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

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(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 <u>gas</u>es

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

accept (ecf)

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

if incorrectly calculated

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

*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 3.3$^{\cdot}$

1

(ii)   measure to more decimal places
 or *use a more sensitive balance / apparatus*
   allow use small<u>er</u> scale (division)
    or *use a small<u>er</u> 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

- *<u>heat</u>ed for different times*

- *<u>heat</u>ed 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]