Use of Amount of Sub; Masses Pure Subs

Mark Scheme

Level	GCSE (9-1)
Subject	Combined Science: Trilogy - Chemistry
Exam Board	AQA
Topic	5.3 Quantitative Chemistry
Sub-Topic	Use of Amount of Sub; Masses Pure Subs
Difficulty Level	Silver Level
Booklet	Mark Scheme

Time Allowed: **48 minutes**

Score: **/47**

Percentage: **/100**

Grade Boundaries:

M1.(a) 408 kg

1

(b) all points correct

± ½ *small square*

2

*allow **1** mark if 5 points correct*

best fit line

1

(c) $\frac{1989 \times 100}{36}$

1

5525 dm^3

1

(d) relative formula mass of $TiCl_4$ is 190

1

25.26 %

1

Answer given to 3 significant figures = 25.3 %

1

*25.23% with or without working gains **3** marks*

(e) argon is unreactive

1

water (vapour) would react with sodium

allow water (vapour) would react with titanium(IV) chloride

1

and air contains oxygen that would react with reactants

allow and air contains oxygen that would react with products

1

(f) (titanium conducts electricity) because electrons in the outer shell of the metal atoms are delocalised

1

and so electrons are free to move

allow the delocalised electrons in the metal carry electrical charge through the metal

1

through the whole structure

1

[15]

M2.(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]

M3.Divide by A_r:

Na = 22.8 / 23

B = 21.8 / 11

O = 55.4 / 16

if student has calculated moles upside down they can score mp 3 mp 4 and mp 5 as follows:

Na 23 / 22.8

B 11 / 21.8

O 16 / 55.4

1

Values

0.991

1.01

1.98

0.505

3.46

0.289

1

Divide by the smallest

1 : 2 : 3.5

Divide by the smallest (1)
3.5 : 1.75 : 1

1

Whole number ratio

2 : 4 : 7

Whole number ratio (1)
14 : 7 : 4

1

Empirical formula

$Na_2B_4O_7$

Empirical formula (1)
$Na_{14}B_7O_4$
*if no working shown allow **4** marks for $Na_2B_4O_7$*

1

[5]

M4. (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)

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

if incorrectly calculated

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

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]

M5. *(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 only 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 and non-renewable fuels produce CO_2*
  accept bio-ethanol and natural gas / coal produce CO_2 / global warming
- *(both) the non-renewable fuels produce CO_2*
  accept coal and natural gas produce CO_2 / global warming
- *(both) renewable fuels produce no smoke*
  accept hydrogen and bio-ethanol do not produce smoke / global dimming
- *(both) renewable fuels produce no SO_2*
  accept hydrogen and bio-ethanol
  do not produce SO_2 / acid rain

2

[9]