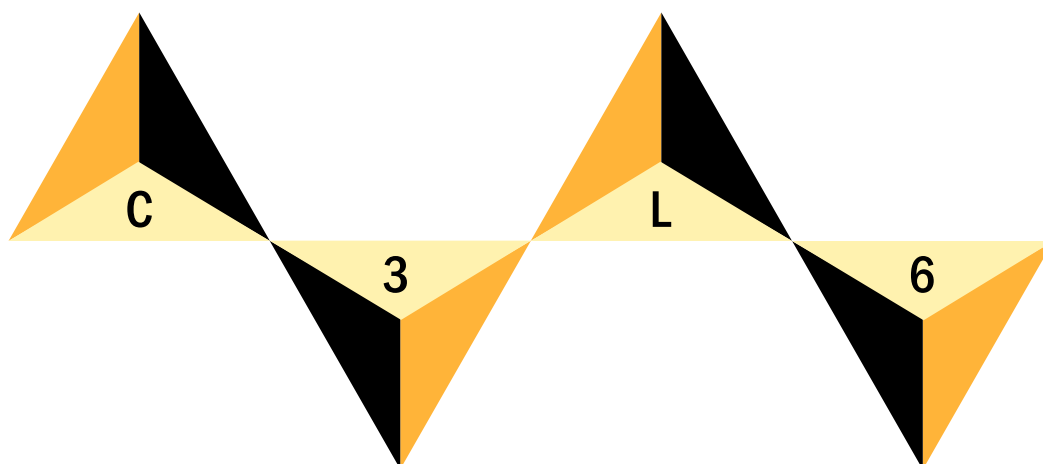




## Cambridge Chemistry Challenge Lower 6th

**June 2015**

# Marking scheme for teachers

(please also read the additional instructions)

|      | p2 | p3 | p4 | p5 | p6 | p7 | Total |
|------|----|----|----|----|----|----|-------|
| mark | 16 | 12 | 13 | 6  | 10 | 3  | 60    |

1(a) equations (underline reduced element):

(i) from mercury(II) oxide:



(ii) from silver(I) carbonate:



(iii) from potassium nitrate(V):

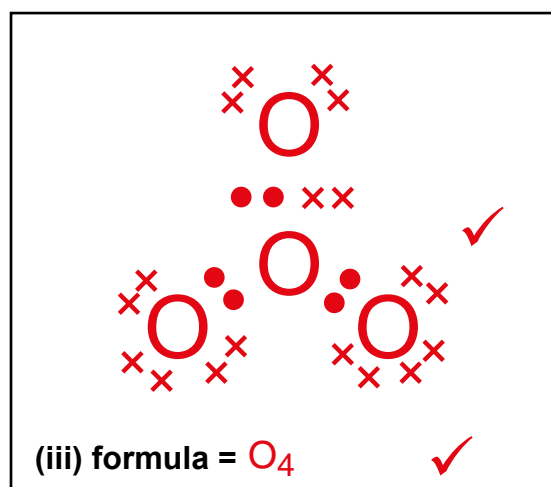
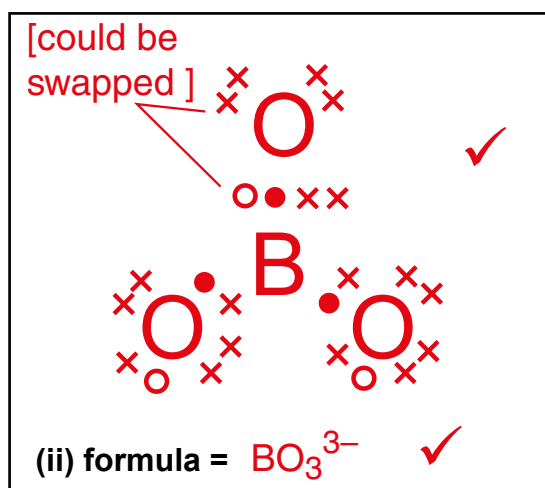
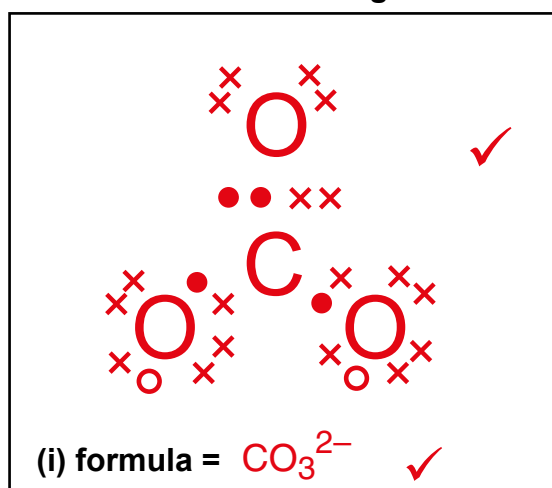


(iv) from sulfuric acid and manganese(IV) oxide:



[ Half quantities accepted. 1 mark for equation; 1 for underlined ]

1(b) dot & cross diagrams



1(c) neutral compound isoelectronic with nitrate(III) ion:

formula:  $\text{O}_3$  ✓

name: ozone ✓

[also allow  $\text{CF}_2$ , difluorocarbene, or  $\text{O}=\text{N}-\text{F}$ , nitrosyl fluoride]

leave  
blank

2

2

2

2

2

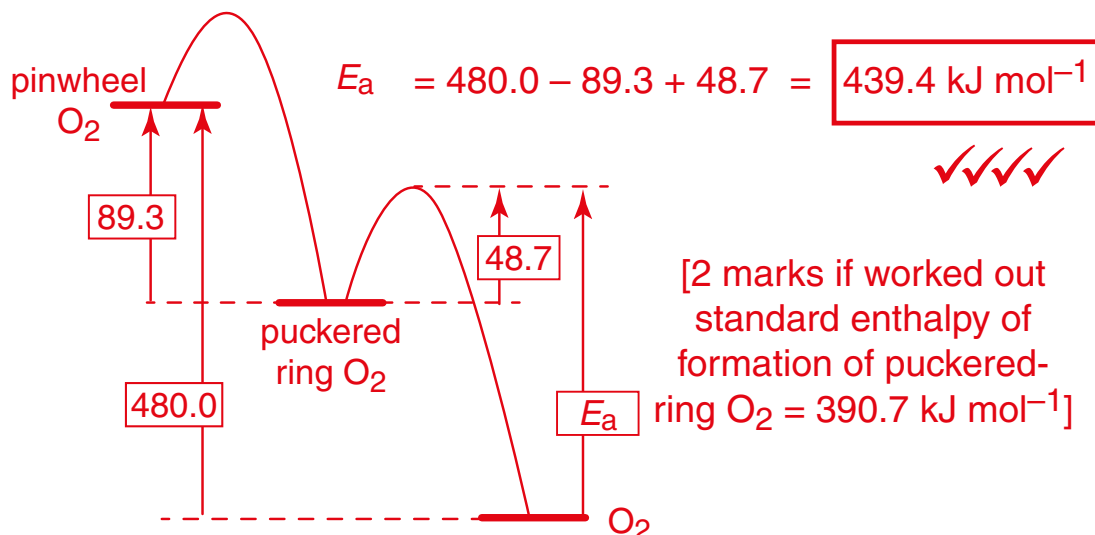
2

2

2

Page total  
16

1(d) activation energy for puckered-ring O<sub>4</sub> from O<sub>2</sub>:



leave blank

4

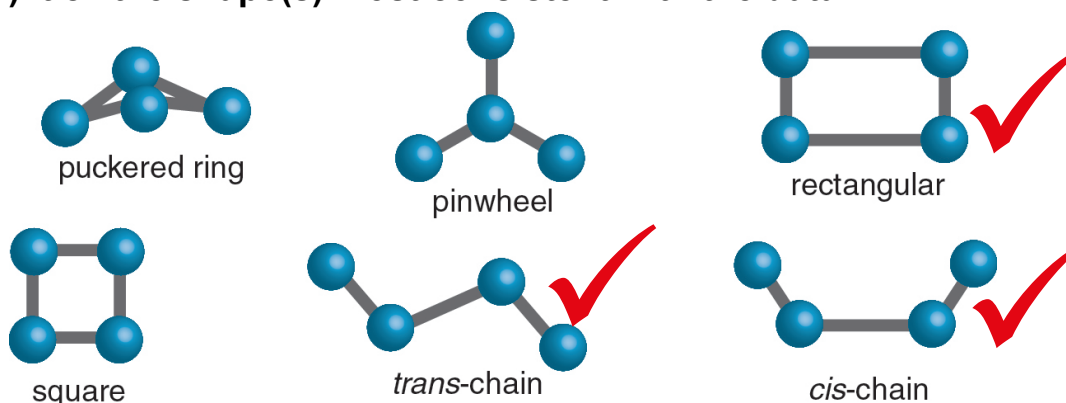
1(e) A = <sup>16</sup>O<sub>2</sub><sup>+</sup> B = <sup>18</sup>O<sub>2</sub><sup>+</sup> C = <sup>16</sup>O<sub>2</sub><sup>+</sup><sup>18</sup>O<sub>2</sub><sup>+</sup>

✓

[1 mark if all three correct]

1

1(f) tick the shape(s) most consistent with the data:



3

[1 mark each; lose 1 mark for any wrong (down to zero)]

1(g) time taken:

$$\text{k.e. of O}_4 \text{ molecule} = 4.00 \text{ keV} = 4000 \times 1.602 \times 10^{-19} \text{ J}$$

$$= 6.408 \times 10^{-16} \text{ J}$$

$$\text{k.e.} = \frac{1}{2}mv^2 \quad \therefore v = \sqrt{\frac{2 \times (\text{k.e.})}{m}}$$

$$\text{mass of } ^{18}\text{O}_4 = 18.00 \times 4 \text{ g mol}^{-1} \equiv \frac{18.00 \times 4}{6.022 \times 10^{23} \times 10^{-3}} \text{ kg molecule}^{-1}$$

$$= 1.1956 \times 10^{-25} \text{ kg}$$

$$v = \sqrt{\frac{2 \times 6.408 \times 10^{-16}}{1.1956 \times 10^{-25}}} = 103500 \text{ m s}^{-1}$$

$$\text{time of flight} = \frac{0.100 \text{ m}}{103500 \text{ m s}^{-1}} = 9.66 \times 10^{-7} \text{ s} (\approx 0.1 \mu\text{s})$$

[lose 1 mark each time a power of ten is incorrectly used]

4

2(a)

i)  
 zero ✓

ii)  
 3, 5 ✓

iii)  
 4, 6, 9 ✓

iv)  
 1, 8 ✓

leave  
 blank

4

[zero marks for part containing missing / additional wrong answers]

2(b) circle one or more:

Free radical

Nucleophilic

Substitution

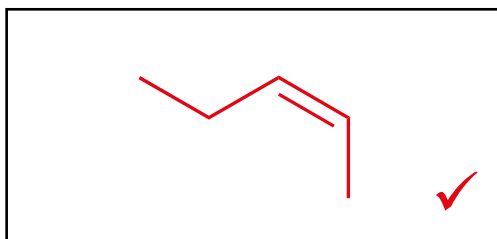
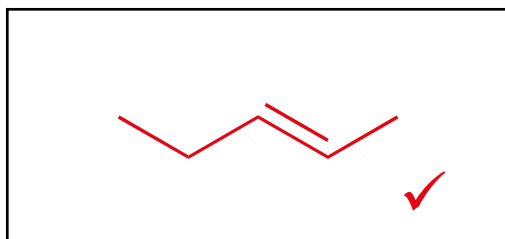
Electrophilic

Addition

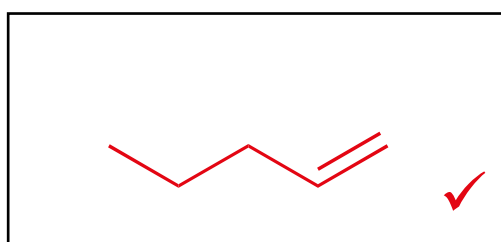
2

[-1 mark for any wrong down to zero]

2(c) three alkenes:



3



2(d)

i)  
 13, 16 ✓

ii)  
 14, 18 ✓

iii)  
 12, 18 ✓

iv)  
 16, 17 ✓

4

[zero marks for part containing missing / additional wrong answers]

Page total  
 13

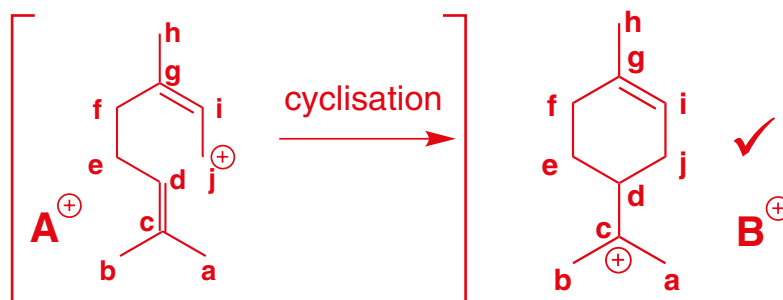
2(e) for  $\alpha$ -terpineol

leave blank

i) connect: d & j ✓

[only structure of  $B^+$  required  
no labels on it needed]

ii) Carbocation  $B^+$ :



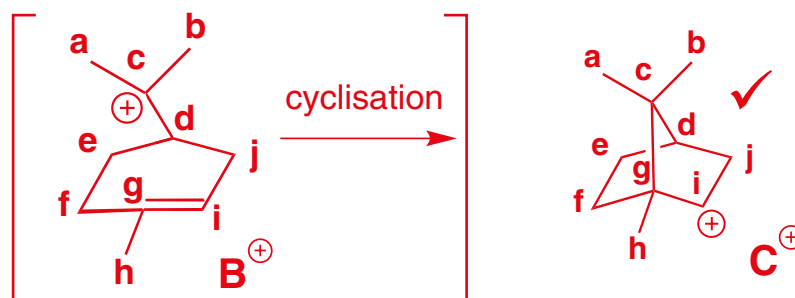
2

2(f) for borneol

i) connect: c & g ✓

[only structure of  $C^+$  required  
no labels on it needed]

ii) Carbocation  $C^+$ :



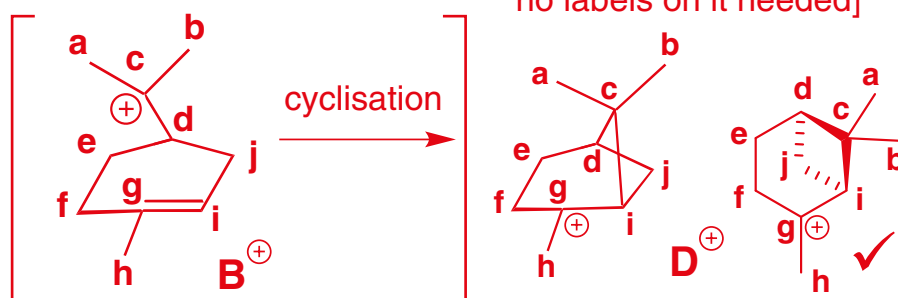
2

2(g) for  $\beta$ -pinene

i) connect: c & i ✓

[only structure of  $D^+$  required  
no labels on it needed]

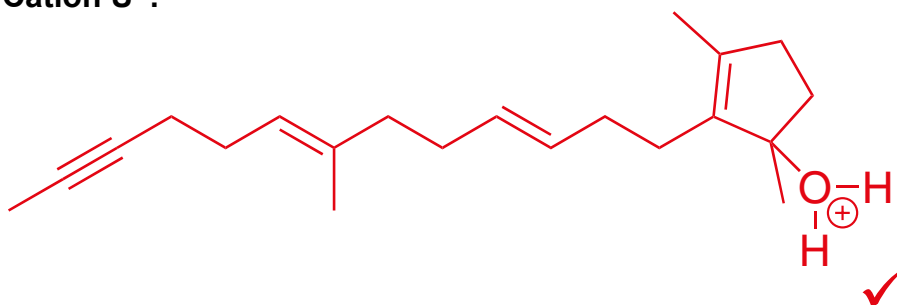
ii) Carbocation  $D^+$ :



2

2(h)

Cation U<sup>+</sup>:



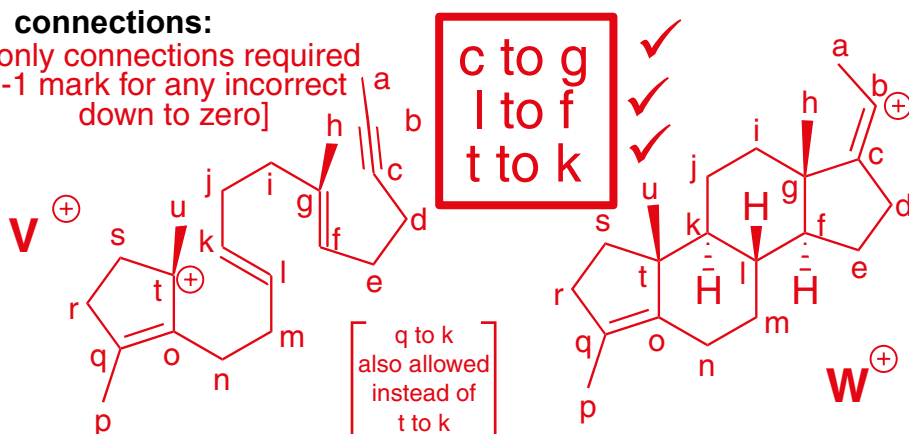
leave blank

1

2(i)

connections:

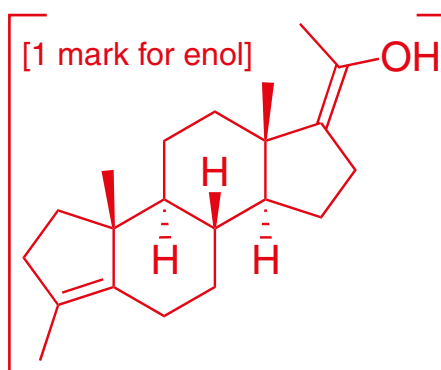
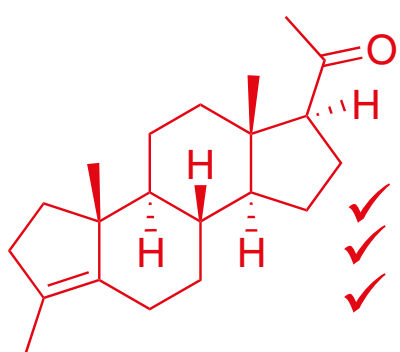
[only connections required  
 -1 mark for any incorrect  
 down to zero]



3

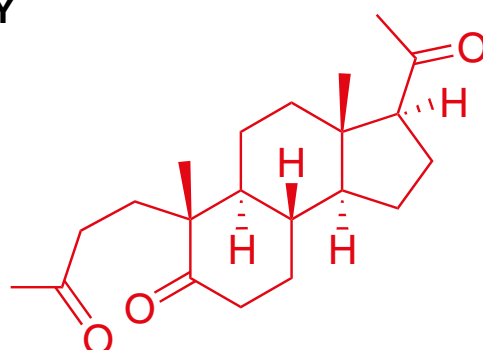
2(j)

Compound X



3

Compound Y

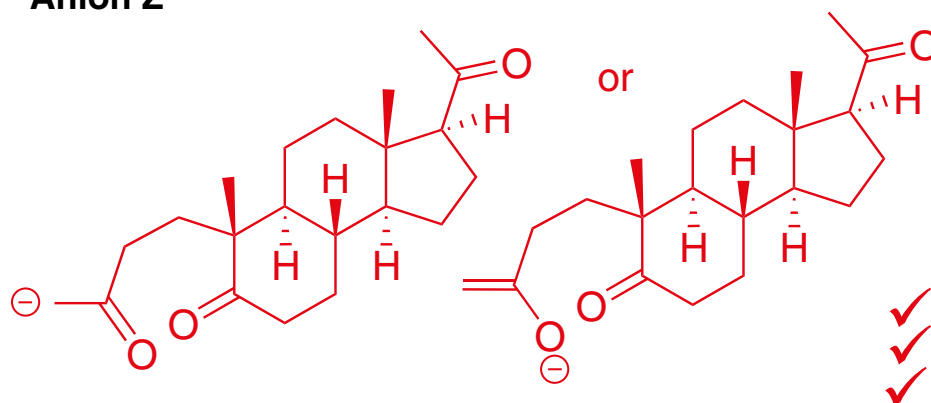


3

leave  
blank

2(j)

Anion  $Z^-$



[ either structure fine ]

3