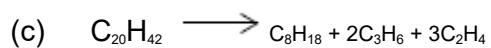


M1.(a) 2,2,4-trimethylpentane

1

(b) 5

1



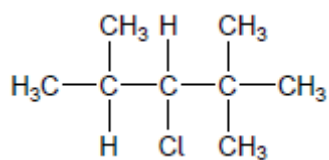
1

(d) Mainly alkenes formed

1

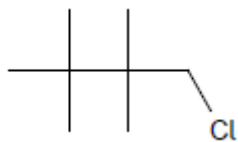
(e) 4 (monochloro isomers)

1



1

(f)



1

(g)  $C_8H_{17}^{35}\text{Cl} = 96.0 + 17.0 + 35.0 = 148.0$   
and  $C_8H_{17}^{37}\text{Cl} = 96.0 + 17.0 + 37.0 = 150.0$   
*Both required*

1

$$M_r \text{ of this } C_8H_{17}Cl = \frac{(1.5 \times 148.0)}{2.5} + \frac{(1.0 \times 150.0)}{2.5} = 148.8$$

1

(h)  $\frac{24.6}{12} \quad \frac{2.56}{1} \quad \frac{72.8}{35.5} = 2.05 : 2.56 : 2.05$

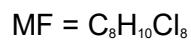
Simplest ratio =  $\frac{2.05}{2.05} : \frac{2.56}{2.05} : \frac{2.05}{2.05}$

=  $1 : 1.25 : 1$

1

Whole number ratio ( $\times 4$ ) =  $4 : 5 : 4$

1



1

[12]

**M2.(a)** (i)  $1.6734 \times 10^{-24}$  (g)

*Only.*

$1.6734 \times 10^{-27}$  kg

*Not  $1.67 \times 10^{-24}$  (g).*

1

(ii) **B**

1

(b) (i)  $\frac{10x + 11y}{x + y} = 10.8$

**OR** ratio 10:11 = 1:4 **OR** 20:80 etc

*Allow idea that there are  $5 \times 0.2$  divisions between 10 and 11.*

1

abundance of  $^{10}\text{B}$  is 20(%)

**OR**

$$\frac{10x}{100} + \frac{11(100-x)}{100} = 10.8$$

$$10x + 1100 - 11x = 1080$$

$$\therefore x = 1100 - 1080 = 20\%$$

*Correct answer scores M1 and M2.*

1

- (ii) Same number of electrons (in outer shell or orbital)  
*Ignore electrons determine chemical properties.*

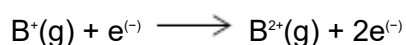
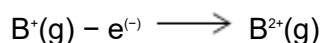
Same electronic configuration / arrangement  
*Ignore protons unless wrong.*

1

- (c) Range between 3500 and 10 000  $\text{kJ mol}^{-1}$

1

- (d)  $\text{B}^+(\text{g}) \longrightarrow \text{B}^{2+}(\text{g}) + \text{e}^{-}$



*Ignore state symbol on electron even if wrong.*

1

- (e) Electron being removed from a positive ion (therefore needs more energy) /  
electron being removed is closer to the nucleus

*Must imply removal of an electron.*

*Allow electron removed from a + particle / species or from a  
2+ ion.*

*Not electron removed from a higher / lower energy level /  
shell.*

*Not electron removed from a higher energy sub-level /  
orbital.*

*Ignore electron removed from a lower energy sub-level /  
orbital.*

*Ignore 'more protons than electrons'.*

*Not 'greater nuclear charge'.*

*Ignore 'greater effective nuclear charge'.  
Ignore shielding.*

1

[8]

**M3.(a)**  $pV = nRT$

*Do not penalise incorrect use of capitals / lower case letters.  
Accept correct rearrangement of equation.*

1

(b)  $2C_4H_{10} + 5O_2 \rightarrow 4CH_3COOH + 2H_2O$

*Accept any correct combination of multiples, including  
fractions.*

1

(c) 23.0 g ethanol produces 30.0 g ethanoic acid

1

15.1% ( $4.54 \times 100 / 30$ )

*Do not penalise precision.  
15.1% scores 2 marks.*

*Accept consequential answer on wrong mass of ethanoic  
acid for second mark only.*

1

[4]

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

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

*If moles and atoms mixed, max = 1*

1

*Mark top and bottom line independently.  
All key terms must be present for each mark.*

1

**OR**

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

**OR**

Average / mean mass of atoms of an element  $\times 12$   
mass of one atom of  $^{12}\text{C}$

**OR**

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

**OR**

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

**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

*This expression = 2 marks.*

$$(b) \quad \frac{(70 \times 3) + (72 \times 4) + 73 + (74 \times 5)}{13} = \frac{941}{13}$$

$$= \underline{72.4}$$

*72.4 only*

1  
1

1

(c)  $^{72}\text{Ge}^+$  or germanium<sup>+</sup>

*Must show '+' sign.*

*Penalise wrong mass number*

1

(d) 70

*If M1 incorrect or blank CE = 0/2*

*Ignore symbols and charge even if wrong.*

1

Lowest mass / lowest m/z  
Accept lightest.  
Accept fewest neutrons.

1

- (e) Electron(s) transferred / flow (at the detector)  
*M1 must refer to electron flow at the detector.*  
*If M1 incorrect CE = 0/2*

1

(From detector / plate) to the (+) ion  
*Do not allow from a charged plate.*

1

- (f) They do not have the same electron configuration / they have different number of electrons (in the outer shell)  
*Ignore electrons determine the properties of an atom.*  
*Ignore they are different elements or different number of protons.*

1

[11]

- M5.** (a) Average/mean mass of (1) atom(s) (of an element)

1

1/12 mass of one atom of  $^{12}\text{C}$   
*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  $^{12}\text{C}$

**OR**

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

**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)  $^{15}\text{N}$  is heavier/ $^{15}\text{N}$  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]

**M6.(a)** (i) Two rings only around nitrogen or sulfur

*Lose this mark if more than 2 atoms are ringed.  
Do not allow two atoms at the same end of the ion.*

1

(ii) 275.8

*Accept this answer only. Do not allow 276*

1

(iii) Carboxylate / COO<sup>-</sup>

*Allow salt of carboxylic acid or just carboxylic acid.*

1

(b)  $(32.1 / 102.1) = 31.4\%$

*Do not penalise precision but do not allow 1 significant figure.*

1

(c) Zineb is mixed with a solvent / water

*Max=2 if M1 missed*

1

Use of column / paper / TLC

*Lose M1 and M2 for GLC*

1

Appropriate collection of the ETU fraction

**OR** Appropriate method of detecting ETU

*Allow ETU is an early fraction in a column or collecting a range of samples over time, lowest retention time / travels furthest on paper or TLC (allow 1 mark for having the longest retention time in GLC).*

1

Method of identification of ETU (by comparison with standard using chromatography)

*If method completely inappropriate, only M1 is accessible*

1

[8]