M1.(a) because this lithium atom has

3 protons

1

and 4 neutrons

1

mass number is total of neutrons and protons

accept protons and neutrons have a mass of 1

accept number of neutrons = 7 - 3(protons)

ignore mass of electron is negligible

1

(b) grams

accept g

1

^{12}C

allow carbon-12 ***or*** *C-12*

ignore hydrogen ***or*** *H*

1

(c) any **three** from:

max ***2*** *if no numbers given*

numbers if given must be correct

- both have 8 protons

  accept same number of protons
- ^{18}O has 10 neutrons
- ^{16}O has 8 neutrons

  accept different number of neutrons or ^{18}O *has two more neutrons for* ***1*** *mark*
- both have 8 electrons.

  accept same number of electrons

3

[8]

M2.(a) (i) lit splint **or** ignite the gas

1

(squeaky) pop / explosion

1

(ii) because it provides energy (for the reaction)

1

to break bonds (in the reactants) **or** so the particles collide successfully

ignore reference to frequency or rate of collisions

*because it provides the activation energy gains **2** marks*

1

(b) (i) 1.67(g)

allow 1.66-1.68

*correct answer (to 3 significant figures) with or without working gains **3** marks*

*if answer incorrect allow up to **2** marks for the following steps:*

24 → 40

1.00 → 40 / 24

or

*moles magnesium = 1 / 24 **or** 0.04(17)*

multiply by 40

*allow ecf from incorrect ratio **or** incorrect number of moles*

3

(ii) **if correct answer from part (b)(i) used**

allow ecf from part (b)(i)

89.8 or 90

if 1.82 g used

82.4 or 82

*correct answer with or without working gains **2** marks*

*if answer incorrect, allow the following for **1** mark:*

1.50 / 1.67 (or their answer from part (b)(i))

if 1.82 g used: 1.50 / 1.82

2

(iii) any **one** from:

ignore measurement errors

- not all the magnesium reacted

  allow the reaction may be reversible
- some of the magnesium oxide / product may have been left in the tube **or** may have been lost

  ignore magnesium lost
- different / unexpected reaction
- magnesium not pure

1

[10]

M3. (a) because they are gases

ignore vapours / evaporate / (g)

allow it is a gas

1

(b) (i) 80 / 79.5

correct answer with or without working = ***2*** *marks*

ignore units

if no answer ***or*** *incorrect answer then evidence of 64 / 63.5 + 16 gains* ***1*** *mark*

2

(ii) 80 / 79.87 / 79.9 / 79.375 / 79.38 / 79.4

correct answer with or without working = ***2*** *marks*

if no answer ***or*** *incorrect answer*

then

evidence of $\frac{64}{80}$ ***or*** $\frac{63.5}{79.5}$ *(x100) gains* ***1*** *mark*

accept (ecf)

$\frac{64 or 63.5}{answer (b)(i)} (\times 100)$ *for* ***2*** *marks if correctly calculated*

if incorrectly calculated

evidence of $\frac{64 or 63.5}{answer (b)(i)} (\times 100)$

gains ***1*** *mark*

2

(iii) 3.2

correct answer with or without working = ***1*** *mark*

allow (ecf)

4 x ((b)(ii)/100) for ***1*** *mark if correctly calculated*

1

(c) (i) 3.3

accept 3.33…….. or $3\frac{1}{3}$ *or 3.3˙ or 3.3̅*

1

(ii) measure to more decimal places
or *use a more sensitive balance / apparatus*
allow use smaller scale (division)
or *use a smaller unit*
ignore accurate / repeat

1

*(iii) any **two** from:*

- *ignore systematic / human / apparatus / zero / measurement / random / weighing / reading errors unless qualified*
- *different balances used **or** faulty balance*
  ignore dirty apparatus
- *reading / using the balance incorrectly **or** recording error*
  accept incorrect weighing of copper / copper oxide
- *spilling copper oxide / copper*
  allow some copper left in tube
- *copper oxide impure*
  allow impure copper (produced)
- *not all of the copper oxide was reduced / converted to copper*
  or *not enough / different amounts of methane used*
  accept not all copper oxide (fully) reacted
- *heated for different times*
- *heated at different temperatures*
  accept Bunsen burner / flame at different temperatures
- *some of the copper made is oxidised / forms copper oxide*
- *some of the copper oxide / copper blown out / escapes (from tube)*
  ignore some copper oxide / copper lost
- *some water still in the test tube*

2

[10]

M4. *(a)* *(i)* *straight line through the 'points' and extended to C_8H_{18}*

*do **not** accept multiple lines*

1

(ii) *5500*

range 5400 to 5600

accept ecf from their graph

1

(iii) *it is a straight line graph*

allow directly proportional

accept constant difference between (energy) values

accept C_5H_{12} close to values on the graph

or *C_5H_{12} comes in middle of the graph*

ignore 'fits the pattern' unqualified

ignore 'line of best fit'

ignore 'positive correlation'

1

(iv) *expected ranges for working are:*

accept correct numerical answer as evidence of working

(5400 to 5600) – (2800 to 2900) = (2500 to 2800)

or

their value from (a)(ii) – a value from 2800 to 2900

or

(5400 to 5600) / their (a)(ii) divided by 2

or

a value from 2800 to 2900 - 2

1

no / not quite / almost / yes

this mark is only awarded on evidence from their correct working

1

*(b) (i) incorrect / no **or** partially correct*

ignore references to hydrogen

1

bio-ethanol produces least energy

mark independently

or

bio-ethanol produces 29 kJ

1

(ii) ignore incorrect / correct

*any **two** from:*

- *hydrogen produces <u>only</u> H_2O*
  accept hydrogen does not produce harmful gases / CO_2 / SO_2
- *coal produces SO_2*
  allow coal causes acid rain / respiratory problems
- *coal produces smoke*
  allow coal causes global dimming
- *both renewable <u>and</u> non-renewable fuels produce CO_2*
  accept bio-ethanol <u>and</u> natural gas / coal produce CO_2 / global warming
- *(both) the non-renewable fuels produce CO_2*
  accept coal <u>and</u> natural gas produce CO_2 / global warming
- *(both) renewable fuel<u>s</u> produce no smoke*
  accept hydrogen <u>and</u> bio-ethanol do not produce smoke / global dimming
- *(both) renewable fuel<u>s</u> produce no SO_2*
  accept hydrogen <u>and</u> bio-ethanol
  do not produce SO_2 / acid rain

2

[9]