OCR
Oxford Cambridge and RSA

OCR Level 3 Cambridge Technicals in Applied Science
Unit 1 Science Fundamentals

Sample Assessment Material

Date – Morning/Afternoon
Time Allowed: 2 hours

You must have:
- None

You may use:
- A calculator

Do not use:
- None

* 800000001 *

First name	
Last name	

Centre number						Candidate number				

INSTRUCTIONS
- Use black ink.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided.
- If additional space is required, use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the bar codes.
- The Periodic Table is printed on the back page.

INFORMATION
- The total mark for this paper is **90**.
- The marks for each question are shown in brackets **[ ]**.
- This document consists of **15** pages.

Answer all questions.

1. This question is about forces existing within the nucleus.

Complete the table to identify the missing type of force.

State whether they are attractive, repulsive or neither.

Some options have been completed for you.

Nuclear particles	Type of force	Attractive	Repulsive	Neither
proton-proton	electrostatic			
proton – neutron		✓		
neutron – neutron	gravitational			

[3]

2. This question is about current flow.

The current flow can be represented in the equation $I = nAvq$

With reference to n, explain the different electrical behaviour of a metal conductor and an insulator of the same dimensions.

(a) Metal conductor .....

.....**[2]**

(b) Insulator.....

.....**[2]**

3. This question is about atomic structure.
A nucleus of uranium is represented by X_{238}^{92} .

(a) How many protons are in the nucleus?

.....**[1]**

(b) How many neutrons are in the nucleus?

.....**[1]**

(c) If the electronic charge is 1.6 x10^{-19}C
Calculate the size of the charge on the nucleus

.....

.....Answer.....**[2]**

(d) In an electrically neutral atom of uranium, how many electrons would orbit the nucleus?

.....**[1]**

4. This question is about electric circuits

(a) Write down the equation for Ohm's Law

.....**[1]**

(b) Fig.4b is a circuit diagram for three cells, a switch and three resistors in series

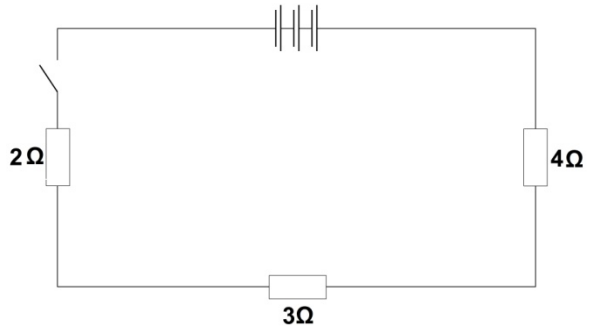

Fig. 4b

The three cells are each 1.5V, and the resistors are 2Ω, 3Ω and 4Ω.

i) Calculate the total resistance in the circuit.
.....

.....Answer.....**[1]**

ii) Calculate the value of the current through each resistor.
.....

.....

.....Answer.....Unit.....**[3]**

iii) Calculate the potential difference across **each** resistor.

.....Answer.....Unit.....

.....Answer.....Unit.....

.....Answer.....Unit.....**[3]**

(c) Calculate the total resistance if the resistors were now connected in parallel.

.....

.....

.....**[3]**

5. This question is about the structure of chemicals.

(a) What is meant by an isotope?

.....

.....

.....**[3]**

(b) Elements are the building blocks of life. They can be classified by the Periodic Table. Explain how elements are organised in the Periodic Table, using examples to support your explanation.

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.....

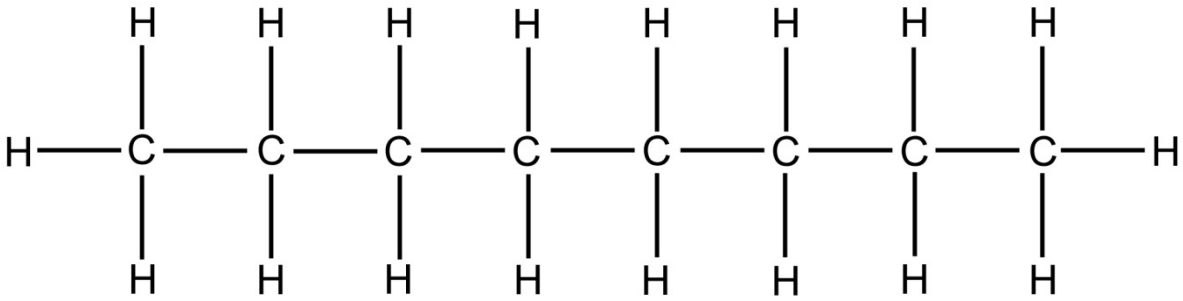
.....

.....**[4]**

6. This question is about isomers.

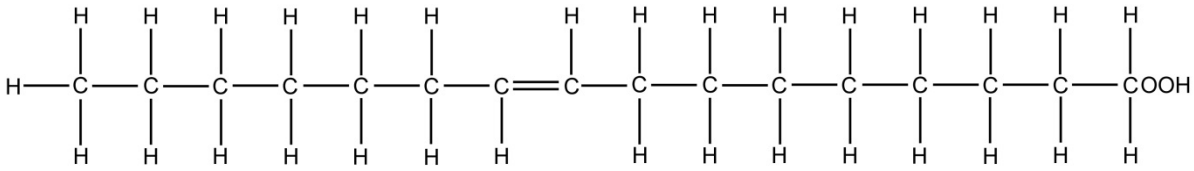
(a) The diagram shows the structural formula of octane.

Draw and name **one** structural isomer of octane.



[3]

(b) The diagram below shows the structural formula of a fatty acid.



i) What type of isomer will this molecule form?

.....**[1]**

Turn over

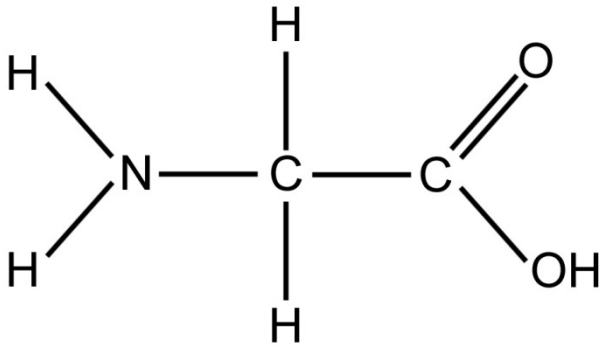
ii) Draw the isomer.

[2]

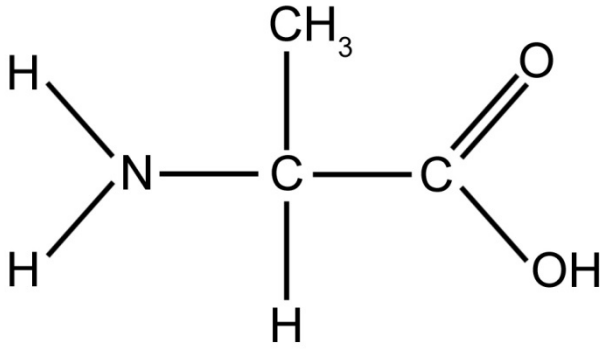
iii) What is this form of the isomer called?

.....**[1]**

(c) The diagrams show the structural formulae of the amino acids glycine and alanine.



glycine



alanine

i) What type of isomer will alanine form?

.....**[1]**

ii) Explain why alanine forms these isomers and glycine does not.

.....**[1]**

7. This question is about reactions.

(a) Describe and give an example of the following reactions:

i) Addition

.....

.....**[2]**

ii) Oxidation

.....

.....**[2]**

iii) Displacement

.....

.....**[2]**

(b) A laboratory technician is investigating the rate of production of oxygen from hydrogen peroxide using a catalyst.

i) Suggest factors that could be changed to increase the rate of reaction.

.....

.....

.....**[3]**

ii) Hydrogen peroxide (H_2O_2) decomposes slowly to produce water and oxygen. Write a balanced equation for this reaction.

.....**[1]**

8. Biological systems of different organisms involve metallic elements.

Choose from this list of elements to complete the table.

Elements

Aluminium

Calcium

Copper

Iron

Magnesium

Potassium

Sodium

Biological system	Element(s)
Transport of oxygen through the blood	and
Regulation of osmotic pressure in cells	and
Development and maintenance of some exoskeletons	and

[5]

9. This question is about cell structure.

(a) Compare the similarities and differences of a prokaryotic cell and a eukaryotic cell.

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.....

.....**[6]**

(b) Explain how the function of the plasma membrane relates to its structure.

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.....**[3]**

10. Explain the role of RNA in protein synthesis. You could include diagrams in your answer.

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.....

.....

.....**[6]**

11. This question is about inorganic chemistry.

(a) Put a tick (√) in the column next to the compounds which are inorganic in the table.

Compound	
C_2H_5OH	
$C_6H_{12}O_6$	
H_2SO_4	
CH_4	
NaOH	
KCN	

[3]

(b) Complete the chemical equation for the reaction between these two chemicals:

$H_2SO_4 + 2NaOH \longrightarrow$ _____ + _____

[2]

(c) A technician sampling the local river is concerned that the level of nitrates in the water is higher than normal.
Suggest reasons for the increase in nitrate levels.

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.....

.....

.....**[2]**

(d) Platinum is an expensive metal which can be used in making jewellery. Describe the use of platinum in medicine.

.....

…….....

.....

.....

.....

.....**[3]**

12. This question is about mixtures.

(a) What is an alloy?

.....

.....**[2]**

(b) Match the following alloys to their use by drawing lines from the alloy to its use.

amalgam	coins/medals
bronze	joining metals
solder	dentistry

[1]

(c) Starch forms a colloidal mixture when added to water. Explain the difference between a colloidal mixture and a solution.

.....

.....

.....

.....**[2]**

13. The human body consists of different types of tissues with specific roles.

(a) Identify the two tissues in Fig.13a and Fig.13b

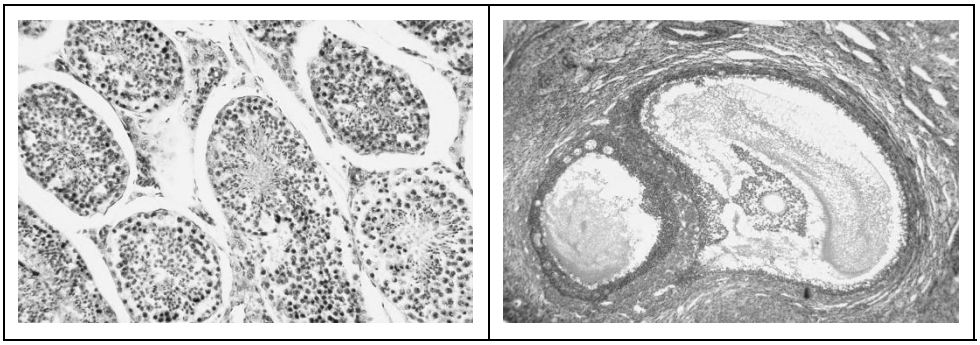

Fig.13a **Fig.13b**

Answer _____ _____

[2]

(b) Describe the key features you observe in Fig.13a.

.....

.....

.....

.....

.....

.....**[3]**

(c) State one site where ciliated epithelial tissue occurs in the body.

.....**[1]**

END OF QUESTION PAPER

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SPECIMEN

Sample Assessment Material

CAMBRIDGE TECHNICALS IN APPLIED SCIENCE
Unit 1 Science Fundamentals

MARK SCHEME

Duration: 2 hours

MAXIMUM MARK 90

SPECIMEN

Version: 1.1 **Date:** 19/11/2015

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>1</td><td></td><td></td><td>
<table>
<tr><td>Nuclear particles</td><td>Type of force</td><td>Attractive</td><td>Repulsive</td><td>Neither</td></tr>
<tr><td>Proton - proton</td><td>Electrostatic</td><td></td><td>✓</td><td></td></tr>
<tr><td>Proton - neutron</td><td>Electrostatic and/or gravitational</td><td>✓</td><td></td><td></td></tr>
<tr><td>Neutron - neutron</td><td>Gravitational</td><td></td><td></td><td></td></tr>
</table>
</td><td>1

1

1</td><td>Same sign of charge repels

Opposite signs attract or gravitational always attractive

Gravitational always attractive</td></tr>
<tr><td>2</td><td></td><td>i)</td><td>n is very large;
therefore current is significant;</td><td>1
1</td><td></td></tr>
<tr><td></td><td></td><td>ii)</td><td>n is zero or negligible;
therefore current is zero or negligible/ it does not conduct electricity;</td><td>1
1</td><td></td></tr>
<tr><td>3</td><td>(a)</td><td></td><td>92</td><td>1</td><td></td></tr>
<tr><td></td><td>(b)</td><td></td><td>238-92
= 146</td><td>1</td><td></td></tr>
<tr><td></td><td>(c)</td><td></td><td>92 x 1.6 x 10^{-19}

= 1.47 x 10^{-17}
(should be quoted as 1.5 x 10^{-17})</td><td>1

1</td><td>Allow ecf from (a) i.e 238 x 1.6 x 10^{-19}= 3.8 x 10^{-17}C

If nucleon number was used
1 mark for substitute
1 mark for correct answer</td></tr>
<tr><td></td><td>(d)</td><td></td><td>92</td><td>1</td><td></td></tr>
<tr><td>4</td><td>(a)</td><td></td><td>V=IR</td><td>1</td><td>1 mark for correct equation</td></tr>
<tr><td></td><td>(b)</td><td>i)</td><td>$R_T = R_1 + R_2 + R_3$;
R_T = 2 + 3 + 4 = 9Ω</td><td>1</td><td></td></tr>
</table>

Question			Answer	Marks	Guidance
		ii)	V_T= 1.5+1.5+1.5 = 4.5V ; I = $\frac{V_T}{R_T}$ = $\frac{4.5}{9}$ = 0.5 A	1 1 1	1 mark for correct value of V_T; 2 marks for correct value of I, 1 if unit not given. ecf
		iii)	V = I x R For 2Ω, V = 0.5 x 2 = 1.0V For 3Ω, V = 0.5 x 3 = 1.5V For 4Ω, V = 0.5 x 4 = 2.0V	1 1 1	 ecf
	(c)		$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ $\frac{1}{R_T} = \frac{1}{2} + \frac{1}{3} + \frac{1}{4} = \frac{13}{12}$ $R_T = \frac{12}{13}$ = 0.9Ω	1 1 1	Allow 1 mark for $\frac{13}{12}$.
5	**(a)**		(Isotopes are) different forms of a single **element;** the same number of **protons**; same atomic number; different numbers of **neutrons**.	3	1 mark for each correct point.
	(b)		Any four points: position in the table is left to right by atomic number; in each row, (represents a period) elements have the same number of electron shells; in each column (is a group) similar physical or chemical characteristics; blocks are sets of elements from adjacent groups which have the same atomic orbital type; the table is divided into metallic and non-metal groups.	4	1 mark for each explanation. Comment in bracket not necessary for the mark.

Question			Answer	Marks	Guidance
6	(a)		Same number of C atoms; Appropriate branch CH_3 group; Correct name (depends on candidates drawing);	3	
	(b)	i)	Geometric/stereoisomer	1	
		ii)	Any two: 2 H on same side as C9 & C10; Correct number of H atoms; Between correct two carbon; atoms	2	
		iii)	cis	1	
	(c)	i)	Optical (isomer)	1	
		ii)	Alanine asymmetric C atom/ glycine does not;	1	
7	(a)	i)	A+B=AB	2	2 marks per description and example. 1 point for correct description only. No points for just the equation.
		ii)	$A - e^- = A^+ + e^-$	2	
		iii)	X+YZ= Y+XZ	2	
	(b)	i)	Smaller particles of catalysts; greater surface area; increase temperature; increase pressure; agitation	3	
		ii)	$2H_2O_2 \rightarrow O_2 + 2H_20$	1	
8			The correct answers are: → Fe, Cu Na+, K+ Ca^{2}+	5	One mark for each correct answer.

Question			Answer	Marks	Guidance
9	(a)		Level 3 A comprehensive answer which accurately compares the similarities and differences of the two cell types. (5-6 marks) Level 2 Answer describes some similarities and differences with limited comparison. (3-4 marks) Level 1 Answer describes one or two differences or similarities. (1-2 marks) Level 0 Insufficient or incorrect science. (0 marks)	6	Relevant points include: Similarities: • plasma membrane • cytoplasm • DNA • ribosomes • cell wall (in plants) Differences: • eukaryotic – DNA stored in nucleus – DNA in mitochondria – organella – size 10 – 100mm • prokaryotic – DNA single loop – DNA as 1 or 2 plasmids – DNA in cytoplasm – extensive membranes – no organella – size 0.2 – 2mm • ribosomes are different sizes in eukaryotic and prokaryotic cells
	(b)		Phospholipid bi-layer; hydrophobic centre acts as barrier to charged/polar molecules; fluid mosaic – channel protein/receptor protein/carrier protein	3	

Question			Answer	Marks	Guidance
10			Level 3 A detailed explanation of the role of mRNA, tRNA and rRNA in protein synthesis. Information is clear and organised into the correct sequence. (5-6 marks) Level 2 The three types of RNA named and an outline of their particular role noted. (3-4 marks) Level 1 The three types of RNA named and DNA mentioned or role of one type described. (1-2 marks) Level 0 Insufficient or incorrect science. (0 marks)	6	Relevant points include: Messenger RNA • produced in nucleus • from DNA template • transcribes genetic information • carries information to cytoplasm and ribosome Transfer RNA • transfer of amino acids • in cytoplasm • to ribosome Ribosomal RNA • transfer mRNA • collates tRNA • amino acids join Protein synthesis • amino acids ferried to ribosome by tRNA according to sequence specified by mRNA • synthesis of peptide, polypeptide, protein • peptide bond formed between adjacent amino acids

Question			Answer	Marks	Guidance
11	**(a)**		Three ticks only: H_2SO_4, NaOH, KCN	3	
	(b)		Na_2SO_4; $2H_2O$ – either order	2	Water must be $2H_2O$
	(c)		Any two from: Fertiliser run off (from fields); decomposing matter in river area; factory output	2	
	(d)		Points could include: Used against advanced forms of cancer; colon/ovarian/testicular/melanoma; drugs are cisplatin, carboplatin, oxaliplatin, cytotoxic chemotherapy drug; administered as an infusion through a vein/IV	3	
12	**(a)**		Mixture not a compound; Two or more metals;	2	
	(b)		Amalgam – dentistry; bronze – coins/medals; solder – joining metals. One mark for all content.	1	
	(c)		Any two relevant points. Molecular size prevents starch from dissolving Starch attracts water molecules; Distributed through the water; Neither dissolved nor suspended	2	
13	**(a)**		Must be in this order: testis; ovary	2	
	(b)		Any three correct features described seminiferous tubule; spermatozoa; interstitial cells (Leydig); sertoli cells; connective tissue; basement membrane	3	
	(c)		One of: trachea; oviduct; any part of the respiratory system	1	