OCR
Oxford Cambridge and RSA

Level 3 Cambridge Technical in Laboratory Skills
05847/05848/05849/05874/05879

Unit 2: Laboratory Techniques

Wednesday 6 June 2018 – Afternoon

C341/1806

Duration: 2 hours

C341/1806

You must have:
- a ruler

You may use:
- a scientific or graphical calculator

First Name		Last Name	

Centre Number						Candidate Number				

Date of Birth	D	D	M	M	Y	Y	Y	Y

INSTRUCTIONS
- Use black ink.
- Complete the boxes above with your name, centre number, candidate number and date of birth.
- Answer **all** the questions.
- Write your answer to each question in the space provided.
- Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- 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 **20** pages.

FOR EXAMINER USE ONLY	
Question No	**Mark**
1	/14
2	/13
3	/15
4	/17
5	/18
6	/13
Total	**/90**

Answer **all** the questions.

1 Scientists often analyse samples they have taken.

(a) (i) Which sampling technique would a forensic scientists use when they find strands of hair at a crime scene?

Tick (✓) **one** box.

Random ☐

Representative ☐

Whole ☐

[1]

(ii) Justify your choice of sampling technique in **(a)(i)**.

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

(b) (i) Which sampling technique would a statistical scientist use to identify the probability of a characteristic occurring within the UK population?

Tick (✓) **one** box.

Random ☐

Representative ☐

Whole ☐

[1]

(ii) Justify your choice of sampling technique in **(b)(i).**

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

(c) Suggest how a DNA sample collected for forensic analysis should be stored.

Give a reason for your answer.

.....

.....

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

(d) Samples of blood can be taken from a suspect for forensic examination in a laboratory.

(i) Describe **one** potential hazard when collecting blood samples.

.....

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

(ii) Suggest **two** ways of reducing the risks associated with the hazard identified in **(d)(i)**.

1 .....

2 .....

[2]

(iii) State **one** way in which 'sharps', including needles, should be treated after taking a blood sample.

.....

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

(e) Blood is often transported to laboratories for analysis.

(i) Give **two** reasons why tubes containing blood samples are enclosed in plastic, watertight containers.

.....

.....

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

(ii) Give **one** reason why tubes and containers are labelled separately.

.....

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

(iii) Give **one** reason why blood samples are transported in a temperature-controlled environment.

.....

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

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2 Jamie is analysing the flavour compounds in a beer sample.

The technique he is using for the analysis is gas chromatography.

Fig. 2.1 shows a block diagram of a gas chromatograph.

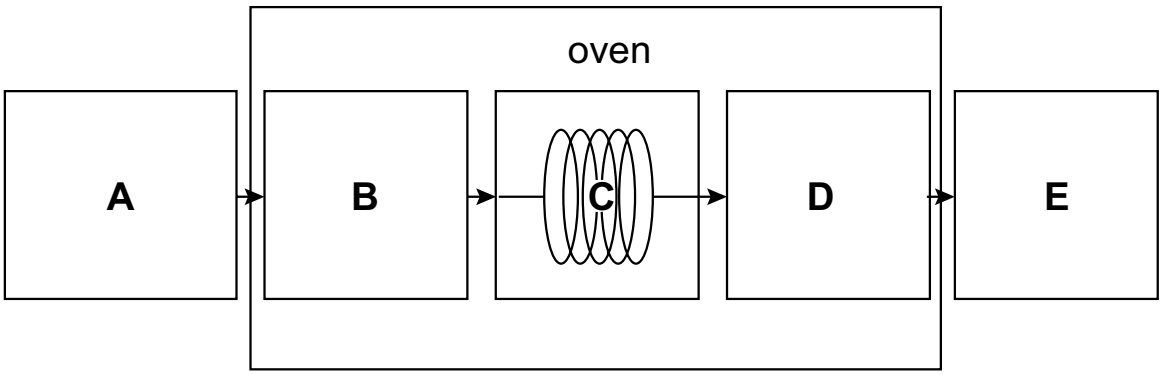

Fig. 2.1

(a) Identify the parts of the gas chromatograph shown in the block diagram in **Fig. 2.1**.

Draw lines to connect parts **A – E** to the correct name of the part.

Letter	Name of part
A	Carrier gas
B	Column
C	Data system
D	Detector
E	Injection

[5]

(b) Jamie adds a chemical to the beer sample. The chemical acts as an **internal standard**.

Suggest **two** properties of a suitable internal standard.

1 .....

.....

2 .....

.....

[2]

(c) The gas chromatograph measures the retention time in the column of each component in the beer sample.

The chromatogram Jamie produces from the analysis of the beer sample is shown in **Fig. 2.2**.

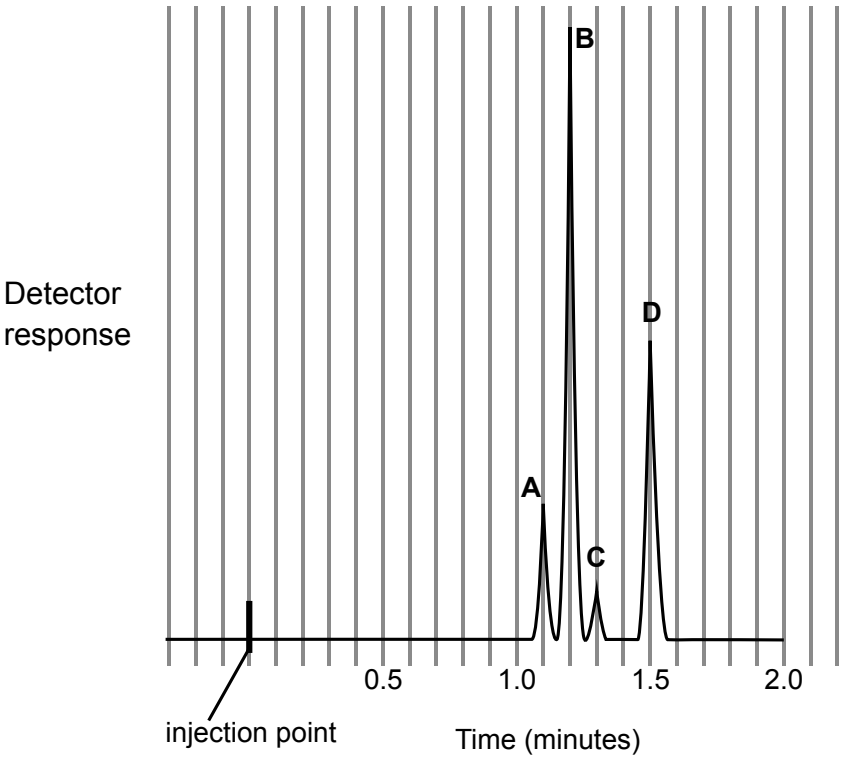

Fig. 2.2

The relative retention time (RRT) can be calculated for each component. The RRT is the length of time each component in the sample is retained in the column, relative to the time that the internal standard is retained.

RRT can be calculated using the equation:
RRT = retention of unknown ÷ retention time of internal standard.

In this system, the retention time of the **internal standard** is **1.7 minutes**.

Published values of RRTs for this system are shown in **Table 2.1**.

Compound	**RRT**
Ethanal	0.65
Ethanol	0.71
Ethyl ethanoate	0.88
Internal standard	1.00
2-methylpropan-1-ol	0.94
3-methyl-1-butanol	1.36
Propan-1-ol	0.76

Table 2.1

(i) Identify peaks **A – D** in **Fig. 2.2**.

Draw a line to connect peaks **A – D** to the correct compound.

Peak	Compound
A	Ethanal
	Ethanol
B	Ethyl ethanoate
	Internal standard
C	2-methylpropan-1-ol
	3-methyl-1-butanol
D	Propan-1-ol

[4]

(ii) Outline how internal standards can be used for a **quantitative** analysis of the beer sample.

.....

.....

.....

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

3 Jodie is a consumer product scientist analysing the composition of antacid remedies. She has been provided with samples of milk of magnesia to analyse.

Milk of magnesia is a suspension of magnesium hydroxide in water.

(a) Jodie does not titrate the milk of magnesia directly against hydrochloric acid. Instead she uses a technique called a back titration to measure the concentration of magnesium hydroxide. A back titration is a two-stage technique.

Jodie first reacts the milk of magnesia with an excess of hydrochloric acid.

(i) Write a **balanced** symbol equation for the reaction between magnesium hydroxide and hydrochloric acid to produce magnesium chloride and water.

$Mg(OH)_2$ + HCl → ..... + ...

[2]

(ii) In the titration she uses a 5.00 cm^3 dose of milk of magnesia. She adds 16.0 cm^3 of 1.00 mol dm^{-3} hydrochloric acid.

Calculate the number of moles of hydrochloric acid added to the milk of magnesia.

Use the equation: n = c × V

c = concentration (mol dm^{-3})

n = number of moles

V = volume (dm^3)

number of moles = ...moles

[3]

(b) Jodie then titrates the unreacted hydrochloric acid against sodium hydroxide.

The volume of 0.100 mol dm^{-3} sodium hydroxide needed to neutralise the unreacted hydrochloric acid is 26.1 cm^3.

Calculate the number of moles of sodium hydroxide that reacted with the hydrochloric acid.

Use the equation: $n = c \times V$

c = concentration (mol dm^{-3})

n = number of moles

V = volume (dm^3)

average number of moles = ...

[3]

(c) Jodie calculates the amount of magnesium hydroxide in a dose of milk of magnesia.

(i) Calculate the number of moles of magnesium hydroxide in the 5.00 cm^3 dose of milk of magnesia.

number of moles = ...

[4]

(ii) Calculate the mass of magnesium hydroxide, in mg, in the 5.00 cm^3 dose of milk of magnesia.

The molar mass of magnesium hydroxide is 58.3 g mol^{-1}.

mass = ... mg

[3]

4 Jeremy is experiencing abdominal pain.

He visits his local hospital. He has an X-ray and ultrasound scan of his abdomen.

(a) (i) State **two** similarities between the images generated by an X-ray scanner and by an ultrasound scanner.

1 .....

.....

2 .....

.....

[2]

(ii) State **two** differences between the images generated by an X-ray scanner and by an ultrasound scanner.

1 .....

.....

2 .....

.....

[2]

(b) A biopsy is used to remove some of Jeremy's kidney cells for examination.

A laboratory technician uses a light microscope, shown in **Fig. 4.1**, to examine the cells.

Fig. 4.1

(i) **Fig. 4.1** shows a number of characteristic features of a light microscope.

Write the letters **A** to **E** in **Table 4.1** to identify the parts shown in **Fig. 4.1.**

Part of microscope	Label
Source of light	
Location of microscope slide	
Eye piece	
Objective lens	
Control used to focus the image	

Table 4.1

[5]

(ii) State **three** benefits of using a light microscope.

1 .....

2 .....

3 .....

[3]

(c) Jeremy's kidney cells are then examined with an electron microscope (EM).

Fig. 4.2 shows the electron micrograph produced.

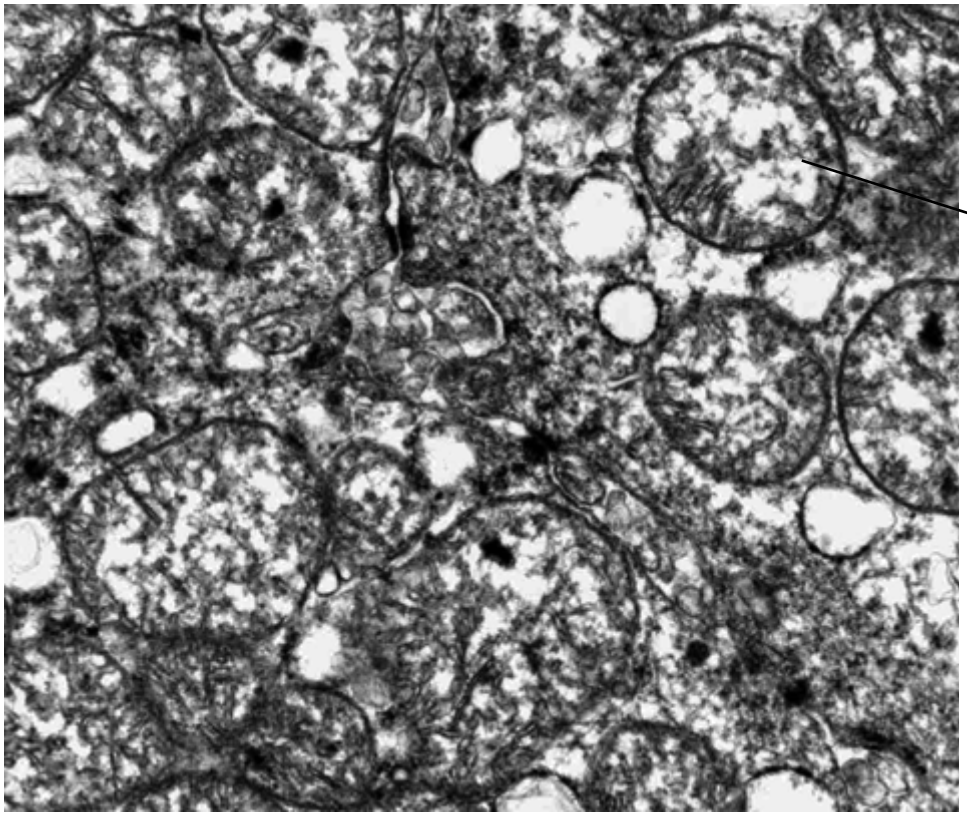

Fig. 4.2

The cells contain many large mitochondria.

The mitochondrion labelled **M** is 2.5 μm in diameter.

(i) Calculate the magnification of the mitochondrion, M.

Use the formula: magnification = $\frac{\text{measured size}}{\text{actual size}}$

Show your working.

magnification = × .....

[3]

(ii) Give **two advantages** of using electron microscopy compared with light microscopy.

1 .....

.....

2 .....

.....

[2]

5 An analytical chemist analyses a solution from a sealed bottle found on a shipwreck.

(a) The scientist uses ion chromatography to analyse the cations in the solution.

(i) Explain how ion chromatography can be used to identify the cations in the solution.

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.....

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

(ii) List **four** other types of chromatography.

1 .....

2 .....

3 .....

4 .....

[4]

(b) The analytical chemist runs a mixture of standards through the ion chromatograph.

The retention times of the cations in the mixture are shown in **Table 5.1**.

Cation	Retention time (minutes)
Ammonium	5.4
Potassium	7.2
Sodium	4.5

Table 5.1

The results of the analysis on the solution found in the shipwreck are shown in **Fig. 5.1**.

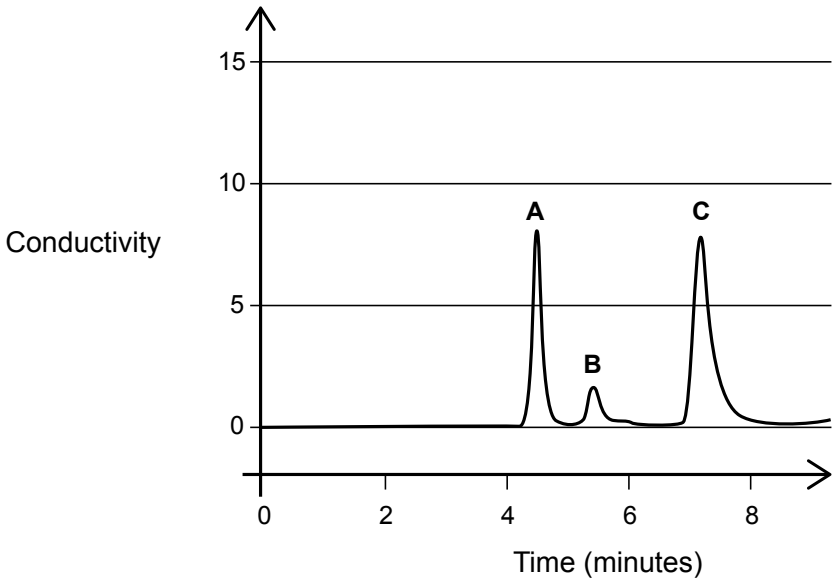

Fig. 5.1

Identify cations **A**, **B** and **C** in the solution. Use the retention times shown in **Table 5.1** and **Fig. 5.1**.

A .....

B .....

C .....

[3]

(c) State **two** alternative techniques that could be used to analyse the cations in the solution.

1 .....

2 .....

[2]

(d) Flame tests can be carried out on solutions of ions to identify the cations present.

Complete **Table 5.2** to show the flame test results for the three cations listed.

Cation	Colour in flame
Barium	
Copper	
Lithium	

Table 5.2

[3]

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6 Sundip is culturing plants for a nursery.

When culturing plants she follows the standard operating procedure shown in **Table 6.1**.

Stage	Activity
1	Sterilise the workbench.
2	Heat-sterilise a pair of forceps.
3	Collect a small piece of tissue from the growing tip of the plant.
4	Using a scalpel, cut the tissue into small pieces, 3-5 mm long. [These pieces of tissue are called explants. Each explant should grow into a new plant.]
5	Pick up one explant using forceps and sterilise its surface.
6	Take the lid off the vial of nutrient jelly.
7	Use the forceps to transfer the explant to the nutrient jelly. Replace the lid on the vial.
8	Incubate the explant and examine its growth.

Table 6.1

(a) Explain why an aseptic technique must be used when culturing explants from the plant.

.....

.....

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

(b) (i) Describe how the forceps in **Stage 2** are sterilised.

.....

.....

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

(ii) Describe how the surface of the explants in **Stage 5** are sterilised.

.....

.....

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

(c) Suggest **two** additional ways in which Sundip can reduce possible contamination during the process.

1 .....

.....

2 .....

.....

[2]

(d) Give **three** more examples of practical work where an aseptic technique is essential.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

END OF QUESTION PAPER

The Periodic Table of the Elements

Key
atomic number
Symbol
name
relative atomic mass

(1) 1	(2) 2	3	4	5	6	7	8	9	10	11	12	(3) 13	(4) 14	(5) 15	(6) 16	(7) 17	(0) 18
1 **H** hydrogen 1.0																	2 **He** helium 4.0
3 **Li** lithium 6.9	4 **Be** beryllium 9.0											5 **B** boron 10.8	6 **C** carbon 12.0	7 **N** nitrogen 14.0	8 **O** oxygen 16.0	9 **F** fluorine 19.0	10 **Ne** neon 20.2
11 **Na** sodium 23.0	12 **Mg** magnesium 24.3											13 **Al** aluminium 27.0	14 **Si** silicon 28.1	15 **P** phosphorus 31.0	16 **S** sulfur 32.1	17 **Cl** chlorine 35.5	18 **Ar** argon 39.9
19 **K** potassium 39.1	20 **Ca** calcium 40.1	21 **Sc** scandium 45.0	22 **Ti** titanium 47.9	23 **V** vanadium 50.9	24 **Cr** chromium 52.0	25 **Mn** manganese 54.9	26 **Fe** iron 55.8	27 **Co** cobalt 58.9	28 **Ni** nickel 58.7	29 **Cu** copper 63.5	30 **Zn** zinc 65.4	31 **Ga** gallium 69.7	32 **Ge** germanium 72.6	33 **As** arsenic 74.9	34 **Se** selenium 79.0	35 **Br** bromine 79.9	36 **Kr** krypton 83.8
37 **Rb** rubidium 85.5	38 **Sr** strontium 87.6	39 **Y** yttrium 88.9	40 **Zr** zirconium 91.2	41 **Nb** niobium 92.9	42 **Mo** molybdenum 95.9	43 **Tc** technetium	44 **Ru** ruthenium 101.1	45 **Rh** rhodium 102.9	46 **Pd** palladium 106.4	47 **Ag** silver 107.9	48 **Cd** cadmium 112.4	49 **In** indium 114.8	50 **Sn** tin 118.7	51 **Sb** antimony 121.8	52 **Te** tellurium 127.6	53 **I** iodine 126.9	54 **Xe** xenon 131.3
55 **Cs** caesium 132.9	56 **Ba** barium 137.3	57–71 lanthanoids	72 **Hf** hafnium 178.5	73 **Ta** tantalum 180.9	74 **W** tungsten 183.8	75 **Re** rhenium 186.2	76 **Os** osmium 190.2	77 **Ir** iridium 192.2	78 **Pt** platinum 195.1	79 **Au** gold 197.0	80 **Hg** mercury 200.6	81 **Tl** thallium 204.4	82 **Pb** lead 207.2	83 **Bi** bismuth 209.0	84 **Po** polonium	85 **At** astatine	86 **Rn** radon
87 **Fr** francium	88 **Ra** radium	89–103 actinoids	104 **Rf** rutherfordium	105 **Db** dubnium	106 **Sg** seaborgium	107 **Bh** bohrium	108 **Hs** hassium	109 **Mt** meitnerium	110 **Ds** darmstadtium	111 **Rg** roentgenium	112 **Cn** copernicium		114 **Fl** flerovium		116 **Lv** livermorium		

57 **La** lanthanum 138.9	58 **Ce** cerium 140.1	59 **Pr** praseodymium 140.9	60 **Nd** neodymium 144.2	61 **Pm** promethium 144.9	62 **Sm** samarium 150.4	63 **Eu** europium 152.0	64 **Gd** gadolinium 157.2	65 **Tb** terbium 158.9	66 **Dy** dysprosium 162.5	67 **Ho** holmium 164.9	68 **Er** erbium 167.3	69 **Tm** thulium 168.9	70 **Yb** ytterbium 173.0	71 **Lu** lutetium 175.0
89 **Ac** actinium	90 **Th** thorium 232.0	91 **Pa** protactinium	92 **U** uranium 238.1	93 **Np** neptunium	94 **Pu** plutonium	95 **Am** americium	96 **Cm** curium	97 **Bk** berkelium	98 **Cf** californium	99 **Es** einsteinium	100 **Fm** fermium	101 **Md** mendelevium	102 **No** nobelium	103 **Lr** lawrencium