Q1.

6 **(a)**

$\frac{66.7}{12}$	$\frac{11.1}{1}$	$\frac{22.2}{16}$
= 5.5	= 11.1	= 1.3875

Divide by 1.3875

C_4H_8O (1) 48 + 8 + 16 = 72 hence C_4H_8O (1) **[2]**

Q2.

2 **(a)** $1s^2$ $2s^2 2p^6$ $3s^2 3p^3$ [1]

(b) 5 or V [1]

(c) **(i)** $3NaOH + H_3PO_4 \longrightarrow Na_3PO_4 + 3H_2O$ [1]

(ii) (50 x 0.5) / 1000 = 0.025 (moles) [1]

(iii) conseq. on **(i)** 3 x .025 = 0.075 (moles) [1]

(d) **(i)** $P_4S_3 + 8O_2 \longrightarrow P_4O_{10} + 3SO_2$ (or $2P_2O_5$) balanced = 2 marks

OR $+ 6O_2 \longrightarrow P_4O_6 + 3SO_2$ (or $2P_2O_3$) unbalanced = 1 mark

[2]

(ii) $P_4O_{10} + 6H_2O \longrightarrow 4H_3PO_4$ [1]

OR $P_4O_6 + 6H_2O \longrightarrow 4H_3PO_3$

$SO_2 + H_2O \longrightarrow H_2SO_3$ [1]

(if SO_3 then e.c.f.) **Total = [9]**

Q3.

(c) **(i)** (1.2) / (2.4) = 1/20 or 0.05 moles [1]

(ii) $2NH_3 + H_2SO_4 \longrightarrow (NH_4)_2SO_4$ or equivalent [1]

(iii) 0.025 mols of H_2SO_4 are required

Vol. of 0.50 mol dm^{-3} H_2SO_4 required = (0.025 x 1000) / 0.5 = $50cm^3$ [1]

Q4.

(d) (i) $2H_2S + 3O_2 \rightarrow 2H_2O + 2SO_2$ **(1)**
from -2 **(1)** to +4 **(1)**
allow e.c.f. on equation

(ii) 68.2g H_2S react with 3 x 24 dm^3 O_2 **(1)**
8.65g H_2S react with $\frac{3 \times 24 \times 8.65}{68.2}$ = 9.13 dm^3 **(1)**
allow 9.16 dm^3 if H_2S = 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/$Fe(OH)_2$ **(1)** **[3]**

(b) barium sulphate/$BaSO_4$ **(1)** **[1]**

(c) (i) $FeSO_4$ **(1)**

$(NH_4)_2SO_4$ **(1)**

(ii) $FeSO_4$ = 151.9 (allow 151.8 to 152) **(1)**

$(NH_4)_2SO_4$ = 132.1 (allow 132) **(1)**

(iii) xH_2O = 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) $CaC_2 + 2H_2O \rightarrow Ca(OH)_2 + C_2H_2$ **(1)**

(ii) $n(C_2H_2) = n(CaC_2)$ = 100 x 46.5 **(1)**

mass of CaC_2 = 100 x 46.5 x 64 =

= 297 570 g

= 297.6 kg (accept 298 kg)
correct units necessary **(1)**

allow e.c.f. on candidate's answer in **(b)** **[3]**

Q7.

(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]**

Q8.

(d) **(i)** $n(Ti) = \frac{0.72}{47.9} = 0.015$ (1)

(ii) $n(Cl) = \frac{(2.85 - 0.72)}{35.5} = 0.06$ (1)

(iii) $0.015 : 0.06 = 1:4$
empirical formula of **A** is $TiCl_4$
Allow ecf on answers to **(i)** and/or **(ii)**. (1)

(iv) $Ti + 2Cl_2 \rightarrow TiCl_4$ (1)
Allow ecf on answers to **(iii)**. [4]

Q9.

4 **(a)** $C:H:O = \frac{48.7}{12} : \frac{8.1}{1} : \frac{43.2}{16}$ (1)
$= 4.06 : 8.1 : 2.70$
$= 1.5 : 3 : 1$
$= 3 : 6 : 2$
empirical formula is $C_3H_6O_2$ (1) [2]

(b) **(i)** $M_r = \frac{mRT}{pV} - \frac{0.13 \times 8.31 \times 400}{1.00 \times 10^5 \times 58.0 \times 10^{-6}}$ (1)

$= 74.5$ (1)

(ii) $C_3H_6O_2 = 36 + 6 + 32 = 74$ (1)
$n(C_3H_6O_2) = 74.5$
hence molecular formula of **E** is $C_3H_6O_2$ (1) [4]

Q10.

(d) **(i)** $C:H:O = \frac{35.8}{12} : \frac{4.5}{1} : \frac{59.7}{16}$ this mark is for correct use of A_r values (1)
$C:H:O = 2.98 : 4.5 : 3.73$
$C:H:O = 1 : 1.5 : 1.25$ this mark is for evidence of correct calculation (1)
gives empirical formula of **W** is $C_4H_6O_5$

(ii) $C_4H_6O_5 = 12 \times 4 + 1 \times 6 + 16 \times 5 = 134$
molecular formula of **W** is $C_4H_6O_5$ (1) [3]

Q11.

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

(ii) 2 mol Li → 1 mol H_2

0.12 mol Li → $\frac{1 \times 0.12}{2}$ = 0.06 mol H_2 (1)

volume of H_2 = 0.06 × 24.0 = 1.44dm^3 (1)

(iii) 2 mol Li → 2 mol LiOH

0.12 mol Li → 0.12 mol LiOH in 0.50 dm^3 (1)

[LiOH] = $\frac{0.12 \times 1}{0.50}$ = 0.24 mol dm^{-3} (1) [5]

Q12.

(c) **(i)** **mass of $C_{14}H_{30}$ burnt**

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

(ii) **mass of CO_2 produced**

M_r of $C_{14}H_{30}$ = (14 x 12 + 30 x 1) = 198 (1)

2 x 198 t of $C_{14}H_{30}$ → 28 x 44 t of CO_2

88.5 t of $C_{14}H_{30}$ → $\frac{28 \times 44 \times 88.5}{2 \times 198}$ (1)

= 275.3 t of CO_2 (1)

allow 275.4 t if candidate has used 88.506
allow ecf on wrong value for M_r of $C_{14}H_{30}$ [4]

Q13.

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

(ii) n(NaOH) = n(HC*l*) = 0.005 (1)

(iii) $CH_3CO_2H + NaOH \rightarrow CH_3CO_2Na + H_2O$ (1)

(iv) n(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
$7.5 \times 10^{-6} \times 1000 = 7.5 \times 10^{-3}$ 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 3.8×10^{-3} 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 = 2.7×10^5 (1) [3]

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

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

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

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

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

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

(c) (i) $HCO_2H + NaHCO_3 \rightarrow HCO_2Na + H_2O + CO_2$ (1)

(ii) 46 g $HCO_2H \equiv$ 84 g $NaHCO_3$ (1)

5.4×10^{-3} g $HCO_2H \equiv \frac{84 \times 5.4 \times 10^{-3}}{46}$ g $NaHCO_3$
$= 9.860869565 \times 10^{-3}$
$= 9.9 \times 10^{-3}$ g $NaHCO_3$ (1) [3]

[Total: 9]

Q15.

2 (a) $(NH_4)_2SO_4 + 2NaOH \rightarrow$ **$2NH_3$ + Na_2SO_4 + $2H_2O$**
correct products (1)
correctly balanced equation (1) [2]

(b) (i) $NaOH + HCl \rightarrow NaCl + H_2O$ (1)

(ii) $n(HCl) = \frac{31.2}{1000} \times 1.00 = 0.0312 = 0.03$ (1)

(iii) $n(NaOH) = \frac{50.0}{1000} \times 2.00 = 0.10$ (1)

(iv) n(NaOH) used up $= 0.10 - 0.0312 = 0.0688 = 0.07$ (1)

(v) $n[(NH_4)_2SO_4] = \frac{0.0688}{2} = 0.0344 = 0.03$ (1)

(vi) mass of $(NH_4)_2SO_4 = 0.0344 \times 132 = 4.5408 = 4.54$ (1)

(vii) percentage purity $= \frac{4.5408 \times 100}{5.00} = 90.816 = 90.8$ (1) [7]

[Total: 9]

Q16.

(e) $C : H : O = \frac{37.5}{12} : \frac{4.17}{1} : \frac{58.3}{16}$

$= 3.13 : 4.17 : 3.64$ (1)

$= 1 : 1.33 : 1.16$ (1)

$= 6 : 8 : 7$

empirical formula is $C_6H_8O_7$ (1) [3]

[Total: 19]

Q17.

2 (a) (i) $Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$ (1)

(ii) $n(HCl) = \frac{35.8}{1000} \times 0.100 = 3.58 \times 10^{-3}$ (1)

(iii) $n(Na_2CO_3) = \frac{35.8}{2} \times 10^{-3} = 1.79 \times 10^{-3}$ mol in 25.0 cm^3 (1)

(iv) $n(Na_2CO_3) = 1.79 \times 10^{-3} \times 10 = 1.79 \times 10^{-2}$ mol in 250 cm^3 (1)

(v) mass of $Na_2CO_3 = 1.79 \times 10^{-2} \times 106 = 1.90g$
M_r of $Na_2CO_3 = 106$ (1)
mass of $Na_2CO_3 = 1.90$ g (1) [6]

(b) $n(H_2O)$ in 5.13 g of washing soda = $\frac{5.13-1.90}{18}$ = 1.79×10^{-1} mol (1)

$n(Na_2CO_3)$ in 5.13 g of washing soda = 1.79×10^{-2} mol

$n(H_2O) : n(Na_2CO_3)$ = 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_2 (1)

this is 10 mol of H_2O (1)

or

1.79×10^{-2} mol $Na_2CO_3.xH_2O \equiv$ 5.13 g of washing soda

1 mol $Na_2CO_3.xH_2O \equiv \frac{5.13}{1.79 \times 10^{-2}}$ = 286.6 g (1)

Na_2CO_3 = 106 and H_2O = 18 hence x = 10 (1) [2]

[Total: 8]

Q18.

1 (a) (i) $NaOH + HCl \rightarrow NaCl + H_2O$ (1)

$(NH_4)_2SO_4 + 2NaOH \rightarrow 2NH_3 + Na_2SO_4 + 2H_2O$ (1)

allow ionic equations in each case

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

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

(iv) $n(NaOH) = 0.0784 - 0.059 = 0.0194$ (1)

(v) $n[(NH_4)_2SO_4] = \frac{0.0194}{2} = 9.7 \times 10^{-3}$ (1)

(vi) mass of $(NH_4)_2SO_4 = 9.7 \times 10^{-3} \times 132.1 = 1.2814$ g (1)

(vii) % of $(NH_4)_2SO_4 = \frac{1.2814 \times 100}{2.96} = 43.30405405 = 43.3$

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 O_2 is used up **or** fish or aquatic life die (1) [2]

(c) manufacture of HNO_3 **or** explosives **or** nylon **or**
as a cleaning agent **or** as a refrigerant
not detergent (1) [1]

[Total:12]

Q19.

2 (a) (i) $n(H_2SO_4) = \frac{25.0 \times 1.00}{1000} - 0.025$ mol (1)

(ii) $n(NaOH) = \frac{16.2 \times 2.00}{1000} - 0.0324$ mol (1)

(iii) $n(H_2SO_4)$ reacting with NaOH $= \frac{0.0324}{2} - 0.0162$ mol (1)

(iv) $n(H_2SO_4)$ reacting with NH_3 = 0.025 - 0.0162 = 0.0088 mol (1)
(v) $n(NH_3)$ reacting with H_2SO_4 = 2 x 0.0088 = 0.0176 mol (1)
(vi) $n(NaNO_3)$ reacting = $n(NH_3)$ produced = 0.0176 mol (1)
(vii) mass of $NaNO_3$ that reacted = 0.0176 x 85 = 1.496 g (1)

(viii) % 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) $NaNO_3$ +5 **and** NH_3 -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) $2H_2O_2 \rightarrow 2H_2O + O_2$ (1) [3]

(b) **(i)** alkanes **or** paraffins (1)

(ii) $2H_2O_2 : O_2$ and $C_{15}H_{32} : 23O_2$ (1)
whence $C_{15}H_{32} : 46H_2O_2$ (1)
allow e.c.f. on **(a)(ii)** [3]

(c) **(i)** $C_{15}H_{32} = 212$ (1)

$n(C_{15}H_{32}) = \frac{212 \times 10^6}{212} = 1 \times 10^6$ mol

allow e.c.f. on wrong M_r of $C_{15}H_{32}$ (1)

(ii) $n(H_2O_2)$ required $= 46 \times 10^6$ mol (1)
mass of $H_2O_2 = 34 \times 46 \times 10^6$ g $= 1564$ 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) $C_xH_y + \left(x + \frac{y}{4}\right)O_2 \longrightarrow xCO_2 + \frac{y}{2}H_2O$

xCO_2 (1)

$\frac{y}{2}H_2O$ (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]

(d) $C_xH_y + \left(x + \frac{y}{4}\right)O_2 \longrightarrow xCO_2 + \frac{y}{2}H_2O$

10 cm^3 20 cm^3 10 cm^3

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 = $\frac{12 \times 0.352}{44}$ = 0.096g (1)

$n(C) = \frac{0.096}{12} = 0.008$ (1)

(ii) mass of H = $\frac{2 \times 0.144}{18}$ = 0.016g (1)

$n(H) = \frac{0.016}{1} = 0.016$ (1)

(iii) mass of oxygen = 0.240 – (0.096 + 0.016) = 0.128g (1)

$n(O) = \frac{0.128}{16} = 0.008$ (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 CH_2O (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) $C_2H_4O_2$ (1) [3]

Q23.

2 **(a)** **(i)** mass of C = $\frac{12 \times 1.32}{44}$ = 0.36g (1)

$n(C) = \frac{0.36}{12} = 0.03$ (1)

(ii) mass of H = $\frac{2 \times 0.54}{18}$ = 0.06 g (1)

$n(H) = \frac{0.06}{1} = 0.06$ (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 CH_2 (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
not Zn **or** other compounds of Zn (any 2) [2]

(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 × 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 mol $ZnSO_4$ is combined with $\frac{9.1 \times 10^{-2}}{1.29 \times 10^{-2}}$

$= 7.054 \equiv 7$ mol H_2O

answer must be expressed as a whole number
allow ecf on candidate's answers to **(b)(ii)** and **(b)(iii)** (1) [7]

(c) **(i)** $n(Zn) = n\ (CH_3CO_2)_2Zn.2H_2O$ (1)

$n(Zn) = \frac{0.015}{65.4} = 2.290 \times 10^{-4}$

$= 2.29 \times 10^{-4}$ (1)

mass of crystals $= 2.29 \times 10^{-4} \times 219.4 = 0.0502655$ g
$= 0.05$ g $= 50$ mg (1)

(ii) concentration of $(CH_3CO_2)_2Zn.2H_2O = \frac{2.29 \times 10^{-4}}{0.005} = 0.0458$

$= 4.58 \times 10^{-2}$ 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)** $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ (1)

(ii) M_r $C_6H_{12}O_6 = 180$ (1)
180 g $C_6H_{12}O_6 \rightarrow 6$ mol CO_2

1200 g $C_6H_{12}O_6 \rightarrow \frac{6 \times 200}{180}$ mol CO_2

= 40.0 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

$= 2.728 \times 10^{11}$ mol CO_2 (1)

2.728×10^{11} mol $CO_2 \equiv 2.728 \times 10^{11} \times 44 = 1.20032 \times 10^{13}$ g

$= 1.20 \times 10^7$ tonnes CO_2 to 3 sf (1) [5]

allow ecf on answer from **(ii)**

(b) **(i)** $2C_8H_{18} + 25O_2 \rightarrow 16CO_2 + 18H_2O$ **or**

$C_8H_{18} + 12\frac{1}{2}O_2 \rightarrow 8CO_2 + 9H_2O$ (1)

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

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

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

= 24.6 mol to 3 sf (1)

(iii) 2 mol C_8H_{18} produce 16×44 g CO_2

24.6 mol C_8H_{18} produce $\frac{16 \times 44 \times 24.6}{2}$ g CO2

= 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 $\frac{8660}{100} = 8.66 \times 10^{-1}$ g

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

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

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

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

(d) possible pollutants and the damage they cause

CO	NO_x		SO_2	H_2O	C	unburned C_8H_{18}
	NO	NO2				
toxic	toxic	toxic	toxic			
	global warming	respiratory problems	respiratory problems	global warming	respiratory problems	respiratory problems
	photochemical smog	acid rain	acid rain			

compound (1)
damage (1) [2]

[Total: 14]

Q26.

4 **(a)** **(i)** $H_2X + 2NaOH \rightarrow Na_2X + 2H_2O$ (1)

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

(iii) $n(\mathbf{R}) = n(H_2X) = \frac{2.16 \times 10^{-3}}{2}$

$= 1.08 \times 10^{-3}$ mol in 25.0 cm^3 (1)

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

(v) 0.0108 mol of **R** = 1.25 g of **R**

1 mol of **R** $= \frac{1.25 \times 1}{0.0108} = 115.7 = 116$ 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]