

Cambridge Chemistry Challenge Lower 6th

## June 2015

## Marking scheme for teachers

(please also read the additional instructions)


1(c) neutral compound isoelectronic with nitrate(III) ion: [also allow $\mathrm{CF}_{2}$, difluorocarbene, or $\mathrm{O}=\mathrm{N}-\mathrm{F}$, nitrosyl fluoride]

1(a) equations (underline reduced element):
(i) from mercury(II) oxide:

(ii) from silver(I) carbonate:

$$
\begin{equation*}
2 \mathrm{Ag}_{2} \mathrm{CO}_{3} \longrightarrow 4 \mathrm{Ag}+2 \mathrm{CO}_{2}+\mathrm{O}_{2} \tag{2}
\end{equation*}
$$

(iii) from potassium nitrate(V):

$$
\begin{equation*}
2 \mathrm{KNO}_{3} \longrightarrow 2 \mathrm{KNO}_{2}+\mathrm{O}_{2} \sqrt{ } \sqrt{ } \tag{2}
\end{equation*}
$$

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

$$
2 \mathrm{H}_{2} \mathrm{SO}_{4}+2 \mathrm{MnO}_{2} \longrightarrow 2 \mathrm{MnSO}_{4}+2 \mathrm{H}_{2} \mathrm{O}+\mathrm{O}_{2}
$$

[ Half quantities accepted. 1 mark for equation; 1 for underlined ] $\sqrt{\sqrt{ }}$
2
leave blank

1(b) dot \& cross diagrams




(iii) formula $=\mathrm{O}_{4}$
$\checkmark$

$$
\text { formula: } \mathrm{O}_{3} \quad \checkmark \quad \text { name: ozone }
$$

1(d) activation energy for puckered-ring $\mathrm{O}_{4}$ from $\mathrm{O}_{2}$ :
leave blank
trans-chain
[1 mark each; lose 1 mark for any wrong (down to zero)]
$1(\mathrm{~g})$ time taken:
k.e. of $\mathrm{O}_{4}$ molecule $=4.00 \mathrm{keV}=4000 \times 1.602 \times 10^{-19} \mathrm{~J}$

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

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

$$
\text { mass of } \begin{aligned}
{ }^{18} \mathrm{O}_{4}=18.00 \times 4 \mathrm{~g} \mathrm{~mol}^{-1} & \equiv \frac{18.00 \times 4}{6.022 \times 10^{23} \times 10^{3}} \mathrm{~kg} \text { molecule }{ }^{-1} \\
& =1.1956 \times 10^{-25} \mathrm{~kg}
\end{aligned}
$$

$$
v=\sqrt{\frac{2 \times 6.408 \times 10^{-19}}{1.1956 \times 10^{-25}}}=103500 \mathrm{~m} \mathrm{~s}^{-1}
$$

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

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

2(a)


[zero marks for part containing missing / additional wrong answers]
2(b) circle one or more:


2(c) three alkenes:


2(d)

leave blank

2(e) for $\alpha$-terpineol
leave blank


2(i)
connections:
[only connections required

-1 | mark for any incorrect |
| :---: |
| down to zero] |

a

2(j)

## Compound X



leave blank

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