Write your name here

Surname	Other names

Centre Number | Candidate Number

Edexcel GCE

Chemistry

Advanced Subsidiary

Unit 3B: Chemistry Laboratory Skills I Alternative

Monday 10 January 2011 – Afternoon
Time: 1 hour 15 minutes

Paper Reference
6CH07/01

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

1 (a) Compound **X** is a white crystalline solid that dissolves easily in water to form a clear, colourless solution. **X** contains one cation and one anion. Complete the table below.

(5)

	Test	Observation	Inference
(i)	Warm solid **X** with dilute	A gas was evolved which turned damp red litmus paper blue.	Ammonia is formed so the ammonium ion is present.
(ii)	Add aqueous barium chloride to a solution of **X**.	....	**X** contains either sulfite (sulfate(IV)) or ..... or .....
(iii)	Add dilute hydrochloric acid to the result of test (ii).	A gas was evolved which	Sulfite (sulfate(IV)) confirmed.

(iv) Describe a further **chemical** test, not involving indicators, that you could use to confirm that ammonia is formed in part (i).

(2)

Test .....

Result .....

.....

(b) Compound **Y** is a white solid that contains one cation and one anion. Complete the table below.

(4)

	Test	Observation	Inference
(i)	Flame test	Brick red (yellow-red) flame.	The cation in **Y** is .....
(ii)	Gently heat a sample of **Y** in a test tube, testing any vapours evolved with cobalt chloride paper.	Vapour turned cobalt chloride paper from blue to	Water is produced. **Y** contains water of crystallization.
(iii)	Heat the sample of **Y** in the test tube.	Brown gas evolved.	Gas is ....
(iv)	Continue to heat the sample of **Y**.	Gas reignited a glowing splint.	Gas is .....

(v) Identify, by name or formula, the anion in **Y**.

(1)

.....

(vi) Give the formula of **Y** (one mole of **Y** contains one mole of water of crystallization).

(2)

.....

(Total for Question 1 = 14 marks)

2 (a) The organic compounds propan-1-ol and propan-2-ol are isomers. Propan-1-ol has the structure $CH_3CH_2CH_2OH$ and propan-2-ol has the structure $(CH_3)_2CHOH$.

Describe a test and its expected result to confirm the presence of the –OH group in propan-1-ol or propan-2-ol.

(2)

Test .....

Result .....

(b) When propan-1-ol or propan-2-ol is heated to 170 °C with concentrated sulfuric acid, propene is formed.

Name the type of reaction that has occurred in the reaction with sulfuric acid.
Describe a test and its positive result to show the presence of the C═C bond in propene.

(3)

Type of reaction .....

Test .....

Result .....

(Total for Question 2 = 5 marks)

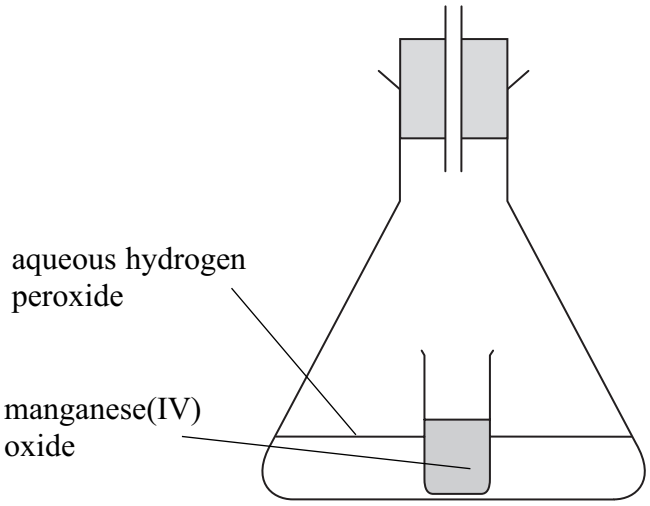
3 Aqueous hydrogen peroxide decomposes according to the following equation.

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$

The decomposition is very slow under normal conditions but it is catalysed by a number of substances. The rate of the reaction using manganese(IV) oxide as the catalyst was investigated by measuring the volume of oxygen produced at various times as the reaction proceeded. Part of the apparatus used for the experiment is shown below. The manganese(IV) oxide was placed in the small glass container which was tipped over to start the reaction and a stop clock was started at the same time.

(a) Complete the diagram to show how the gas was collected **and** its volume measured.

(2)

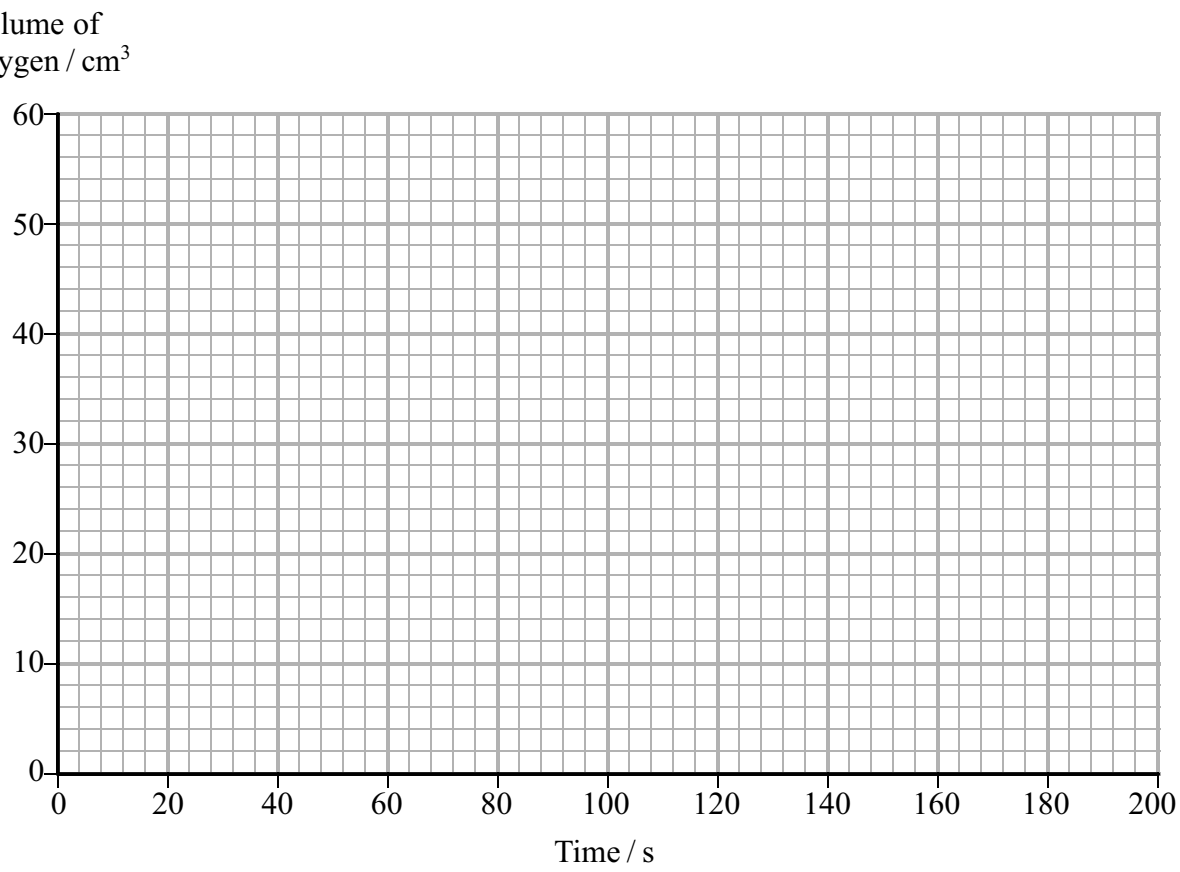


(b) In an experiment using 0.25 g of manganese(IV) oxide granules (small pieces) and 50 cm^3 of aqueous hydrogen peroxide of concentration 0.080 mol dm^{-3}, the following results were obtained.

Time / s	0.0	20.0	30.0	40.0	60.0	80.0	100	120	150
Volume of O_2 / cm^3	0	29	36	40	45	46	47	48	48

(i) Plot these results on the grid below and draw a best fit line through the points.

(3)



(ii) The rate of reaction may be assumed to be approximately constant up to the first volume measurement (20.0 seconds in this experiment) and is called the initial rate. Use this approximation to calculate the initial rate of this reaction, giving your answer to **two** significant figures and stating the units.

(2)

(iii) In a second experiment, the manganese(IV) oxide granules were replaced by the same mass of the compound as a fine powder. The volume and concentration of the aqueous hydrogen peroxide were kept the same.
On the grid in (b)(i), draw the line that you would expect to obtain in this experiment.

(2)

(iv) Explain any similarities in the lines you have drawn on the grid.
Use the collision theory of reaction rates to explain any differences between the shapes of the lines.

(3)

(c) Catalysts are not used up during a reaction. Outline an experiment to demonstrate that the manganese(IV) oxide is not used up in the decomposition of hydrogen peroxide (practical details of the experiment are **not** required).

(4)

(Total for Question 3 = 16 marks)

4 Bromoethane may be prepared by reacting ethanol with bromine and red phosphorus.

$$10C_2H_5OH(l) + 2P(s) + 5Br_2(l) \rightarrow 10C_2H_5Br(l) + 2H_3PO_4(aq) + 2H_2O(l)$$

The steps of the experimental procedure are as follows.

1. Measure 10.0 cm^3 of ethanol into a round-bottom flask.
2. Add 1.5 g of red phosphorus to the ethanol.
3. Pre-cool 5 cm^3 of liquid bromine in an ice bath, then slowly add it to the mixture of ethanol and red phosphorus, while cooling the flask under running water.
4. Gently reflux the mixture for about 10 minutes.
5. Rearrange the apparatus for distillation, immersing the receiver in ice-cold water and distil until no more bromoethane is formed.
6. Decant as much water as possible and then wash the product with dilute sodium carbonate solution and distilled water, decanting off the aqueous layer each time.
7. Transfer the washed product to a separating funnel and, from this, run off the organic layer into a small distillation flask.
8. Add anhydrous calcium chloride, stopper the flask and allow it to stand until the liquid turns clear.
9. Distil the bromoethane over a suitable temperature range, immersing the receiver in ice-cold water.

Data

Property	Ethanol	Bromoethane
Density / g cm^{-3}	0.789	1.47
Molar mass / g mol^{-1}	46.0	109
Boiling temperature / °C	78.4	38.4

(a) Suggest the apparatus most suitable for measuring the volume of ethanol to an accuracy of $\pm$ 0.1 cm^3 (step 1).

(1)

.....

(b) Explain why it is necessary to pre-cool the bromine (step 3).

(1)

.....

.....

(c) Suggest why it is also necessary to cool the mixture while adding the bromine (step 3).

(1)

.....

(d) Draw a labelled diagram of the apparatus that you would use to heat the mixture under reflux (step 4).

(3)

(e) Suggest why, in both the distillations, the receiver is immersed in ice-cold water (steps 5 and 9).

(1)

.....

(f) State the purpose of the following in this procedure:

(i) Washing the product with dilute sodium carbonate solution (step 6).

(1)

.....

(ii) Adding anhydrous calcium chloride to the organic layer (step 8).

(1)

.....

(g) Suggest a suitable temperature range for the collection of the product in the final distillation (step 9), giving the temperatures in whole numbers.

(1)

From .....

To .....

(h) (i) Calculate the number of moles of ethanol used in the preparation.

(1)

(ii) Given that one mole of ethanol forms one mole of bromoethane, calculate the maximum mass, in grams, of bromoethane that may be prepared using 10 cm^3 of ethanol.

(1)

(iii) Using the procedure described, a student prepared 13.3 g of bromoethane. Calculate the percentage yield of bromoethane in this preparation.

(1)

(iv) Suggest why the yield is calculated in relation to the ethanol rather than the bromine.

(1)

.....

.....

.....

(v) Suggest **one** reason, other than volatility of the reactants or products, why the preparation does **not** produce a 100 % yield.

(1)

.....

.....

.....

(Total for Question 4 = 15 marks)

TOTAL FOR PAPER = 50 MARKS

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)											(13)	(14)	(15)	(16)	(17)	
6.9 Li lithium 3	9.0 Be beryllium 4											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							

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

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

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
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

* Lanthanide series

* Actinide series