

APOLLO

Energy from fuels

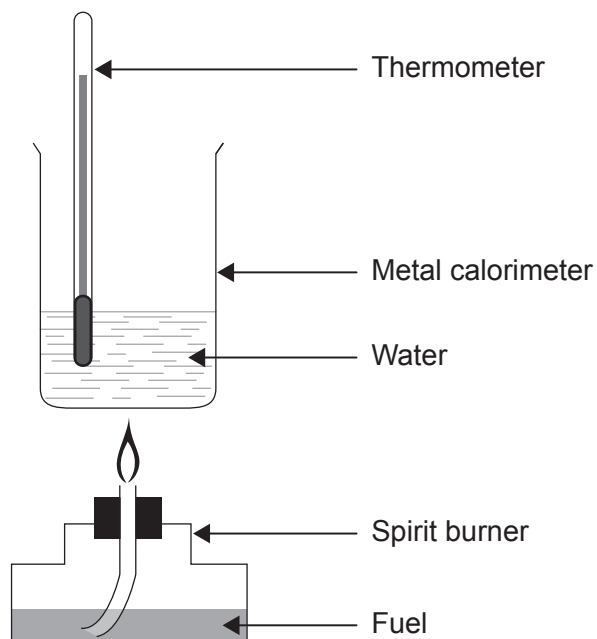
HL

Chemistry

First assessment 2025

9 questions | questions

19. What is the standard enthalpy change, $\Delta H_{\text{combustion}}^{\ominus}$, according to the data?



Amount of fuel burned = 0.110 mol

Mass of water = 200 g

Initial temperature of water = 21.0 °C

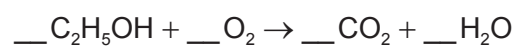
Final temperature of water = 25.0 °C

Specific heat capacity of water, $c_w = 4.18 \text{ J g}^{-1} \text{ K}^{-1}$

$$Q = mc\Delta T$$

- A. $-2110 \text{ kJ mol}^{-1}$
- B. $-30.4 \text{ kJ mol}^{-1}$
- C. $+30.4 \text{ kJ mol}^{-1}$
- D. $+2110 \text{ kJ mol}^{-1}$

20. What is the coefficient of oxygen when the equation for the complete combustion of ethanol is balanced using the smallest whole numbers?



- A. 1
- B. 2
- C. 3
- D. 7

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Turn over
2220-0210

9. Ethanol is a biofuel that is made from glucose. Glucose is formed by the biological fixation of carbon through photosynthesis.

(a) State the equation for photosynthesis.

[1]

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(b) (i) Outline **two** advantages of using ethanol as a fuel instead of gasoline (petrol).

[2]

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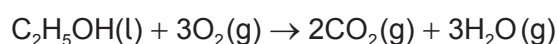
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(ii) Calculate the enthalpy change for the combustion of ethanol in kJ mol^{-1} . Use section 12 of the data booklet.

[3]



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(Question 9 continued)

- (c) Calculate the increase in temperature in a sample of 500.0 cm^3 of water heated by the combustion of 4.00 g of ethanol. Use sections 2 and 14 of the data booklet. [2]

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- (d) Explain this trend in the atomic radii of the atoms in the ethanol molecule [3]



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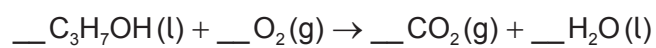
4445-0221

- 23.** Which of the following statements best describes an environmental implication associated with the use of fossil fuels?
- A. Increased biodiversity due to the establishment of habitats through mining
 - B. Decreased emission of greenhouse gases leading to global cooling
 - C. Enhanced soil fertility due to the deposition of coal dust
 - D. Acid rain formation from the release of sulfur dioxide and nitrogen oxides

— 11 —

0020–0207

19. What is the sum of the coefficients when 1 mol of propan-1-ol, $\text{C}_3\text{H}_7\text{OH}$, undergoes complete combustion?



- A. 11.5
- B. 12
- C. 12.5
- D. 13

21. Which statement is a disadvantage of using biofuels instead of fossil fuels?

- A. Land is used that could be used to grow food.
- B. Combustion releases more energy per mol of fuel.
- C. Emissions of CO_2 to the atmosphere are lower overall.
- D. Crop waste can be used as a fuel.

22. Which products may form when propane undergoes incomplete combustion?

- A. CO_2 and H_2 only
- B. CO , C and H_2
- C. CO_2 , H_2O and H_2
- D. CO_2 , CO and C

— 5 —

0020-0219

22. Which is a renewable energy source?

- A. natural gas
- B. uranium
- C. coal
- D. wood

5. Heptadecane, $C_{17}H_{36}$, can be extracted from crude oil or cactus plants.

(a) Write an equation for the complete combustion of $C_{17}H_{36}$. [1]

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(b) The enthalpy of combustion of $C_{17}H_{36}$ is $-11\,350\text{ kJ mol}^{-1}$.

(i) Calculate the maximum energy produced when 2.00 g of $C_{17}H_{36}$ is combusted. [2]

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(ii) Determine the maximum temperature change when 500.0 cm^3 of water is heated by a 2.00 g sample of $C_{17}H_{36}$. [2]

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(iii) Outline **two** assumptions made in the calculation in (b)(ii). [2]

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28EP17

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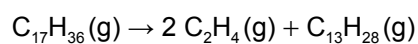
(Question 5 continued)

- (c) Explain why biofuels contribute less to climate change than fossil fuels. [1]

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- (d) Heptadecane can be broken down into smaller molecules. Consider the reaction:



- (i) Determine the standard enthalpy change, $\Delta H^\ominus$, for the reaction stated, using section 12 of the data booklet. [3]

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- (ii) Determine the enthalpy change of reaction. Use the data provided and section 13 of the data booklet. [2]

$$\Delta H_f(\text{C}_{17}\text{H}_{36}) = -393.9 \text{ kJ mol}^{-1}$$

$$\Delta H_f(\text{C}_{13}\text{H}_{28}) = -311.5 \text{ kJ mol}^{-1}$$

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28EP18

(Question 5 continued)

- (iii) Comment on the difference between the two values calculated in (d)(i) and (d)(ii). [1]

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- (iv) Predict the sign of the entropy change of the reaction, giving a reason. [1]

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- (v) Discuss, with reference to (d)(ii) and (d)(iv), how temperature affects the spontaneity of the reaction. [2]

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- (e) Ethene can be converted to ethanol in one reaction. State the equation for this reaction. [1]

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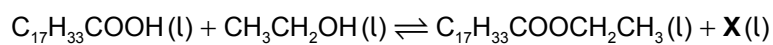


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(Question 5 continued)

- (f) Ethanol reacts with oleic acid to produce ethyl oleate.



- (i) Identify the type of reaction and the side product **X**(l). [1]

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- (ii) Calculate the atom economy of the reaction. [1]

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- (iii) Discuss why the atom economy of a reaction is an important consideration when evaluating the impact of a reaction in an industrial process. [2]

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- (iv) Deduce the equilibrium constant expression, K_c , for the reaction. Assume that the reaction is homogeneous. [1]

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28EP20

(Question 5 continued)

- (g) The equilibrium constant, K_c , is 9.3×10^{-5} at 75°C .
- (i) Determine the amount of ethyl oleate present in the reaction mixture at equilibrium when 0.10 mol dm^{-3} of oleic acid reacts with 0.10 mol dm^{-3} of ethanol at 75°C and state any assumptions you have made in your calculation. [2]

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- (ii) State **one** method of increasing the yield. [1]

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28EP21

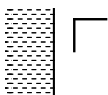
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28EP22



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