

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

1. (a) Potassium dichromate(VI) solution acidified with dilute sulphuric acid is an oxidising agent. It is used to show the presence of some chemical compounds which can be oxidised.

State the colour change that occurs when an acidified solution of potassium dichromate(VI) is reduced.

From to **(1)**

- (b) Identify the following compounds from their behaviour when treated with acidified potassium dichromate(VI) solution

- (i) A pungent acidic gas which is readily oxidised.

..... **(1)**

- (ii) TWO colourless organic liquids, both of formula $C_4H_{10}O$, which are oxidised on heating.

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.....

(2)

- (iii) A colourless organic liquid, also of formula $C_4H_{10}O$, which resists oxidation even on heating.

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(1)



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(c) Aluminium powder in sodium hydroxide solution is a reducing mixture which can be used in tests to identify certain ions. (Zinc or Devarda's alloy can also be used in place of the aluminium.)

(i) Identify an anion that can be detected by its reaction with one of these mixtures.

.....
(1)

(ii) Identify the gas produced when the reaction in (i) occurs.

.....
(1)

(iii) Describe a test to show the gas in (ii) is present. Give the positive result of this test.

.....
.....
(1)

(d) A compound containing the anion detected in (c)(i), was thought to contain either lithium or sodium cations.

Describe how you would carry out a flame test to identify the metal ion present, giving the result for each cation.

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(4)

(Total 12 marks)

Q1

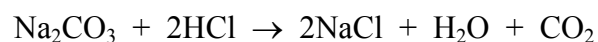
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- (c) 25.0 cm³ samples of the sodium carbonate solution were titrated against aqueous hydrochloric acid using methyl orange indicator.

The equation for the reaction is



The results of three titrations (in cm³) were: 29.10, 28.60 and 28.70.

- (i) State the colour change at the end-point of the titration.

From to
(1)

- (ii) Calculate the mean (or average) titre that you would use to calculate the concentration of the hydrochloric acid.

(1)

- (iii) Use your mean titre and the concentration of the sodium carbonate solution from (b) to calculate the concentration of the hydrochloric acid in mol dm⁻³.

If you have been unable to calculate the concentration of the sodium carbonate solution in (b) use a value of 1.50 mol dm⁻³ (this is **not** the correct answer to (b)).

(3)

(Total 13 marks)

Q2

5

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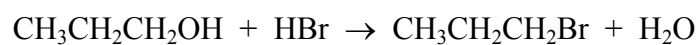


N 2 9 2 2 4 A 0 5 1 6

3. 1-bromopropane may be prepared from propan-1-ol using the following method:

- Propan-1-ol, water and solid sodium bromide are mixed in a flask and 50 % sulphuric acid is added, a little at a time, with cooling.
- The mixture is heated under reflux and then distilled.
- The distillate is mixed with sodium carbonate solution in a separating funnel and the lower organic layer removed.
- Solid anhydrous calcium chloride is added to the organic layer, which is finally distilled. The distillate boiling in the range 70–72 °C is collected.

The reaction may be represented by the following equation:



Hazard information about 1-bromopropane

- flammable
- harmful by skin absorption

(a) (i) Why is the mixture cooled while the sulphuric acid is added?

.....
.....

(1)



(ii) Draw a labelled diagram of the apparatus used for heating under reflux.

(3)

(iii) What property of 1-bromopropane allows it to be separated from the sodium carbonate solution using a separating funnel?

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(1)

(iv) What is the purpose of the anhydrous calcium chloride?

.....
(1)

(v) Suggest a safety precaution (other than the use of a fume cupboard, laboratory coat or safety goggles) that would be appropriate for this experiment. Give a reason for your choice.

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.....
.....
(2)



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- (b) (i) Calculate the theoretical maximum mass of 1-bromopropane that could be obtained from 7.55 g of propan-1-ol.

[Molar masses/ g mol^{-1} : propan-1-ol 60.0, 1-bromopropane 123]

(2)

- (ii) In the actual experiment 8.30 g of 1-bromopropane was obtained.
Calculate the percentage yield of the reaction.

(1)

- (iii) Suggest a reason why the yield is less than 100 %.

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.....

(1)

Q3

(Total 12 marks)



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N 2 9 2 2 4 A 0 9 1 6

4. The enthalpy change for the reaction between aqueous sodium hydroxide solution and aqueous hydrochloric acid was determined by the following method:

- Aqueous hydrochloric acid was titrated against 25.0 cm³ of 1.50 mol dm⁻³ aqueous sodium hydroxide solution using a suitable indicator. The mean (or average) titre was 22.75 cm³.
- 25.0 cm³ of the sodium hydroxide solution was carefully measured into a polystyrene cup and 22.75 cm³ of the hydrochloric acid was transferred to a clean dry beaker. Both solutions were allowed to stand for five minutes before their temperatures were noted.
- The hydrochloric acid was then added to the sodium hydroxide solution, the mixture stirred thoroughly and the highest temperature noted.
- The experiment was repeated three times giving an average temperature change of +10.5°C.

(a) (i) Explain why the titration was carried out.

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.....

(1)

(ii) Why was it necessary to allow the two solutions to stand before mixing?

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.....

(1)



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- (b) (i) Calculate the heat produced in the reaction, in joules.
Use the approximations that the density of the final solution is 1.00 g cm^{-3} and its specific heat capacity is $4.18 \text{ J g}^{-1} \text{ K}^{-1}$.

(2)

- (ii) Calculate the enthalpy change for the reaction, in kJ mol^{-1} .

(3)

- (c) State ONE assumption made when calculating this enthalpy change, other than those stated in (b)(i).

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(1)

(Total 8 marks)

Q4



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N 2 9 2 2 4 A 0 1 5 1 6

THE PERIODIC TABLE

1
2
3
4
5
6
7
0

Period

1	H Hydrogen 1
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Molar mass g mol ⁻¹
Symbol
Name
Atomic number

4	He Helium 2
---	-------------------

7	Li Lithium 3	Be Beryllium 4	9	B Boron 5	C Carbon 6	7	N Nitrogen 7	8	O Oxygen 8	9	F Fluorine 9	10	Ne Neon 10																						
23	Na Sodium 11	24	Mg Magnesium 12	27	Al Aluminium 13	28	Si Silicon 14	31	P Phosphorus 15	32	S Sulphur 16	35.5	Cl Chlorine 17	40	Ar Argon 18																				
39	K Potassium 19	40	Ca Calcium 20	45	Sc Scandium 21	48	Ti Titanium 22	51	V Vanadium 23	52	Cr Chromium 24	55	Mn Manganese 25	56	Fe Iron 26	59	Ni Nickel 28	63.5	Cu Copper 29	65.4	Zn Zinc 30	70	Ga Gallium 31	73	Ge Germanium 32	75	As Arsenic 33	79	Se Selenium 34	80	Br Bromine 35	84	Kr Krypton 36		
85	Rb Rubidium 37	88	Sr Strontium 38	89	Y Yttrium 39	91	Zr Zirconium 40	93	Nb Niobium 41	96	Mo Molybdenum 42	99	Tc Technetium 43	101	Ru Ruthenium 44	103	Rh Rhodium 45	106	Pd Palladium 46	108	Ag Silver 47	112	Cd Cadmium 48	115	In Indium 49	119	Sn Tin 50	122	Sb Antimony 51	127	Te Tellurium 52	128	I Iodine 53	131	Xe Xenon 54
133	Cs Caesium 55	137	Ba Barium 56	139	La Lanthanum 57	178	Hf Hafnium 72	181	Ta Tantalum 73	184	W Tungsten 74	186	Re Rhenium 75	190	Os Osmium 76	192	Ir Iridium 77	195	Pt Platinum 78	197	Au Gold 79	201	Hg Mercury 80	204	Tl Thallium 81	207	Pb Lead 82	209	Bi Bismuth 83	210	Po Polonium 84	210	At Astatine 85	222	Rn Radon 86
223	Fr Francium 87	226	Ra Radium 88	227	Ac Actinium 89																														

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	163	Dy Dysprosium 66	165	Ho Holmium 67	167	Er Erbium 68	169	Tm Thulium 69	173	Yb Ytterbium 70	175	Lu Lutetium 71
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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
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