Cambridge Chemistry Challenge Lower 6th

June 2025

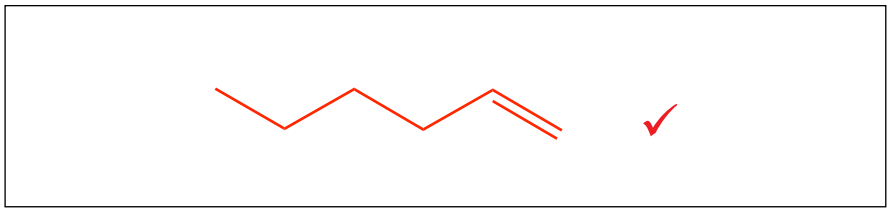
Marking scheme for teachers

(please also read the additional instructions)

	p2	p3	p4	p5	p6	p7	Total
mark	10	14	12	10	8	11	65

Marks available

1(a) (i)



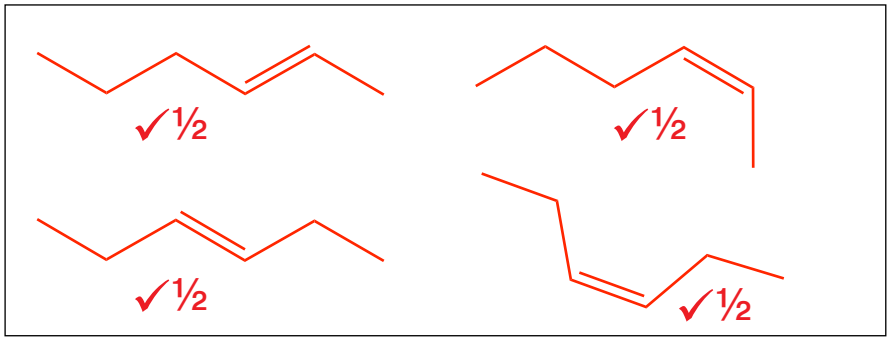
1

(ii)

$C_6H_{12} + H_2 \longrightarrow C_6H_{14}$ ✓

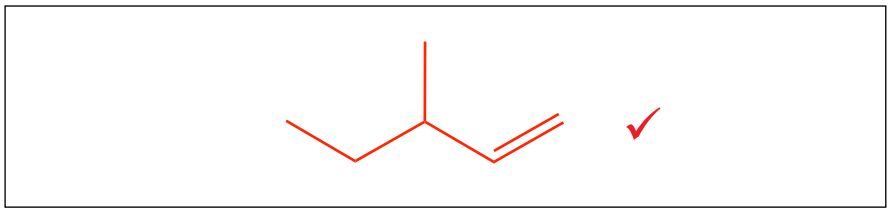
1

(iii)



2

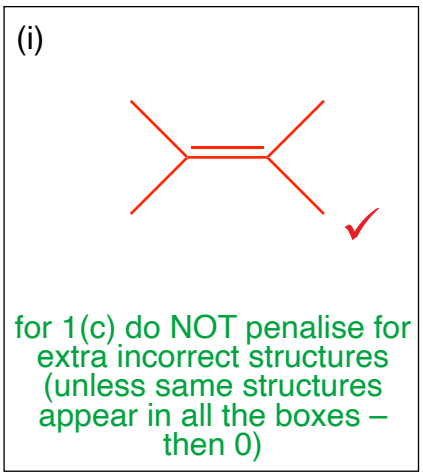
1(b)



1

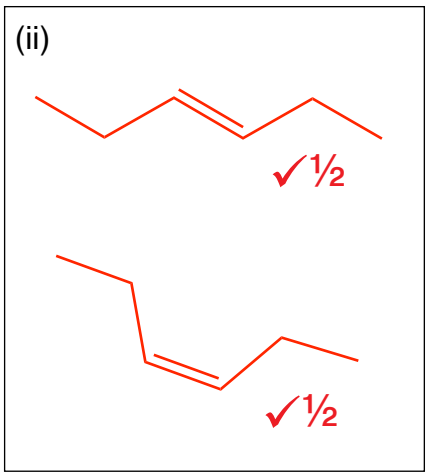
1(c)

(i)



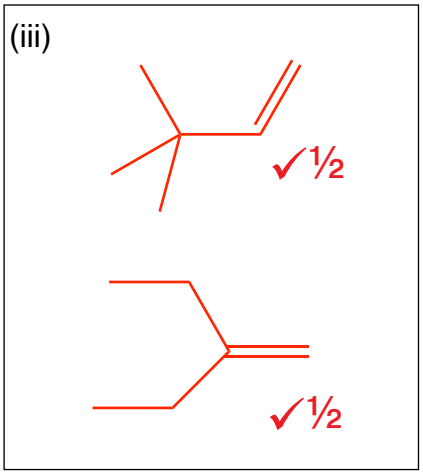
for 1(c) do NOT penalise for extra incorrect structures (unless same structures appear in all the boxes – then 0)

(ii)

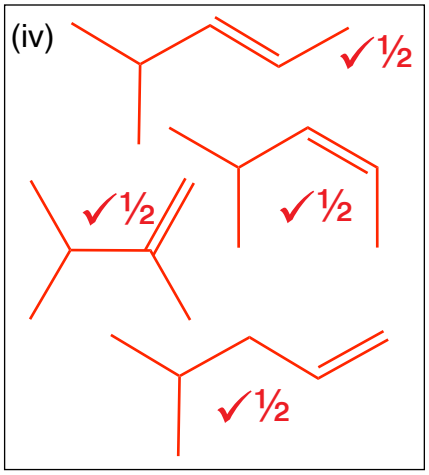


5

(iii)



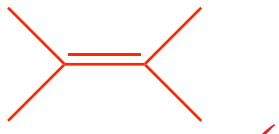
(iv)



Page total 10

Marks available

1(d)

(i) 

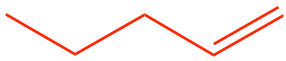
(ii) 

2

one mark if both structures correct but wrong way round

1(e)

A 1 for structure, 1 for peaks, 1 for correct underlining



139.0, 114.3, 35.9, 22.1, 13.6 ppm

3

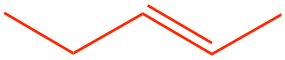
B 1 for structure, 1 for peaks, 1 for correct underlining



132.5, 123.1, 20.2, 14.2, 12.6 ppm

3

C 1 for structure, 1 for peaks, 1 for correct underlining



133.2, 123.6, 25.6, 17.9, 14.1 ppm

3

1(f)

AB

$$K_{AB} = \frac{[\mathbf{B}]_{eq}}{[\mathbf{A}]_{eq}} = \frac{0.75}{0.10} = 7.5$$

1

AC

$$K_{AC} = \frac{[\mathbf{C}]_{eq}}{[\mathbf{A}]_{eq}} = \frac{3.00}{0.10} = 30$$

1

BC

$$K_{BC} = \frac{[\mathbf{C}]_{eq}}{[\mathbf{B}]_{eq}} = \frac{3.00}{0.75} = 4$$

1

Page total 14

Marks available

1(g)

(i)

$\Delta_r H°_{AB} = -8.314 \times 298 \times \ln(7.5) = -5.0$ kJ mol^{-1} ✓

allow e.c.f. from 1(f)

(ii)

$\Delta_r H°_{AC} = -8.314 \times 298 \times \ln(30) = -8.4$ kJ mol^{-1} ✓

allow e.c.f. from 1(f)

4

(iii) one mark for correct sign and value. 0 marks otherwise

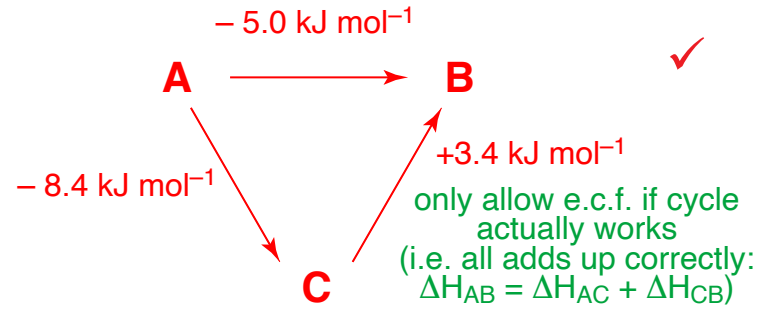
allow e.c.f. from 1(f) BUT must be $+RT(\ln K_{BC})$ not $-RT(\ln K_{BC})$

$\Delta_r H°_{CB} = 8.314 \times 298 \times \ln(4) = +3.4$ kJ mol^{-1} ✓

[$= -8.314 \times 298 \times \ln(1/4) = +3.4$ kJ mol^{-1}]

1 mark for correct units for all three ✓

(iv)



✓

only allow e.c.f. if cycle actually works (i.e. all adds up correctly: $\Delta H_{AB} = \Delta H_{AC} + \Delta H_{CB}$)

arrows must be correct for the values given

1

1(h)

(i)

LARGER (SMALLER) ✓

(circle one)

1

(ii) L ✓

(iii) N ✓

(iv) M ✓

3

1(j)

gradient = $-\ \Delta_r H°_{AC} / R$

$\Delta_r H°_{AC} = -1075 \times 8.314 = -8.94$ kJ mol^{-1} ✓✓✓

2 marks if + 8.94 kJ mol^{-1}

one mark off if no unit or wrong unit

3

Page total 12

Marks available

2(a)

(i) $1s^2\ 2s^2\ 2p^1$ ✓

(ii) 5 protons ✓½

6 neutrons ✓½

2

(iii)

$10.013x + 11.009(1 - x) = 10.810$ ✓

$11.009x - 10.013x = 11.009 - 10.810$

$x = (11.009 - 10.810) / (11.009 - 10.013) = 0.1998$

19.98% ^{10}B ✓

2

(iv)

$^{11}_{5}B \longrightarrow {}^{4}_{2}He + {}^{7}_{3}Li$

i.e. lithium atom ✓

mass number = 7 ✓

2

2(b)

(i)

$2B(s) + 3Cl_2(g) \longrightarrow 2BCl_3(g)$ ✓

state symbols are NOT required
half quantities are fine

1

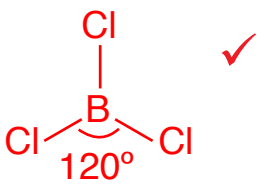
(ii)

$4B(s) + 3O_2(g) \longrightarrow 2B_2O_3(g)$ ✓

state symbols are NOT required
half quantities are fine

1

(iii)



✓

half mark for the shape
half mark for the angle

(iv)

6 ✓

2

Page total 10

Marks available

2(c) (i)

$B_2O_3(s) + 6HF(aq) \longrightarrow 2BF_3(g) + 3H_2O(l)$ ✓

(state symbols are NOT required)

1

(ii)

$B_2O_3(s) + 3C(s) + 3Cl_2(g) \longrightarrow 2BCl_3(g) + 3CO(g)$ ✓

(state symbols are NOT required)

1

(iii)

$B_2O_3(s) + 3C(s) + 3Cl_2(g) \xrightarrow{\Delta_r H^\circ} 2BCl_3(g) + 3CO(g)$

2(–636.5) 2(–403) 3(–110)

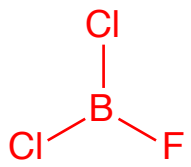
$2B(s) + 3/2\ O_2(g) + 3C(s) + 3Cl_2(g)$

$\Delta_r H^\circ = +2(636.5) + 2(–403) + 3(–110) = +137\ kJ\ mol^{-1}$ ✓✓

(one mark for $–137\ kJ\ mol^{-1}$)

2

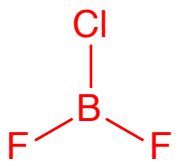
2(d) (i)



33.7 ppm ✓

(half mark for $BClF_2$)

(ii)

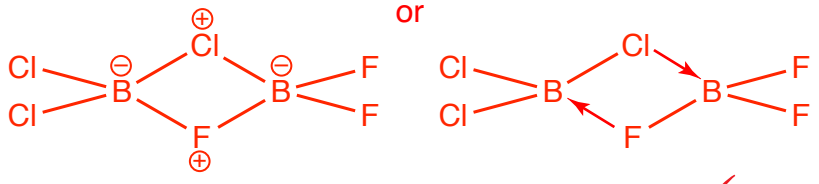


20.7 ppm ✓

(half mark for BCl_2F)

2

(iii)



or

(accept either) ✓

1

(iv)

1 **2** ✓ **3** **4**

circle one answer

1

Page total 8

Marks available

2(e) (i)

Na	B	O	H
12.06 / 22.99 = 0.525	11.34 / 10.81 = 1.049	71.32 / 16.00 = 4.458	5.29 / 1.008 = 5.25
= 1 :	2 :	8.5 :	10
= 2 :	4 :	17 :	20

empirical formula: $Na_2B_4O_{17}H_{20}$ ✓✓ — 2

(ii)

$Na_2B_4O_7 \cdot 10H_2O$ ✓

i.e. a=2, b=4, c=7, d=10 — 1

(iii)

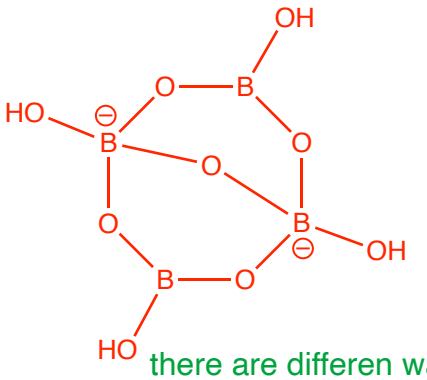
$[B_4O_9H_4 \cdot 8H_2O]^{2-}$ or $[B_4O_9H_4]^{2-}$ ✓ — 1

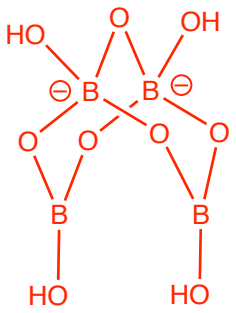
(iv)

$[B_4O_5(OH)_4]^{2-}$ ✓

i.e. w=4, x=5, y=4, z=2 — 1

(v)





there are differen ways of drawing this;
two marks if correct but no charges,
otherwise no partial credit (it's too complicated!) ✓✓✓ — 3

2(f) (i)

RMM $(Na_2B_4O_7) = 201.11$ RMM $(H_2O) = 18.016$

each has one unit of $(Na_2B_4O_7)$

K: no. of waters = (30 / 18.016) / (70 / 201.11) = 4.8 ≈ 5

$Na_2B_4O_7 \cdot 5H_2O$

L: no. of waters = (21.1 / 18.016) / (79.9 / 201.11) = 2.9 ≈ 3

$Na_2B_4O_7 \cdot 3H_2O$ — 2

M: no. of waters = (8.3 / 18.016) / (91.7 / 201.11) = 1.01 ≈ 1

$Na_2B_4O_7 \cdot 1H_2O$

N: no. of waters = 0 $Na_2B_4O_7 \cdot 0H_2O$

half mark for each no. of water

(ii)

$Na_2B_4O_7 + H_2SO_4 \longrightarrow 2B_2O_3 + Na_2SO_4 + H_2O$ — 1

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