Gateways School

**Amount of substance**

**Revision PPQ**

32 marks

**Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_**

**Q1.**

(a)     Calcium phosphate reacts with aqueous nitric acid to produce phosphoric acid and calcium nitrate as shown in the equation.

Ca3(PO4)2    +    6HNO3    2H3PO4    +    3Ca(NO3)2

(i)      A 7.26 g sample of calcium phosphate reacted completely when added to an excess of aqueous nitric acid to form 38.0 cm3 of solution.

Calculate the concentration, in mol dm–3, of phosphoric acid in this solution.
Give your answer to 3 significant figures.

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**(5)**

(ii)     Calculate the percentage atom economy for the formation of calcium nitrate in this reaction.
Give your answer to 1 decimal place.

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**(2)**

(b)     Write an equation to show the reaction between calcium hydroxide and phosphoric acid to produce calcium phosphate and water.

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**(1)**

(c)     Calcium dihydrogenphosphate can be represented by the formula Ca(H2PO4)*x* where *x* is an integer.
A 9.76 g sample of calcium dihydrogenphosphate contains 0.17 g of hydrogen, 2.59 g of phosphorus and 5.33 g of oxygen.

Calculate the empirical formula and hence the value of *x*.
Show your working.

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**(4)**

**(Total 12 marks)**

**Q2.**

Read the following instructions that describe how to make up a standard solution of a solid in a volumetric flask.
Answer the questions which follow.

‘Take a clean 250 cm3 volumetric flask. Use the balance provided and a clean, dry container, to weigh out the amount of solid required. Tip the solid into a clean, dry 250 cm3 beaker and add about 100 cm3 of distilled water. Use a stirring rod to help the solid dissolve, carefully breaking up any lumps of solid with the rod. When the solid has dissolved, pour the solution into the flask using a filter funnel. Add water to the flask until the level rises to the graduation mark.’

(a)     Suggest **three** further instructions that would improve the overall technique in this account.

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**(3)**

(b)     In a series of titrations using the solution made up in part (a), a student obtained the following titres (all in cm3).

|  |  |  |
| --- | --- | --- |
| **Rough** | **1** | **2** |
| 25.7 | 25.20 | 25.35 |

State what this student must do in order to obtain an accurate average titre in this experiment.

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**(2)**

**(Total 5 marks)**

**Q3.**

The correct technique can improve the accuracy of a titration.

(a)     State why it is important to fill the space below the tap in the burette with solution **A** before beginning an accurate titration.

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**(1)**

(b)     Suggest **one** reason why a 250 cm3 conical flask is preferred to a 250 cm3 beaker for a titration.

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**(1)**

(c)     During a titration, a chemist rinsed the inside of the conical flask with deionised water. The water used for rinsing remained in the conical flask.

(i)      Give **one** reason why this rinsing can improve the accuracy of the end-point.

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(ii)     Explain why the water used for rinsing has **no** effect on the accuracy of the titre.

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**(1)**

(d)     Suggest **one** reason why repeating a titration makes the value of the average titre more reliable.

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**(1)**

**(Total 5 marks)**

**Q4.**

A sample of pure Mg(NO3)2 was decomposed by heating as shown in the equation below.

2Mg(NO3)2(s)    2MgO(s) + 4NO2(g) + O2(g)

(a)     A 3.74 × 10−2 g sample of Mg(NO3)2 was completely decomposed by heating.

Calculate the total volume, in cm3, of gas produced at 60.0 °C and 100 kPa.
Give your answer to the appropriate number of significant figures.
The gas constant *R* = 8.31 J K−1 mol−1.

Total volume of gas = \_\_\_\_\_\_\_\_\_\_\_ cm3

**(5)**

(b)     The mass of MgO obtained in this experiment is slightly less than that expected from the mass of Mg(NO3)2 used.
Suggest **one** practical reason for this.

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**(1)**

**(Total 6 marks)**

**Q5.**

Which one of the following contains the greatest number of moles of methanol? (The Avogadro number (*L*) is 6.02 × 1023, the relative molecular mass (*M*r) of methanol is 32.)

**A**       6.6 × 1022 molecules

**B**       3.3 g of methanol

**C**       2.5 × 10−3 m3 of methanol vapour at 300 K and 100 kPa

**D**       70 cm3 of 1.5 M aqueous methanol

**(Total 1 mark)**

**Q6.**

Which one of the following contains the smallest number of moles of carbon dioxide gas?

**A**       2.65 g

**B**       0.0150 m3 at 1000 K and 33.0 kPa

**C**       1.50 dm3 at 327 °C and 200 kPa

**D**       1500 cm3 at 300 K and 100 kPa

**(Total 1 mark)**

**Q7.**

Use the information below to answer this question.

A saturated solution of magnesium hydroxide, Mg(OH)2, contains 0.1166 g of Mg(OH)2 in 10.00 dm3 of solution. In this solution the magnesium hydroxide is fully dissociated into ions.

Which one of the following is the concentration of Mg2+(aq) ions in the saturated solution?

**A**       2.82 × 10−2 mol dm−3

**B**       2.00 × 10−3 mol dm−3

**C**       2.82 × 10−3 mol dm−3

**D**       2.00 × 10−4 mol dm−3

**(Total 1 mark)**

**Q8.**

The removal of silicon dioxide with limestone in the Blast Furnace can be represented by the following equation.

CaCO3(s) + SiO2(s) → CaSiO3(l) + CO2(g)

The volume of carbon dioxide, measured at 298 K and 1.01 × 105 Pa, formed in this reaction during the removal of 1.00 tonne (1000 kg) of silicon dioxide is

**A**       24.5 dm3

**B**       408 dm3

**C**       24.5 m3

**D**       408 m3

**(Total 1 mark)**