



Rewarding Learning

ADVANCED SUBSIDIARY (AS)  
General Certificate of Education  
2018

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]

MONDAY 21 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 **2(b)**.

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

Total Marks	
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1 Fig. 1.1 below represents the atom of an element.

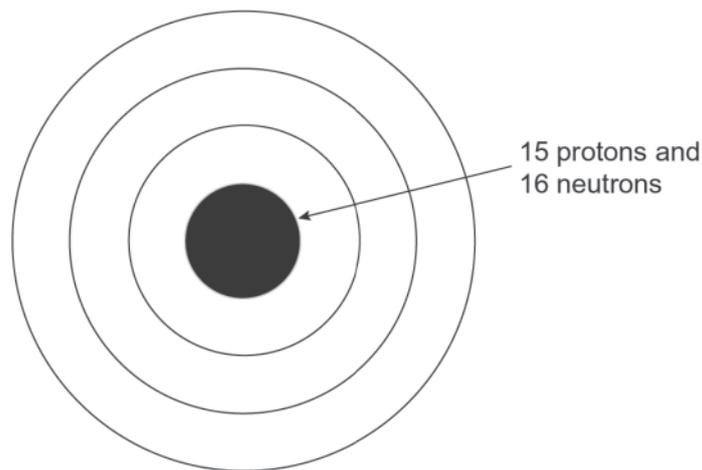


Fig. 1.1

Source: Principal Examiner

(a) (i) Name the part of the atom where the protons and neutrons are to be found.

\_\_\_\_\_ [1]

(ii) Explain why the atom is overall electrically neutral.

\_\_\_\_\_  
\_\_\_\_\_ [1]

(iii) Complete Fig. 1.1 above to show the electronic configuration of the atom, using an X to represent an electron. [1]

(iv) Is this atom likely to be a metal, a non-metal or a semiconductor? Circle your answer and give a reason for your response.

**Metal**                      **Non-metal**                      **Semiconductor**

Reason: \_\_\_\_\_ [2]

Examiner Only	
Marks	Remark



- 2 (a) (i) Define the term electrical conductivity in terms of electrical resistance, cross section area and length. If you give the definition in terms of an equation, state what each symbol means.

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[1]

- (ii) In what unit is electrical conductivity measured?

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[1]

Examiner Only	
Marks	Remark

(b) Describe an experiment to measure the electrical conductivity of the material of a thin metal wire. In your description you should:

- state what measurements you would make and the measuring instruments required;
- state what you would do to ensure the value obtained for electrical conductivity was both reliable and accurate; and
- state how you would use these measurements to calculate the electrical conductivity.

**You will be assessed on the quality of your written communication in this question.**

Measurements and instruments used

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Reliability and accuracy

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Calculations

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[6]

Examiner Only	
Marks	Remark

3 Fig. 3.1 below shows the stress–strain graphs for four different materials.

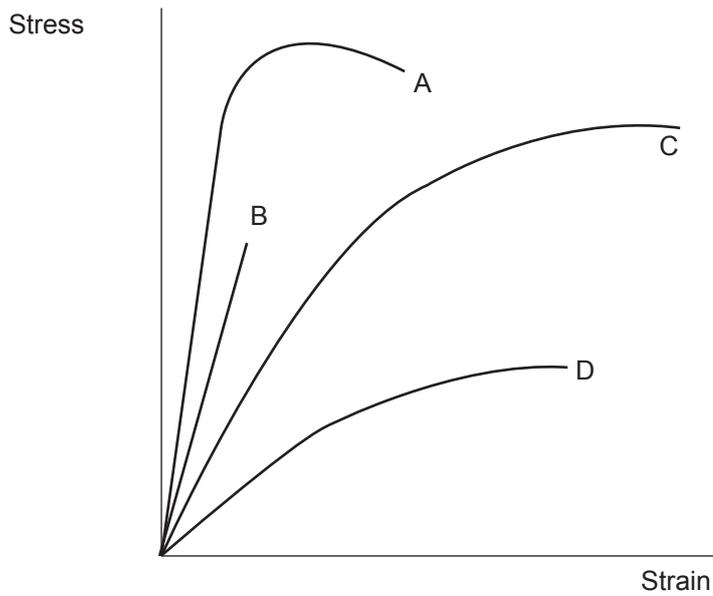


Fig. 3.1

(a) Using the letters A, B, C or D, write down which of these materials:

(i) has the greatest Young Modulus.

\_\_\_\_\_ [1]

(ii) is the most ductile.

\_\_\_\_\_ [1]

(iii) has the greatest tensile strength.

\_\_\_\_\_ [1]

Examiner Only	
Marks	Remark



4 The density of pure gold is  $19.3 \text{ g cm}^{-3}$ .

(a) (i) Show carefully that 75.0g of pure gold has a volume of  $3.89 \text{ cm}^3$ .

**You are advised to show your working.**

[2]

A jeweller mixes together 75.0g of pure gold with  $2.80 \text{ cm}^3$  of pure copper in order to produce 100g of 18 carat gold from which jewellery products can be made.

(ii) By first calculating the volume of the mixture, find the density of the 18 carat gold.

**You are advised to show your working.**

Density = \_\_\_\_\_  $\text{g cm}^{-3}$  [2]

Examiner Only	
Marks	Remark

- (iii) Gold is stored in banks in the form of heavy bullion bars. Its density is  $19.3 \text{ g cm}^{-3}$ .



Fig. 4.1

© ktsimage / iStock / Thinkstock

Calculate the density of gold in  $\text{kg m}^{-3}$ .

**You are advised to show your working.**

Density = \_\_\_\_\_  $\text{kg m}^{-3}$  [2]

Examiner Only

Marks Remark



Carbon fibre reinforced plastic is a composite material which is used in making aircraft structures. In many cases it is replacing alloys of steel and aluminium.

- (c) (i) Explain fully why carbon fibre reinforced plastic can be described as a composite material.

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 [2]

- (ii) Suggest why the use of carbon fibre reinforced plastic has reduced the cost of air travel.

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 [2]

- (iii) Suggest a major disadvantage of using composite materials.

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 [1]

Examiner Only

Marks Remark

- 5 (a) Describe and explain the main differences between the behaviour of thermoplastics and thermosets (thermosetting plastics) when they are heated.

Description:

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 [2]

Explanation:

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 [4]

- (b) Give a common everyday use for a thermoset and thermoplastic.

Thermoset: \_\_\_\_\_ [1]

Thermoplastic: \_\_\_\_\_ [1]

- (c) Material scientists sometimes use a polarising light microscope.

- (i) What is the difference between polarised and unpolarised light?

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 [2]

- (ii) State one use of a polarising light microscope.

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 [1]

Examiner Only	
Marks	Remark

- 6 (a) The following materials are all made of mixtures of metals. In each case one of the metals is identified. Complete the table by naming the other metals.

Material	Main Metal	Second metal
Brass	Copper	
Stainless steel	Steel	
Bronze		Tin

[3]

Some metals are very hard, which makes them difficult to work and cut.

- (b) (i) What name is given to the process which softens metals so that they become easier to work and cut?

\_\_\_\_\_ [1]

- (ii) Describe briefly the process identified in (b)(i).

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_ [3]

- (c) Copper is a very ductile metal. Explain what this means.

\_\_\_\_\_ [1]

Examiner Only

Marks Remark

7 Carbon nanotubes are made from a particular form (allotrope) of carbon.

(a) (i) What name is given to this particular allotrope?

\_\_\_\_\_ [1]

(ii) What is a carbon nanotube?

\_\_\_\_\_ [1]

(b) Carbon nanotubes are finding increasing use in healthcare. One use is in scaffolding for tissue regeneration.

Identify three **other** applications of carbon nanotubes in healthcare.

1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_ [3]

Examiner Only

Marks

Remark

- 8 Diodes are made of a single crystal consisting of N-type silicon and P-type silicon.

Fig. 8.1 shows a silicon diode.

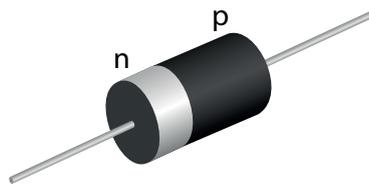


Fig. 8.1

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- (a) In what way is the doping of N-type silicon different to P-type silicon?

N-type silicon \_\_\_\_\_

P-type silicon \_\_\_\_\_ [2]

- (b) At the junction between the N-type silicon and P-type silicon there is a depletion layer.

- (i) Describe what is meant by a silicon diode being in reverse bias.

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_ [2]

- (ii) What, if anything, happens to the width of the depletion layer when the diode is in reverse bias?

\_\_\_\_\_ [1]

- (iii) Explain why the depletion layer behaves as you have described in (ii).

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_ [2]

Examiner Only	
Marks	Remark

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