THE MOLE MARKING SCHEME

1. 1989 Q3

Mass of oxygen = 0.318 – 0.254 = 0.064

M	O
$\frac{0.254}{63.5}$	$\frac{0.064}{16}$

Formula = MO

2. 1989 Q29

$2KOH(aq) + H_2SO_4(aq) \longrightarrow 2H_2O(l) + K_2SO_4(aq)$

Moles of KOH = $\frac{20 \times 1}{1000}$

= 0.02

Moles of H_2SO_4 = ½ (Moles of KOH)

= ½ (0.02)

= 0.01 moles

$5cm^3$ contain 0.01 moles

$1000cm^3$ will contain $\frac{1000 \times 0.01}{5}$

= 2moles

3. 1990 Q5

Moles of NaOH on $200cm^3 = \frac{80}{40} \times \frac{200}{100} = 4 \times 10^{-3}$

Moles of acid = ½ x $^4/_{10^{-3}}$

= 2 x10

RFM of acid = 0.81 x 90

= 2 $x10^{-3}$

4. 1990 Q9

Na	O
$\frac{590}{23}$	$\frac{410}{16}$

Empirical formula = NaO

Empirical formula mass =23 + 16

=39

5. 1990 Q12

RAM of H = 10 x $^{18.7}/_{100}$ + 11 x $^{81.3}/_{100}$

= 1.87 + 8.94

= 10.8

6. 1990 Q20

$Zn^{2+} + 2HCl\ (aq) \longrightarrow Zn^{2+}\ (aq) + 2HCl\text{-}(aq) + H_2(g)$

7. 1992 Q7

Moles of CuCl2 = 2.50 x 10^{-3} = 0.25

No. Of chloride ions = 0.25 x 6.0 x 10^{23} x 2 = 3.0 x 10^{23}

8. 1992 Q29

(a) (i)

	C	H	O
	$\frac{64.9}{12} = 5.4$	$\frac{13.5}{1} = 13.5$	$\frac{21.6}{16} = 1.35$
Ration	$\frac{5.4}{1.35} = 4$	$\frac{13.5}{1.35} = 10$	$\frac{1.35}{1.35} = 1$

(ii) Empirical formula = $C_4H_{10}O_1$

(12 x 4) + (1 x 10) + (16 x 1) x n =74

74n = 74

n= 1

Molecular formula = $C_4H_{10}O$ or $C_4H_{10}O_1$

(iii) I P= Alcohols/alkanols R=ester

II S = Hydrogen gas

III $CH_3CH_2CH_2CH_2OH$ or isomers

(iv) $2CH_3CH_2CH_2CH_2OH + 2Na \longrightarrow CH_3CH_2CH_2CH_2ONa + H_2$

or

$2C_4H_9OH(l) + 2Na(s) \longrightarrow 2Cl_4H_9ONa(l) + H_2\ (g)$

(v) M= Less soluble reasons :- Longer carbon chain/any, solubility of organic compounds decreases any molecular mass increases

(b) $2CH_3\text{-}C\text{-}OH + Na_2CO_3 \longrightarrow 2CH_3—C—ONa^+\ CO_2H_2O$

9. 1993 Q7

% of H = 100 - 79.9=20.1

C	H
79.9	$\frac{20.1}{1}$
$\frac{66.6}{6.66}$ or	$\frac{20.1}{6.66}$
1	3

10. 1993 Q9

Conc of NaOH $= \frac{4}{10}$
$= 0.1M$

Moles of NaOH $= 0.1 \times 22.2 \times 10$
$= 2.22 \times 10$

Moles of dibasic acid $= \frac{1}{2}(2.22 \times 10^{-3})$
$= 1.11 \times 10^{-3}$

RF mass of acid $= \frac{0.1}{1.11\ x10^{-3}}$
$= 90.90/90.1$

11. 1994 Q3

Mass of water 34.8-15.9=18.9g

$\frac{18.9}{15.9} = \frac{18x}{106}$ $\quad x = \frac{18.9 \times 106}{18 \times 15.9} = \frac{2003.4}{286.2}$

$NaCO_3$= (2 x 23) + 12 + 42 = 106

12. 1994 Q16

2 Moles of H_2 (g) = 2 Moles of H_2O

= 100cm^3 of H_2 (g) = 50cm^3 O_2 (g) 100cm^3 H_2O

Oxygen is excess by 50cm^3

13. 1995 Q3 P1

1 mole $CaCO_3$ 2 moles of HCL

Therefore 0.1($^1/_2$) mole $CaCO_3$ 0.2 Mole (½)

CaCO3 = 40 + 12 + 48 = 100g (½)

Therefore 15g $CaCO_3$ = $\frac{15}{100g}$ = 0.15Moles

Excess moles 0.15 – 0.05 (½)

Excess mass= (0.05) x 100 (½) = 5g (3 marks)

14. 1995 Q14 P1

a) $(C_3H_6O)n$ = 116

(3 x 12 + 6 + 16)n =116 ($^1/_2$) Molecular formulae = 2(C□H□O)

58n = 116 ($^1/_2$) = $C_3H_{12}O_2$ ($^1/_2$)

n = $\frac{116}{58}$ = 2 ($^1/_2$) (2 marks)

a) Percentage of Carbon = $\frac{12 \times 6}{116}$ x 1000($^1/_2$) = 62.07 ($^1/_2$) Range (62.05 – 62)

OR

$\frac{3 \times 12}{58}$ x 100 ($^1/_2$) = 62.07 ($^1/_2$) (mark consequently)

15. 1996 Q24 P1

A gas with a smell of rotten eggs is formed H_2S gas is formed / A greenish solution is formed? Effervescence / A gas is produced / Black solid dissolves. (1 mark)

16. 1997 Q19 P1

(a)-$Ca(OH)_2(aq) + Ca(HCO_3)_2(aq) \rightarrow 2CaCO_3$ (s) + H_2O(l)

(b) Moles = $\frac{\text{Volume x Morality}}{1000}$

Moles of CO^{2+} = $\frac{90 \times 0.01}{1000}$

= 0.009 moles

(c) - It forms scum initially then produces lather
- All the Ca^{2+} had not been precipitated.
- Water was still hard

17. 1997 Q28 P1

No. of moles of hydrogen H_2 = $^{10}/_{2}$ = 5 Moles

No. of moles of Nitrogen dioxide NO_2 = 46

Relative molecular mass of NO_2 = 46

1 Mole of No_2 = 5 x 46

5 Moles = 30g

18. 1998 Q6 P1

ALT 1

$CxHy + O_2$ x $CO_2 + {}^{y}/_{2}\ H_3O$

XCO_2 $^{y}/_{2}\ H_2O$

3:52 1:44

r: $\frac{3.52}{44} = 0.08$ $\frac{1.44}{44} = 0.08$

$= \frac{0.08}{0.08} = 1$ $\frac{0.08}{0.08} = 1$

$X = 1$ $^{y}/_{2} = 1$

=E.F = CH_2 y = 2

E.F.M = 14

N= $\frac{56}{14}$ =4

M.F. $(CH_2)_4 = C_4H_8$

Mass of C = $12 \times \frac{3.52}{44} = 0.96$

Mass of H = $2 \times \frac{1.44}{18} = 0.16$g

Moles of C = $\frac{0.96}{12} = 0.08$

Moles of H = $\frac{0.16}{1} = 0.16$

Ratio 0.08 : 0.16

0.08 : 0.08

1 : 2

EF : CH_2

N : 4

MF = $(CH_2)_4 = C_4 H_8$

19. 1999 Q7 P1

C = 2: 3 Valency C_2S_3 or C_2S_5

Accept B_2S_3 OR B_2S_3 if the candidate identifies C as Boron (B)

20. 1999 Q10 P1

Moles of nitric acid $= \frac{50 \times 2}{1000} = 0.1$

Moles of KOH IN $50CM^3 = 0.1$

moles OF KOH IN $50cm^3 = 0.1\ ^1/_2$

moles of KOH IN $100cm^3 = 0.1\ ^1/_2$

$= 0.2 \times 56$

$= 11.2g$

21. 1999 Q4b P2

$Fe(s) + Cu^{2-}(aq) = Fe^{2+}(s) + Cu(s)$

Moles of Fe (s) $= \frac{3.36}{56(I)} = 0.06\ (^1/_2)$

Moles of Cu = 0.06

Mass of CU = 0.06 63.5 (1) = 3.81 (g)

(Mark consequentially from equation given $(^1/_2)$ for units)

21. 2000 Q11 P1

Alt 1

Molarity of NaOH = 4 = 0.1M

Moles of NaOH = 20 x 0.1 / 1000 = 0.002

moles of $H_2SO_4 = 0.001$

8cm3 = 0.001

1000cm3=?

= 0.1235M

Alt. 2

$H_2SO_4(aq) + 2NaOH(aq) \longrightarrow Na_2SO_4(aq) + H_2O(l)$

Molarity of NaOH = 4 / 40 = 0.1M

$\frac{MaVa}{mbVb} = \frac{1\ ma\ x8}{2\ 0.1\ x20} = \frac{1}{2}$

Ma = 0.1x20 / 8 x 2

= 0.125M

22. 2001 Q10 P1

R.m.m of $H_2O = 2 + 16 = 18$

R.m.m of $Na_2CO_3 = 46 + 12 + 48 = 106$

Moles $H_2O = \frac{14.5}{18} = 0.805$

Moles of $Na_2CO_3 = \frac{85.5}{100} = 0.866$

Mole ration $Na_2CO_3 : H_2O$

1: 1

16 + 18 = 100%

$\frac{18n}{106 + 18n} = \frac{14.5}{100}$

18n x(-100) = 14.5 (106 + 18n)

1800n = 1537 + 261n

1539n = 1537

1537 = 09987

1539

23. 2003 Q6 P1

$Na_2SO_3(s) + 2\ HCl\ (aq) \longrightarrow 2NaCl\ (aq) + SO_2\ (g) + H_2O(l)$

Moles of So2 = 160 / 2400 =0.04

Moles ratio 1:1

Moles of $NaSo_3 = 0.04$

Mass of NaSO3

0.04 x 126

=5.04 gm

24. 2004 Q14 P1

a) $Mg2^{+}_{(aq)} + CO_3^{2}{}_{(aq)} \longrightarrow MgCO_{3(s)}$ (1) penalize ½ more for missing state symbols

b) RFM of $MgCO_3$ = 24 + 12 + 48 =84 (½)
= 24 + 12 + 16 x 3 (½)

Moles of Mg^{2+} = $\frac{8.4}{8}$ = 0.1 (½)

$\frac{xx0.5}{1000}$ = 0.1 (½)

$X = \frac{1000x0.1}{0.5}$

25. 2005 Q9 P1

$GCO_3(s) + 2HCI\ (aq) \rightarrow GCl_2(aq) + CO_2(g) + H_2O(l)$

1 mol 2 mol

Moles of acid used = $\frac{20}{1000}$ x 1 = 0.02 moles

Of the carbonate = ½ of acid = 0.01 moles

0.01 moles = 1 g

1 mole = $\frac{1 \times 1}{0.01}$ = 100g

Molar mass of GCO_3 = G + 16 x 3

100 = G + 60

G = 40

R.A.M of G = 40

26. 2005 Q2b P2

b) i) $2NaOH_{(aq)} + H_2SO_{4\,(aq)} \rightarrow Na_2SO_{4(aq)} + 2H_2O_{(l)}$

2 Mol 1 Mol

ii) No. of moles of H_2SO_4 used = $\frac{40}{1000}$ x 0.5 moles
= 0.02 moles

No. of moles of NaOH = 0.02 x 2
= 0.04 moles

0.5 x 2 mole = 1.0 moles will react with 1 litre of the solution of the acid

100 cm^3 = 0.04 moles of NaOH

1000 cm^2 = $\frac{0.04 \times 1000}{100}$ = 0.4 moles

Molar mass of NaOH = 23 +16 +1
= 40

1 mole = 40

0.4 moles = 0.4 x 40
= 16g

Mass of the unreacted = 17.6 – 16
= 1.6g

27. 2006 Q8 (P1), 7c-g p2

8. Mass of water 94.5 – 51.3 = 43.2

R.M.M. of Ba(OH)2 = 171

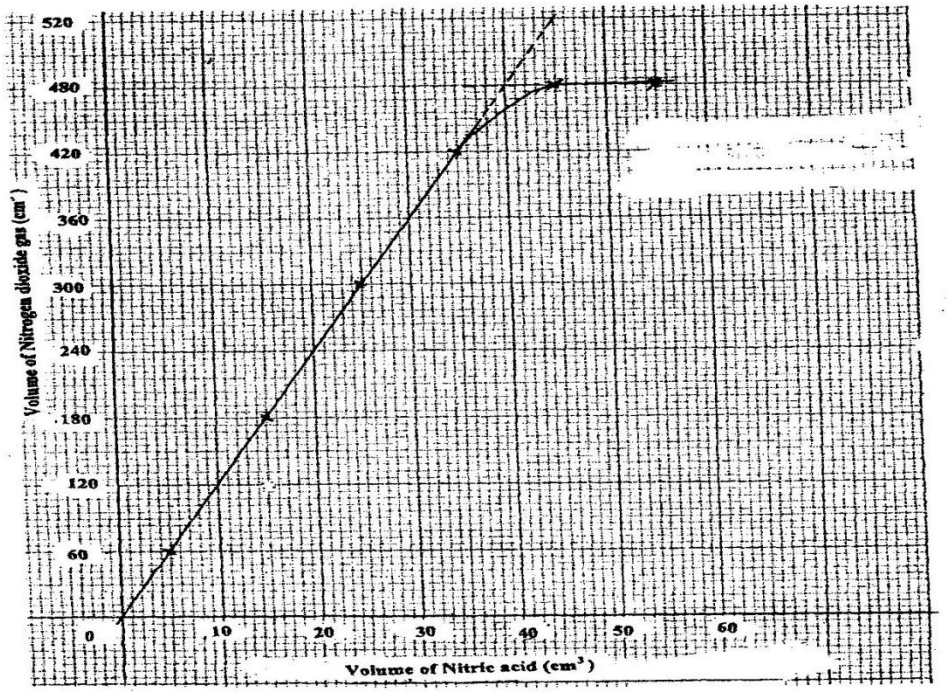
R.M.M of H_2O = 18

$\frac{51.3}{171}$ $\frac{43.2}{18}$ = 8

0.3 = 1 $\frac{2.4}{0.3}$ 8

0.3

7.c)



d) i) 360 cm3 (Correct value read from graph) (1mark)

ii) 40 cm^3 (Correct value read from graph) (1mark)

e) i) Moles of lead = $\frac{2.07}{2.07}$

$\therefore$1 mole of lead = $\frac{40}{0.01}$

= 4000cm (2marks)

ii) $\frac{480}{0.01}$ = $48000cm^3$ (2marks)

f) i) Moles of nitric acid = $\frac{4000}{1000}$

That react with 1 mole of lead

= 4 (1mark)

ii) Moles of nitrogen dioxide = $\frac{48000}{24000}$ = 2 (1mark)

g) $Pb_{(s)} + 4HNO_{3(aq)} \longrightarrow pb(NO_3)_{2(aq)} + 2H_2O_{(l)} + 2NO_{2(g)}$

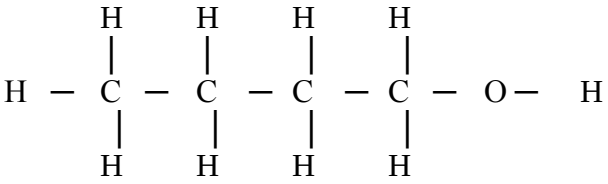
28. 2007 Q20 P1

(a)

Element	C	H	O
%	$\frac{64.9}{12}$	$\frac{21.6}{16}$	$\frac{13.5}{1}$
Moles	5.41	1.35	13.5
Ration	4	1	10

[E.F.= C_4H_9OH]

(b)



29. 2007 Q22 P1

$Al_2(SO_4)_3 \rightarrow 3SO_{4-2} + 2Al^{3+}$

Moles a^2 $Al_2(SO_4)_3 = \frac{6.84}{342} = 0.02$

Moles $a^2SO_4^{-2} = 0.02 \times 3 = 0.06$

30. 2008 Q2 P1

Mass of hydrated salt = (33.111 – 30.296)= 2.815g

Mass of anhydrous salt = 32.781 – 30.296) = 2.485g

E.F = $CaSo_4$ $\frac{33.111g}{32\ 781g} = 0.330$

Mass of water = (2.815 – 2.485) = 0.330g

Accept any correct method

$CaSO_4$	x H_20
Mass 2.485	0.320
Moles 2. 485 = 0.0183	$^{0.330}/_{18}$ = 0.0183
Ration	$^{0.0183}/_{0.0183} = {}^{0.0183}/_{0.0183}$

Or; $CaSo_4.XH_2O \rightarrow CaSo_4 + XH_2O$

$\frac{2.815g}{CaSo_4 \times H_2O} = \frac{2.485g}{136}$

$Y = \frac{2.815}{2.485} \times 136 = 154$

$CaSo_4 \times H_2O = 154$

$136 + 18x = 154$

$18x = 154 – 136 = 18$

$X = {}^{18}/_{18} = 1$

31. 2008 Q5 P1

RFM of $Ca_3(PO_4)_2$ Ca=40 x 3 = 120

P = 31 x 2 = 62

O= 16 x 8 = 128

310

H_3PO4 H=1 x 3 = 3

P = 31 x 1 = 31 1 mole $Co_3(PO4)2$ gives moles of H_3PO_4

O = 16 x 4 = 64/98 310g Co_3 (PO4) 2 gives 2.98 g

155 x 100g Co_3 (PO4) gives $\frac{2.98 \times 155 \times 100}{310}$

= 98000g

= 98kg

32. 2008 Q27 P1

(a) $Mg(OH)_2(aq) + 2\ HCL\ (aq) \rightarrow Mg\ Cl_2\ (aq) + H_2O_{(l)}$

Mole ration (1:2)

No of moles of acid = $\frac{0.1 \times 23}{1000} = 0.0023$

No of moles of $Mg(OH)_2 = \frac{½ \times 0/1 \times 23}{1000} = 0.00115$

Mass of $Mg(OH)_w$ in antacid = 0.00115 x 58 = 0.067g

33. 2009 Q13 P1

% of $Mg(OH)_2$ in anti- acid

$Mg(OH)_2 = \frac{0.67}{0.50} \times 100 = 13.34\%$

Moles of oxygen = 0.83 = 0.026 (½) / 0.0259375

Moles of $NaNO_3$ = 2 x 0.026 / 0.051875

0.05 (½) / 0.051875

R. M .M $NaCO_3$ = 85 (½)

Mass of $NaNO_3$ = converted $\frac{0.052 \times 85}{4.41}$ / 4.4094 (½)

$\frac{4.41}{8.53}$

51. 693%5

Or 183

51.7% (3 marks)

34. 2011 Q26 P1

(i) Metal M (½ mark)

19.352– 10.240 = 0.112g

(ii) Oxygen (½ mark)

10.400 – 10.352 = 0.048g

Element	M	O
Mole ratio	$\frac{0.112}{56}$	$\frac{0.048}{16}$
	0.0020	0.0030
Simple ratio	2	3

E.F M_2O_3

35. 2012 Q3 P2

(a) (i) concentrated sulphuric (vi) acid (1mark)

if sulphuric acid ½ / sulphuric (vi) acid penalise ½ mark

(ii) potassium nitrate √ or KNO_3 ½

(iii) is condense the nitric acid fumes into liquid or to cool nitric acid vapour. Reject to cool the nitric acid (1mark)

(b) (i) Nitric acid attacks rubber/ corrodes√ rej reacts with rubber

(ii) The reaction produces nitrogen √ ½ (ii) oxide which readily gets oxidised by air to form nitrogen oxide that as brown.
Identifying that brown gas is NO_2 √ ½

(c) (i) -Rej Electrolysis of brine / steam alkanes
- From natural gas, crude oil, watergas, biogas.

(ii) equation √1 $HNO_{3\,(g)} + NH_{(g)} \longrightarrow NH_4NO_{3(l)}$ or $_{(aq)}$√ 1

Moles of NH_4NO_3 17kg ⟶ 80kg $\frac{17 \times 4800}{80} = 1020$

Moles of NH_3 ? ⟶ 4800

Use of ratio $\frac{6 \times 17 \times 10^4}{1000}$ = 1020kg √ ½

Answers √ ½

(iii) - Manufacture of explosives - etching of metals (2marks)
- manufacture of dyes - clearing of gas wave
- Manufacture of royal water
- Manufacture of drugs
- As an oxidising agent

36. 2012 Q8 P1

Moles of NaOH = $\frac{36}{1000} \times 0.1$

= 0.0036

$H_2SO_{4\,(aq)} + 2NaOH_{(aq)} \longrightarrow NaSO_{4(aq)} + H_2O_{(l)}$

Or mole ratio 1:2

Or $\left(\frac{0.0036}{2}\right)$

= 0.0018 (1.8×10^{-3})

$\frac{0.0018 \times 100}{10}$ ⎫ 0.018 moles in a $100cm^3$

RFM of H_2SO_4 = 98

Mass of acid = 98 x 0.018

= 1.764g