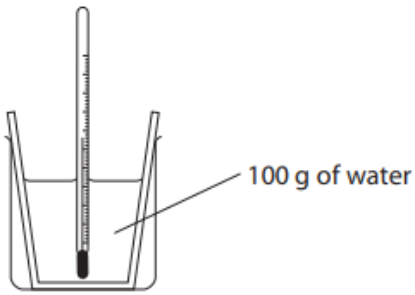
Chemistry Worksheet
Grade 10
Topic: Energy changes

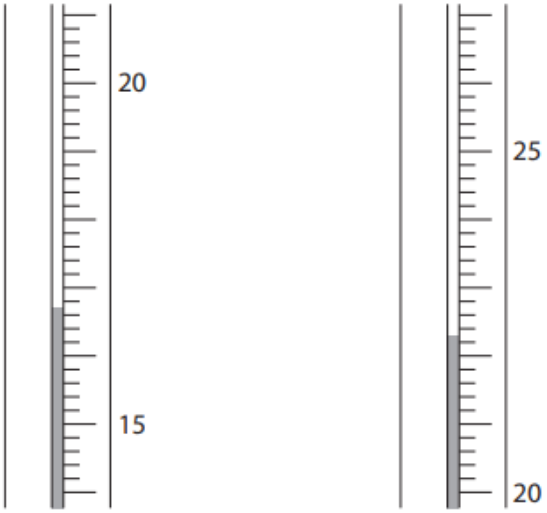
1 A student uses this apparatus to measure the temperature change when lithium iodide dissolves in water.



He measures the steady temperature of the water before adding the lithium iodide.

He then adds the lithium iodide, stirs the mixture until all the solid dissolves and records the maximum temperature reached.

The diagram shows the thermometer readings before and after dissolving the lithium iodide.



(a) Use the readings to complete the table.

(3)

Temperature in °C after adding lithium iodide	
Temperature in °C before adding lithium iodide	
Temperature change in °C	

(b) In a second experiment, using the same mass of water, the student records a temperature increase of 4.9 °C.

(i) Use this expression to calculate the heat energy change in this experiment.

heat energy change (in joules) = mass of water (in grams) × 4.2 × temperature change (in °C)

(2)

heat energy change = ... J

(ii) In this experiment, 6.3 g of lithium iodide were used.

Calculate the amount, in moles, of lithium iodide in 6.3 g.

[M_r of lithium iodide = 134]

(2)

amount of LiI = ... mol

(c) In a third experiment the student obtains these results.

heat energy change in J	2400
amount of lithium iodide in mol	0.048

(i) Calculate the molar enthalpy change, in kJ/mol, in this experiment.

(2)

molar enthalpy change = ... kJ/mol

2.

Carbon monoxide reacts with hydrogen in a reversible reaction.

$$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g) \quad \Delta H = -91\,kJ/mol$$

The reaction reaches an equilibrium if carried out in a closed container.

(a) Explain, in terms of bond breaking and bond forming, why this reaction is exothermic.

.....

.....

.....

..... [2]

(b) When one mole of methanol, CH_3OH, is formed, 91 kJ of energy is released.

Calculate the amount of energy released when 160 g of methanol is formed.
[M_r of methanol = 32]

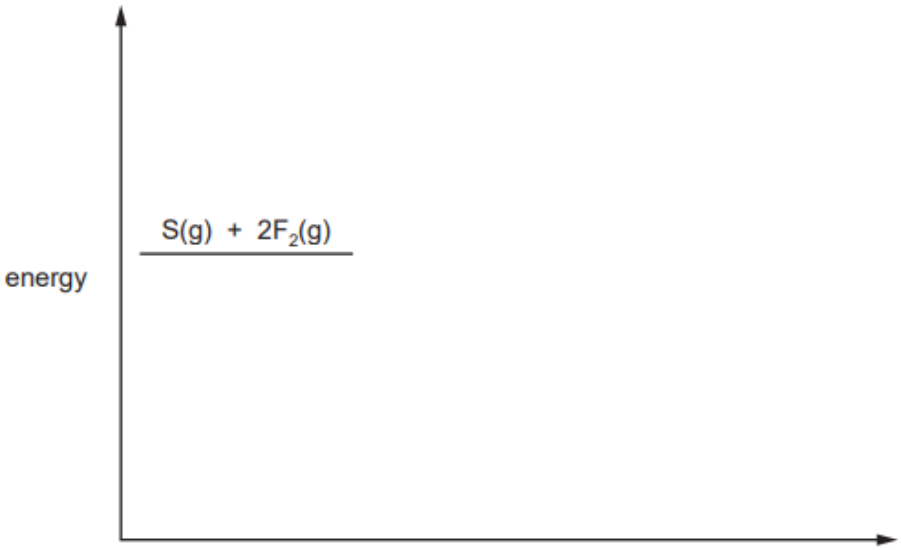
energy released = ... kJ [2]

(c)

$$S(g) + 2F_2(g) \rightarrow SF_4(g)$$

The reaction is exothermic.

(i) Complete the energy level diagram for this reaction. Include an arrow which clearly shows the energy change during the reaction.

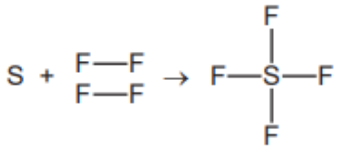


[3]

(ii) 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.



..... kJ/mol [3]

3.

(a)

Ethanol is used as a fuel.

$$C_2H_5OH + 3O_2 \rightarrow 3H_2O + 2CO_2$$

The complete combustion of one mole of ethanol releases 1350 kJ of energy.

A sample of ethanol reacts with excess oxygen to make 0.240 dm^3 of carbon dioxide, measured at room temperature and pressure.

Calculate the energy released, in kJ, in this reaction.

energy released ..... kJ [2]

(b)

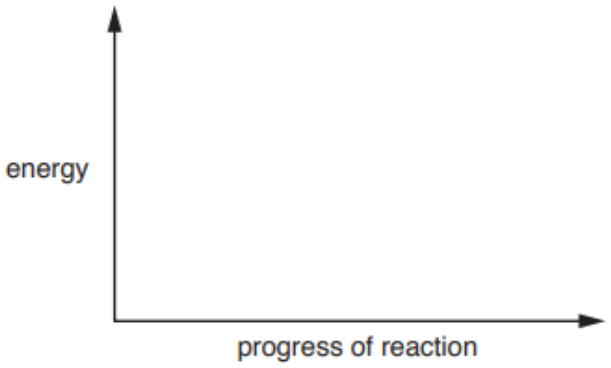
Hydrogen is also produced when steam is passed over hot coke (carbon).

This reaction is endothermic.

$$H_2O(g) + C(s) \rightarrow CO(g) + H_2(g)$$

(i) On the axes below draw a labelled energy profile diagram for the reaction to show:

- the reactants and products
- the enthalpy change for the reaction
- the activation energy of the reaction.



[3]

(ii) The mixture of gases produced when steam is passed over hot coke also contains hydrogen sulfide, H_2S, as an impurity.

This can be removed by reacting the gas with moist iron(III) hydroxide.

Complete the equation for this reaction.

$$\ldots\ldots Fe(OH)_3 + \ldots\ldots H_2S \rightarrow Fe_2S_3 + \ldots\ldots H_2O$$ [1]

(c) Fossil fuels contain small amounts of sulfur.

(i) Describe how the combustion of fossil fuels leads to the formation of acid rain.

.....

.....

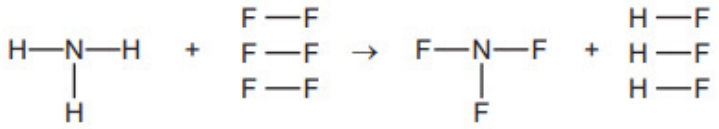
..... [2]

(ii) Describe one effect of acid rain on buildings.

..... [1]

4.

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]