

M1. (a) 37

*These answers only.
Allow answers in words.*

1

48

Ignore any sum(s) shown to work out the answers.

1

(b) (i) Electron gun / high speed/high energy electrons

Not just electrons.

Not highly charged electrons.

1

Knock out electron(s)

Remove an electron.

1

(ii) $\text{Rb(g)} \rightarrow \text{Rb}^{\text{+}}(\text{g}) + \text{e}^{-}$

OR

$\text{Rb(g)} + \text{e}^{-} \rightarrow \text{Rb}^{\text{+}}(\text{g}) + 2\text{e}^{-}$

OR

$\text{Rb(g)} - \text{e}^{-} \rightarrow \text{Rb}^{\text{+}}(\text{g})$

Ignore state symbols for electron.

1

(c) Rb is a bigger (atom) / e further from nucleus / electron lost from a higher energy level/ More shielding in Rb / less attraction of nucleus in Rb for outer electron / more shells

Answer should refer to Rb not Rb molecule

If converse stated it must be obvious it refers to Na

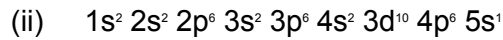
Answer should be comparative.

1

(d) (i) s / block s / group s

Only

1



Allow $3d^{10}$ before $4s^2$

Allow in any order.

1

(e) $\frac{(85 \times 2.5) + 87 \times 1}{3.5}$

M1 is for top line

1

1

= 85.6

Only

1

OR

$\frac{(58 \times 5) + 87 \times 2}{7}$

M1 ^{85}Rb 71.4% and ^{87}Rb 28.6%

M2 divide by 100

1

1

85.6

M3 = 85.6

1

(f) Detector

Mark independently

Allow detection (plate).

1

Current / digital pulses / electrical signal related to abundance

Not electrical charge.

1

(g) Smaller

Chemical error if not smaller, CE = 0/3

If blank mark on.

1

Bigger nuclear charge / more protons in Sr
Not bigger nucleus.

1

Similar/same shielding

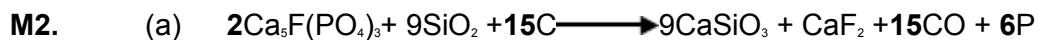
QWC

(Outer) electron entering same shell/sub shell/orbital/same number of shells.

Do not allow incorrect orbital.

1

[16]



1

(b) **M1** ($\text{P}_4 =$) **0**

M2 ($\text{H}_3\text{PO}_4 =$) **(+) 5**

Accept Roman numeral V for M2

2

(c) H_2SO_4

Both numbers required

$$\begin{aligned} M_r &= 2(1.00794) + 32.06550 + 4(15.99491) \\ &= \mathbf{98.06102} \text{ or } \mathbf{98.0610} \text{ or } \mathbf{98.061} \text{ or } \mathbf{98.06} \text{ or } \mathbf{98.1} \end{aligned}$$

Calculations not required

and

H_3PO_4

$$\begin{aligned} M_r &= 3(1.00794) + 30.97376 + 4(15.99491) \\ &= \mathbf{97.97722} \text{ or } \mathbf{97.9772} \text{ or } \mathbf{97.977} \text{ or } \mathbf{97.98} \text{ or } \mathbf{98.0} \end{aligned}$$

1

(d) (i) A substance that speeds up a reaction OR alters / increases the rate of a reaction **AND** is chemically unchanged at the end / not used up.

Both ideas needed

Ignore reference to activation energy or alternative route.

1

(ii) The addition of water (**QoL**) to a molecule / compound

QoL- for the underlined words

1

(iii) **M1** $\text{CH}_3\text{CH}=\text{CH}_2 + \text{H}_2\text{O} \longrightarrow \text{CH}_3\text{CH}(\text{OH})\text{CH}_3$

(C_3H_8)

For M1 insist on correct structure for the alcohol but credit correct equations using either C_3H_8 or double bond not given.

M2 propan-2-ol

2

[8]

M3.(a)

$$\frac{(82 \times 2) + (83 \times 2) + (84 \times 10) + (86 \times 3)}{17} \quad \frac{(1428)}{(17)}$$

M1 for the top line

M2 is for division by 17

1

1

= 84.0

Not 84

No consequential marking from M1 or M2

Ignore units

1

The A_r in the Periodic table takes account of the other isotopes / different amounts of isotopes (or words to that effect regarding isotopes)

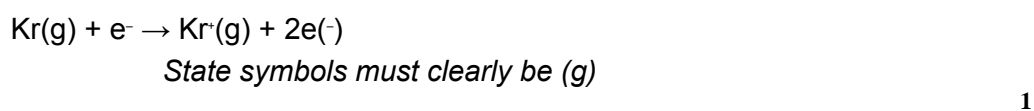
Award independently

Comparison implied
Isotope(s) alone, M4 = 0

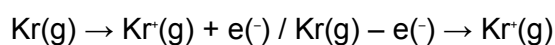
1

- (b) (Beam of electrons from) an electron gun / high speed / high energy electrons 1

Knocks out electron(s) (to form a positive ion) 1



OR



The ^{84}Kr isotope
One mark for identifying the 84 isotope 1

Has 2 electrons knocked out / gets a 2+ charge
One mark for the idea of losing 2 electrons (from this isotope) 1

[9]

- M4.** (a) Average/mean mass of (1) atom(s) (of an element) 1

1/12 mass of one atom of ^{12}C
Accept answer in words
Can have top line $\times 12$ instead of bottom line $\div 12$ 1

OR

(Average) mass of one mole of atoms
1/12 mass of one mole of ^{12}C

OR

(Weighted) average mass of all the isotopes

1/12 mass of one atom of ^{12}C

OR

Average mass of an atom/isotope compared to C-12
on a scale in which an atom of C-12 has a mass of 12

$$\frac{(95.12 \times 14) + (4.88 \times 15)}{100}$$

Allow 95.12 + 4.88 instead of 100

1

$$= 14.05$$

If not to 2 d.p. then lose last mark

Not 14.04

1

- (b) ^{15}N is heavier/ ^{15}N has a bigger m/z/different m/z values

Not different no's of neutrons

Not ionisation potential

1

Electromagnet/electric field/magnet/accelerating
potential or voltage/electric current

1

- (c) No difference

1

Same no of electrons (in outer orbital/shell/sub shell)/same
electron configuration

M2 dependent on M1

Not just electrons determine chemical properties

Ignore protons

1

[8]

M5. Mass number = number of protons + neutrons (in the nucleus/atom)

Not in a substance or compound or element

7 protons and 7 electrons

1

1

8 neutrons

1

[3]

M6. (a) (i) Different number / amount of neutrons
Not different neutrons
Ignore same protons and/or electrons
CE incorrect statement relating to protons / electrons

1

(ii) Same electron configuration / same number of electrons (in the outer shell)
Ignore same no of protons
Ignore electrons determine chemical properties
CE if wrong statement relating to protons / neutrons

1

(b) Average mass of 1 atom (of an element)
1/12 mass atom of ^{12}C

OR

Average/mean mass of atoms of an element
1/12 mass of one atom of ^{12}C

OR

(Average) mass of one mole of atoms
1/12 mass of one mole of ^{12}C

OR

(Weighted) average mass of all the isotopes
1/12 mass of one atom of ^{12}C

OR

Average mass of an atom/isotope compared to C-12
on a scale in which an atom of C-12 has a mass of 12

If moles and atoms mixes Max = 1

Mark top and bottom line independently

1/12 on bottom line can be represented as x 12 on top line

This expression = 2 marks

2

$$(c) \quad (i) \quad \frac{(64 \times 12) + (66 \times 8) + (67 \times 1) + (68 \times 6)}{27} \quad \frac{(\quad = 1771)}{27}$$

$$= \underline{65.6}$$

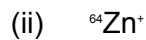
If not 27 max 1 mark (for top line)

Mark is for dividing by 27 or string

*If **evidence** of arithmetic or transcription error seen in M1 or M2 allow consequential M3 and consequential (c)(ii)*

65.6 = 3 marks

3



M1 for identifying Zn / zinc

M2 is for the + sign and the 64

M2 is dependent on M1

2

(d) Size of the charge (on the ion) / different charges / different m/z

Allow forms 2+ ions

QWC

1

(e) (ions hit detector and) cause current/(ions) accept
electrons/cause electron flow/electric pulse caused
bigger current = more of that isotope/current proportional to abundance

Implication that current depends on the number of ions

M2 dependent on M1

2

[12]