**Q1.**The table below shows data for the four hydrocarbons ethyne, propyne, propene and propane. Δ*H*c is the standard enthalpy of combustion of these hydrocarbons.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|   | **Compound** | **Name** | ***M*r** | **−Δ*H*c / kJ mol−1** |
|   | HC≡CH | ethyne | 26 | 1300 |
|   | HC≡CCH3 | propyne | 40 | 1940 |
|   | H2C=CHCH3 | propene | 42 | 2060 |
|   | CH3CH2CH3 | propane | 44 | 2220 |

The complete combustion of 2.0 g of one of the above hydrocarbons releases exactly 100 kJ of heat energy.

This hydrocarbon is

**A**       ethyne

**B**       propyne

**C**       propene

**D**       propane

**(Total 1 mark)**

**Q2.**When 0.10 g of propane was burned the quantity of heat evolved was 5.0 kJ. The enthalpy of combustion of propane in kJ mol−1 is

**A**       −800

**B**       −1500

**C**       −2200

**D**       −2900

**(Total 1 mark)**

**Q3.**This question is about the reaction given below.

CO(g) + H2O(g)  CO2(g) + H2(g)

Enthalpy data for the reacting species are given in the table below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|   | Substance | CO(g) | H2O(g) | CO2(g) | H2(g) |
|   | Δ*H* / kJ mol−1 | −110 | −242 | −394 | 0 |

The standard enthalpy change for this reaction of carbon monoxide and steam is

**A**       +42 kJ mol−1

**B**       −42 kJ mol−1

**C**       +262 kJ mol−1

**D**       −262 kJ mol−1

**(Total 1 mark)**

**Q4.**Use the information below to answer this question.

        C(s) + O2(g) → CO2(g)                 Δ*H* = −394 kJ mol−1

H2(g) +  O2(g) → H2O(l)                     Δ*H* = −286 kJ mol−1

    4C(s) + 5H2(g) → C4H10(g)               Δ*H* = −126 kJ mol−1

The standard enthalpy of combustion of butane, in kJ mol−1, is

**A**       −2880

**B**       −2590

**C**       −806

**D**       −554

**(Total 1 mark)**

**Q5.**Use the information below to answer this question.

C(s) + O2(g) → CO2(g)                    ∆*H* = −393.5 kJ mol−1

H2(g) +  O2(g) → H2O(l)                ∆*H* = −285.8 kJ mol−1

3C(s) + 4H2(g) → C3H8(g)               ∆*H* = −104.0 kJ mol−1

4C(s) + 5H2(g) → C4H10(g)             ∆*H* = −125.2 kJ mol−1

The value in kJ mol−1 of the enthalpy of thermal dissociation when butane forms propane, hydrogen and carbon is

**A**       −26.3

**B**       −17.5

**C**       +17.5

**C**       +21.2

**(Total 1 mark)**

**Q6.**Use the information below to answer this question.

C(s) + O2(g) → CO2(g)                    ∆*H* = −393.5 kJ mol−1

H2(g) +  O2(g) → H2O(l)                ∆*H* = −285.8 kJ mol−1

3C(s) + 4H2(g) → C3H8(g)               ∆*H* = −104.0 kJ mol−1

4C(s) + 5H2(g) → C4H10(g)             ∆*H* = −125.2 kJ mol−1

The value in kJ mol−1 for the enthalpy of combustion of propane is

**A**       −211.7

**B**       −419.7

**C**       −2220

**C**       −2878

**(Total 1 mark)**

**Q7.**The data below refer to the industrial production of nitric acid from ammonia.

*Reaction 1*    4NH3(g) + 5O2(g)   4NO(g) + 6H2O(g)              ∆*H* = −909 kJ mol−1

*Reaction 2*    2NO(g) + O2(g)   2NO2(g)                                 ∆*H* = −115 kJ mol−1

*Reaction 3*    3NO2(g) + H2O(l)   2HNO3(aq) + NO(g)           ∆*H* = −117 kJ mol−1

The direct oxidation of ammonia to nitrogen dioxide can be represented by the equation

4NH3(g) + 7O2(g) → 4NO2(g) + 6H2O(g)

for which the standard enthalpy change, in kJ mol−1, is

**A**       −1139

**B**       −1024

**C**       −794

**D**       −679

**(Total 1 mark)**

**Q8.**Using the information below, answer this question.

Fe2O3(s) + 3H2(g) → 2Fe(s) + 3H2O(g)   Δ*H*= +96 kJ mol−1,  Δ*S* = +138 J K−1 mol−1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|   |  | **Fe2O3(s)** | **H2(g)** | **Fe(s)** |
|   | Δ*H* / kJ mol−1 | −822.0 |        0 |         0 |
|   | Δ*S* / J K−1 mol−1 |     90.0 | 131.0 |     27.0 |

The standard enthalpy of formation of steam is

**A**       +286 kJ mol−1

**B**       +242 kJ mol−1

**C**       −242 KJ mol−1

**D**       −286 kJ mol−1

**(Total 1 mark)**

**Q9.**Using the data below, which is the correct value for the standard enthalpy of formation for TiCl4(l)?

C(s) + TiO2(s) + 2Cl2(g) → TiCl4(l) + CO2(g)                ∆H = −232 kJ mol−1

Ti(s) + O2(g) → TiO2(s)                             = −912 kJ mol−1

C(s) + O2(g) → CO2(g)                             = −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)**

**Q10.**When ethanamide (CH3CONH2) 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 () / 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)**

**Q11.**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) → LiF(s)

**B**       Li+(g) + F−(g) → LiF(s)

**C**       Li+(aq) + F−(g) → LiF(s)

**D**       Li(s) + F2(g) → LiF(s)

**(Total 1 mark)**

**Q12.**Consider the reactions

C2H4(g) + 2O2(g) → 2CO(g) + 2H2O(g)                            *∆H* = −758 kJ mol−1

2C(s) + 2H2(g) → C2H4(g)                                        *∆H* = +52 kJ mol−1

H2(g) +  O2(g) → H2O(g)                                         *∆H* = −242 kJ mol−1

The enthalpy of formation of carbon monoxide is

**A**       −111 kJ mol−1

**B**       −163 kJ mol−1

**C**       −222 kJ mol−1

**D**       -464 kJ mol−1

**(Total 1 mark)**

**Q13.**Given the following data

C(s) + 2H2(g) → CH4(g)                       *∆H* = −75 kJ mol−1

  H2(g) → 2H(g)                           *∆H* = +436 kJ mol−1

which one of the following is the enthalpy change, in kJ mol−1, of the reaction below?

CH4(g) → C(s) + 4H(g)

**A**       −947

**B**       +511

**C**       +797

**D**       +947

**(Total 1 mark)**

**Q14.**Nitric acid is produced industrially from ammonia, air and water using the following sequence of reactions:

|  |  |  |
| --- | --- | --- |
|   | (1)        4NH3 (g) + 5O2(g) → 4NO(g) + 6H2O(g) | ∆*H* = –909 kJ mol−1  |
|   | (2)        2NO(g) + O2(g) → 2NO2(g) | ∆*H*  = –115 kJ mol−1 |
|   | (3)        3NO2(g) + H2O(l) → 2HNO3(aq) + NO(g) | ∆*H* = –117 kJ mol−1  |

Which is the enthalpy change (in kJ mol−1) for the following reaction?

4NH3(g) + 7O2(g) → 4NO2(g) + 6H2O(g)

**A**       −679

**B**       −794

**C**       −1024

**D**       −1139

**(Total 1 mark)**

**M1.**A

**[1]**

**M2.**C

**[1]**

**M3.**B

**[1]**

**M4.**A

**[1]**

**M5.**D

**[1]**

**M6.**C

**[1]**

**M7.**A

**[1]**

**M8.**C

**[1]**

**M9.**C

**[1]**

**M10.**B

**[1]**

**M11.**D

**[1]**

**M12.**A

**[1]**

**M13.**D

**[1]**

**M14.**D

**[1]**