

**CHEMICAL AND PHYSICAL SYSTEMS
 HIGHER LEVEL
 PAPER 3**

May 2002

1 hour 15 minutes

Name

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Number

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INSTRUCTIONS TO CANDIDATES

- Write your candidate name and number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all of the questions from the two Options in the spaces provided. You may continue your answers in a continuation answer booklet, and indicate the number of booklets used in the box below. Write your name and candidate number on the front cover of the continuation answer booklets, and attach them to this question paper using the tag provided.

OPTIONS ANSWERED	EXAMINER	TEAM LEADER	IBCA
G	/25	/25	/25
I	/25	/25	/25
NUMBER OF CONTINUATION BOOKLETS USED	TOTAL /50	TOTAL /50	TOTAL /50

Option G – Fuel and Energy

G1. A student wished to determine the molar heat of combustion of methanol by burning methanol in a spirit burner that was placed under a beaker containing a known volume of water, and recording the temperature change while the methanol was burning.

The following results were obtained:

Mass of methanol burnt	0.550 g
Volume of water heated	200 cm ³
Initial temperature of water	23.5 °C
Final temperature of water	33.5 °C

(a) Define the term *molar heat of combustion*. [2]

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(b) Write a balanced equation for the complete combustion of methanol in oxygen, using the state symbols for each reactant and product in the equation. [2]

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(c) Given that the specific heat capacity of water is 4.19 kJ kg⁻¹ K⁻¹, find the molar heat of combustion of methanol. [3]

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(d) From the results obtain in (c) deduce the value of the enthalpy of combustion ΔH_c for methanol. [1]

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- G4.** A heat engine removes 100 J each cycle from a heat reservoir at 300 K and exhausts 85 J of thermal energy to a reservoir at 200 K. Calculate the change in entropy for the whole system. [2]

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Option I – Global Environment

11. This question concerns the effects of acid rain on the environment.

(a) Describe the pollutants, sources and chemical reactions leading to acid rain.

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(b) Describe and explain **two** environmental effects of acid rain.

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12. This question concerns the structure and formation of ozone, and the depletion of ozone due to CFCs.

(a) In the space provided, draw the Lewis formula to show the structure of O₂ and O₃. [2]

(b) Use chemical equations to explain the mechanism of ozone formation in the stratosphere. [2]

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(c) Explain using relevant chemical equations how the chlorofluorocarbon, CF₂Cl₂ could disrupt the formation of ozone. [3]

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(d) Explain the importance of the ozone layer to life on earth. [2]

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13. This question concerns toxic substances in water.

- (a) Two ways of expressing toxicity is in terms of LD_{50} and maximum daily tolerance. Explain what these terms mean, and discuss a disadvantage of each toxicity expression. [4]

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- (b) Two of the toxic heavy metals are mercury and lead. Discuss the sources of these metals, and their health and environmental effects. [4]

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