**Question 7**

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| **a.** | n(HCl) = 0.1971 × 0.05 = **0.00985 mol** ➊ |
| **b.** | n(NaOH) = 1.000 × 5.90 / 1000 = **0.0059 mol** ➊ = n(HCl) ➊ |
| **c.** | n(HCl) reacts – 0.00985 – 0.00590 = **0.00395 mol** ➊➊ |
| **d.** | n(NH3) = n(HCl) = 0.00395 mol = n(N) ➊m(N) = 0.00395 × 14.0 = **0.0553 g** ➊%N = 0.055s / 0.895 × 100 = **6.18 %** ➊ |

1. D

**Question 1** *(Total = 11 marks)*

1. Zn (s) + 2 HCl (aq) → H2 (g) + ZnCl2 (aq) *(1 mark)*
2. Shavings provide a greater surface area so that reaction is more rapid than with a whole piece. *(1 mark)*
3. n(NaOH) = cV = 0.100 × 23.4 × 10–3 = 2.34 × 10–3 mol *(1 mark)*
4. n(HCl)originally = cV = 0.150 × 100 × 10–3 = 0.0150 mol *(1 mark)*

n(HCl)reacting with 25 mL NaOH = 2.34 × 10–3 mol

*As the 25 mL aliquot of NaOH represented one quarter of the 100 mL of solution formed by treating the shavings with HCl:*

n(HCl)reacting with 100 mL NaOH = 4 × 2.34 × 10–3 = 9.36 × 10–3 mol

n(HCl)reacting with zinc = 0.0150 – 9.36 × 10–3 = 5.64 × 10–3 mol *(1 mark)*

1. n(Zn) = ½ n(HCl) = ½ × 5.64 × 10–3 = 2.82 × 10–3 mol

m(Zn) = n × M = 2.82 × 10–3 × 65.4 = 0.184 g *(1 mark)*

m(Cu) = sample mass – mass of zinc = 0.500 – 0.184 = 0.316 g

% Cu = 0.316 × 100 ÷ 0.500 = 63.2% *(1 mark)*

1. n(H2) = n(Zn) = 2.82 × 10–3 mol

V(H2) = nRT/P = (2.82 × 10–3 × 8.31 × 298) / 101 = 0.0691 L = 69.1 mL *(1 mark)*

Therefore teh 100 mL gas syringe is **large enough**. *(1 mark)*

*Alternatively*

V(H2) = n × Vm(at SLC) = 2.82 × 10–3 × 24.5 = 0.0691 L = 69.1 mL

1. Atomic Absorption Spectroscopy – used for determination of metals. *(1 + 1 = 2 marks)*



**Question 1** *(6 marks)*

1. 2 S2=O32- (aq) → S4O62– (aq) + 2 e‑ *(1 mark)*
2. n(S2O32–) = 0.05020 × 0.02243 = 1.126 × 10–3 mol

n(I2) =  = 5.630 × 10–4 mol *(2 marks)*

1. n(CO) = 5 × 5.63 × 10–4 = 2.81 × 10–3 mol *(1 mark)*
2. V(CO) = 2.81 × 10–3 × 24.5 = 0.0690 L

%CO =  = 3.45% *(2 marks)*

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| **C** | *n*(NaOH) in 1000 mL = 16.0 g ÷ 40.0 g mol–1 = 0.400 mol*n*(NaOH) in 20.0 m = 0.400 × (20 ÷ 1000) = 8.00 × 10–3 molThe equation for the reaction between NaOH (aq) and HCl (aq) isNaOH (aq) + HCl (aq) → NaCl (aq) + H2O (l)Hence *n*(HCl) required = *n*(NaOH) = 8.00 × 10–3 molSince *n* = *cV*, then *V* = *n* ÷ *c*So *V*(HCl) required = *n*(HCl) ÷ *c*(HCl) = 8.00 × 10–3 ÷ 0.450 = 0.0178 L = 17.8 mLThe fact that a larger volume of HCl was needed to reach the endpoint suggests that either there was more NaOH than expected in the aliquot or the acid in the titration flask was less concentrated than expected.Alternatives A and B would have caused there to be less NaOH in the titration flask and hence require a smaller volume of HCl to reach the endpoint.Alternative C, rinsing the burette with NaOH, would have caused the concentration of the HCl in the burette to decrease. Hence a **larger volume of HCl (aq)** would be needed to reach the endpoint.Alternative D – correct technique – hence no effect on the *V*(HCl) required. |

**Question 18 D**

Water in the burette would lower the calculated concentration. Water in the pipette would raise the calculated concentration. Hence, the overall effect would depend on the relative amounts of water in the glassware.

**Question 19 B**

If more acid is added to reach the endpoint, the calculated concentration will be lower than the actual concentration, ie. the acid appears less concentrated.

**3 - A**





**Question 3** *(8 marks)*

1. Fe2+ (aq) → Fe3+(aq) + e–

Cr2O72– (aq) + 14 H+ (aq) + 6 e– → 2 Cr3+ (aq) + 7 H2O (l)

Cr2O72– (aq) + 6 Fe2+ (aq) + 14 H+ (aq) → 2 Cr3+ (aq) + 6 Fe3+ (aq) + 7 H2O (l) *(3 marks)*

1. *n*(Cr2O72–) = *c* × *V*

 = 0.150 × 0.01355

 = 2.03 × 10–3 mol *(1 mark)*

1. *n*(Fe2+) = 6 × *n*(Cr2O72–)

 = 1.22 × 10–2 mol in 25.00 mL of the aliquot *(1 mark)*

1. *m*Fe2+) = 1.22 × 10–2 ×  × 55.9 g

 = 2.73 g *(1 mark)*

1. Percentage by mass of Fe2+ =  × 100% Percentage composition of Fe2+ =  × 100%

 = 34.6% = 36.8 % *(2 marks)*





**Question 2**

The equation for the reaction is: Ba(OH)2 + 2 HCl → BaCl2 + 2 H2O

*n*(HCl) = 2 × *n*(Ba(OH)2) = 2 × *c* × *V* = 2 × 0.0250 × 0.350 = 0.0175 mol

*V*(HCl) =  =  = 00350 L = 35.0 mL








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