MEGA LECTURE

TOPIC 2 ASSESSED HW MARK SCHEME

1. (a) 34.0

Penalise precision once

1

(b) 1.76 mol dm^{-3}

1

(c) answer to (b) divided by 0.05

35(.3) on correct figures

1

Shows working

Correct answer only scores this mark
Lose this mark if any units are given for the factor

1

[4]

2. Include washings or words to that effect / mix contents

Accept 'use distilled / deionised water'.
Allow 'weigh directly into flask' if washing included.

1

[1]

1

3. (a)

	Method 1		Method 2	

Method 1 — Mass of H_2O = 4.38 − 2.46

(= 1.92 g)

Method 2 — Percentage of H_2O = 44%

If there is an AE in M1 then can score M2 and M3
If M_r incorrect can only score M1

1

$ZnSO_4$	H_2O	$ZnSO4$	$H2O$
$\underline{2.46}$	$\underline{1.92}$	$\underline{\;56\;}$	$\underline{44}$
161.5	18	161.5	18

1

(0.0152	0.107)	(0.347	2.444)
(1 :	7)	(1 :	7)

x = 7   x = 7

If x = 7 with working then award 3 marks.
Allow alternative methods.
If M1 incorrect due to AE, M3 must be an integer.

1

(b)   Moles HCl = $\underline{0.12(0)}$

1

mol $ZnCl_2$ = $\underline{0.06(0)}$ **OR** $\underline{0.12 / 2}$

1

If M2 incorrect then CE and cannot score M2, M3 and M4.

mass $ZnCl_2$ = 0.06 × 136.4
Allow 65.4 + (2 × 35.5) for 136.4

1

= $\underline{8.18(4)}$ (g) **OR** $\underline{8.2}$ (g)
Must be to 2 significant figures or more.
Ignore units.

1

2

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(c)   Moles $ZnCl_2$ = $\dfrac{10.7}{136.4}$ (= 0.0784)

        1

OR moles Zn = 0.0784

Mass Zn reacting = 0.0784 × 65.4 = (5.13 g)
        M2 is for their M1 × 65.4

        1

% purity of Zn = $\dfrac{5.13}{5.68} \times 100$

M3 is M2 × 100 / 5.68 provided M2 is < 5.68

        1

= <u>90.2%</u> *OR* <u>90.3%</u>
        Allow alternative methods.
        M1 = Moles $ZnCl_2$ = $\dfrac{10.7}{136.4}$ (= 0.0784)

        M2 = Theoretical moles Zn = $\dfrac{5.68}{65.4}$ (=
        0.0869)
        M3 = M1 × 100 / M2 = (0.0784 × 100 / 0.0869)
        M4 = <u>90.2%</u> OR <u>90.3%</u>

        1

        [11]

4.   (a)   To make sure all the solutions (from both the burette and pipette) react
        with each other / are in the flask
        Penalise 'solid' or 'residue'.
        Do not allow any suggestion of removal of
        species.

        1

    (b)   Water does not change the number of moles <u>of either reagent / reactants</u>
        Water is not a reagent / does not react with either reactant.
        Do not allow 'water is not involved in the reaction'.
        Apply list principle.

        1

        [2]

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5.   (a)   Any **three** from:

A method of weighing by difference / wash the solid from its weighing container into the beaker

> *If the nature of any washing is imprecise penalise once only.*

Wash the (wet) rod into the flask / beaker after use

> *Do not allow a method where the solution is made up directly in the flask.*

Wash the (wet) beaker into the flask after transfer

> *Ignore any instructions that refer to rinsing equipment (before use) or use of deionised water.*

Wash the filter funnel (after transfer) into the flask

Use a teat pipette to make up to the mark on the volumetric flask

Ensure the <u>bottom of the (liquid) meniscus</u> is on the graduation mark

Mix / shake the final solution in the flask / invert flask

Max 3

(b)   Do (a) further titration(s)
> *Mark these points independently.*

1

To obtain concordant results
> *Allow results with ± 0.1*

1

[5]

6.   Total volume = $(10 \times 12) / 0.25 = 480$ (cm^3) **M1**
> *Allow any correct method.*

1

Therefore add 470 (cm^3) **M2**
> *For **M2**, allow **M1** – 10, even if **M1** is incorrect.*
> *Correct answer without working scores 1 mark only.*

1

[2]

6

7

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MEGA LECTURE

7.   **(a)**   P = 100 000 Pa and T = 298 K

Wrong conversion of V or incorrect conversion of P / T lose M1 + M3

       1

$$n = \frac{PV}{RT} \text{ or } \frac{100\,000 \times 4.31}{8.31 \times 298}$$

If not rearranged correctly then cannot score M2 and M3

       1

n(total) = 174(.044)

       1

n (NO) = <u>69.6</u>

Allow student's M3 × 4 / 10 but must be to 3 significant figures

       1

$$\frac{3000}{17}$$

    (b)   **(i)**

Allow answer to 2 significant figures or more

       1

176.5

Allow 176   177
But if answer = 0.176   0.18 (from 3 / 17) then allow 1 mark

       1

      (ii)   176.47 × 46 = 8117.62

M1 is for the answer to (b)(i) × 46. But lose this mark if 46 ÷ 2 at any stage
However if 92 ÷ 2 allow M1

       1

$$8117.62 \times \frac{80}{100} \ (= 6494\,g)$$

M2 is for M1 × 80 / 100

       1

$$\frac{6494}{1000} = 6.5$$

M3 is for the answer to M2 ÷ 1000 to min 2 significant figures (kg)

     OR

8

If 163 mol used:

163 × 46 = 7498 (1)

$$7498 \times \frac{80}{100} = 5998.4\,g\,(1)$$

6.00 kg (1)

1

(c)

$$0.543 \times \frac{2}{3}\ (=0.362)$$

$$\text{if not} \ \times \frac{2}{3} \ CE = 0/2$$

1

$$0.362 \times \frac{1000}{250} = 1.45\ (mol\,dm^{-3})$$

Allow 1.447   1.5 (mol dm^3) for 2 marks.

1

[11]

8. (a) (i) M1 - M_r calcium phosphate = 310(.3)
If M_r wrong, lose M1 and M5.

1

M2 - Moles calcium phosphate = $\dfrac{7.26}{M1}$ (= 0.0234)

0.0234 moles can score M1 and M2.
If M_r incorrect, can score M2 for $\dfrac{7.26}{M1}$.

*Allow M2 and / or M3 to 2 significant figures
here but will lose M5 if answer not 1.23.*

1

M3 - Moles phosphoric acid = 2 × 0.0234 = 0.0468
*Allow student's M2 × 2. If not multiplied by 2
then lose M3 and M5.*

1

M4 - Vol phosphoric acid = 0.038(0) dm^3
If not 0.038(0) dm^3 then lose M4 and M5.

1

Conc phosphoric acid = $\dfrac{0.0468}{0.038(0)}$
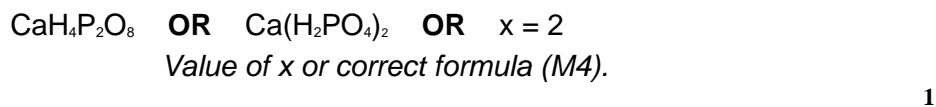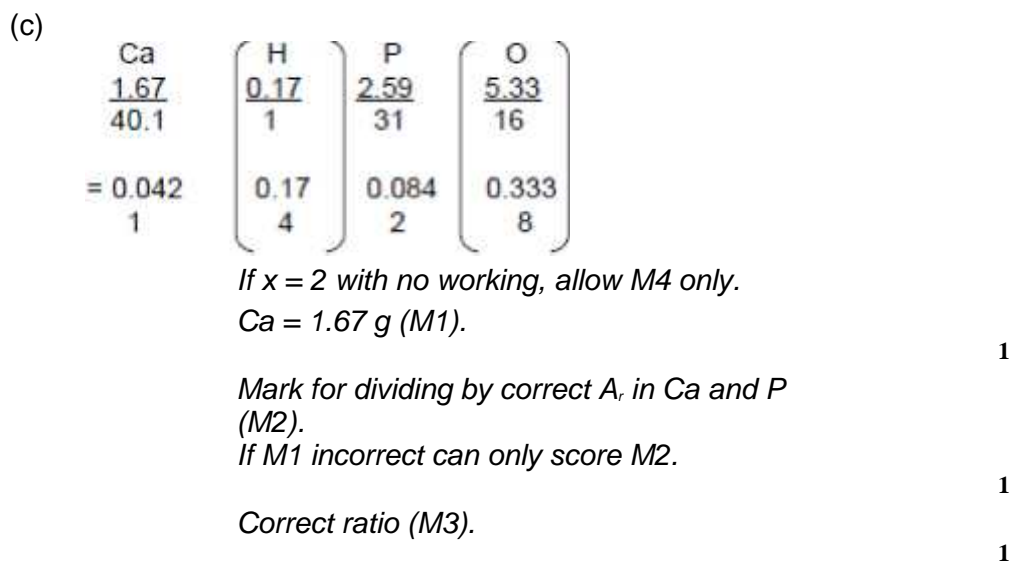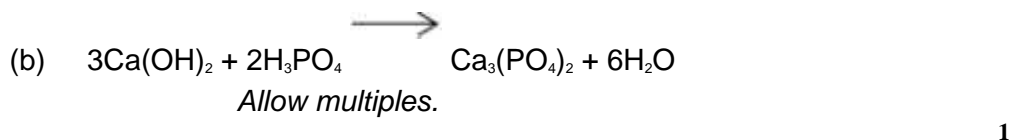
9

M5 = <u>1.23</u> (mol dm ^{3})

This answer only – unless arithmetic or
transcription error that has been penalised by 1
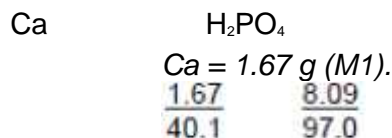*mark.*
Allow no units but incorrect units loses M5.

1

(ii)
$$\frac{492.3}{688.3} \times 100 \quad \textbf{OR} \quad \frac{492}{688} \times 100$$

1 mark for both M_r correctly placed.

= 71.5%

2

(b) $3Ca(OH)_2 + 2H_3PO_4 \longrightarrow Ca_3(PO_4)_2 + 6H_2O$

Allow multiples.

1

(c)

Ca	H	P	O
$\frac{1.67}{40.1}$	$\frac{0.17}{1}$	$\frac{2.59}{31}$	$\frac{5.33}{16}$
= 0.042	0.17	0.084	0.333
1	4	2	8

If x = 2 with no working, allow M4 only.
Ca = 1.67 g (M1).

1

Mark for dividing by correct A_r in Ca and P
(M2).
If M1 incorrect can only score M2.

1

Correct ratio (M3).

1

$CaH_4P_2O_8$ **OR** $Ca(H_2PO_4)_2$ **OR** x = 2

Value of x or correct formula (M4).

1

Alternative

Ca H_2PO_4

Ca = 1.67 g (M1).
$$\frac{1.67}{40.1} \qquad \frac{8.09}{97.0}$$

10

Mark for dividing by correct A_r / M_r in Ca and H_2PO_4 (M2).
If M1 incorrect can only score M2.

$$= 0.042 \qquad 0.083$$
$$\quad 1 \qquad\qquad 2$$

Correct ratio (M3).

$CaH_4P_2O_8$ **OR** $Ca(H_2PO_4)_2$ **OR** $x = 2$

Value of x or correct formula (M4).

[12]

11

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MEGA LECTURE

9.   (a)   (i) $\underline{4.98 \times 10^{-3}}$

                Only   **1**

           (ii) 2.49×10^{-3}

                Allow answer to (a)(i) ÷ 2

                Allow answers to 2 or more significant figures

                                             1

           (iii) 2.49×10^{-2}

                Allow (a)(ii) × 10

                Allow answers to 2 or more significant figures

                                             1

           (iv)   138.2

                3.44 divided by the candidate.s answer to (a) (iii)

                138.2 or 138.1 (i.e. to 1 d.p.)

                                           1

           (v) $(138 - 60) \div 2 = 39.1$

                Allow 39 – 39.1

                Allow ((a)(iv) – 60) ÷ 2

                                           1

               K/potassium

                Allow consequential on candidate's answer to (a)(iv) and (a)(v) if a group 1 metal

                Ignore + sign

                                           1

   (b)   PV = n RT or rearranged

                If incorrectly rearranged CE = 0

                                           1

$$T = \frac{0.022 \times 100000}{0.658 \times 8.31}$$

                Correct M2 also scores M1

                                         1

               402(.3) K (or 129 °C)

                allow 402-403K

                or 129-130 °C

                do not penalise °K

                M3 must include units for mark

                                           1

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(c) Pressure build up from gas/may explode/stopper fly out/glass shatters/breaks

Penalise incorrect gas

1

13

(d) (i) $M_r = 84.3$
If 84 used, max 1

1

$\dfrac{6.27}{84.3} = 0.074(4)$

CE if not 84 or 84.3
Allow answers to 2 or more significant figures
M2 = 0.074-0.075

1

(ii) M1 M_r MgSO$_4$ = 120(.4)
allow 120.3 and 120.1
CE if wrong Mr

1

M2 Expected mass MgSO$_4$ = 0.074(4) × 120(.4) = 8.96 g
Allow 8.8 – 9.0 or candidate's answer to (d)(i) ×
120(.4)

1

M3 95% yield = $\dfrac{8.96 \times 95}{100}$ = 8.51 g
Allow 8.3 – 8.6
M3 dependent on M2

Alternative method

M2 0.074(4) × 95/100 = 0.0707

M3 0.0707 × 120(.4) = 8.51 g
Allow (d)(i) × 95/100
Allow 8.3 – 8.6
M3 dependent on M2

1

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MEGA LECTURE

10.   (a)   Mol Pb = 8.14 / 207(.2) (= 0.0393 mol)

M1 and M2 are process marks

1

Mol HNO_3 = 0.0393 × 8 / 3 = 0.105 mol

Allow mark for M1 × 8/3 or M1 × 2.67

1

Vol HNO_3 = 0.105 / 2 = 0.0524 (dm^3)

Accept range 0.0520 to 0.0530
No consequential marking for M3
Answer to 3 sig figs required

1

(b)   101000 (Pa) and 638 × 10^{-6} (m^3)

1

n = pV/RT   (= $\underline{101000 \times 638 \times 10^{-6}}$)   (8.31 ×
298   )

Can score M2 with incorrect conversion of p and V
If T incorrect lose M1 and M3

1

$\underline{0.026}$(0) (mol)

If answer correct then award 3 marks
Allow answers to 2 sig figs or more
26.02 = 1
If transcription error lose M3 only

1

(c)   (i) $2Pb(NO_3)_2(s)$ $2 PbO(s) + 4NO_2(g) + (1)O_2(g)$

Allow multiples
Allow fractions

1

(ii)   Decomposition not complete / side reactions / by-products / some (NO_2)
escapes / not all reacts / impure $Pb(NO_3)_2$

Ignore reversible / not heated enough / slow

1

(iii)   Hard to separate O_2 from NO_2 / hard to separate the 2 gases

Allow mixture of gases
Not 'all products are gases'

1

[9]

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MEGA LECTURE

11. A

[1]

12. D

[1]

13. A

[1]

14. B

[1]

15. B

[1]

16. D

[1]

17. A

[1]

18. A

[1]