

Write your name here

Surname

Other names

**Pearson Edexcel**  
**International**  
**Advanced Level**

Centre Number

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Candidate Number

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# Chemistry

**Advanced**

**Unit 6: Chemistry Laboratory Skills II**

Tuesday 27 January 2015 – Afternoon

**Time: 1 hour 15 minutes**

Paper Reference

**WCH06/01**

**Candidates may use a calculator.**

Total Marks

## Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*

## Information

- The total mark for this paper is 50.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- You will be assessed on your ability to organise and present information, ideas, descriptions and arguments clearly and logically, including your use of grammar, punctuation and spelling.
- A Periodic Table is printed on the back cover of this paper.

## Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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**PEARSON**

**Answer ALL the questions. Write your answers in the spaces provided.**

**1** A white solid, **A**, has one metal cation, and an anion containing two non-metallic elements.

(a) A flame test is carried out on **A**.

(i) Describe how you would carry out this flame test in the laboratory.

(3)

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(ii) A yellow flame is seen. Give the **formula** of the metal ion present.

(1)

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(b) Solid **A** dissolves in water to form a colourless solution.

This solution decolorises a dilute aqueous solution of iodine.

Dilute hydrochloric acid is added to a fresh solution of **A**.

A very pale yellow precipitate, **B**, forms slowly and an acidic gas, **C**, is given off.

Gas **C** turns acidified sodium dichromate(VI) from orange to green.

(i) Identify, by name or formula, the precipitate **B** and the gas **C**.

(2)

Precipitate, **B** .....

Gas, **C** .....



(ii) What is the colour of a **dilute** aqueous solution of iodine?

(1)

(iii) Give the **name** of the anion in compound **A**.

(1)

(iv) Give the **formula** of compound **A**.

(1)

**(Total for Question 1 = 9 marks)**



2 A white solid, **D**, is formed when ethanoyl chloride is added to a concentrated solution of ammonia. The molecular formula of **D** is  $C_2H_5ON$ .

When solid **D** is heated with excess aqueous sodium hydroxide solution, ammonia gas is given off and a solution, **E**, is formed.

(a) Ammonia has a distinctive smell. Give **two** other tests, each of a different type, which could be used to show the presence of ammonia. Give the result of each test.

(3)

Test 1 .....

.....

Test 2 .....

.....

(b) Excess dilute sulfuric acid is added to solution **E** and an organic liquid, **F**, is distilled from the mixture.

(i) Draw a labelled diagram of the apparatus used for this distillation.

(2)



(ii) Addition of pure liquid **F** to aqueous sodium carbonate gives effervescence.

Identify liquid **F** by name or formula.

(1)

(c) (i) Give the name and displayed formula of solid **D**.

(2)

Name .....

Displayed formula

(ii) Write an equation for the formation of solid **D** from ethanoyl chloride and concentrated ammonia solution. State symbols are not required.

(1)

**(Total for Question 2 = 9 marks)**



- 3 This is an experiment to determine the oxidation number of vanadium in a purple solution, **T**, of a vanadium compound.

#### Preparation of solution T

Solution **T** was formed when 25.00 cm<sup>3</sup> of a 0.100 mol dm<sup>-3</sup> solution of sodium vanadate(V), NaVO<sub>3</sub>, was reduced by heating with excess zinc and dilute sulfuric acid.

When the reduction was complete, the yellow NaVO<sub>3</sub> solution had turned purple.

#### Titration of solution T

The mixture was filtered through glass wool, directly into 50.00 cm<sup>3</sup> of 0.0200 mol dm<sup>-3</sup> potassium manganate(VII), KMnO<sub>4</sub>, solution.

Further potassium manganate(VII) solution of the same concentration was added from a burette to this reaction mixture, which was kept at a temperature of about 80°C. The end point is reached when all the vanadium ions had been oxidized back into vanadate(V) ions by the manganate(VII) ions.

The end point occurred when a further 25.00 cm<sup>3</sup> had been added.

- (a) (i) Draw a diagram of the apparatus for carrying out the titration, while **keeping** the titration mixture at about 80°C.

(2)



(ii) What is removed from the reaction mixture by filtering through glass wool? (1)

(iii) Suggest why the mixture is filtered directly into potassium manganate(VII) solution before carrying out the rest of the titration. (1)

(iv) Explain why an indicator is **not** required for this titration. (1)

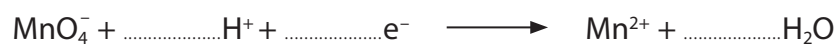
(b) (i) Calculate the number of moles of vanadate(V) ions,  $\text{VO}_3^-$ , in  $25.00 \text{ cm}^3$  of a  $0.100 \text{ mol dm}^{-3}$  solution of sodium vanadate(V),  $\text{NaVO}_3$ . (1)

(ii) Calculate the **total** volume of potassium manganate(VII) solution. Hence the **total** number of moles of potassium manganate(VII) used to oxidize the purple vanadium solution, **T**. (2)



(iii) Complete the half equation for the reduction of manganate(VII) ions to manganese(II) ions.

(1)



(iv) By considering either the number of electrons transferred or by using the changes in oxidation numbers, calculate the oxidation number of vanadium in the purple solution, **T**.

You **must** show your working.

(3)

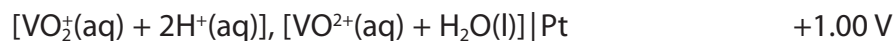
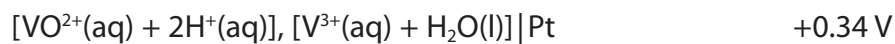
(c) In acidic solution, the vanadate ions,  $\text{VO}_3^-$  are changed into  $\text{VO}_2^+$ . Write an ionic equation for this reaction. State symbols are not required.

(1)





(d) Some standard electrode potentials of tin and vanadium are given below.



Use these values to predict the lowest oxidation number of vanadium that can be produced from  $\text{VO}_2^{+}$  using tin as the reducing agent. Explain your reasoning.

(2)

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**(Total for Question 3 = 15 marks)**



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4 Cholesteryl benzoate was the first liquid crystal to be discovered. It can be prepared by the following procedure.

- Step 1** Dissolve 1.0 g of cholesterol in 3 cm<sup>3</sup> of pyridine in a conical flask.
- Step 2** Add 0.40 cm<sup>3</sup> of benzoyl chloride.
- Step 3** Heat the mixture on a steam bath for about 10 minutes.
- Step 4** Cool the mixture, and add 15 cm<sup>3</sup> of methanol.
- Step 5** Collect the solid cholesteryl benzoate by suction filtration. Rinse the flask and the crude crystals with a little cold methanol.
- Step 6** Recrystallize the cholesteryl benzoate using ethyl ethanoate as the solvent.

Some physical data for the chemicals involved are shown below.

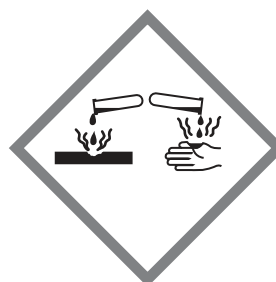
|                      | Molar mass<br>/ g mol <sup>-1</sup> | Density<br>/ g cm <sup>-3</sup> | Melting<br>temperature<br>/ K | Boiling<br>temperature<br>/ K |
|----------------------|-------------------------------------|---------------------------------|-------------------------------|-------------------------------|
| Cholesterol          | 386.7                               |                                 |                               | 633                           |
| Benzoyl chloride     | 140.6                               | 1.21                            |                               | 470                           |
| Cholesteryl benzoate | 490.8                               |                                 | 423                           |                               |
| Pyridine             | 79.1                                |                                 |                               | 388                           |
| Ethyl ethanoate      | 88.1                                |                                 | 190                           | 350                           |

(a) Suggest the apparatus you would use to measure the volume of benzoyl chloride.

(1)

(b) The warning symbols on a bottle of benzoyl chloride are shown below. Write the meaning of each symbol in the space provided.

(2)



.....

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(c) 1 mol of cholesterol reacts with 1 mol of benzoyl chloride to form 1 mol of cholesteryl benzoate.

(i) Determine which reactant is in excess by calculating how many moles of cholesterol and of benzoyl chloride are used in the preparation.

(3)

(ii) Calculate the percentage yield when 0.65 g of cholesteryl benzoate is obtained.

(2)

(d) Suggest how the mixture is cooled in **Step 4**.

(1)

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(e) Suggest why methanol is added to the cooled mixture in **Step 4**.

(1)

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# The Periodic Table of Elements

|  | 1                                    | 2                                    |  |  |  |   |  |                                       |   |   |  |   | 3                                       | 4                                    | 5  | 6                                     | 7                                       | 0 (8)                              |
|--|--------------------------------------|--------------------------------------|--|--|--|---|--|---------------------------------------|---|---|--|---|---|--------------------------------------|--|---------------------------------------|---|------------------------------------|
|  | (1)                                  | (2)                                  | (3)                                    | (4)  | (5)                                      | (6)                                     | (7)                                    | (8)                                   | (9)                                     | (10)                                      | (11)                                     | (12)  | (13)                                    | (14)                                 | (15)                                     | (16)                                  | (17)                                    | (18)                               |
|  | 6.9<br><b>Li</b><br>lithium<br>3     | 9.0<br><b>Be</b><br>beryllium<br>4   | 45.0<br><b>Sc</b><br>scandium<br>21    | 47.9<br><b>Ti</b><br>titanium<br>22        | 50.9<br><b>V</b><br>vanadium<br>23       | 52.0<br><b>Cr</b><br>chromium<br>24     | 54.9<br><b>Mn</b><br>manganese<br>25   | 55.8<br><b>Fe</b><br>iron<br>26       | 58.9<br><b>Co</b><br>cobalt<br>27       | 58.7<br><b>Ni</b><br>nickel<br>28         | 63.5<br><b>Cu</b><br>copper<br>29        | 65.4<br><b>Zn</b><br>zinc<br>30   | 10.8<br><b>B</b><br>boron<br>5          | 12.0<br><b>C</b><br>carbon<br>6      | 14.0<br><b>N</b><br>nitrogen<br>7        | 16.0<br><b>O</b><br>oxygen<br>8       | 19.0<br><b>F</b><br>fluorine<br>9       | 4.0<br><b>He</b><br>helium<br>2    |
|  | 23.0<br><b>Na</b><br>sodium<br>11    | 24.3<br><b>Mg</b><br>magnesium<br>12 | 88.9<br><b>Y</b><br>yttrium<br>39      | 91.2<br><b>Zr</b><br>zirconium<br>40       | 92.9<br><b>Nb</b><br>niobium<br>41       | 95.9<br><b>Mo</b><br>molybdenum<br>42   | [98]<br><b>Tc</b><br>technetium<br>43  | 101.1<br><b>Ru</b><br>ruthenium<br>44 | 102.9<br><b>Rh</b><br>rhodium<br>45     | 106.4<br><b>Pd</b><br>palladium<br>46     | 107.9<br><b>Ag</b><br>silver<br>47       | 112.4<br><b>Cd</b><br>cadmium<br>48   | 27.0<br><b>Al</b><br>aluminium<br>13    | 28.1<br><b>Si</b><br>silicon<br>14   | 31.0<br><b>P</b><br>phosphorus<br>15     | 32.1<br><b>S</b><br>sulfur<br>16      | 35.5<br><b>Cl</b><br>chlorine<br>17     | 39.9<br><b>Ar</b><br>argon<br>18   |
|  | 39.1<br><b>K</b><br>potassium<br>19  | 40.1<br><b>Ca</b><br>calcium<br>20   | 88.9<br><b>Y</b><br>yttrium<br>39      | 91.2<br><b>Zr</b><br>zirconium<br>40       | 92.9<br><b>Nb</b><br>niobium<br>41       | 95.9<br><b>Mo</b><br>molybdenum<br>42   | [98]<br><b>Tc</b><br>technetium<br>43  | 101.1<br><b>Ru</b><br>ruthenium<br>44 | 102.9<br><b>Rh</b><br>rhodium<br>45     | 106.4<br><b>Pd</b><br>palladium<br>46     | 107.9<br><b>Ag</b><br>silver<br>47       | 112.4<br><b>Cd</b><br>cadmium<br>48   | 69.7<br><b>Ga</b><br>gallium<br>31      | 72.6<br><b>Ge</b><br>germanium<br>32 | 74.9<br><b>As</b><br>arsenic<br>33       | 79.0<br><b>Se</b><br>selenium<br>34   | 79.9<br><b>Br</b><br>bromine<br>35      | 83.8<br><b>Kr</b><br>krypton<br>36 |
|  | 85.5<br><b>Rb</b><br>rubidium<br>37  | 87.6<br><b>Sr</b><br>strontium<br>38 | 138.9<br><b>La*</b><br>lanthanum<br>57 | 178.5<br><b>Hf</b><br>hafnium<br>72        | 180.9<br><b>Ta</b><br>tantalum<br>73     | 183.8<br><b>W</b><br>tungsten<br>74     | 186.2<br><b>Re</b><br>rhenium<br>75    | 190.2<br><b>Os</b><br>osmium<br>76    | 192.2<br><b>Ir</b><br>iridium<br>77     | 195.1<br><b>Pt</b><br>platinum<br>78      | 197.0<br><b>Au</b><br>gold<br>79         | 200.6<br><b>Hg</b><br>mercury<br>80   | 204.4<br><b>Tl</b><br>thallium<br>81    | 207.2<br><b>Pb</b><br>lead<br>82     | 209.0<br><b>Bi</b><br>bismuth<br>83      | [209]<br><b>Po</b><br>polonium<br>84  | [210]<br><b>At</b><br>astatine<br>85    | [222]<br><b>Rn</b><br>radon<br>86  |
|  | [223]<br><b>Fr</b><br>francium<br>87 | [226]<br><b>Ra</b><br>radium<br>88   | [227]<br><b>Ac*</b><br>actinium<br>89  | [261]<br><b>Rf</b><br>rutherfordium<br>104 | [262]<br><b>Db</b><br>dubnium<br>105     | [266]<br><b>Sg</b><br>seaborgium<br>106 | [264]<br><b>Bh</b><br>bohrium<br>107   | [277]<br><b>Hs</b><br>hassium<br>108  | [268]<br><b>Mt</b><br>meitnerium<br>109 | [271]<br><b>Ds</b><br>darmstadtium<br>110 | [272]<br><b>Rg</b><br>roentgenium<br>111 | Elements with atomic numbers 112-116 have been reported but not fully authenticated |   |                                      |  |                                       |   |                                    |
|  |                                      |                                      |  | 140<br><b>Ce</b><br>cerium<br>58           | 141<br><b>Pr</b><br>praseodymium<br>59   | 144<br><b>Nd</b><br>neodymium<br>60     | [147]<br><b>Pm</b><br>promethium<br>61 | 150<br><b>Sm</b><br>samarium<br>62    | 152<br><b>Eu</b><br>europium<br>63      | 157<br><b>Gd</b><br>gadolinium<br>64      | 159<br><b>Tb</b><br>terbium<br>65        | 163<br><b>Dy</b><br>dysprosium<br>66  | 165<br><b>Ho</b><br>holmium<br>67       | 167<br><b>Er</b><br>erbium<br>68     | 169<br><b>Tm</b><br>thulium<br>69        | 173<br><b>Yb</b><br>ytterbium<br>70   | 175<br><b>Lu</b><br>lutetium<br>71      |                                    |
|  |                                      |                                      |  | 232<br><b>Th</b><br>thorium<br>90          | [231]<br><b>Pa</b><br>protactinium<br>91 | 238<br><b>U</b><br>uranium<br>92        | [237]<br><b>Np</b><br>neptunium<br>93  | [242]<br><b>Pu</b><br>plutonium<br>94 | [243]<br><b>Am</b><br>americium<br>95   | [247]<br><b>Cm</b><br>curium<br>96        | [245]<br><b>Bk</b><br>berkelium<br>97    | [251]<br><b>Cf</b><br>californium<br>98   | [254]<br><b>Es</b><br>einsteinium<br>99 | [253]<br><b>Fm</b><br>fermium<br>100 | [256]<br><b>Md</b><br>mendelevium<br>101 | [254]<br><b>No</b><br>nobelium<br>102 | [257]<br><b>Lr</b><br>lawrencium<br>103 |                                    |

\* Lanthanide series  
\* Actinide series

