ENTHALPY CHANGE CALCULATION

1 Hydrogen bromide decomposes to form hydrogen and bromine. The equation is shown.

$$2HBr(g) \rightarrow H_2(g) + Br_2(g)$$

The bond energies are shown in the table. The reaction is endothermic.

bond	bond energy in kJ / mol
Br–Br	+1
H–Br	+3
H–H	+4

What is the energy change for the reaction?

A +263 kJ / mol **B** +103 kJ / mol **C** –103 kJ / mol **D** –263 kJ / mol

2 Hydrogen peroxide, H–O–O–H, decomposes to form water and oxygen.

$$2H_2O_2(g) \rightarrow 2H_2O(g) + O_2(g)$$

The bond energies are shown in the table. The reaction is exothermic.

bond	bond energy in kJ / mol
O–H	+460
O–O	+150
O=O	+496

What is the energy change for the reaction?

A –346 kJ / mol **B** –196 kJ / mol **C** +196 kJ / mol **D** +346 kJ / mol

3 The equation for the reaction between hydrogen and chlorine is shown.

$$H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$$

The reaction is exothermic.

The bond energies are shown in the table.

bond	bond energy in kJ / mol
Cl–Cl	+2
H–Cl	+4
H–H	+4

What is the energy change for the reaction?

A –1536 kJ / mol

B –184 kJ / mol

C +184 kJ / mol

D +246 kJ / mol

4 Ethene reacts with hydrogen. The equation is shown.

$$CH_2{=}CH_2 + H_2 \rightarrow C_2H_6$$

The bond energies are shown in the table. The reaction is exothermic.

bond	bond energy in kJ / mol
C–C	+350
C=C	+610
C–H	+410
H–H	+436

What is the energy change for the reaction?

A –560 kJ / mol **B** –124 kJ / mol **C** +486 kJ / mol **D** +5496 kJ / mol

5 Nitrogen reacts with hydrogen to produce ammonia.

$$N_2 + 3H_2 \rightarrow 2NH_3$$

The reaction is exothermic. The bond energies are shown in the table.

bond	bond energy in kJ / mol
N≡N	945
H–H	436
N–H	390

What is the energy change for this reaction?

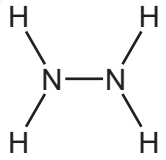
A –1473 kJ / mol

B –87 kJ / mol

C 87 kJ / mol

D 1473 kJ / mol

6 The compound hydrazine is used as a rocket fuel. It has the structural formula shown.



One of the reactions of hydrazine is shown. This reaction is exothermic.

$$N_2H_4 \rightarrow N_2 + 2H_2$$

The bond energies are shown in the table.

	bond energy in kJ / mol
H–H	+
N–H	+
N–N	+
N≡N	+

What is the energy change for this reaction?

A –339 kJ / mol **B** –97 kJ / mol **C** +97 kJ / mol **D** +339 kJ / mol

7 Some bond energies are shown in the table.

bond	bond energy in kJ / mol
H–H	+
O=O	+
H–O	+

Hydrogen reacts with oxygen. The reaction is exothermic.

$$2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$$

What is the energy change for the reaction?

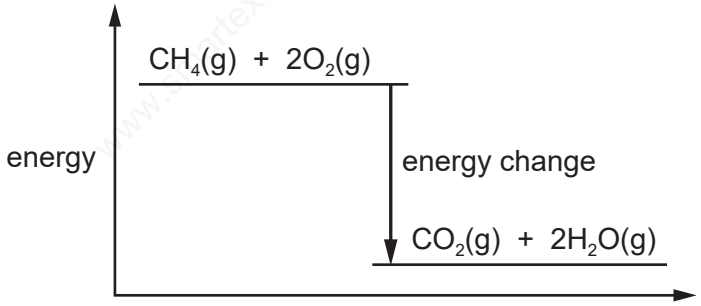
A –3208 kJ / mol

B –908 kJ / mol

C –472 kJ / mol

D –448 kJ / mol

8 The energy level diagram for the combustion of methane is shown.



Which row gives the equation and energy change for this reaction?

	equation	energy change in kJ / mol
A	$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$	+891
B	$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$	–891
C	$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$	+891
D	$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$	–891

9 The equation for the complete combustion of methane gas is shown.

$$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$$

Bond energies are shown.

bond	bond energy in kJ / mol
C–H	412
H–O	463
C=O	743
O=O	498

What is the overall energy change, in kJ / mol, for the above reaction?

A –1192 **B** –694 **C** +694 **D** +1192

10 Methane burns in excess oxygen.

The equation is shown.

$$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$$

Bond energies are shown.

bond	bond energy / kJ mol^{-1}
C=O	805
C–H	410
O=O	496
O–H	460

What is the energy change for the reaction?

A $(4 \times 410 + 2 \times 496) - (2 \times 805 + 4 \times 460)$

B $(2 \times 805 + 2 \times 460) - (410 + 2 \times 496)$

C $(410 + 2 \times 496) - (805 + 2 \times 460)$

D $(410 + 496) - (805 + 460)$

11 Ethene gas, C_2H_4, is completely burned in excess oxygen to form carbon dioxide and water.

The equation for this exothermic reaction is shown.

$$C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$$

The table shows the bond energies involved in the reaction.

bond	bond energy (kJ / mol)
C=C	614
C–H	413
O=O	495
C=O	799
O–H	467

What is the total energy change in this reaction?

A –954 kJ / mol

B –1010 kJ / mol

C –1313 kJ / mol

D –1369 kJ / mol