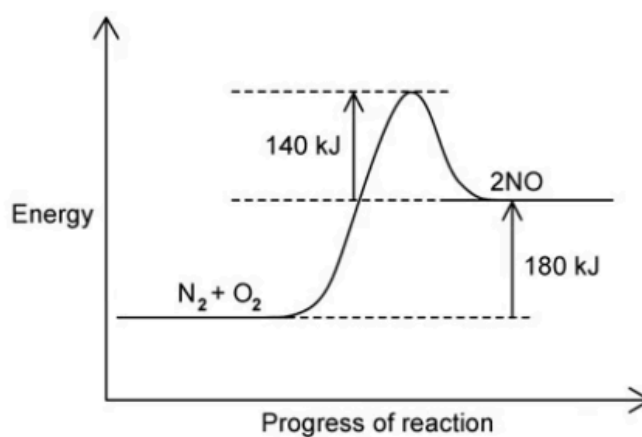1.

Which of the following processes is endothermic?

    A. Reacting sodium with water.

    B. The use of petrol in an engine.

    C. Distilling crude oil.

    D. Burning fossil fuels.

Answer: C

2.

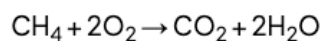The reaction profile for making nitrogen monoxide, NO, is shown below:

What is the activation energy for this reaction?

    A. +140 kJ

    B. +180 kJ

    C. +320 kJ

    D. -330 kJ

Answer: C

3.

Methane combusts in oxygen as shown producing an energy change of –890 kJ/mol.

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

The table shows some of the bond energies involved.

bond	bond energy / (kJ / mol)
H—O	+460
O=O	+496
C—H	+410
C=O	–

What is the energy of the C=O bond?

A. –155 kJ/mol

B. +333 kJ/mol

C. –840 kJ/mol

D. +841 kJ/mol

Answer: D

4.

A student adds a small amount of ammonium chloride to a beaker of water. The temperature of the water decreases from 21 °C to 17 °C.

Which type of reaction has occurred and why?

|	type of reaction	reason
A	exothermic	heat is released
B	exothermic	heat is absorbed
C	endothermic	heat is released
D	endothermic	heat is absorbed

Answer: D

5.

During the reaction the amount of energy given out is 780 kJ / mol.

The F–F bond energy is 160 kJ / mol.

Use this information to determine the bond energy, in kJ / mol, of one S–F bond in SF_4.

$$S + \begin{array}{c} F\!-\!F \\ F\!-\!F \end{array} \rightarrow \begin{array}{c} F \\ | \\ F\!-\!S\!-\!F \\ | \\ F \end{array}$$
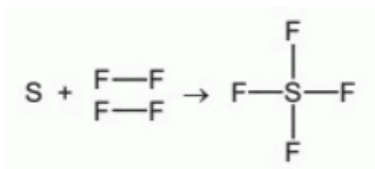
.... kJ / mol [3]

- Bond energy of $2F_2$ = 2 x 160 = 320 kJ / mol
- Bond energy of all bonds in SF_4 = 780 + 320 = 1100 kJ / mol
- Bond energy of one bond in SF_4 = 1100 / 4 = 275 kJ / mol

6. **Is electrolysis endothermic or exothermic? Explain**
   - Endothermic
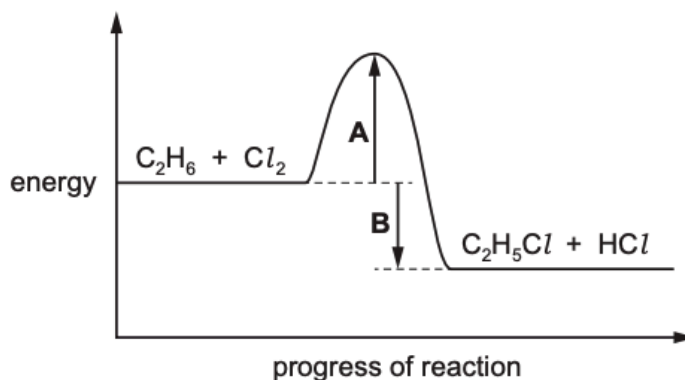   - Because electrical energy is supplied/taken in

7. **Is reaction in a cell exothermic or endothermic?**
   - Exothermic
   - Because electrical energy is released

 NOTE: always round off the bond energies to the nearest whole number

8.

The energy profile diagram of this reaction is shown.

Name the energy change labelled A
Activation energy

Name the energy change labelled B

Energy change of the reaction

9. **From the calculated energy change, deduce whether the reaction is endothermic or exothermic.**

Reason to give:

Energy released when forming bonds is greater/less than the energy absorbed while breaking the bonds. OR

The overall energy change is positive/negative

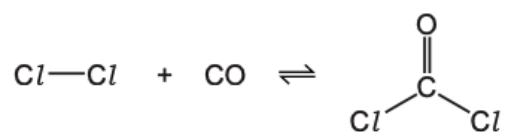10. **State what is meant by the symbol ΔH**

Enthalpy change

NOTE:

1 atm = 100,000 Pa

1 atm = 100 kPa

11.

The reaction between chlorine and carbon monoxide can be represented as shown.

$$Cl—Cl \ + \ CO \rightleftharpoons$$

When one mole of chlorine reacts with one mole of carbon monoxide, 230 kJ of energy is released.

Some bond energies are shown in the table.

bond	bond energy in kJ/mol
Cl–Cl	240
C=O	745
C–Cl	400

Use the information to calculate the energy of the bond between the C and the O in carbon monoxide, CO.

M1 bond energy in making bonds
= [(2 × 400) + 745] = 1545 (kJ mol–1)

M2 use of total E change
–230 = [240 + E(C≡O)] – 1545
OR
[240 + E(C≡O)] = –230 + 1545 = (+1315)

M3 E(C≡O)
= [–230 + 1545] – 240 = 1075 (kJ mol–1)