Chemical Energetics

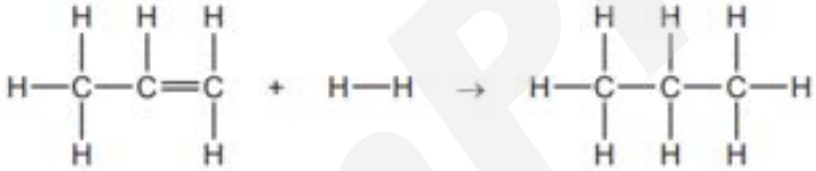
(Past Year Topical Questions 2010-2015)

Oct/Nov 2011 (33)/Q7

(iii) Bond energy is the amount of energy, in kJ, which must be supplied to break one mole of the bond.

bond	bond energy in kJ/mol
H—H	+436
C=C	+610
C—C	+346
C—H	+415

Use the data in the table to show that the following reaction is exothermic.



.....

.....

..... [3]

Oct/Nov 2012 (33)/Q7

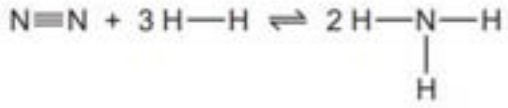
(d) (i) What is the difference between an endothermic and an exothermic reaction?

.....

..... [1]

+6018 – 375 2833

(ii) Bond breaking is an endothermic process. Bond energy is the amount of energy needed to break or form one mole of the bond. Complete the table and explain why the forward reaction is exothermic.



bond	bond energy kJ/mol	energy change kJ	exothermic or endothermic
N≡N	944	+944	endothermic
H—H	436	3 × 436 = +1308	
N—H	388		

.....

..... [3]

Oct/Nov 2013 (31)

(c) Use the bond energies to show that the following reaction is exothermic.
Bond energy is the amount of energy (kJ/mol) which must be supplied to break one mole of the bond.

Bond energies in kJ/mol

Cl–Cl	+242
C–Cl	+338
C–H	+412
H–Cl	+431

bonds broken	energy in kJ / mol
.....	.....
.....	.....
total energy =	.....

bonds formed	energy in kJ / mol
.....	.....
.....	.....
total energy =	.....

.....

..... [4]

May/June 2014 (31)/Q3

(c) Most helium is obtained from natural gas found in the USA. Natural gas contains methane and 7% helium. One possible way to obtain the helium would be to burn the methane.

(i) Write an equation for the complete combustion of methane.

..... [1]

(ii) Suggest why this would **not** be a suitable method to obtain the helium.

.....

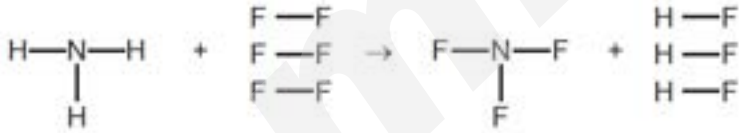
..... [1]

(iii) Suggest another method, other than diffusion, by which helium could be separated from the mixture of gases in natural gas.

..... [1]

May/June 2014 (33)/Q5

(e) Ammonia is used to make nitrogen trifluoride, NF_3.
Nitrogen trifluoride is essential to the electronics industry. It is made by the following reaction.



Determine if the above reaction is exothermic or endothermic using the following bond energies and by completing the following table. The first line has been done as an example.
Bond energy is the amount of energy, in kJ/mole, needed to break or make one mole of the bond.

bond	bond energy in kJ/mole
N–H	390
F–F	155
N–F	280
H–F	565

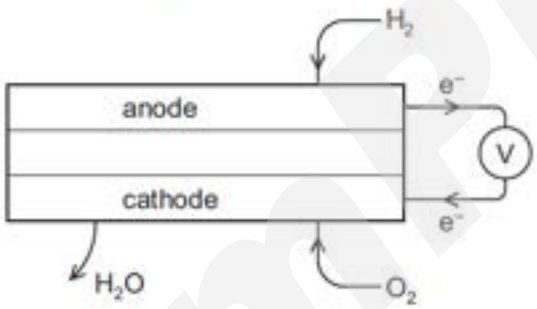
bond	energy change / kJ
N–H	(3 × 390) = 1170
F–F	
N–F	
H–F	

.....

..... [4]

Oct/Nov2014 (33)

4 A fuel cell produces electrical energy by the oxidation of a fuel by oxygen.
The fuel is usually hydrogen but methane and methanol are two other fuels which may be used.
A diagram of a hydrogen fuel cell is given below.



(a) When the fuel is hydrogen, the only product is water.
What additional product would be formed if methane was used?

..... [1]

(b) Write the equation for the chemical reaction that takes place in a hydrogen fuel cell.

..... [1]

(c) (i) At which electrode does oxidation occur? Explain your choice.

..... [1]

(ii) Write an ionic equation for the reaction at this electrode.

..... [2]

(d) Fuel cells are used to propel cars.
Give **two** advantages of a fuel cell over a gasoline-fuelled engine.

.....

..... [2]

[Total: 7]

May/June 2015 (31)

1 (a) Coal is a solid fossil fuel.

Name **two** other fossil fuels.

..... [2]

(b) Two of the elements present in a sample of coal are carbon and sulfur.

A sample of coal was heated in the absence of air and the products included water, ammonia and hydrocarbons.

Name **three** other elements present in this sample of coal.

..... [2]

May/June 2015 (33)/Q6

(c) The combustion of propane, C_3H_8, is exothermic.

Give an equation for the complete combustion of propane.

..... [2]

(d) Photosynthesis is an unusual endothermic reaction.

(i) Where does the energy for photosynthesis come from?

..... [1]

(ii) Give the word equation for photosynthesis.

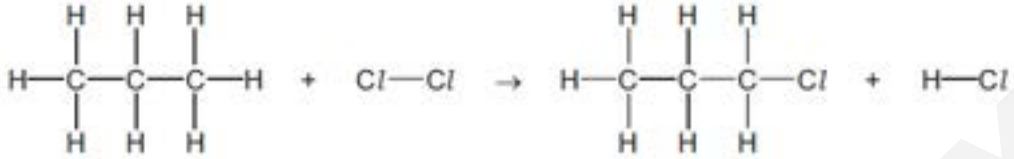
..... [1]

[Total: 14]

Oct/Nov 2015 (32)/Q4

(b) Bond breaking is an endothermic change and bond forming is an exothermic change.

Bond energy is the amount of energy in kJ/mol needed to break one mole of the specified bond.



Use the following bond energies to determine whether this reaction is exothermic or endothermic. You must show your reasoning.

bond	bond energies in kJ/mol
C–C*l*	338
C–H	412
C*l*–C*l*	242
H–C*l*	431
C–C	348

.....

.....

.....

..... [3]