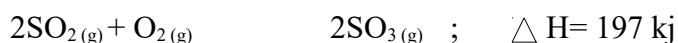


NAME	INDEX NUMBER
SCHOOL	DATE _____

ENERGY CHANGES

1. 1989 Q 2 P1A

The catalytic oxidation of sulphur dioxide is represented by the following equation:



(i) What information about the reaction is given $\Delta H = 197\text{kJ}$?

.....

.....

.....

.....

.....

....

(ii) Name one catalyst that can be used in this section

.....

.

2. 1990 Q 15 P1A

The following experiments were performed and the temperature change in each case was determined. 107g of solid potassium hydroxide was dissolved in 100m³ of water.

- (i) 0.7g of solid potassium hydroxide was dissolved in 100cm³ of 0.125M hydrochloric acid.
- (ii) 50 cm³ solution containing 0.7 g of potassium hydroxide was mixed with 50cm³ of 0.25m hydrochloric acid.

(a) In which one of the above three experiments would you expect the highest temperature change? Explain your answer.

.....

.....

.....

.....

.....

(b) If the heat releases in experiment I is ΔH_I , ΔH_{II} and ΔH_{III} (1 Mark)

.....
.....
.....
.....
.....
.....

3. **1990 Q 23 P1A**

When 20cm³ of 0.5 m sulphuric acid was mixed with 20cm³ of 1M sodium hydroxide, the temperature of the solution changed from 24.2°C to 31.1°C. Calculate the molar heat of neutralization.

(Specific heat capacity of the solution is 4.2 J deg – 1g – 1 and its density is 1gcm³)

.....
.....
.....
.....
.....

4. **1990 P1A Q27**

(a) In a class experiment 5.0 g of ethanol CH₃CH₂OH, were completely burnt and all the heat evolved was used to heat 500 cm³ of from 20°C to 80°C. Given that the specific heat capacity of water = 4.2j g-1 del-1 density of water = 1g cm³, C = 12.0,) = 16.0 and H = 1.0

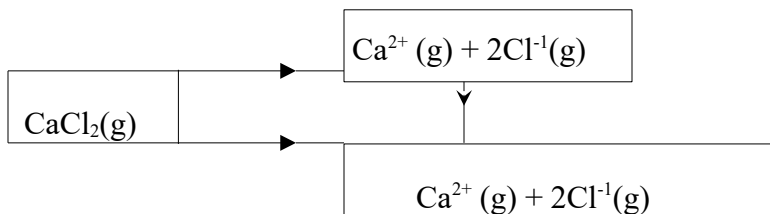
Write a balanced equation to show the reaction that takes place when ethanol burns. (1 mark)

.....
.....

Given out when one mole of ethanol was burned completely. (2 marks).

.....
.....
.....
.....
.....

(c) Use the information in the energy cycle diagram below to



(i) What name is given to the enthalpy change
 ΔH_2

ΔH_3

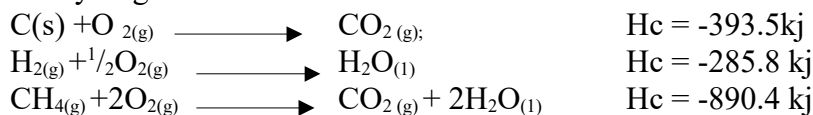
(ii) Given that $\Delta H_1 = 2237 \text{ kJ}$ and $\Delta H_2 = 22378 \text{ kJ}$, calculate the value of ΔH_3
 (2 marks)

.....

..

5. 1991 Q 5 P1A

The equation below show the molar enthalpies of combustion for carbon, hydrogen and methane



Use the above information to answer the questions below:

(i) Write the equation for the formation of methane from its elements.

.....

(ii) Calculate the molar enthalpy of formation for methane

.....

...

6. 1992 P1A Q 4

4g of methanol (CH_3OH) requires 93.5 kJ to vaporize completely. Calculate the heat required to vaporize one mole of methanol completely (C=12.0, H=1.0,

O = 1.0)

(2 marks)

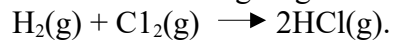
.....
.....
.....
.....
.....

7. **1992 P1A Q9**

Draw an energy diagram for the reaction, on the diagram show clearly the activation energy and enthalpy of reaction.

8. **1992 P1A Q10**

Use the bond energies given below to calculate the heat of reaction for



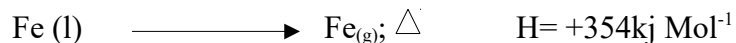
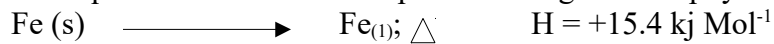
Bond	Bond energy
H-H	435 KJ Mol ⁻¹
CL-CL	243 KJ Mol ⁻¹
H-CL	431 kJ Mol ⁻¹

.....
.....
.....

.....
....

9. 1993 P1A Q2

The equations below would represent changes in the physical states for



.....
.....
.....
.....
.....
....

10. 1993 P1A Q4

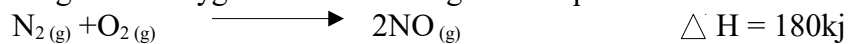
Given that the lattice energy of NaCl is $+771 \text{ kJ Mol}^{-1}$ and hydration energy of $\text{Na}_{(s)}$ & are 496 kJ Mol^{-1} and 364 kJ Mol^{-1} respectively.

Calculate the heat of solution for one mole of NaCl(s). (2 marks)

.....
.....
.....
.....
.....
....

11. 1993 P1A Q 10

Nitrogen and oxygen react according to the equation

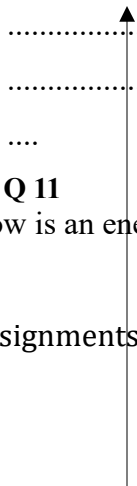


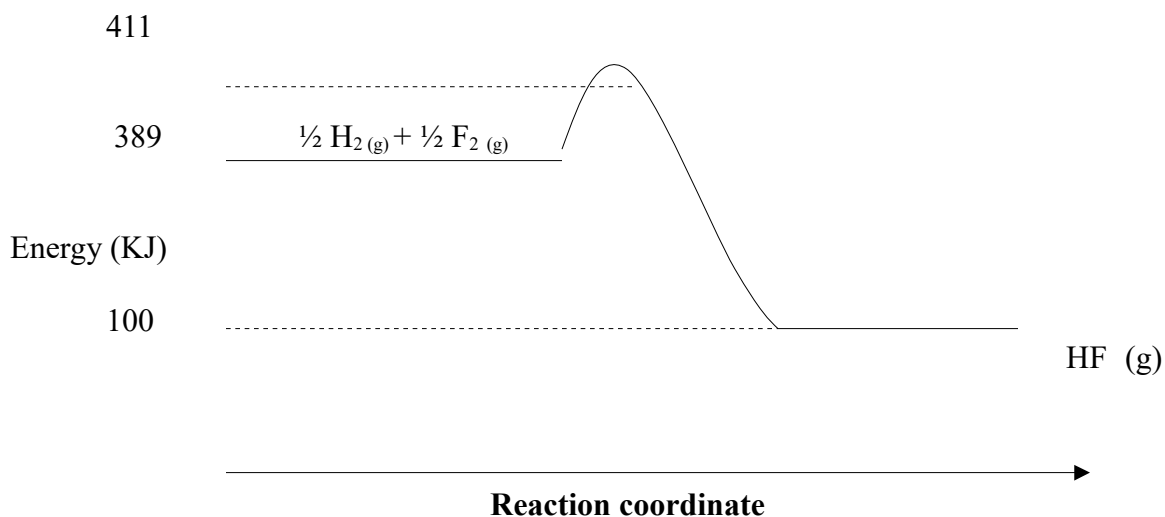
If the reaction was allowed to reach equilibrium, explain the effect on the yield of $\text{NO}_{(g)}$ if the temperature below was increased. (2 marks)

.....
.....
.....
.....
.....
....

12. 1994 1A Q 11

Below is an energy level diagram for the reaction: $\frac{1}{2} \text{H}_{2(g)} + \frac{1}{2} \text{F}_{2(g)} \longrightarrow \text{HF}_{(g)}$





.....

.....

.....

.....

.....

....

13. 1994 P1A Q18

When excess magnesium powder was added to 100cm^3 of 0.5M iron (II) sulphate solution, the pale green colour of the solution faded and the temperature rose by $6.0\text{ }^\circ\text{C}$.

(a) Write an ionic equation for the reaction that takes place. (1 mark)

.....

.....

..

(b) Calculate the molar heat of reaction given that heat change = mass \times temperature change $\times 4.2\text{ Jg}^{-1}\text{C}^{-1}$ and the density of solutions is 1.0gcm^{-3} (2 marks)

.....

.....

.....

.....

.....

....

14. 1995 1A Q26

Explain why the enthalpy of neutralization of ethanoic acid with sodium hydroxide is different from that of hydrochloric acid with sodium hydroxide. (2 marks)

.....

.....

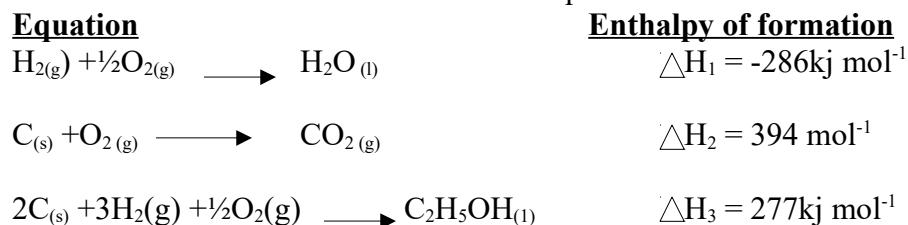
.....

.....

.....

15. 1996 P1A Q 19

Use the information below to answer the questions that follow:-



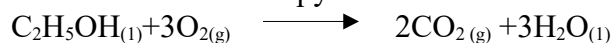
(a) Define the term enthalpy of formation of a compound (1 mark)

.....

.....

..

(b) Calculate the molar enthalpy of combustion ΔH_4 of ethanol:



16. 1997 PP1B Q5

The reaction between bromine and methanoic acid at 30⁰ C proceeds according to the information given below



Concentration of Br ₂ (aq) Moldm ⁻³	Time minutes
10.0 x 10 ⁻³	0
8.1 x 10 ⁻³	1
6.6 x 10 ⁻³	2

4.4×10^{-3}	4
3.0×10^{-3}	6
2.0×10^{-3}	8
1.3×10^{-3}	10

(a) On the grid below, plot a graph of concentration of Bromine (Vertical axis against time)

(b) From the graph determine:

(i) The concentration of bromine at the end of 3 minutes

.....

(ii) The rate of reaction at time 't' where $t = 1 \frac{1}{2}$ minutes

.....

(c) Explain how the concentration of bromine affects the rate of reaction

.....

.....

- (d) On the same axis sketch the curve that would be obtained if the reaction was carried out at 20^o C and label the curve as curve II. Give a reason for your answer.

.....

...

17. 1997 P1A Q 20

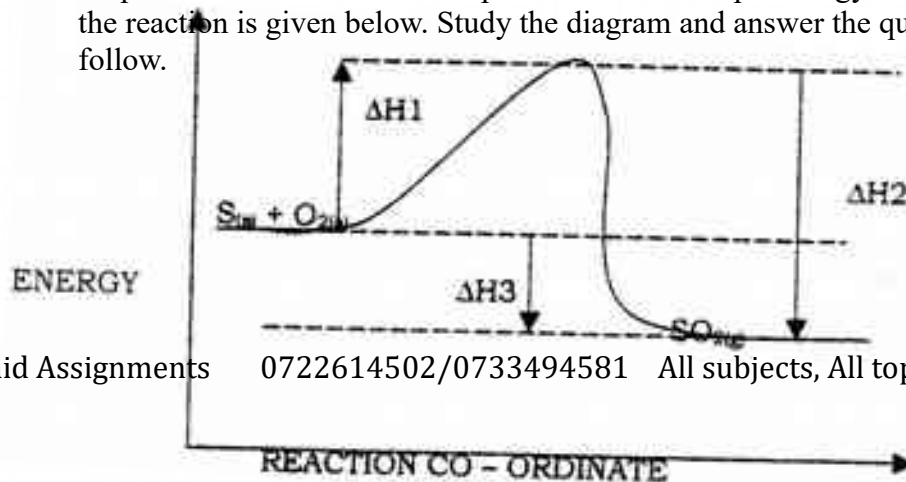
When 0.6g of element J were completely burnt in oxygen and all the heat evolved was used to heat 500cm³ of water, the temperature of the water rose from 23°C to 32°C. Calculate the relative atomic mass of element J given that the specific heat capacity of water = 4.2 KJ⁻¹g⁻¹ density of water = 1.0g/cm³ and molar heat of combustion of j is 380 KJmol⁻¹. (3 marks)

.....

....

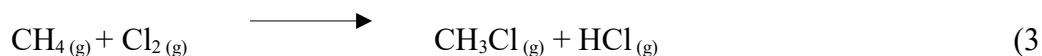
18. 1997 P1A Q 13

Sulphur burns in air to form sulphur dioxide. A simple energy level diagram for the reaction is given below. Study the diagram and answer the questions that follow.



Bond	Bond energy (kJmol ⁻¹)
C — H	414
Cl — Cl	244
C — Cl	326
H — Cl	431

Calculate the enthalpy change for the reaction.



marks)

.....

.....

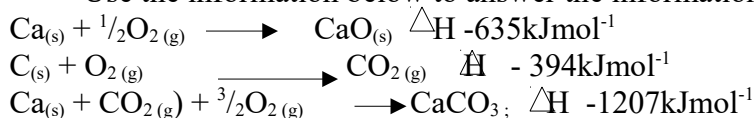
.....

.....

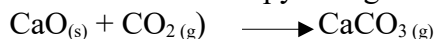
....

20. 1999 P1 Q15

Use the information below to answer the information that follows



Calculate the enthalpy change for the reaction.



.....

.....

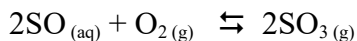
.....

.....

....

21. 1999 Q 6d P2

The reaction between sulphur dioxide and oxygen to form trioxide in the contact process is exothermic.



Factory manufacturing sulphuric acid by contact process produces 350kg of sulphur trioxide per day (conditions) for the reaction catalyst. 2 atmospheres pressure and temperatures between. (400 – 500 °C)

i) What is meant by an exothermic reaction?

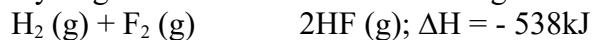
.....
.....
..

- ii) How would the yield per day of sulphur trioxide be affected if temperatures lower than 4000°C are used? Explain.

.....
.....
.....
.....
....

22. 2000 Q 24

Hydrogen and fluorine react according to the equation below



- (a) On the grid provide below, sketch the energy level diagram for the forward reaction

- (b) Calculate the molar enthalpy of formation of HF

.....
.....
.....
.....
....

23. 2001 Q 2

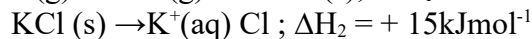
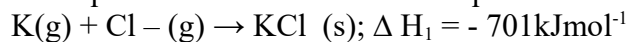
In an experiment, 0.8gm of magnesium of powder were reacted with excess dilute sulphuric acid at 25°C. The time for the reaction to come to completion was recorded.

The experiment was repeated at 40°C. In which experiment was the time taken shorter? Explain your answer.

.....
.....
.....
.....
.....
.....

24. 2002 Q 13

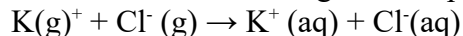
Use the equations below to answer the questions that follow



(a) What is the name of

ΔH_1 ?

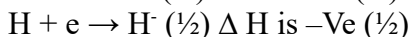
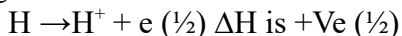
(b) Calculate the heat change for the process



.....
.....
.....
.....
.....

25. 2003 Q 5

An atom of hydrogen can form two ions. Write two equations to show how a neutral atom of hydrogen can form two ions. In each case show the sign of the energy change involved.

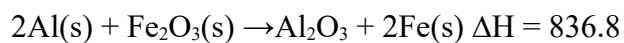
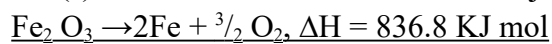
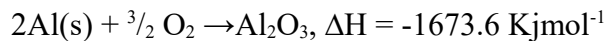
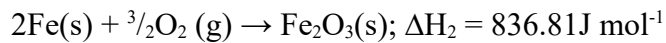
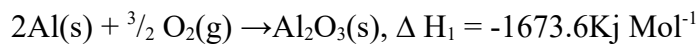


.....
.....
.....

.....
.....
.....
.....
.....
.....
.....
.....

26. 2003 Q 3

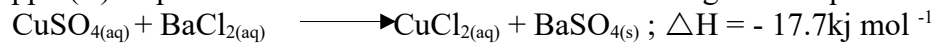
Use the following equations to determine the heat evolved when aluminum metal is reacted with iron (III) oxide (3 marks)



.....
.....
.....
.....
.....
.....
.....

27. 2004 Q 5

Copper(II) sulphate reacts with barium chloride according to the equation below.



Calculate the temperature change when 900cm³ of m copper (II) sulphate were added to 600cm³ of 1M Barium (II) chloride.

.....
.....
.....

.....
....

28. 2004 Q 9

Study the information in the table below and answer the questions that follow.

Alcohol	Heat of combustion on KJ mol ⁻¹
Methanol	715
Ethanol	1371
Propanol	2010
Butanol	2673

Give a reason why the difference in the molar heats of combustion between successive alcohols are close.

(3 marks)

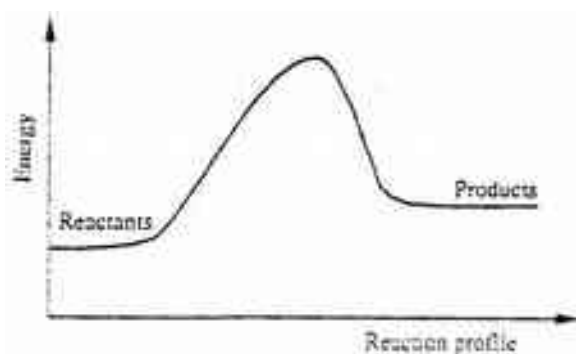
(3)

.....
.....
.....

...

29. 2004 Q 25

Below is a sketch of a reaction profile.



a) (1 mark)

On the diagram, show the heat of reaction, ΔH .

b) (2 marks)

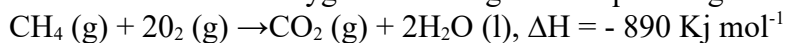
State and explain the type of reaction represented by the profile

(2)

.....
.....
.....
.....
.....

30. 2005 Q 13

Methane reacts with oxygen according to the equation given below.

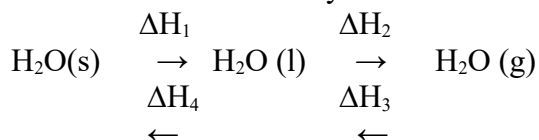


Calculate the volume of methane which would produce 111.25 KJ when completely burnt. (Molar volume of a gas = 24 litres.) (2 marks)

.....

31. 2005 Q 19

The scheme below shows the energy changes that are involved between ice, water and steam. Study it and answer the questions that follow



(a) What name is given to the energy change, ΔH_4 ? (1 mark)

.....
 .

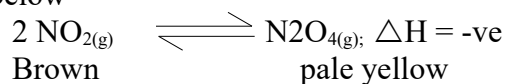
(b) What is the sign of ΔH_3 ? Give a reason (2 marks)

.....

 ..

32. 2006 Q 9

At 200C, NO_2 and N_2O_4 gases exist in equilibrium as shown in the equation below



State and explain the observation that would be made when;

a) A syringe containing the mixture at 200C is immersed in ice-cold water. (1 1/2 marks)

.....

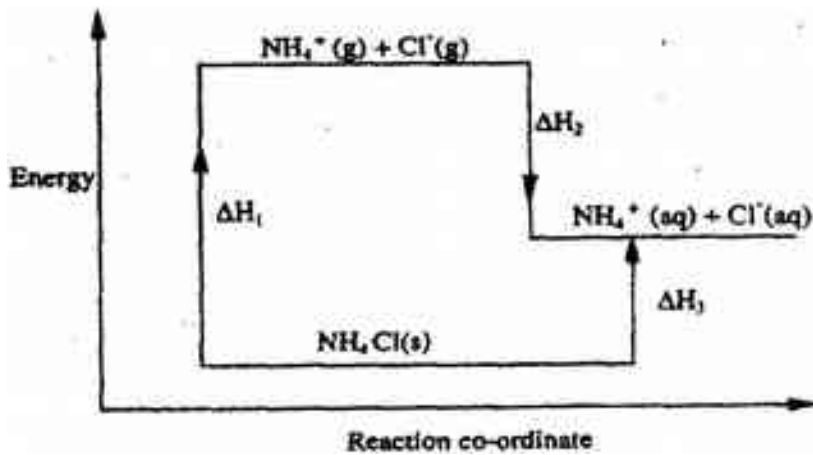
.....
...

b) The volume of the gaseous mixture in a syringe is reduced. (1 ½ marks)

.....
.....
.....
.....
.....

33. 2006 Q 28

Study the diagram below and answer the questions that follow.



a) What do ΔH_1 and ΔH_2 represent? (2 marks)

.....
.....
.....

b) Write an expression to show the relationship between ΔH_1 , ΔH_2 and ΔH_3 . (1 mark)

.....
.....
.....

34. 2006 Q 2a P2

a) In an experiment to determine the molar heat of reaction when magnesium displaces copper, 0.15g of magnesium powder were added to 25.0cm³ of 2.0M copper (II)

chloride solution. The temperature of copper (II) chloride solution was 25°C. While that of the mixture was 43°C.

- i) Other than increase in temperature, state and explain the observations which were made during the reaction. (3 marks)

.....
.....
.....
.....

- ii) Calculate the heat change during the reaction (specific heat capacity of the solution = 4.2Jg⁻¹K⁻¹ and the density of the solution = 1g/cm³) (2 marks)

.....
.....
.....
.....
.....

- iii) Determine the molar heat of displacement of copper by magnesium. (Mg=24.0).

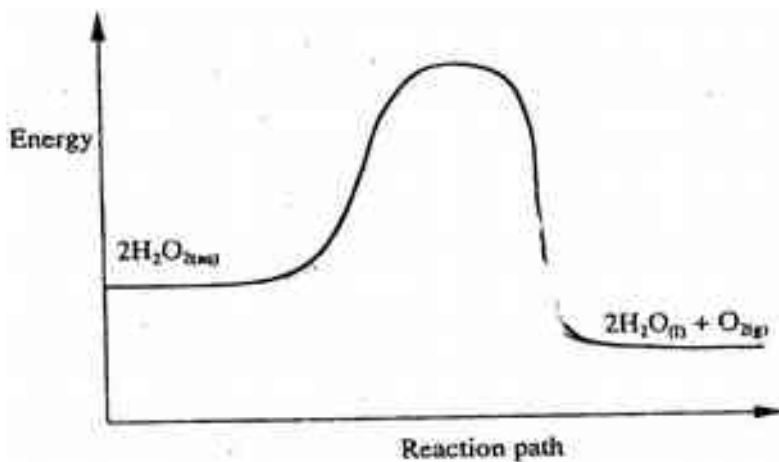
.....
.....
.....
.....
.....

- iv) Write the ionic equation for the reaction. (1 mark)

.....
.....
..

v) Sketch an energy level diagram for the reaction. (2 marks)

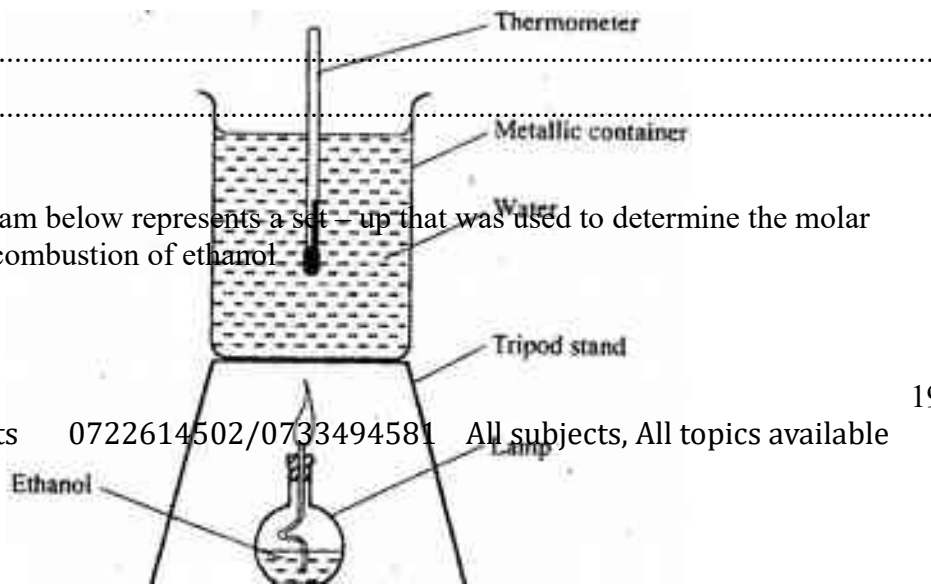
35. 2007 Q 27
The diagram below is a sketch of the graph of the non-catalysed decomposition of hydrogen peroxide. (1 mark)



On the same axis, sketch the graph for the decomposition of hydrogen peroxide when manganese (IV) oxide is added. (2 marks)

36. 2007 Q 1 P2
(a) State two factors that should be considered when choosing fuel for cooking (2 marks)

(b) The diagram below represents a set-up that was used to determine the molar heat of combustion of ethanol.



During the experiment, the data given below was recorded

Volume of water	450cm ³
Initial temperature of water	25 ^o C
Final temperature of water	46.5 ^o C
Mass of ethanol + Lamp before burning	125.5g
Mass of ethanol + lamp after burning	124.0g

Calculate the:

- (i) Heat evolved during the experiment (density of water = 1g/cm³
Specific heat capacity of water = 4.2 Jg⁻¹K⁻¹) (3 marks)

.....
.....
.....
.....
.....
....

- (ii) Molar heat of combustion of ethanol (C = 12.0, O = 16.0, H=1.0) (2 marks)

.....
.....
.....
.....
.....
....

(c) Write the equation for the complete combustion of ethanol
(1 mark)

.....
.

(d) The value of the molar heat of combustion of ethanol obtained in (b) (ii) above is lower than the theoretical value. State two sources of error in the experiment.
(2 marks)

.....
.....
..

37. 2008 Q 7 P2

(a) Define the standard enthalpy of formation of a substance
(1 mark)

.....
.....
..

(b) Use the thermo chemical equations below to answer the questions that follow.

- $C_2H_6(g) + \frac{7}{2} O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l); \quad \Delta H_1 = -1560 \text{ kJ mol}^{-1}$
- $C_{(graphite)} + O_2(g) \rightarrow CO_2(g); \quad \Delta H_2 = -394 \text{ kJ mol}^{-1}$
- $H_2(g) + \frac{1}{2} O_2(g) \rightarrow H_2O(l); \quad \Delta H_3 = -286 \text{ kJ mol}^{-1}$

(i) Name two types of heat changes represented by ΔH_3 (2 marks)

.....
.....
..

(ii) Draw an energy level diagram for the reaction represented by equation 1

(iii) Calculate the standard enthalpy of formation of ethane (2 marks)

.....
.....
.....
.....
.....
.....

(iv) When a sample of ethane was burnt, the heat produced raised the temperature of 500g of water by 21.5 K, (specific heat capacity of water = $4.2\text{Jg}^{-1}\text{K}^{-1}$). Calculate the:

I. Heat change for the reaction (2 marks)

.....
.....
.....
.....
.....
.....

II. Mass of ethane was burnt. (relative formula mass of ethane= 30) (2 marks)

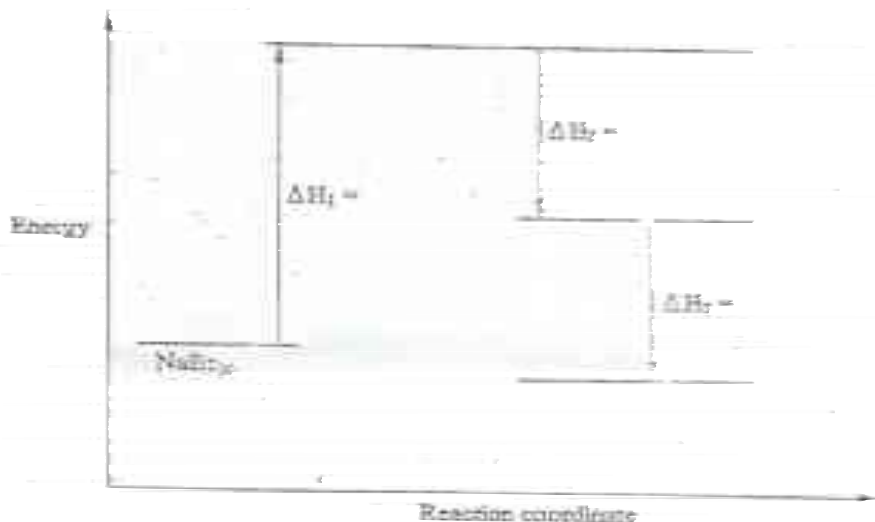
.....
.....
.....
.....
.....
.....

38. 2009 Q 9
(a) What is meant by molar heat of solution?
(1 mark)

.....

 ..

(b) The lattice energy of sodium bromide and hydration energies of sodium and bromide ions are: 733,406 and 335 kJ mol⁻¹ respectively



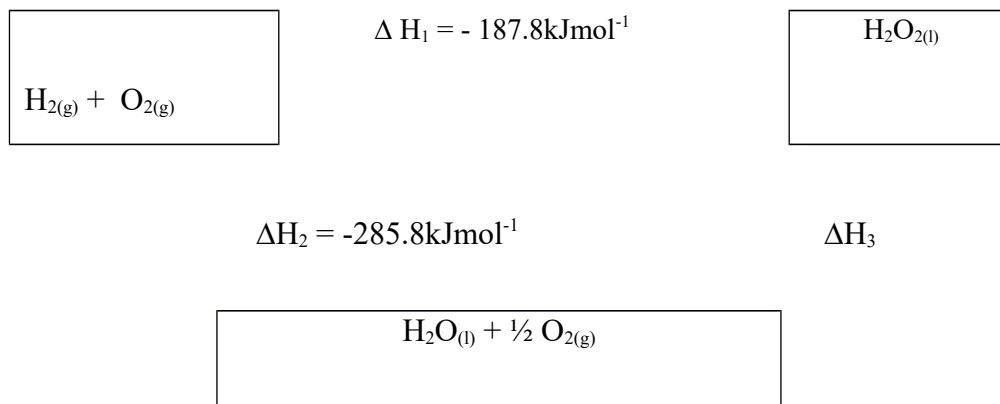
(i) Complete the energy cycle diagram above by inserting the values of ΔH_1 , ΔH_2 and ΔH_3

(ii) Determine the molar heat of solution of solid sodium bromide ($\frac{1}{2}$)

.....

39. 2010 Q 10

The figure below shows an energy cycle.



- a) Give the name of the enthalpy change ΔH_1 . (1 mark)

.....
.

- b) Determine the value of ΔH_3 . (2 marks)

.....
.....
..
.....
.....
..

40. 2010 Q 12

A beaker contained 75.0cm³ of aqueous copper (II) sulphate at 23.7°C when scrap iron metal was added to the solution, the temperature rose to 29.3°C.

- a) Write an ionic equation for the reaction that took place. (1 mark)

.....
.

- b) Given that the mass of copper deposited was 5.83g, calculate the molar enthalpy change in kJmol⁻¹. (Specific heat capacity of solution = 4.2Jg⁻¹ K⁻¹, density of solution 1.0gcm⁻³, Cu = 63.5) (2 marks)

.....
.....
.....
...

41. 2010 Q 4b

- a) The standard enthalpy change of formation of methanol is -239 kJmol⁻¹.
i) Write the thermal chemical equation for the standard enthalpy change of formation of methanol. (1 mark)

-
- .
- ii) Methanol is manufactured by reacting carbon(II)oxide with hydrogen at 300°C and a pressure of 250 atmospheres.

The equation for the reaction is:



- (I) How would the yield of methanol be affected if the manufacturing process above is carried out at 300°C and a pressure of 400 atmosphere? Explain (2 marks)

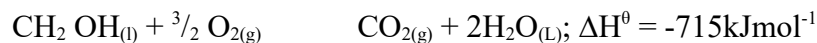
.....

.....

.....

...

- (II) Use the following data to calculate the enthalpy change for the manufacture of methanol from carbon(II)oxide and hydrogen (3 marks)



.....

.....

.....

...

.....

.....

..

ii) The calculate enthalpy change in part B(ii) (II) above differ from the standard enthalpy change of formation of methanol. Give a reason.

(1 mark)

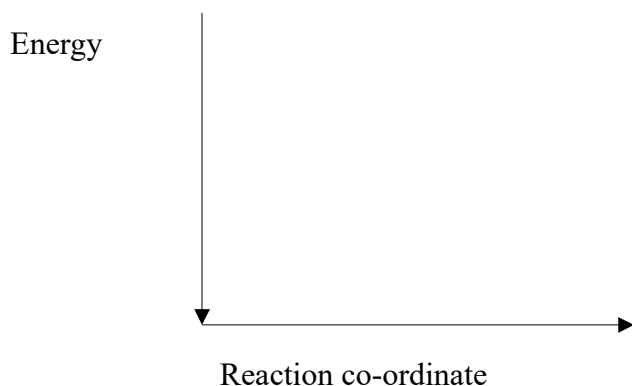
.....
.....
..

42. 2011 Q 23

The thermal chemical reaction between carbon and sulphur is as shown by the equation below



On the grid below, sketch and label the energy diagram for the reaction. (2 marks)



43. 2011 Q 7 P2

a) What is meant by molar heat of combustion?

(1 mark)

.....
.....
..

b) State the Hess's Law.

(1 mark)

.....
.....
..

Use the following standard enthalpies of combustion of graphite,hydrogen and enthalpy of formation of propane.

$$\Delta H_c (\text{ Graphite }) = -393 \text{ Kj mol}^{-1}$$

$$\Delta H_c (\text{ H}_2(\text{g})) = -286\text{Kj mol}^{-1}$$

$$\Delta H_f (\text{ C}_3\text{H}_8 (\text{g})) = -104 \text{ Kj mol}^{-1}$$

(1 mark) i) Write the equation for the formation of propane.

.....

marks) ii) Draw an energy cycle diagram that links the heat of formation of propane with its heat of combustion of graphite and hydrogen. (3

marks) iii) Calculate the standard heat of combustion of propane (2

.....
.....
.....

...

(1 mark) d) Other than the enthalpy of combustion, state one factor which should be considered when choosing a fuel.

.....

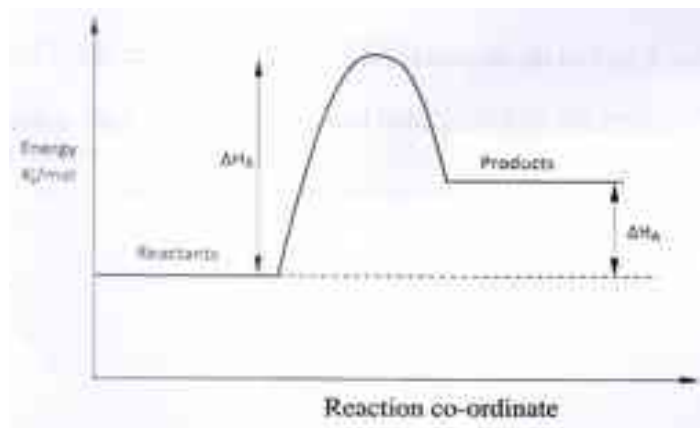
acid e) The molar enthalpies of neutralization for dilute hydrochloric acid and dilute nitric (V) are 57.22 KJ/mol while that of ethanoic acid is -55.2Kj mol. Explain this observation. (2 marks)

.....
.....

.....
...

44. 2012 Q17 P1

Study the energy level diagram below and answer the questions that follow.



(a) Give the name of ΔH_A (2 marks)

.....

(b) How can ΔH_B be reduced? Give a reason (2 marks)

.....
.....
.....
.....
.....