Practice Question Set For A-Level
Subject : Chemistry
Paper-2 Topic: Physical

Name of the Student:_____
Max. Marks : 25 Marks **Time : 25 Minutes**

Q1.

A bomb calorimeter can be used for accurate determination of the heat change during combustion of a fuel.

A bomb calorimeter is a container of fixed volume that withstands the change in pressure during the reaction.

The fuel is mixed with pure oxygen in the calorimeter, ignited and the temperature change is recorded.

The total heat capacity (C_{cal}) of the calorimeter is calculated using a fuel for which the heat change is known.

In an experiment to calculate C_{cal}, 2.00 g of hexane (M_r = 86.0) is ignited. A temperature change (ΔT) of 12.4 °C is recorded.

Under the conditions of the experiment, 1.00 mol of hexane releases 4154 kJ of energy when combusted.

(a) The heat energy released in the calorimeter, $q = C_{cal}\Delta T$

Calculate the heat capacity (C_{cal}) in kJ K^{-1}

C_{cal} _____ kJ K^{-1}

(3)

(b) When the experiment is repeated with 2.00 g of octane (M_r = 114.0) the temperature change recorded is 12.2 °C

Calculate the heat change, in kJ mol^{-1}, for octane in this combustion reaction.

If you were unable to calculate a value for C_{cal} in part (a), use 6.52 kJ K^{-1} (this is **not** the correct value).

Heat change _____ kJ mol^{-1}

(2)

(c) State why the heat change calculated from the bomb calorimeter experiment is **not** an enthalpy change.

_____

_____

_____

(1)

(d) The thermometer used to measure the temperature change of 12.2 °C in part (b) has an uncertainty of ± 0.1 °C in each reading.

Calculate the percentage uncertainty in this use of the thermometer.

Suggest **one** change to this experiment that decreases the percentage uncertainty while using the same thermometer.

Percentage uncertainty _____

Change _____

_____

_____

(2)

(Total 8 marks)

Q2.

Nitrogen dioxide is produced from ammonia and air as shown in these equations

$$4\ NH_3(g) + 5\ O_2\ (g) \rightarrow 4\ NO(g) + 6\ H_2O(g) \qquad \Delta H = -909\ kJ\ mol^{-1}$$

$$2\ NO(g) + O_2\ (g) \rightarrow 2\ NO_2\ (g) \qquad \Delta H = -115\ kJ\ mol^{-1}$$

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

$4\ NH_3(g) + 7\ O_2\ (g) \rightarrow 4\ NO_2\ (g) + 6\ H_2O(g)$

A −679 ⬭

B −794 ⬭

C −1024 ⬭

D −1139 ⬭

(Total 1 mark)

Q3.

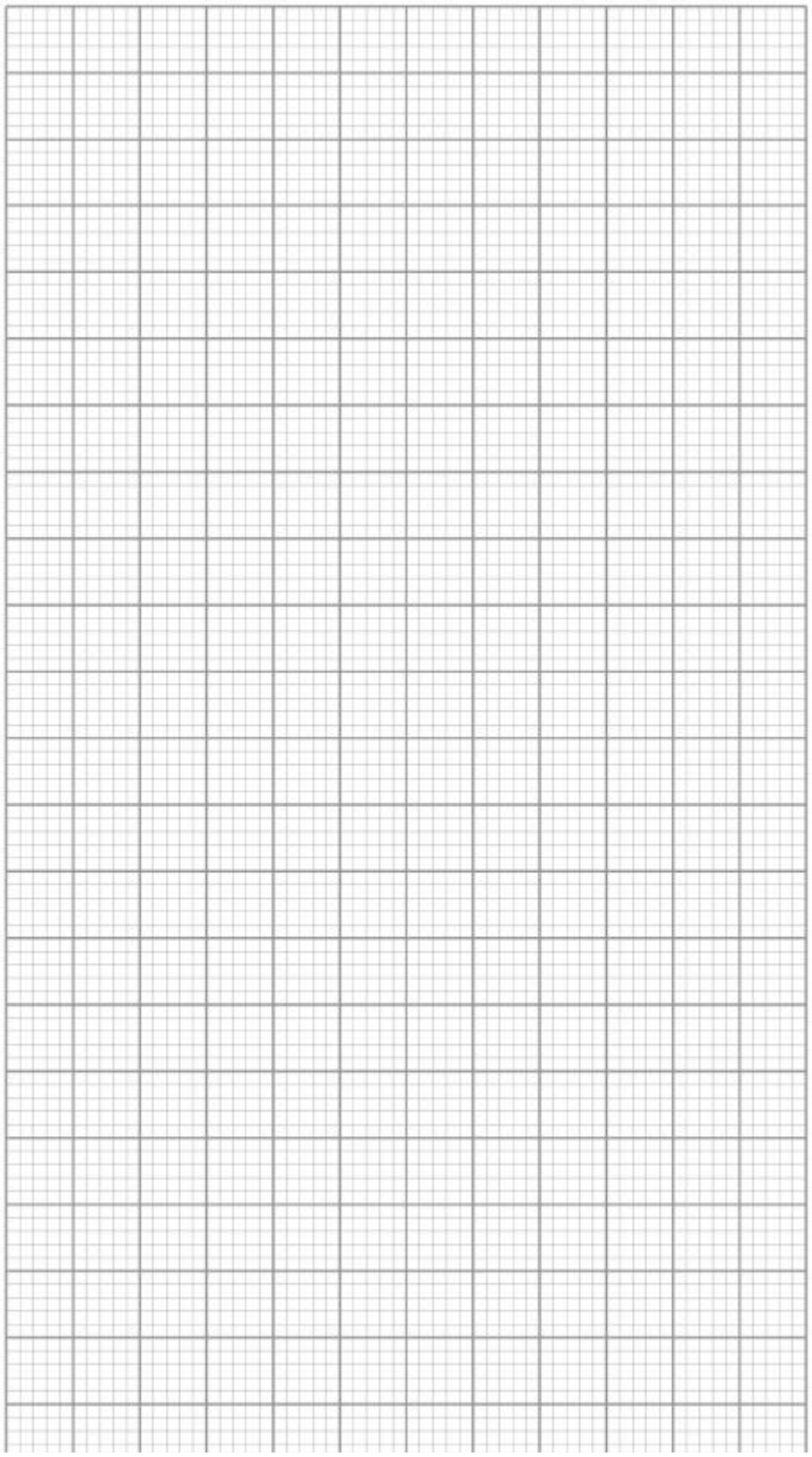
A student carried out an experiment to find the temperature rise for a reaction between hydrochloric acid and sodium hydroxide solution.

- The student used a measuring cylinder to place 50 cm^3 of 0.400 mol dm^{-3} hydrochloric acid into a glass beaker.
- The student recorded the temperature at one-minute intervals for three minutes.
- At the fourth minute the student added 50 cm^3 of 0.400 mol dm^{-3} sodium hydroxide solution and stirred to mix the solutions, but did not record the temperature.
- The student recorded the temperature at one-minute intervals for a further eight minutes.

The results are shown in the table.

Time / min	0	1	2	3	4	5	6	7	8	9	10	11	12
Temperature / °C	19.8	19.8	19.8	19.8		21.4	21.7	21.6	21.5	21.4	21.3	21.2	21.1

(a) Plot a graph of temperature against time on the grid below.



Use your graph to find the temperature rise, ΔT, at the fourth minute.
Show your working on the graph by drawing suitable lines of best fit.

ΔT _____ °C

(5)

(b) The uncertainty in each of the temperature readings from the thermometer used in this experiment was ±0.1° C

Calculate the percentage uncertainty in the value for the temperature rise.

Percentage uncertainty _____

(1)

(c) Suggest a change to the experiment that would minimise heat loss.

_____

_____

(1)

(d) Suggest and explain another change to the experiment that would decrease the percentage uncertainty in the use of the same thermometer.

_____

_____

_____

_____

(2)

(e) A second student completed an experiment to determine the enthalpy of neutralisation for the reaction between ethanedioic acid solution (HOOCCOOH) and potassium hydroxide solution.

The student added 25 cm^3 of 0.80 mol dm^{-3} ethanedioic acid solution to 75 cm^3 of 0.60 mol dm^{-3} potassium hydroxide solution.
The temperature increased by 3.2 °C

Give an equation for the reaction between ethanedioic acid solution and potassium hydroxide solution.
Calculate the enthalpy change (ΔH) per mole of water formed in this reaction.
Assume that the specific heat capacity of the reaction mixture is 4.2 J K^{-1} g^{-1}
Assume that the density of the reaction mixture is 1.00 g cm^{-3}

Equation _____

ΔH _____ kJ mol^{-1}

(5)

(f) In a similar experiment to that in **part (e)**, the enthalpy of neutralisation for the reaction between sulfuric acid and potassium hydroxide solution was found to be –57.0 kJ mol^{-1} per mole of water formed.

Suggest an explanation for the difference between this value and your answer to **part (e)**.

(If you were unable to obtain an answer to **part (e)** you should assume a value of –28.5 kJ mol^{-1}. This is **not** the correct answer.)

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_____

_____

_____

_____

(2)

(Total 16 marks)