

# Chemical Energetics: Bond Energies

---

32 Use of the Data Booklet is relevant to this question.

The bond energy of the Br–O bond is  $235 \text{ kJ mol}^{-1}$ .

Which reactions are exothermic?

- 1  $\text{OH}\cdot + \text{HBr} \rightarrow \text{H}_2 + \text{BrO}\cdot$
- 2  $\text{OH}\cdot + \text{HBr} \rightarrow \text{H}_2\text{O} + \text{Br}\cdot$
- 3  $\text{H}\cdot + \text{HBr} \rightarrow \text{H}_2 + \text{Br}\cdot$

w/14/qp11

---

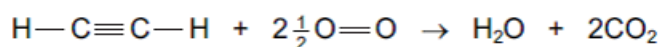
6 Which stage in the free radical substitution of ethane by chlorine will have the lowest activation energy?

- A  $\text{Cl}_2 \rightarrow 2\text{Cl}\cdot$
- B  $\text{Cl}\cdot + \text{C}_2\text{H}_6 \rightarrow \text{C}_2\text{H}_5\cdot + \text{HCl}$
- C  $\text{C}_2\text{H}_5\cdot + \text{Cl}_2 \rightarrow \text{C}_2\text{H}_5\text{Cl} + \text{Cl}\cdot$
- D  $\text{Cl}\cdot + \text{C}_2\text{H}_5\cdot \rightarrow \text{C}_2\text{H}_5\text{Cl}$

w/13/qp13

---

5 Ethyne,  $\text{C}_2\text{H}_2$ , completely combusts, as shown in the equation.



Using the average bond enthalpies in the table, what is the enthalpy change of combustion of ethyne?

bond	average bond enthalpy/ $\text{kJ mol}^{-1}$
C—H	410
C≡C	840
O=O	496
C=O	740
O—H	460
C—O	360

- A  $-980 \text{ kJ mol}^{-1}$    B  $-540 \text{ kJ mol}^{-1}$    C  $+540 \text{ kJ mol}^{-1}$    D  $+980 \text{ kJ mol}^{-1}$

w/12/qp13

---

11 Which process could be used to calculate the bond energy for the covalent bond X-Y by dividing its  $\Delta H$  by  $n$ ?

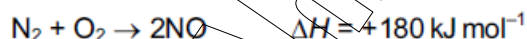
- A  $XY_n(g) \rightarrow X(g) + nY(g)$
- B  $2XY_n(g) \rightarrow 2XY_{n-1}(g) + Y_2(g)$
- C  $Y(g) + XY_{n-1}(g) \rightarrow XY_n(g)$
- D  $nXY(g) \rightarrow nX(g) + \frac{n}{2} Y_2(g)$

w/12/qp11

---

4 Use of the Data Booklet is relevant to this question.

A reaction which causes the presence of oxides of nitrogen in car exhausts is the formation of NO.



What is the bond energy in  $\text{kJ mol}^{-1}$  of the bond between the atoms in NO?

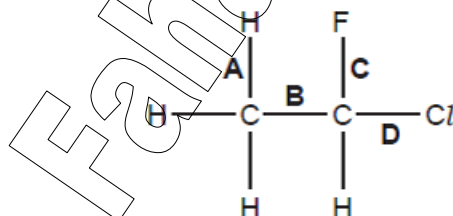
- A 655
- B 835
- C 1310
- D 1670

w/12/qp11

---

22 Use of the Data Booklet is relevant to this question.

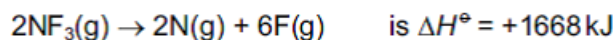
Which bond in the structure below has the lowest bond energy?



w/11/qp12

---

6 The standard enthalpy change for the reaction



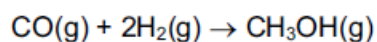
What is the bond energy of the N-F bond?

- A  $-556 \text{ kJ mol}^{-1}$
- B  $-278 \text{ kJ mol}^{-1}$
- C  $+278 \text{ kJ mol}^{-1}$
- D  $+556 \text{ kJ mol}^{-1}$

w/11/qp11

---

- 4 Methanol may be prepared by the reaction between carbon monoxide and hydrogen.



The relevant average bond energies are given below.

$$E(\text{C}\equiv\text{O}) \quad 1077 \text{ kJ mol}^{-1}$$

$$E(\text{C}-\text{O}) \quad 360 \text{ kJ mol}^{-1}$$

$$E(\text{C}-\text{H}) \quad 410 \text{ kJ mol}^{-1}$$

$$E(\text{H}-\text{H}) \quad 436 \text{ kJ mol}^{-1}$$

$$E(\text{O}-\text{H}) \quad 460 \text{ kJ mol}^{-1}$$

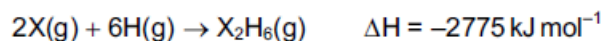
What is the enthalpy change of this reaction?

- A  $-537 \text{ kJ mol}^{-1}$
- B  $-101 \text{ kJ mol}^{-1}$
- C  $+101 \text{ kJ mol}^{-1}$
- D  $+537 \text{ kJ mol}^{-1}$

w/10/qp12

---

- 8 The equation below represents the combination of gaseous atoms of non-metal X and of hydrogen to form gaseous  $\text{X}_2\text{H}_6$  molecules.



The bond energy of an X-H bond is  $395 \text{ kJ mol}^{-1}$ .

What is the bond energy of an X-X bond?

- A  $-405.0 \text{ kJ mol}^{-1}$
- B  $-202.5 \text{ kJ mol}^{-1}$
- C  $+202.5 \text{ kJ mol}^{-1}$
- D  $+405.0 \text{ kJ mol}^{-1}$

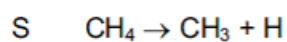
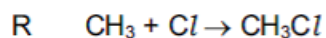
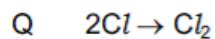
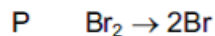
s/11/qp11

---

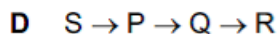
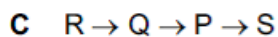
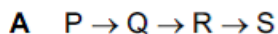
4 Some bond energy values are listed below.

bond	bond energy / $\text{kJ mol}^{-1}$
C-H	410
C-Cl	340
Cl-Cl	244
Br-Br	193

These bond energy values relate to the following four reactions.



What is the order of enthalpy changes of these reactions from most negative to most positive?



s/10/qp11

---