OXFORD
INTERNATIONAL
AQA EXAMINATIONS

OXFORD AQA INTERNATIONAL A-LEVEL
CHEMISTRY
(9620)

PAPER 5

Specimen 2018 Morning Time allowed: 1 hour 25 minutes

Materials
For this paper you must have:
- a pencil
- a ruler
- a calculator
- a data booklet

Instructions
- use black ink or ball-point pen
- answer **all** questions
- show all your working.

Information
- The marks for questions are shown in brackets
- The maximum mark for this paper is 60 marks

Please write clearly, in block capitals, to allow character computer recognition.

Centre number ☐☐☐☐☐ Candidate number ☐☐☐☐

Surname ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Forename(s) ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Candidate signature _____

Answer **all** questions in the spaces provided.

1 Water that reacts with soap to form a scum is called Hard Water. Hardness is caused by the presence of dissolved calcium or magnesium ions. The hardness of a sample of water can be determined by titrating the water with a solution containing the ligand $EDTA^{4-}$. $EDTA^{4-}$ reacts in a 1:1 ratio forming very stable complexes with these metal ions.

0 1 . 1 Write an equation for the reaction of $EDTA^{4-}$ with aqueous calcium ions, $[Ca(H_2O)_6]^{2+}$.

[1 mark]

0 1 . 2 A solution containing a known concentration of $EDTA^{4-}$ ions can be prepared using the hydrated disodium salt (RFM = 372.4)
Calculate the mass of the hydrated disodium salt required to prepare $250cm^3$ of 0.0200 mol dm^{-3} solution.
Outline the procedure for the preparation of this solution.

[7 marks]

0 1 . 3 A 25.0 cm^3 sample of water reacted with 5.55 cm^3 of a 0.0200 mol dm^{-3} solution of $EDTA^{4-}$ ions.

Calculate the concentration, in g dm^{-3}, of the Ca^{2+} ions present in the water.

[3 marks]

0 1 . 4 The maximum total error for the burette is ±0.15 cm^3. This error takes into account multiple measurements.

Estimate the maximum percentage error in using the burrette in the titration in **Question 01.4**.

[1 mark]

0 1 . 5 Suggest one way that the percentage error in the burette could be reduced.

[1 mark]

0 1 . 6 During the titration, the chemist rinsed the inside of the conical flask with deionised water. The water used for rinsing remained in the conical flask.

Give one reason why this rinsing can improve the accuracy of the end-point of the titration.

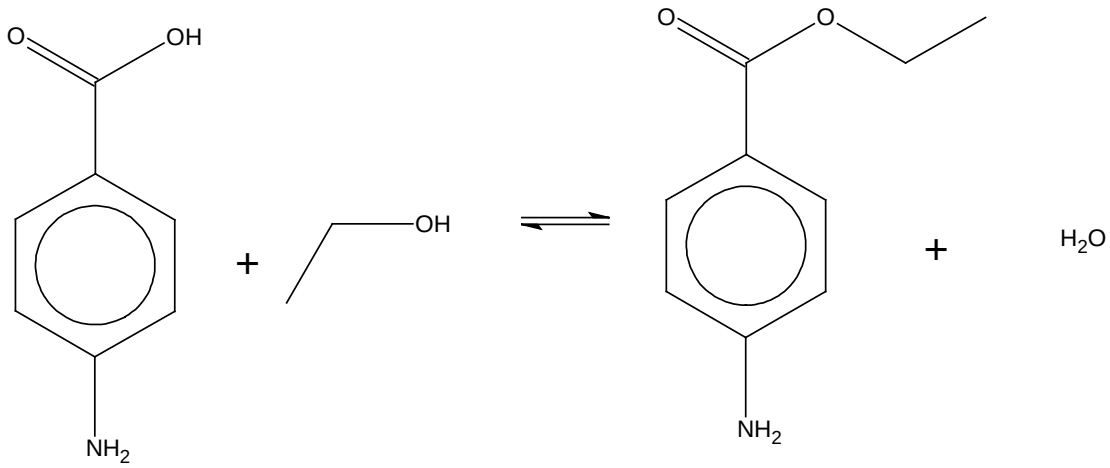
[1 mark]

0 1 . 7 Explain why the water used for rinsing has no effect of the accuracy of the titre.

[1 mark]

2 Benzocaine is a useful anaesthetic.

Benzocaine is an ester and can be prepared by the reaction of 4-aminobenzoic acid with ethanol:



Benzocaine

1.20g of 4-aminobenzoic acid were placed with an excess of ethanol into a 100cm^3 round bottomed flask. 2cm^3 of concentrated sulfuric acid were added and the flask was swirled. The reaction mixture was then heated under reflux for 45 minutes. The resulting mixture was then allowed to cool to room temperature.

The reaction mixture was placed into a beaker and aqueous sodium carbonate solution was added dropwise, and the mixture was swirled gently. During this stage gas was evolved, and the benzocaine formed as a precipitate. Addition of sodium carbonate solution was continued until gas was no longer evolved.

The benzocaine was then isolated, and the solid was washed with water. Once the benzocaine has been isolated, it was recrystallized using a suitable solvent. Finally, the melting point was determined.

0 2 . 1 Explain why reflux is commonly used to complete organic preparations.

[2 marks]

0 2 . 2 Calculate the maximum mass of benzocaine that can be formed by the reaction of 4-aminobenzoic acid (Mr = 137.0) with excess ethanol.

[3 marks]

0 2 . 3 Suggest the main reason why the actual mass that is obtained is less than the maximum mass.

[1 mark]

0 2 . 4 Identify the gas evolved when the aqueous sodium carbonate is added and explain why this gas is evolved during this stage of the procedure.

[2 marks]

Identity of the gas _____

Explanation _____

0 2 . 5 Explain why the benzocaine is washed with water.

[1 mark]

0 2 . 6 The benzocaine was recrystallised to purify it.

Outline the method that should be used to recrystallise the benzocaine.

[4 marks]

0 2 . 7 The purity of the product can be determined by measuring the melting point.

State two observations about the melting point that indicates that it is pure.

[2 marks]

Only **one** answer per question is allowed.

For each answer completely fill in the circle alongside the appropriate answer.

CORRECT METHOD  WRONG METHODS 

If you want to change your answer you must cross out your original answer as shown. 

If you wish to return to an answer previously crossed out, ring the answer you now wish to select as shown. 

0 3 Which of these elements has the highest second ionisation energy?

[1 mark]

A Na ⬭

B Mg ⬭

C Ne ⬭

D Ar ⬭

0 4 Which of the following shows chlorine in its correct oxidation states in the compounds shown?

[1 mark]

	HCl	$KClO_3$	HClO	
A	–1	+3	+1	⬭
B	+1	–5	–1	⬭
C	–1	+5	+1	⬭
D	+1	+5	–1	⬭

0 5 Which of the following contains the most chloride ions?

[1 mark]

A 10 cm^3 of 3.30×10^{-2} mol dm^{-3} aluminium chloride solution ⬭

B 20 cm^3 of 5.00×10^{-2} mol dm^{-3} calcium chloride solution ⬭

C 30 cm^3 of 3.30×10^{-2} mol dm^{-3} hydrochloric acid ⬭

D 40 cm^3 of 2.50×10^{-2} mol dm^{-3} sodium chloride solution ⬭

0 6

Figure 1

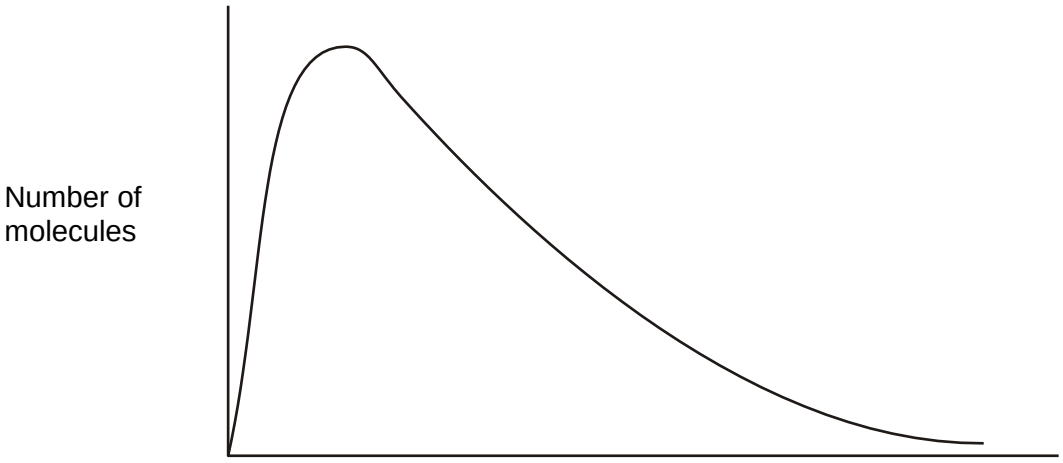


Figure 1 shows a Maxwell-Boltzmann distribution
What does the area under the curve represent?

[1 mark]

A Total energy of particles ⬭

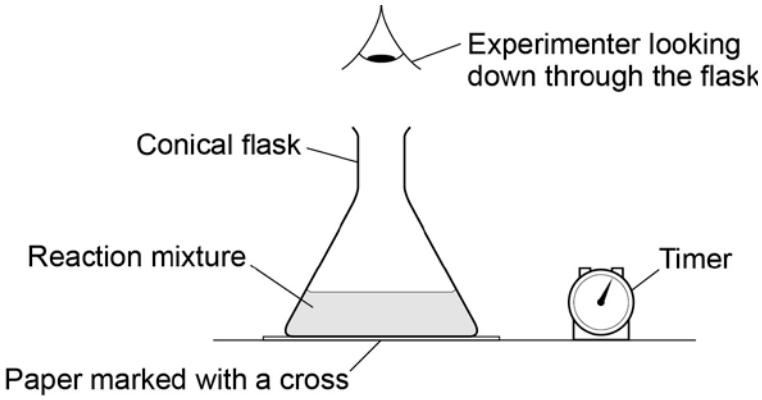
B Total number of particles ⬭

C Number of particles that can react ⬭

D The total number particles that have the activation energy ⬭

The apparatus in **Figure 2** was set up to measure the time taken for 20.0 cm^3 of sodium thiosulfate solution to react with 5.0 cm^3 of hydrochloric acid in a 100 cm^3 conical flask at 20 °C. The timer was started when the sodium thiosulfate solution was added to the acid in the flask. The timer was stopped when it was no longer possible to see the cross on the paper.

Figure 2



0 7 What is likely to decrease the accuracy of the experiment?

[1 mark]

A Rinsing the flask with acid before each new experiment. ⬭

B Stirring the solution throughout each experiment. ⬭

C Using the same piece of paper for each experiment. ⬭

D Using different measuring cylinders to measure the volumes ⬭

0 8 The experiment was repeated at 20 °C using a 250 cm^3 conical flask.

Which statement is correct about the time taken for the cross to disappear when using the larger conical flask?

[1 mark]

A The time taken will **not** be affected by using the larger conical flask. ⬭

B The time taken will be decreased by using the larger conical flask. ⬭

C The time taken will be increased by using the larger conical flask. ⬭

D It is impossible to predict how the time taken will be affected by using the larger conical flask. ⬭

0 9 Which change requires the largest amount of energy?

[1 mark]

A $He^+(g) \longrightarrow He^{2+}(g) + e^-$ ⬭

B $Li(g) \longrightarrow Li^+(g) + e^-$ ⬭

C $Mg^+(g) \longrightarrow Mg^{2+}(g) + e^-$ ⬭

D $N(g) \longrightarrow N^+(g) + e^-$ ⬭

1 0 A sample of 2.18 g of oxygen gas has a volume of 1870 cm^3 at a pressure of 101 kPa.

What is the temperature of the gas?
The gas constant is $R = 8.31\ J\ K^{-1}\ mol^{-1}$.

[1 mark]

A 167 K ⬭

B 334 K ⬭

C 668 K ⬭

D 334 000 K ⬭

1 1 An ester is hydrolysed as shown by the following equation.

$$RCOOR' + H_2O \longrightarrow RCOOH + R'OH$$

What is the percentage yield of RCOOH when 0.50 g of RCOOH ($M_r = 100$) is obtained from 1.0 g of RCOOR′ ($M_r = 150$)?

[1 mark]

A 33% ⬭

B 50% ⬭

C 67% ⬭

D 75% ⬭

1 2 A saturated aqueous solution of magnesium hydroxide contains 1.17×10^{-3} g of $Mg(OH)_2$ in 100 cm^3 of solution. In this solution, the magnesium hydroxide is fully dissociated into ions.

What is the concentration of $Mg^{2+}(aq)$ ions in this solution?

[1 mark]

A 2.82×10^{-2} mol dm^{-3} ⬭

B 2.01×10^{-3} mol dm^{-3} ⬭

C 2.82×10^{-3} mol dm^{-3} ⬭

D 2.01×10^{-4} mol dm^{-3} ⬭

Turn over for the next question

1 3 The rate equation for the hydrogenation of ethene

$$C_2H_4(g) + H_2(g) \longrightarrow C_2H_6(g)$$

is $Rate = k[C_2H_4][H_2]$

At a fixed temperature, the reaction mixture is compressed to triple the original pressure.

What is the factor by which the rate of reaction changes?

[1 mark]

A 6 ⬭

B 9 ⬭

C 12 ⬭

D 27 ⬭

1 4 When one mole of ammonia is heated to a given temperature, 50% of the compound dissociates and the following equilibrium is established.

$$NH_3(g) \rightleftharpoons \tfrac{1}{2}N_2(g) + \tfrac{3}{2}H_2(g)$$

What is the total number of moles of gas present in this equilibrium mixture?

[1 mark]

A 1.5 ⬭

B 2.0 ⬭

C 2.5 ⬭

D 3.0 ⬭

1 5 What is the pH of a 0.020 mol dm^{-3} solution of a diprotic acid which is completely dissociated?

[1 mark]

A 1.00 ⬭

B 1.40 ⬭

C 1.70 ⬭

D 4.00 ⬭

1 6 The acid dissociation constant, K_a, of a weak acid HA has the value 2.56×10^{-4} mol dm^{-3}

What is the pH of a 4.25×10^{-3} mol dm^{-3} solution of HA?

[1 mark]

A 5.96 ⬭

B 3.59 ⬭

C 2.98 ⬭

D 2.37 ⬭

1 7 Magnesium reacts with hydrochloric acid according to the following equation.

$$Mg + 2HCl \longrightarrow MgCl_2 + H_2$$

A student calculated the minimum volume of 2.56 mol dm^{-3} hydrochloric acid required to react with an excess of magnesium to form 5.46 g of magnesium chloride (M_r = 95.3).

Which of the following uses the correct standard form and the appropriate number of significant figures to give the correct result of the calculation?

[1 mark]

A 4.476×10^{-2} dm^3 ⬭

B 4.48×10^{-2} dm^3 ⬭

C 4.50×10^{-2} dm^3 ⬭

D 44.8×10^{-3} dm^3 ⬭

1 8 In which reaction is hydrogen acting as an oxidising agent?

[1 mark]

A $Cl_2 + H_2 \longrightarrow 2HCl$ ⬭

B $(CH_3)_2CO + H_2 \longrightarrow (CH_3)_2CHOH$ ⬭

C $N_2 + 3H_2 \longrightarrow 2NH_3$ ⬭

D $2Na + H_2 \longrightarrow 2NaH$ ⬭

1 9 In which reaction is the metal oxidised?

[1 mark]

A $2Cu^{2+} + 4I^- \longrightarrow 2CuI + I_2$ ⬭

B $[Fe(H_2O)_6]^{3+} + Cl^- \longrightarrow [Fe(H_2O)_5(Cl)]^{2+} + H_2O$ ⬭

C $[CoCl_4]^{2-} + 6H_2O \longrightarrow [Co(H_2O)_6]^{2+} + 4Cl^-$ ⬭

D $Mg + S \longrightarrow MgS$ ⬭

2 0 The following cell has an EMF of +0.46 V.

$$Cu \mid Cu^{2+} \mid\mid Ag^+ \mid Ag$$

Which statement is correct about the operation of the cell?

[1 mark]

A Metallic copper is oxidised by Ag^+ ions. ⬭

B The silver electrode has a negative polarity. ⬭

C The silver electrode gradually dissolves to form Ag^+ ions. ⬭

D Electrons flow from the silver electrode to the copper electrode via an external circuit. ⬭

2 1 In an experiment to identify a Group 2 metal (X), 0.102 g of X reacts with an excess of aqueous hydrochloric acid according to the following equation.

$$X + 2HCl \longrightarrow XCl_2 + H_2$$

The volume of hydrogen gas given off is 65 cm^3 at 99 kPa pressure and 303 K.
The gas constant is R = 8.31 $J\ K^{-1}\ mol^{-1}$.

Which is X?

[1 mark]

A Barium ⬭

B Calcium ⬭

C Magnesium ⬭

D Strontium ⬭

2 2 What forms when a solution of sodium carbonate is added to a solution of gallium(III) nitrate?

[1 mark]

A A white precipitate of gallium(III) carbonate. ⬭

B A white precipitate of gallium(III) hydroxide. ⬭

C A white precipitate of gallium(III) carbonate and bubbles of carbon dioxide. ⬭

D A white precipitate of gallium(III) hydroxide and bubbles of carbon dioxide. ⬭

2 3 Which compound gives a colourless solution when an excess of dilute aqueous ammonia is added?

[1 mark]

A $FeCl_2$ ⬭

B $AgCl$ ⬭

C $CuCl_2$ ⬭

D $AlCl_3$ ⬭

2 4 What is the final species produced when an excess of aqueous ammonia is added to aqueous aluminium chloride?

[1 mark]

A $[Al(NH_3)_6]^{3+}$ ⬭

B $[Al(OH)_3(H_2O)_3]$ ⬭

C $[Al(OH)_4(H_2O)_2]^-$ ⬭

D $[Al(OH)(H_2O)_5]^{2+}$ ⬭

2 5 The following equation represents the oxidation of vanadium(IV) ions by manganate(VII) ions in acid solution.

$$5V^{4+} + MnO_4^- + 8H^+ \longrightarrow 5V^{5+} + Mn^{2+} + 4H_2O$$

What volume of 0.020 mol dm^{-3} $KMnO_4$ solution is required to oxidise completely a solution containing 0.010 mol of vanadium(IV) ions?

[1 mark]

A 10 cm^3 ⬭

B 25 cm^3 ⬭

C 50 cm^3 ⬭

D 100 cm^3 ⬭

2 6 How many structural isomers have the molecular formula C_4H_9Br?

[1 mark]

A 2 ⬭

B 3 ⬭

C 4 ⬭

D 5 ⬭

2 7 What is the major product of the reaction between but-1-ene and DBr?
(D is deuterium and represents ^2H)

[1 mark]

A $CH_2DCH_2CH_2CH_2Br$ ⬭

B $CH_2DCH_2CHBrCH_3$ ⬭

C $CH_3CH_2CHBrCH_2D$ ⬭

D $CH_3CH_2CHDCH_2Br$ ⬭

2 8 Which alcohol could **not** be produced by the reduction of an aldehyde or a ketone?

[1 mark]

A 2-methylbutan-1-ol ⬭

B 2-methylbutan-2-ol ⬭

C 3-methylbutan-1-ol ⬭

D 3-methylbutan-2-ol ⬭

2 9 Which compound forms optically active compounds on reduction?

[1 mark]

A $CH_3CH_2C(CH_3)=CHCH_3$ ⬭

B $CH_3CH_2C(CH_3)=CH_2$ ⬭

C CH_3COCH_3 ⬭

D $CH_3CH_2COCH_3$ ⬭

3 0 Which compound can polymerise by reaction with itself?

[1 mark]

A $NH_2CH_2CH_2NH_2$ ⬭

B $CH_3CH_2CONH_2$ ⬭

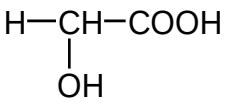
C $HOOCCH_2COOH$ ⬭

D NH_2CH_2COCl ⬭

3 1 Which of the molecules has a chiral centre?

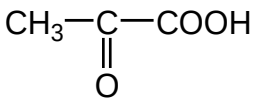
[1 mark]

A



⬭

B



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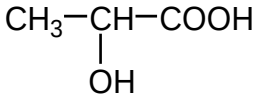
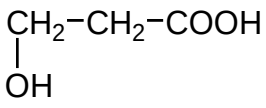
C



⬭

D



⬭

3 2 Which amine has only **three** peaks in its proton NMR spectrum?

[1 mark]

A Methylamine ⬭

B Trimethylamine ⬭

C Diethylamine ⬭

D Propylamine ⬭

END OF QUESTIONS