CHEMISTRY

Physical Chemistry

Level & Board	AQA (A-LEVEL)
TOPIC:	ENERGETICS
PAPER TYPE:	QUESTION PAPER 2
TOTAL QUESTIONS	10
TOTAL MARKS	38

Energetics - 2

1. A student does an experiment to determine a value for the enthalpy of combustion of heptane.
The figure below shows some of the apparatus used.
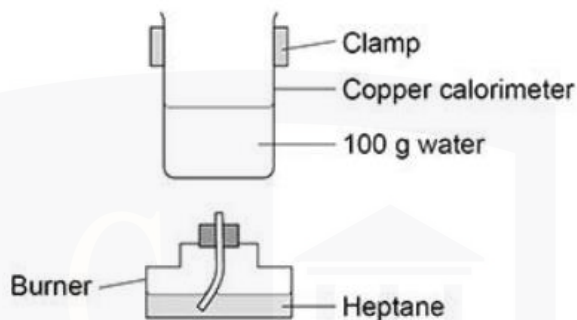
(a) Design a table to record all the readings necessary to determine an experimental value for the enthalpy of combustion for heptane in this experiment.

(2)

(b) The student considered using a glass beaker on a tripod and gauze instead of the clamped copper calorimeter.

Suggest two disadvantages of using a glass beaker on a tripod and gauze**.**
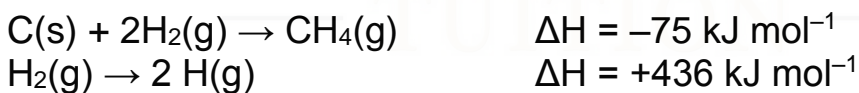
(2)

(c) Suggest two reasons why the value of enthalpy of combustion from this experiment is less exothermic than a data book value.
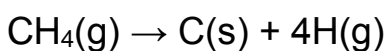
(2)

(d) Suggest one addition to this apparatus that would improve the accuracy of the enthalpy value obtained.

(1)

2. Some enthalpy change data are shown.

$C(s) + 2H_2(g) \rightarrow CH_4(g)$ $\Delta H = -75 \text{ kJ mol}^{-1}$
$H_2(g) \rightarrow 2 H(g)$ $\Delta H = +436 \text{ kJ mol}^{-1}$

What is the enthalpy change, in kJ mol^{-1} for the following reaction?

$CH_4(g) \rightarrow C(s) + 4H(g)$

A. −947
B. −361

C. +361

D. +947

(1)

3. The temperature changed from 21.8 °C to 19.2 °C during a calorimetry experiment.

The uncertainty of each reading of the thermometer is ±0.1 °C What is the percentage uncertainty in the temperature change?

A. 0.5%

B. 1.0%

C. 3.8%

D. 7.7%

(1)

4. An experiment is done to determine the enthalpy of combustion of a fuel using a calorimeter containing water.

b = mass of fuel burned / g

w = mass of water heated / g

ΔT = temperature rise of water / K

Mr = relative molecular mass of fuel

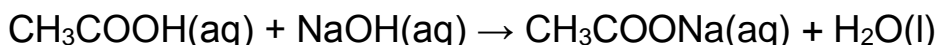c = specific heat capacity of water / J K^{-1} g^{-1}

Which expression gives the enthalpy of combustion (in J mol^{-1}), assuming there is no heat loss?

A. $-\dfrac{cw\,\Delta T\,Mr}{b}$

B. $-\dfrac{cb\,\Delta T\,Mr}{w}$

C. $-\dfrac{cw\,b\,Mr}{\Delta T}$

D. $-\dfrac{cw\,\Delta T\,b}{Mr}$

(1)

5. This question is about enthalpy changes.

(a) When ethanoic acid reacts with sodium hydroxide, the enthalpy change, ΔH, is –56.1 kJ mol^{-1}

$$CH_3COOH(aq) + NaOH(aq) \rightarrow CH_3COONa(aq) + H_2O(l)$$

Calculate the temperature rise when 25 cm^3 of 2.0 mol dm^{-3} aqueous ethanoic acid react with 25 cm^3 of 2.0 mol dm^{-3} aqueous sodium hydroxide.

Assume that both solutions have the same initial temperature, have a density of 1.0 g cm^{-3} and a specific heat capacity of 4.18 J K^{-1} g^{-1}

(4)

(b) A student recorded the temperature of aqueous ethanoic acid in a polystyrene cup for three minutes.
At the fourth minute, the student added sodium hydrogencarbonate.
The student stirred the mixture and carried on recording the temperature every minute for several minutes.
The student's measurements are shown in the graph.
A best-fit line showing the temperature before mixing has been drawn.
Draw an appropriate best-fit line on the graph and use it to find the temperature change at the time of mixing.
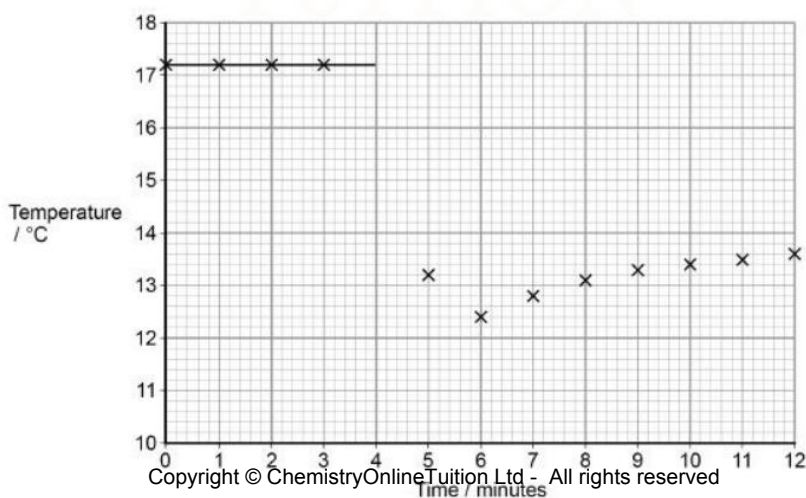
(6)

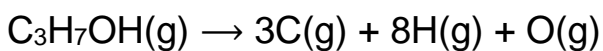**6.** What is the temperature rise, in K, when 504 J of heat energy are absorbed by 0.110 kg of solid iron?

Specific heat capacity of iron = 0.448 J K^{-1} g^{-1}

A. 9.78×10^{-2}
B. 1.02×10^{1}
C. 2.83×10^{2}
D. 1.02×10^{4}

(1)

7. Calculate the enthalpy change, in kJ, for this dissociation of mole of propan-1-ol.

$C_3H_7OH(g) \rightarrow 3C(g) + 8H(g) + O(g)$

	C–H	C–C	C–O	O–H
Mean bond dissociation enthalpy / kJ mol^{-1}	412	348	360	463

A. −4751
B. −4403
C. +4403
D. +4751

(1)

8. The figure below shows apparatus used in an experiment to determine the enthalpy of combustion of leaf alcohol.
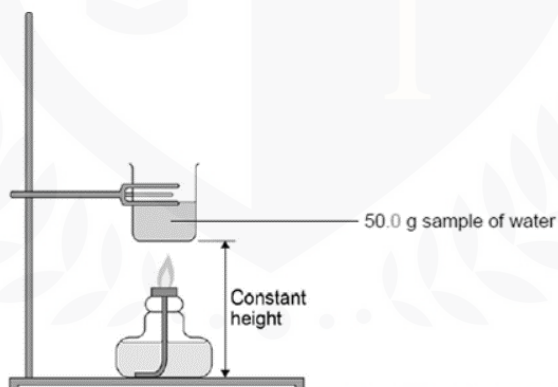
The alcohol is placed in a spirit burner and weighed.
The burner is lit and the alcohol allowed to burn for a few minutes.
The flame is extinguished and the burner is re-weighed.
The temperature of the water is recorded before and after heating.
The following table shows the results obtained.

Initial mass of spirit burner and alcohol / g	56.38
Final mass of spirit burner and alcohol / g	55.84
Initial temperature of water / °C	20.7
Final temperature of water / °C	40.8

(a) Write an equation for the complete combustion of leaf alcohol ($CH_3CH_2CH=CHCH_2CH_2OH$).

(1)

(b) Use the results from the table above to calculate a value for the enthalpy of combustion of leaf alcohol.
Give units in your answer.
(The specific heat capacity of water is 4.18 J K^{-1} g^{-1})

(4)

(c) State how your answer to part (b) is likely to differ from the value quoted in reference sources.
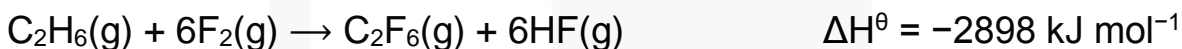Give one reason for your answer.

I am Sorry !!!!!

(2)

(d) A 50.0 g sample of water was used in this experiment.
Explain how you could measure out this mass of water without using a balance.

(2)

9. The table shows the standard enthalpy of formation, $\Delta_f H^\theta$, for some of the substances in the reaction

$$C_2H_6(g) + 6F_2(g) \rightarrow C_2F_6(g) + 6HF(g) \qquad \Delta H^\theta = -2898 \text{ kJ mol}^{-1}$$

	$C_2H_6(g)$	$C_2F_6(g)$
$\Delta_f H^\theta$ /kJ mol^{-1}	−84	−1344

What is the standard enthalpy of formation, in kJ mol^{-1}, for HF(g)?

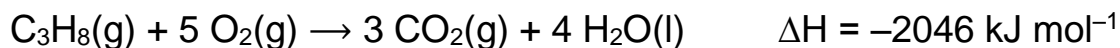**A.** −1638
B. −273
C. +273
D. +1638

(1)

10. This question is about enthalpy changes.

(a) Define the term enthalpy change.

(1)

(b) Propane undergoes complete combustion.

$$C_3H_8(g) + 5\,O_2(g) \longrightarrow 3\,CO_2(g) + 4\,H_2O(l) \qquad \Delta H = -2046\ kJ\ mol^{-1}$$

The table below shows some bond enthalpy data.

Bond	C–H	C=O	O–H
Mean bond enthalpy / kJ mol^{-1}	412	743	463

The bond enthalpy for O=O is 496 kJ mol^{-1}

For $H_2O(l) \longrightarrow H_2O(g)$ $\Delta H = +41\ kJ\ mol^{-1}$

Use these data to calculate a value for the C–C bond enthalpy in propane.

(4)

(c) Explain why the value given for the O=O bond enthalpy in part (b) is not a mean value.

(1)

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