Write your name here

Surname	Other names

Pearson Edexcel
International
Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

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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P 4 5 0 4 6 A 0 1 1 6

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)

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

(1)

(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^3 of a 0.100 mol dm^{-3} solution of sodium vanadate(V), $NaVO_3$, was reduced by heating with excess zinc and dilute sulfuric acid.

When the reduction was complete, the yellow $NaVO_3$ solution had turned purple.

Titration of solution T

The mixture was filtered through glass wool, directly into 50.00 cm^3 of 0.0200 mol dm^{-3} potassium manganate(VII), $KMnO_4$, 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^3 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)

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

(1)

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

(1)

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(b) (i) Calculate the number of moles of vanadate(V) ions, VO_3^-, in 25.00 cm^3 of a 0.100 mol dm^{-3} solution of sodium vanadate(V), $NaVO_3$.

(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)

$$MnO_4^- + \text{.....}H^+ + \text{.....}e^- \longrightarrow Mn^{2+} + \text{.....}H_2O$$

(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, VO_3^- are changed into 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.

$Sn^{2+}(aq)\|Sn(s)$	–0.14 V
$V^{2+}(aq)\|V(s)$	–1.18 V
$V^{3+}(aq),V^{2+}(aq)\|Pt$	–0.26 V
$[VO^{2+}(aq) + 2H^{+}(aq)], [V^{3+}(aq) + H_2O(l)]\|Pt$	+0.34 V
$[VO_2^{+}(aq) + 2H^{+}(aq)], [VO^{2+}(aq) + H_2O(l)]\|Pt$	+1.00 V

Use these values to predict the lowest oxidation number of vanadium that can be produced from 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^3 of pyridine in a conical flask.

Step 2 Add 0.40 cm^3 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^3 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 / g mol^{-1}	Density / g cm^{-3}	Melting temperature / K	Boiling temperature / 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)

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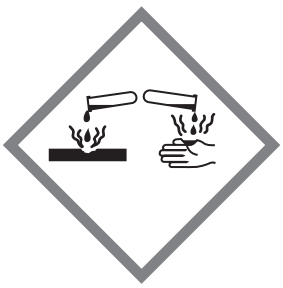
(b) The warning symbols on a bottle of benzoyl chloride are shown below. Write the meaning of each symbol in the space provided.

(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)

.....

.....

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

(1)

.....

.....

(f) Describe how to carry out the recrystallization to obtain pure dry crystals of cholesteryl benzoate in **Step 6**.

(5)

(g) How would you show that the recrystallized cholesteryl benzoate crystals in **Step 6** are purer than the crude crystals obtained in **Step 5**?

(2)

(Total for Question 4 = 17 marks)

TOTAL FOR PAPER = 50 MARKS

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The Periodic Table of Elements

1	2											3	4	5	6	7	0 (8) (18)
							1.0 H hydrogen 1										4.0 He helium 2
(1)	(2)		Key									(13)	(14)	(15)	(16)	(17)	
6.9 Li lithium 3	9.0 Be beryllium 4		relative atomic mass atomic symbol name atomic (proton) number									10.8 B boron 5	12.0 C carbon 6	14.0 N nitrogen 7	16.0 O oxygen 8	19.0 F fluorine 9	20.2 Ne neon 10
23.0 Na sodium 11	24.3 Mg magnesium 12	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	27.0 Al aluminium 13	28.1 Si silicon 14	31.0 P phosphorus 15	32.1 S sulfur 16	35.5 Cl chlorine 17	39.9 Ar argon 18
39.1 K potassium 19	40.1 Ca calcium 20	45.0 Sc scandium 21	47.9 Ti titanium 22	50.9 V vanadium 23	52.0 Cr chromium 24	54.9 Mn manganese 25	55.8 Fe iron 26	58.9 Co cobalt 27	58.7 Ni nickel 28	63.5 Cu copper 29	65.4 Zn zinc 30	69.7 Ga gallium 31	72.6 Ge germanium 32	74.9 As arsenic 33	79.0 Se selenium 34	79.9 Br bromine 35	83.8 Kr krypton 36
85.5 Rb rubidium 37	87.6 Sr strontium 38	88.9 Y yttrium 39	91.2 Zr zirconium 40	92.9 Nb niobium 41	95.9 Mo molybdenum 42	[98] Tc technetium 43	101.1 Ru ruthenium 44	102.9 Rh rhodium 45	106.4 Pd palladium 46	107.9 Ag silver 47	112.4 Cd cadmium 48	114.8 In indium 49	118.7 Sn tin 50	121.8 Sb antimony 51	127.6 Te tellurium 52	126.9 I iodine 53	131.3 Xe xenon 54
132.9 Cs caesium 55	137.3 Ba barium 56	138.9 La* lanthanum 57	178.5 Hf hafnium 72	180.9 Ta tantalum 73	183.8 W tungsten 74	186.2 Re rhenium 75	190.2 Os osmium 76	192.2 Ir iridium 77	195.1 Pt platinum 78	197.0 Au gold 79	200.6 Hg mercury 80	204.4 Tl thallium 81	207.2 Pb lead 82	209.0 Bi bismuth 83	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86
[223] Fr francium 87	[226] Ra radium 88	[227] Ac* actinium 89	[261] Rf rutherfordium 104	[262] Db dubnium 105	[266] Sg seaborgium 106	[264] Bh bohrium 107	[277] Hs hassium 108	[268] Mt meitnerium 109	[271] Ds darmstadtium 110	[272] Rg roentgenium 111							

Elements with atomic numbers 112-116 have been reported but not fully authenticated

* Lanthanide series	140 Ce cerium 58	141 Pr praseodymium 59	144 Nd neodymium 60	[147] Pm promethium 61	150 Sm samarium 62	152 Eu europium 63	157 Gd gadolinium 64	159 Tb terbium 65	163 Dy dysprosium 66	165 Ho holmium 67	167 Er erbium 68	169 Tm thulium 69	173 Yb ytterbium 70	175 Lu lutetium 71
* Actinide series	232 Th thorium 90	[231] Pa protactinium 91	238 U uranium 92	[237] Np neptunium 93	[242] Pu plutonium 94	[243] Am americium 95	[247] Cm curium 96	[245] Bk berkelium 97	[251] Cf californium 98	[254] Es einsteinium 99	[253] Fm fermium 100	[256] Md mendelevium 101	[254] No nobelium 102	[257] Lr lawrencium 103