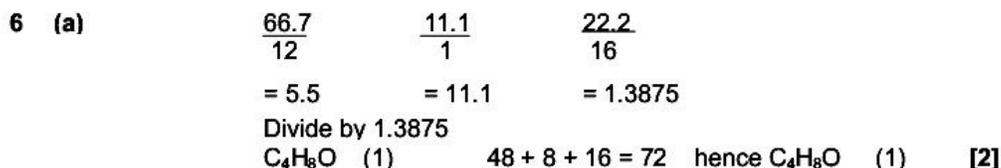
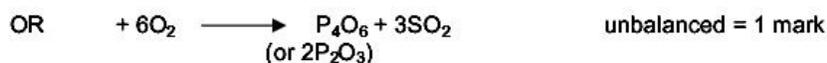
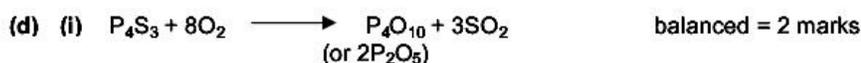
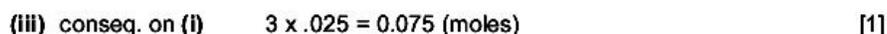
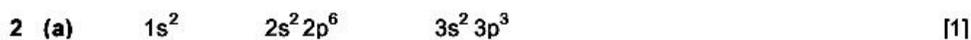


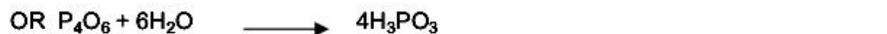
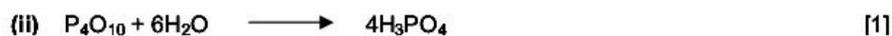
Q1.



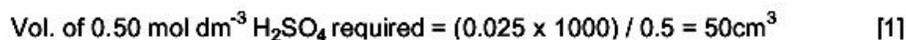
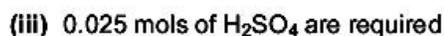
Q2.



[2]



Q3.



Q4.

- (d) (i) $2\text{H}_2\text{S} + 3\text{O}_2 \rightarrow 2\text{H}_2\text{O} + 2\text{SO}_2$ (1)
 from -2 (1) to +4 (1)
 allow e.c.f. on equation
- (ii) 68.2g H_2S react with $3 \times 24 \text{ dm}^3 \text{ O}_2$ (1)
 8.65g H_2S react with $\frac{3 \times 24 \times 8.65}{68.2} = 9.13 \text{ dm}^3$ (1)
 allow 9.16 dm^3 if $\text{H}_2\text{S} = 68$ is used
 allow e.c.f on (d)(i) [5]

Q5.

- 1 (a) (i) ammonia/ NH_3 (1)
 (ii) NH_4^+ (1)
 (iii) iron(II) hydroxide/ $\text{Fe}(\text{OH})_2$ (1) [3]
- (b) barium sulphate/ BaSO_4 (1) [1]
- (c) (i) FeSO_4 (1)
 $(\text{NH}_4)_2\text{SO}_4$ (1)
 (ii) $\text{FeSO}_4 = 151.9$ (allow 151.8 to 152) (1)
 $(\text{NH}_4)_2\text{SO}_4 = 132.1$ (allow 132) (1)
 (iii) $x\text{H}_2\text{O} = 392 - (132.1 + 151.9) = 108$ (1)
 $x = \frac{108}{18} = 6$ (1)
 allow e.c.f. on candidate's sulphate in (c)(i)
 e.c.f. answer must be a whole number [6]

[Total: 10]

Q6.

- (c) (i) $\text{CaC}_2 + 2\text{H}_2\text{O} \rightarrow \text{Ca}(\text{OH})_2 + \text{C}_2\text{H}_2$ (1)
- (ii) $n(\text{C}_2\text{H}_2) = n(\text{CaC}_2) = 100 \times 46.5$ (1)
 mass of $\text{CaC}_2 = 100 \times 46.5 \times 64 =$
 $= 297\,570 \text{ g}$
 $= 297.6 \text{ kg}$ (accept 298 kg)
 correct units necessary (1)
 allow e.c.f. on candidate's answer in (b) [3]

Q7.

$$\begin{aligned} \text{(b) C:H:O} &= \frac{40}{2} : \frac{6.7}{1} : \frac{53.3}{16} && [1] \\ &= 3.33 : 6.7 : 3.33 && [1] \\ &= 1 : 2 : 1 && [2] \end{aligned}$$

Q8.

$$\begin{aligned} \text{(d) (i) } n(\text{Ti}) &= \frac{0.72}{47.9} = 0.015 && (1) \\ \text{(ii) } n(\text{Cl}) &= \frac{(2.85 - 0.72)}{35.5} = 0.06 && (1) \\ \text{(iii) } 0.015 : 0.06 &= 1:4 && \\ &\text{empirical formula of A is TiCl}_4 && \\ &\text{Allow ecf on answers to (i) and/or (ii).} && (1) \\ \text{(iv) } \text{Ti} + 2\text{Cl}_2 &\rightarrow \text{TiCl}_4 && (1) \\ &\text{Allow ecf on answers to (iii).} && [4] \end{aligned}$$

Q9.

$$\begin{aligned} 4 \text{ (a) C:H:O} &= \frac{48.7}{12} : \frac{8.1}{1} : \frac{43.2}{16} \quad (1) \\ &= 4.06 : 8.1 : 2.70 \\ &= 1.5 : 3 : 1 \\ &= 3 : 6 : 2 \\ &\text{empirical formula is C}_3\text{H}_6\text{O}_2 \quad (1) && [2] \end{aligned}$$

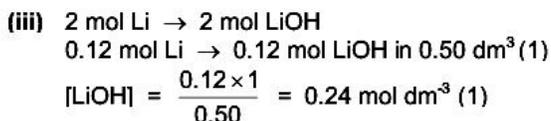
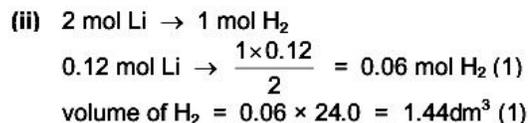
$$\begin{aligned} \text{(b) (i) } M_r &= \frac{mRT}{pV} = \frac{0.13 \times 8.31 \times 400}{1.00 \times 10^5 \times 58.0 \times 10^{-6}} \quad (1) \\ &= 74.5 \quad (1) \\ \text{(ii) } \text{C}_3\text{H}_6\text{O}_2 &= 36 + 6 + 32 = 74 \quad (1) \\ n(\text{C}_3\text{H}_6\text{O}_2) &= 74.5 \\ &\text{hence molecular formula of E is C}_3\text{H}_6\text{O}_2 \quad (1) && [4] \end{aligned}$$

Q10.

$$\begin{aligned} \text{(d) (i) } \text{C:H:O} &= \frac{35.8}{12} : \frac{4.5}{1} : \frac{59.7}{16} \quad \text{this mark is for correct use of } A_r \text{ values} \quad (1) \\ &= 2.98 : 4.5 : 3.73 \\ &= 1 : 1.5 : 1.25 \quad \text{this mark is for evidence of correct calculation} \quad (1) \\ &\text{gives empirical formula of W is C}_4\text{H}_6\text{O}_5 \\ \text{(ii) } \text{C}_4\text{H}_6\text{O}_5 &= 12 \times 4 + 1 \times 6 + 16 \times 5 = 134 \\ &\text{molecular formula of W is C}_4\text{H}_6\text{O}_5 \quad (1) && [3] \end{aligned}$$

Q11.

(c) (i) $n(\text{Li}) = \frac{0.83}{6.9} = 0.12$ (1)



[5]

Q12.

(c) (i) mass of $\text{C}_{14}\text{H}_{30}$ burnt

$$\frac{8195 \times 10.8}{1000} = 88.506 = 88.5 \text{ t} \quad (1)$$

(ii) mass of CO_2 produced

$$M_r \text{ of } \text{C}_{14}\text{H}_{30} = (14 \times 12 + 30 \times 1) = 198 \quad (1)$$

$$2 \times 198 \text{ t of } \text{C}_{14}\text{H}_{30} \rightarrow 28 \times 44 \text{ t of } \text{CO}_2$$

$$88.5 \text{ t of } \text{C}_{14}\text{H}_{30} \rightarrow \frac{28 \times 44 \times 88.5}{2 \times 198} \quad (1)$$

$$= 275.3 \text{ t of } \text{CO}_2 \quad (1)$$

allow 275.4 t if candidate has used 88.506

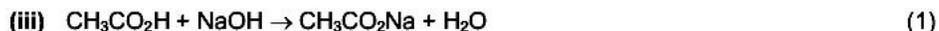
allow ecf on wrong value for M_r of $\text{C}_{14}\text{H}_{30}$

[4]

Q13.

(b) (i) $n(\text{NaOH}) = \frac{22.5 \times 2.00}{1000} = 0.045$ (1)

(ii) $n(\text{NaOH}) = n(\text{HCl}) = 0.005$ (1)



(iv) $n(\text{NaOH}) = 0.045 - 0.005 = 0.04$
allow ecf on (i) and/or (ii) (1) [4]

Q14.

1 Throughout this question, deduct **one mark only** for sig. fig. error.

(a) (i) the volume of solution A present in one 'typical ant' is
 $7.5 \times 10^{-6} \times 1000 = 7.5 \times 10^{-3} \text{ cm}^3$ (1)

(ii) the volume of pure methanoic acid in one 'typical ant' is
 $7.5 \times 10^{-3} \times \frac{50}{100} = 3.75 \times 10^{-3}$ gives $3.8 \times 10^{-3} \text{ cm}^3$

allow ecf on (i) (1)

(iii) no. of ants = $\frac{1000}{3.8 \times 10^{-3}} = 263157.8947$ gives 2.6×10^5

use of 3.75×10^{-3} gives $266666.6667 = 2.7 \times 10^5$ (1) [3]

(b) (i) the volume of solution A, in one ant bite is
 $\frac{80}{100} \times 7.5 \times 10^{-3} = 6.0 \times 10^{-3} \text{ cm}^3$

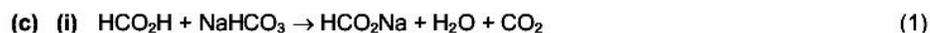
allow ecf on (a)(i) (1)

the volume of pure methanoic acid in one bite is
 $\frac{50}{100} \times 6.0 \times 10^{-3} = 3.0 \times 10^{-3} \text{ cm}^3$

allow ecf on first part of (b)(i) (1)

(ii) the mass of methanoic acid in one bite is
 $3.0 \times 10^{-3} \times 1.2 = 3.6 \times 10^{-3} \text{ g}$

allow ecf on (b)(i) (1) [3]



(ii) $46 \text{ g HCO}_2\text{H} = 84 \text{ g NaHCO}_3$ (1)

$5.4 \times 10^{-3} \text{ g HCO}_2\text{H} = \frac{84 \times 5.4 \times 10^{-3}}{46} \text{ g NaHCO}_3$
 $= 9.860869565 \times 10^{-3}$
 $= 9.9 \times 10^{-3} \text{ g NaHCO}_3$ (1) [3]

[Total: 9]

Q15.

- 2 (a) $(\text{NH}_4)_2\text{SO}_4 + 2\text{NaOH} \rightarrow 2\text{NH}_3 + \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$ (1)
 correct products (1) [2]
 correctly balanced equation
- (b) (i) $\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$ (1)
- (ii) $n(\text{HCl}) = \frac{31.2}{1000} \times 1.00 = 0.0312 = 0.03$ (1)
- (iii) $n(\text{NaOH}) = \frac{50.0}{1000} \times 2.00 = 0.10$ (1)
- (iv) $n(\text{NaOH}) \text{ used up} = 0.10 - 0.0312 = 0.0688 = 0.07$ (1)
- (v) $n[(\text{NH}_4)_2\text{SO}_4] = \frac{0.0688}{2} = 0.0344 = 0.03$ (1)
- (vi) mass of $(\text{NH}_4)_2\text{SO}_4 = 0.0344 \times 132 = 4.5408 = 4.54$ (1)
- (vii) percentage purity = $\frac{4.5408 \times 100}{5.00} = 90.816 = 90.8$ (1) [7]
- [Total: 9]**

Q16.

- (e) $\text{C} : \text{H} : \text{O} = \frac{37.5}{12} : \frac{4.17}{1} : \frac{58.3}{16}$
- = 3.13 : 4.17 : 3.64 (1)
- = 1 : 1.33 : 1.16 (1)
- = 6 : 8 : 7
- empirical formula is $\text{C}_6\text{H}_8\text{O}_7$ (1) [3]
- [Total: 19]**

Q17.

- 2 (a) (i) $\text{Na}_2\text{CO}_3 + 2\text{HCl} \rightarrow 2\text{NaCl} + \text{H}_2\text{O} + \text{CO}_2$ (1)
- (ii) $n(\text{HCl}) = \frac{35.8}{1000} \times 0.100 = 3.58 \times 10^{-3}$ (1)
- (iii) $n(\text{Na}_2\text{CO}_3) = \frac{35.8}{2} \times 10^{-3} = 1.79 \times 10^{-3} \text{ mol in } 25.0 \text{ cm}^3$ (1)
- (iv) $n(\text{Na}_2\text{CO}_3) = 1.79 \times 10^{-3} \times 10 = 1.79 \times 10^{-2} \text{ mol in } 250 \text{ cm}^3$ (1)
- (v) mass of $\text{Na}_2\text{CO}_3 = 1.79 \times 10^{-2} \times 106 = 1.90\text{g}$ (1)
 M_r of $\text{Na}_2\text{CO}_3 = 106$ (1)
 mass of $\text{Na}_2\text{CO}_3 = 1.90 \text{ g}$ (1) [6]

(b) $n(\text{H}_2\text{O})$ in 5.13 g of washing soda = $\frac{5.13 - 1.90}{18} = 1.79 \times 10^{-1}$ mol (1)

$n(\text{Na}_2\text{CO}_3)$ in 5.13 g of washing soda = 1.79×10^{-2} mol
 $n(\text{H}_2\text{O}) : n(\text{Na}_2\text{CO}_3) = 10 : 1$ (1)

or

1.90 g Na_2CO_3 are combined with 3.23 g H_2O
 106 g Na_2CO_3 are combined with $\frac{3.23 \times 106}{1.90} = 180.2$ g H_2O (1)

this is 10 mol of H_2O (1)

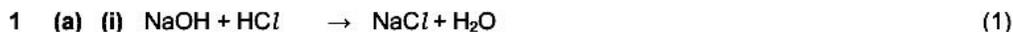
or

1.79×10^{-2} mol $\text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O} \equiv 5.13$ g of washing soda
 1 mol $\text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O} \equiv \frac{5.13}{1.79 \times 10^{-2}} = 286.6$ g (1)

$\text{Na}_2\text{CO}_3 = 106$ and $\text{H}_2\text{O} = 18$ hence $x = 10$ (1) [2]

[Total: 8]

Q18.



allow ionic equations in each case

(ii) $n(\text{NaOH}) = n(\text{HCl}) = \frac{39.2 \times 2.00}{1000} = 0.0784$ (1)

(iii) $n(\text{NaOH}) = n(\text{HCl}) = \frac{29.5 \times 2.00}{1000} = 0.059$ (1)

(iv) $n(\text{NaOH}) = 0.0784 - 0.059 = 0.0194$ (1)

(v) $n[(\text{NH}_4)_2\text{SO}_4] = \frac{0.0194}{2} = 9.7 \times 10^{-3}$ (1)

(vi) mass of $(\text{NH}_4)_2\text{SO}_4 = 9.7 \times 10^{-3} \times 132.1 = 1.2814$ g (1)

(vii) % of $(\text{NH}_4)_2\text{SO}_4 = \frac{1.2814 \times 100}{2.96} = 43.30405405 = 43.3$ (1)

give one mark for the correct expression (1)

give one mark for answer given as 43.3 – i.e. to 3 sig. fig. (1)

allow ecf where appropriate

[9]

- (b) fertiliser in the river causes
 excessive growth of aquatic plants/algae or algal bloom (1)
 when plants and algae die O₂ is used up or fish or aquatic life die (1) [2]
- (c) manufacture of HNO₃ or explosives or nylon or
 as a cleaning agent or as a refrigerant (1) [1]
 not detergent

[Total:12]

Q19.

- 2 (a) (i) $n(\text{H}_2\text{SO}_4) = \frac{25.0 \times 1.00}{1000} = 0.025 \text{ mol}$ (1)
- (ii) $n(\text{NaOH}) = \frac{16.2 \times 2.00}{1000} = 0.0324 \text{ mol}$ (1)
- (iii) $n(\text{H}_2\text{SO}_4) \text{ reacting with NaOH} = \frac{0.0324}{2} = 0.0162 \text{ mol}$ (1)
- (iv) $n(\text{H}_2\text{SO}_4) \text{ reacting with NH}_3 = 0.025 - 0.0162 = 0.0088 \text{ mol}$ (1)
- (v) $n(\text{NH}_3) \text{ reacting with H}_2\text{SO}_4 = 2 \times 0.0088 = 0.0176 \text{ mol}$ (1)
- (vi) $n(\text{NaNO}_3) \text{ reacting} = n(\text{NH}_3) \text{ produced} = 0.0176 \text{ mol}$ (1)
- (vii) mass of NaNO₃ that reacted = 0.0176 x 85 = 1.496 g (1)
- (viii) $\% \text{ of NaNO}_3 = \frac{1.496 \times 100}{1.64} = 91.2195122 = 91.2$
- give one mark for the correct expression (1)
- give one mark for answer given as 91.2 – i.e to 3 sig. fig. (1)
- allow ecf where appropriate

[9]

- (b) NaNO₃ +5 and NH₃ -3 both required (1) [1]

[Total: 10]

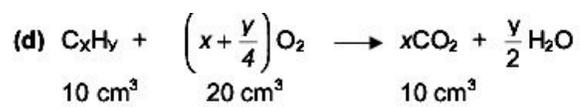
Q20.

- 1 (a) (i) substance that speeds up a chemical reaction (1)
by lowering E_a
or by providing an alternative reaction pathway
or without being used up in the process (1)
- (ii) $2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2$ (1) [3]
- (b) (i) alkanes or paraffins (1)
- (ii) $2\text{H}_2\text{O}_2 : \text{O}_2$ and $\text{C}_{15}\text{H}_{32} : 23\text{O}_2$ (1)
whence $\text{C}_{15}\text{H}_{32} : 46\text{H}_2\text{O}_2$ (1)
allow e.c.f. on (a)(ii) [3]
- (c) (i) $\text{C}_{15}\text{H}_{32} = 212$ (1)
 $n(\text{C}_{15}\text{H}_{32}) = \frac{212 \times 10^6}{212} = 1 \times 10^6 \text{ mol}$
allow e.c.f. on wrong M_r of $\text{C}_{15}\text{H}_{32}$ (1)
- (ii) $n(\text{H}_2\text{O}_2)$ required = $46 \times 10^6 \text{ mol}$ (1)
mass of $\text{H}_2\text{O}_2 = 34 \times 46 \times 10^6 \text{ g} = 1564 \text{ tonnes}$
final answer must be in tonnes (1)
allow e.c.f. on (b)(ii) and (c)(i) [4]
- (d) they would dissolve (1) [1]

[Total: 11]

Q21.

- 1 (a) the actual number of atoms of each element present (1)
in one molecule of a compound (1) [2]
- (b) $\text{C}_x\text{H}_y + \left(x + \frac{y}{4}\right)\text{O}_2 \rightarrow x\text{CO}_2 + \frac{y}{2}\text{H}_2\text{O}$
- $x\text{CO}_2$ (1)
- $\frac{y}{2}\text{H}_2\text{O}$ (1) [2]
- (c) (i) oxygen/ O_2 (1)
- (ii) carbon dioxide/ CO_2 (1)
- (iii) 10 cm^3 (1)
- (iv) 20 cm^3 (1) [4]



1 mol of C_xH_y gives 1 mol of CO_2

whence $x = 1$ (1)

1 mol of C_xH_y reacts with 2 mol of O_2

whence $\left(x + \frac{y}{4}\right) = 2$

and $y = 4$ (1)

molecular formula is CH_4 (1)

[3]

[Total: 11]

Q22.

- 1 (a) (i) mass of C = $\frac{12 \times 0.352}{44} = 0.096\text{g}$ (1)
- $n(\text{C}) = \frac{0.096}{12} = 0.008$ (1)
- (ii) mass of H = $\frac{2 \times 0.144}{18} = 0.016\text{g}$ (1)
- $n(\text{H}) = \frac{0.016}{1} = 0.016$ (1)
- (iii) mass of oxygen = $0.240 - (0.096 + 0.016) = 0.128\text{g}$ (1)
- $n(\text{O}) = \frac{0.128}{16} = 0.008$ (1)
- allow ecf at any stage [6]
- (b) C : H : O = 0.008 : 0.016 : 0.008 = 1:2:1
- allow C : H : O = $\frac{0.096}{12} : \frac{0.016}{1} : \frac{0.128}{16} = 1:2:1$
- gives CH₂O (1) [1]
- (c) (i) $M_r = \frac{mRT}{pV} = \frac{0.148 \times 8.31 \times 333}{1.01 \times 10^5 \times 67.7 \times 10^{-6}}$ (1)
- = 59.89
- allow 59.9 or 60 (1)
- (ii) C₂H₄O₂ (1) [3]

Q23.

- 2 (a) (i) mass of C = $\frac{12 \times 1.32}{44} = 0.36\text{g}$ (1)
- $n(\text{C}) = \frac{0.36}{12} = 0.03$ (1)
- (ii) mass of H = $\frac{2 \times 0.54}{18} = 0.06\text{ g}$ (1)
- $n(\text{H}) = \frac{0.06}{1} = 0.06$ (1)
- (iii) yes **because** 0.03 mol of C are combined with 0.06 mol of H **or**
C : H ratio is 1 : 2 **or**
empirical formula is CH₂ (1) [5]

(b) (i) $C : H : O = \frac{64.86}{12} : \frac{13.50}{1} : \frac{21.64}{16}$ (1)

$= 5.41 : 13.50 : 1.35$

$= 4 : 10 : 1$

gives $C_4H_{10}O$ (1)

Q24.

1 (a) $ZnCO_3$ $Zn(OH)_2$ ZnO (any 2) [2]
not Zn or other compounds of Zn

(b) (i) to ensure all of the water of crystallisation had been driven off or to be at constant mass (1)

(ii) mass of $ZnSO_4 = 76.34 - 74.25 = 2.09$ g (1)

$M_r ZnSO_4 = 65.4 + 32.1 + (4 \times 16.0) = 161.5$

allow use of $Zn = 65$ and/or $S = 32$ to give values between 161 and 161.5 (1)

$n(ZnSO_4) = \frac{2.09}{161.5} = 0.01294 = 1.29 \times 10^{-2}$

$ZnSO_4 = 161$ gives 1.30×10^{-2} (1)

(iii) mass of H_2O driven off = $77.97 - 76.34 = 1.63$ g (1)

$n(H_2O) = \frac{1.63}{18} = 0.0905 = 9.1 \times 10^{-2}$ (1)

(iv) 1.29×10^{-2} mol ZnSO_4 are combined with 9.1×10^{-2} mol H_2O

$$1 \text{ mol ZnSO}_4 \text{ is combined with } \frac{9.1 \times 10^{-2}}{1.29 \times 10^{-2}}$$

$$= 7.054 = 7 \text{ mol H}_2\text{O}$$

answer must be expressed as a whole number

allow ecf on candidate's answers to (b)(ii) and (b)(iii)

(1) [7]

(c) (i) $n(\text{Zn}) = n(\text{CH}_3\text{CO}_2)_2\text{Zn} \cdot 2\text{H}_2\text{O}$

(1)

$$n(\text{Zn}) = \frac{0.015}{65.4} = 2.29 \times 10^{-4}$$

$$= 2.29 \times 10^{-4}$$

(1)

$$\text{mass of crystals} = 2.29 \times 10^{-4} \times 219.4 = 0.0502655 \text{ g}$$
$$= 0.05 \text{ g} = 50 \text{ mg}$$

(1)

(ii) concentration of $(\text{CH}_3\text{CO}_2)_2\text{Zn} \cdot 2\text{H}_2\text{O} = \frac{2.29 \times 10^{-4}}{0.005} = 0.0458$

$$= 4.58 \times 10^{-2} \text{ mol dm}^{-3}$$

(1)

allow correct answers if Zn = 65 is used

[4]

[Total: 13]

Q25.

1 In this question, numerical answers should be given to three significant figures.

(a) (i) $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O}$

(1)

(ii) $M_r \text{ C}_6\text{H}_{12}\text{O}_6 = 180$

(1)

$$180 \text{ g C}_6\text{H}_{12}\text{O}_6 \rightarrow 6 \text{ mol CO}_2$$

$$1200 \text{ g C}_6\text{H}_{12}\text{O}_6 \rightarrow \frac{6 \times 200}{180} \text{ mol CO}_2$$

$$= 40.0 \text{ mol to 3 sf}$$

allow ecf on wrong equation and/or wrong M_r

(1)

(iii) 6.82×10^9 people will produce $6.82 \times 10^9 \times 40.0$ mol CO_2

$$= 2.728 \times 10^{11} \text{ mol CO}_2$$

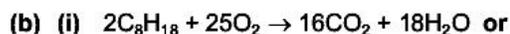
(1)

$$2.728 \times 10^{11} \text{ mol CO}_2 = 2.728 \times 10^{11} \times 44 = 1.20032 \times 10^{13} \text{ g}$$

$$= 1.20 \times 10^7 \text{ tonnes CO}_2 \text{ to 3 sf}$$

(1) [5]

allow ecf on answer from (ii)



(ii) $M_r C_8H_{18} = (8 \times 12) + (18 \times 1) = 114$ (1)

mass of 4.00 dm^3 of octane = $4000 \times 0.70 = 2800 \text{ g}$ (1)

$n(C_8H_{18}) = \frac{2800}{114} = 24.56140351 \text{ mol in } 4.00 \text{ dm}^3$

= 24.6 mol to 3 sf (1)

(iii) 2 mol C_8H_{18} produce $16 \times 44 \text{ g CO}_2$

$24.6 \text{ mol } C_8H_{18}$ produce $\frac{16 \times 44 \times 24.6}{2} \text{ g CO}_2$

= 8659.2 g CO_2

= 8660 g CO_2 to 3 sf (1) [5]

(c) 6.82×10^9 people produce 1.20×10^7 tonnes CO_2 per day

8660 g CO_2 produced when car travels 100 km

when travelling 1 km , car produces $\frac{8660}{100} = 8.66 \times 10^{-1} \text{ g}$

= $8.66 \times 10^{-5} \text{ tonnes}$ (1)

to produce 1.20×10^7 tonnes CO_2 car must travel

$\frac{1.20 \times 10^7}{8.66 \times 10^{-5}}$

= $1.385681293 \times 10^{11} = 1.39 \times 10^{11} \text{ km}$ to 3 sf (1) [2]

(d) possible pollutants and the damage they cause

CO	NO _x		SO ₂	H ₂ O	C	unburned C ₈ H ₁₈
	NO	NO ₂				
toxic	toxic	toxic	toxic			
	global warming	respiratory problems	respiratory problems	global warming	respiratory problems	respiratory problems
	photochemical smog	acid rain	acid rain			

compound
damage

(1)

(1) [2]

[Total: 14]

Q26.



(ii) $n(\text{OH}^-) = \frac{21.6 \times 0.100}{1000} = 2.16 \times 10^{-3} \text{ mol}$ (1)

(iii) $n(\text{R}) = n(\text{H}_2\text{X}) = \frac{2.16 \times 10^{-3}}{2}$
 $= 1.08 \times 10^{-3} \text{ mol in } 25.0 \text{ cm}^3$ (1)

(iv) $n(\text{R}) = 1.08 \times 10^{-3} \times \frac{250}{25.0} = 0.0108 \text{ mol in } 250 \text{ cm}^3$ (1)

(v) 0.0108 mol of **R** = 1.25 g of **R**
1 mol of **R** = $\frac{1.25 \times 1}{0.0108} = 115.7 = 116 \text{ g}$ (1) [5]

(b) (i) M_r of **S** = 116
 M_r of **T** = 134
 M_r of **U** = 150 **all three needed** (1)

(ii) **S** (1) [2]

