**Q1.** (a) Define the term *standard molar enthalpy of formation*, $\Delta H_f^{\ominus}$.

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**(3)**

(b) State Hess's law.

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**(1)**

(c) Propanone, $CH_3COCH_3$, burns in oxygen as shown by the equation

$$CH_3COCH_3(l) + 4\ O_2(g) \rightarrow 3H_2O(l) + 3CO_2(g)$$

Use the data given below to calculate the standard enthalpy of combustion of propanone.

| | $CO_2(g)$ | $H_2O(l)$ | $CH_3COCH_3(l)$ |
|---|---|---|---|
| $\Delta H_f^{\ominus}$/kJ mol$^{-1}$ | –394 | –286 | –248 |

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**(3)**
**(Total 7 marks)**

**Q2.** Using the data below, which is the correct value for the standard enthalpy of formation for

$TiCl_4(l)$?

$C(s) + TiO_2(s) + 2Cl_2(g) \rightarrow TiCl_4(l) + CO_2(g)$ $\quad \Delta H^{\ominus} = -232$ kJ mol$^{-1}$

$Ti(s) + O_2(g) \rightarrow TiO_2(s)$ $\quad \Delta H_f^{\ominus} = -912$ kJ mol$^{-1}$

$C(s) + O_2(g) \rightarrow CO_2(g)$ $\quad \Delta H_f^{\ominus} = -394$ kJ mol$^{-1}$

**A** $-1538$ kJ mol$^{-1}$

**B** $-1094$ kJ mol$^{-1}$

**C** $-750$ kJ mol$^{-1}$

**D** $+286$ kJ mol$^{-1}$

**(Total 1 mark)**

**Q3.** When ethanamide ($CH_3CONH_2$) burns in oxygen the carbon is converted into carbon dioxide, the hydrogen is converted into water and the nitrogen forms nitrogen gas.

| Substance | ethanamide | carbon dioxide | water |
|---|---|---|---|
| Enthalpy of formation ($\Delta H_f^{\ominus}$) / kJ mol$^{-1}$ | −320 | −394 | −286 |

Using the data above, which one of the following is a correct value for the enthalpy of combustion of ethanamide?

**A** $-1823$ kJ mol$^{-1}$

**B** $-1183$ kJ mol$^{-1}$

**C** $-1000$ kJ mol$^{-1}$

**D** $-360$ kJ mo1$^{-1}$

**(Total 1 mark)**

**Q4.** In which one of the following reactions is the standard enthalpy change equal to the standard enthalpy of formation of lithium fluoride?

**A** $Li(g) + F(g) \rightarrow LiF(s)$

**B** $Li^+(g) + F^-(g) \rightarrow LiF(s)$

**C** $Li^+(aq) + F^-(g) \rightarrow LiF(s)$

**D** $Li(s) + \frac{1}{2}F_2(g) \rightarrow LiF(s)$

**(Total 1 mark)**