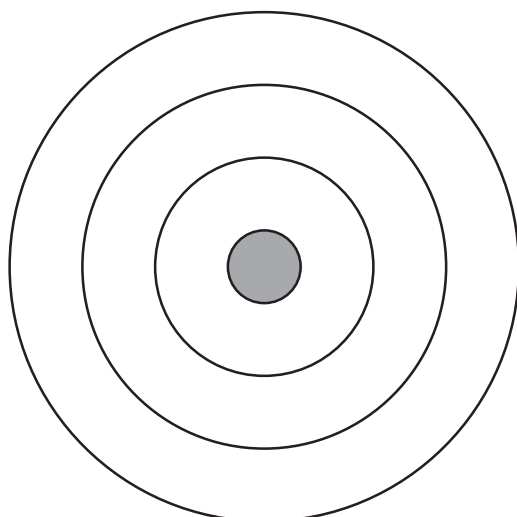


Fig. 7.2

(ii) Explain fully why pure silicon, at room temperature, is a poor conductor of electricity.

[2]

Examiner Only	
Marks	Remark

Both n-type and p-type silicon are better electrical conductors than pure silicon.

(iii) Tick (✓) the appropriate boxes in the table below to identify the majority electrical charge carriers in n-type and p-type silicon.

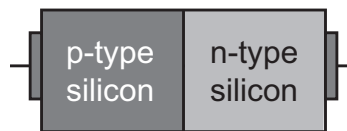
	n-type silicon	p-type silicon
Negative electrons		
Positive holes		
Negative holes		

[2]

(iv) What is added to pure silicon to change it into n-type silicon?

_____ [1]

(c) A PN junction diode consists of p-type silicon and n-type silicon joined together. At the PN junction the majority charge carriers combine to create a depletion layer.



PN junction diode

Fig 7.3

(i) Draw a circuit diagram showing a battery in series with a lamp and a diode in **reverse** bias. Use the correct symbols for the three components.

[2]

(ii) Explain briefly why the diode does not conduct electricity when it is in **reverse** bias.

[3]

Examiner Only	
Marks	Remark

8 (a) (i) What is a polymer?

[1]

Some polymeric materials are called thermosets. Others are called thermoplastics.

(ii) Describe carefully the **differences** between thermosets and thermoplastics in terms of:

Response to heat

Molecular structures

[4]

(b) PVC, also known as poly (vinyl chloride) or poly (chloroethene) is a polymer. It comes in two forms: plasticised PVC and unplasticised PVC (uPVC).

uPVC is widely used to make sewage pipes.



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Fig. 8.1

(i) State two properties of **uPVC** that make it particularly suitable for this purpose.

1. _____

2. _____ [2]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

(ii) State **two** common uses for **plasticised** PVC.

1. _____
2. _____ [2]

(c) Smart materials are finding increasing uses. For example, a quantum-tunnelling composite (QTC) is a flexible polymer which contains tiny metal particles.

(i) State **two** applications of QTCs.

1. _____
2. _____ [2]

(ii) A QTC is normally an electrical insulator. How can it be made to conduct?

_____ [1]

Spectacle frames often bend with misuse. Frames made of nitinol can return to their original shape on warming.



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Fig. 8.2

(iii) What specific type of smart material could be used to make nitinol spectacle frames?

_____ [1]

THIS IS THE END OF THE QUESTION PAPER

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