

Energy from Chemicals

Question Paper

Level	O Level
Subject	Chemistry
Exam Board	Cambridge International Examinations
Topic	Energy from Chemicals
Booklet	Question Paper

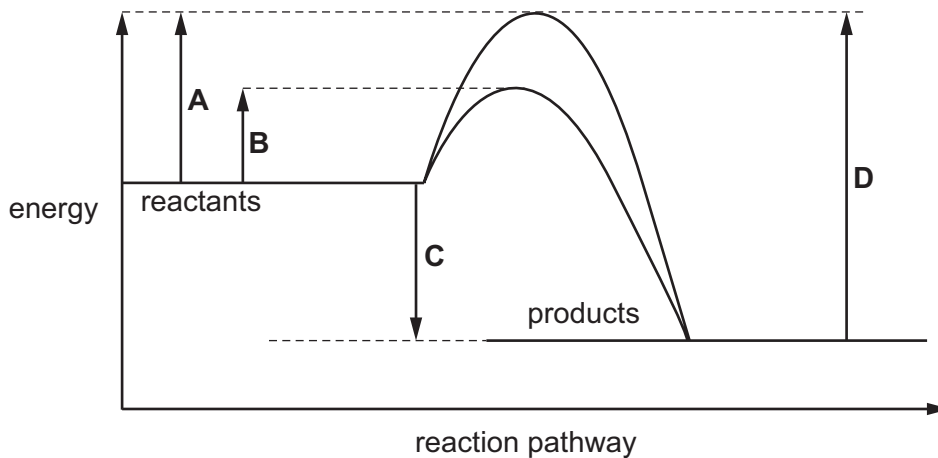
Time Allowed: 50 minutes

Score: /42

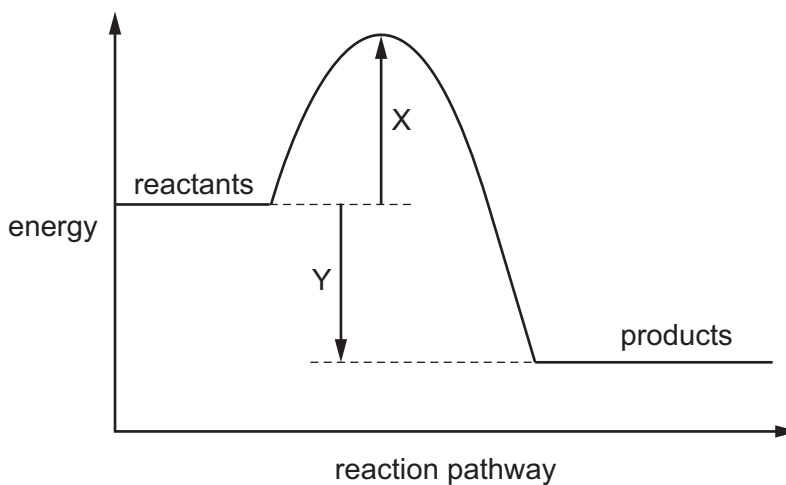
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- 1 The diagram shows an energy profile diagram for a chemical reaction, both with and without a catalyst.

Which energy change is the activation energy for the catalysed reaction?



- 2 The diagram shows the energy profile of a chemical reaction. Two energy changes are labelled X and Y.



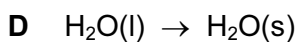
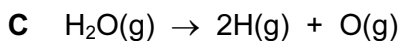
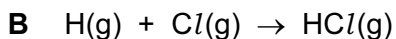
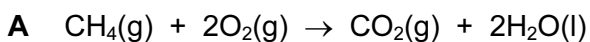
Which statement about the reaction is correct?

- A The activation energy of the reaction is $X + Y$.
- B The enthalpy change of the reaction is X.
- C The enthalpy change of the reaction is $X + Y$.
- D The reaction is exothermic.

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3 Which change is endothermic?



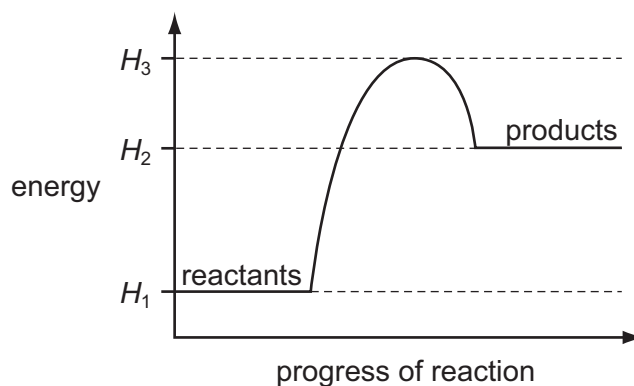
4 The enthalpy changes when methane, butane and octane are burned completely in oxygen are shown below.

	enthalpy change (kJ/mol)
methane, CH_4	-890
butane, C_4H_{10}	-2877
octane, C_8H_{18}	-5512

Which are the enthalpy changes when propane and pentane are burned completely in oxygen?

	propane, C_3H_8 (kJ/mol)	pentane, C_5H_{12} (kJ/mol)
A	-2220	-4210
B	-2220	-3530
C	-1560	-4210
D	-1560	-3530

5 The energy profile diagram for a reaction is shown.



Which statement is correct?

- A The activation energy of the reaction is $(H_3 - H_1)$.
- B The activation energy of the reaction is $(H_3 - H_2)$.
- C ΔH is $(H_1 - H_2)$.
- D ΔH is $(H_1 - H_3)$.

6 Bitumen, diesel, naphtha and paraffin (kerosene) are all fractions obtained by the fractional distillation of petroleum.

Which row gives a correct use for the named fraction?

	fraction	use
A	bitumen	a source of polish
B	diesel	a fuel for aircraft engines
C	naphtha	a fuel for heating
D	paraffin	a fuel for cooking

7 Petroleum is separated into fractions by fractional distillation.

Which fraction distils off at the highest temperature?

- A diesel
- B paraffin (kerosene)
- C lubricating oils
- D petrol (gasoline)

8 What is **not** essential for photosynthesis?

- A carbon dioxide
- B sugar
- C light
- D water

9 Petroleum is a mixture of hydrocarbons which can be separated into fractions by fractional distillation.

Which row shows the fractions in order of decreasing boiling point?

	highest b.p.	→		lowest b.p.
A	diesel	paraffin	naphtha	petrol
B	paraffin	naphtha	petrol	diesel
C	naphtha	petrol	diesel	paraffin
D	petrol	naphtha	paraffin	diesel

10 Which is **not** true about the process of photosynthesis?

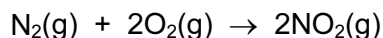
- A Carbon dioxide and water react in a 1 : 1 molar ratio.
- B Glucose is produced and can be used as a source of energy.
- C Oxygen is produced.
- D The reaction is exothermic.

11 When crude oil is distilled several products are obtained.

What is the correct order of their boiling points?

	highest boiling point → lowest boiling point			
A	diesel	paraffin (kerosene)	petrol (gasoline)	lubricating oil
B	lubricating oil	diesel	paraffin (kerosene)	petrol (gasoline)
C	paraffin (kerosene)	petrol (gasoline)	lubricating oil	diesel
D	petrol (gasoline)	paraffin (kerosene)	diesel	lubricating oil

12 Nitrogen and oxygen react according to the equation.

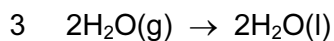
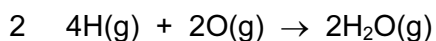
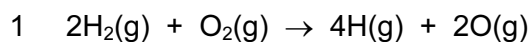


The enthalpy change for the reaction shown is +66 kJ.

If two moles of nitrogen and two moles of oxygen are used, what will be the enthalpy change?

- A** +16.5 kJ **B** +33 kJ **C** +66 kJ **D** +132 kJ

13 The formation of liquid water from hydrogen and oxygen is thought to occur in three stages.



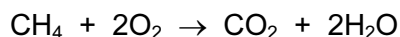
Which stages would be exothermic?

- A** 1, 2 and 3 **B** 1 and 2 only **C** 1 only **D** 2 and 3 only

14 Which equation represents a combustion reaction?

- A $\text{C}_2\text{H}_4 + \text{H}_2\text{O} \rightarrow \text{C}_2\text{H}_5\text{OH}$
- B $\text{C}_2\text{H}_5\text{OH} + \text{O}_2 \rightarrow \text{CH}_3\text{CO}_2\text{H} + \text{H}_2\text{O}$
- C $\text{CH}_3\text{CO}_2\text{H} + 2\text{O}_2 \rightarrow 2\text{CO}_2 + 2\text{H}_2\text{O}$
- D $\text{CH}_3\text{CO}_2\text{H} + \text{CH}_3\text{OH} \rightarrow \text{CH}_3\text{CO}_2\text{CH}_3 + \text{H}_2\text{O}$

15 The combustion of methane is exothermic. The equation is given below.



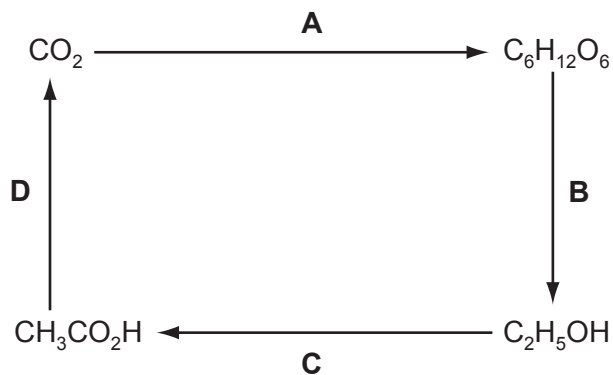
What can be deduced from the fact that the reaction is exothermic?

- A Fewer bonds are broken than are made.
 - B Less energy is involved in breaking bonds than is involved in making bonds.
 - C More bonds are broken than are made.
 - D More energy is involved in breaking bonds than is involved in making bonds.
- 16 In which parts of a motor car do the reactions, shown in the equations, take place?

	$\text{N}_2 + \text{O}_2 \rightarrow 2\text{NO}$	$2\text{CO} + 2\text{NO} \rightarrow 2\text{CO}_2 + \text{N}_2$
A	engine	engine
B	engine	exhaust
C	exhaust	engine
D	exhaust	exhaust

- 17 The diagram shows the steps by which carbon dioxide can be converted into organic products and finally returned to the atmosphere.

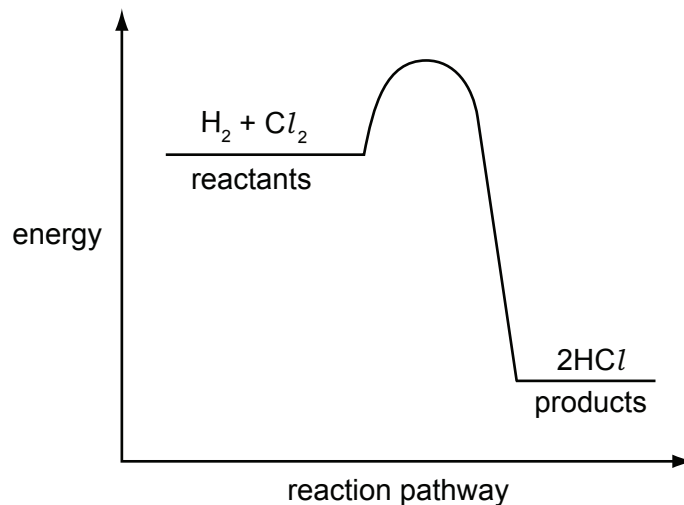
Which step is endothermic?



- 18 Which process is a renewable energy source?

- A combustion of coal
- B electrolysis of aluminium oxide
- C fractional distillation of petroleum
- D photosynthesis

19 The energy profile diagram for the reaction between hydrogen and chlorine is shown.



What information about this reaction does the diagram show?

	type of reaction	sign of enthalpy change, ΔH
A	endothermic	negative
B	endothermic	positive
C	exothermic	negative
D	exothermic	positive

20 Useful fractions are obtained by the fractional distillation of petroleum.

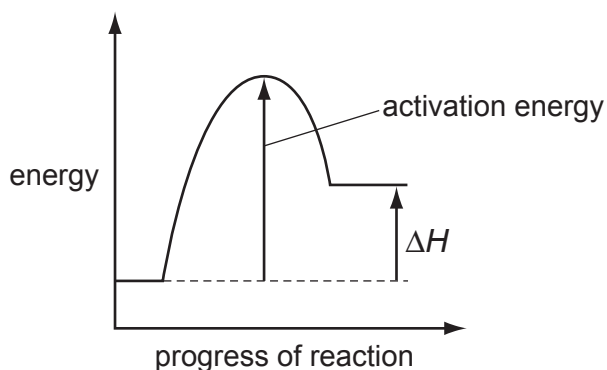
Which fraction is matched by its use?

	fraction	use
A	bitumen	fuel in cars
B	lubricating oils	for making waxes and polishes
C	paraffin (kerosene)	for making roads
D	petrol (gasolene)	aircraft fuel

- 21 Which pair of statements about the combustion of a carbohydrate and its formation by photosynthesis is **not** correct?

	combustion	photosynthesis
A	chemical energy converted to heat energy	chemical energy converted to light energy
B	no catalyst needed	catalyst needed
C	oxygen used up	oxygen released
D	reaction exothermic	reaction endothermic

- 22 The energy profile for the forward direction of a **reversible** reaction is shown.



Which row correctly shows the sign of both the activation energy and the type of the enthalpy change for the **reverse** reaction?

	sign of activation energy	type of enthalpy change
A	negative	endothermic
B	negative	exothermic
C	positive	endothermic
D	positive	exothermic

- 23 Which hydrocarbon will burn completely in oxygen to give equal numbers of moles of carbon dioxide and water?

A C₂H₆ **B** C₃H₆ **C** C₄H₁₀ **D** C₅H₁₂

24 The burning of hydrogen is an exothermic reaction.

Which statement explains this?

- A More bonds are broken than are formed.
- B More bonds are formed than are broken.
- C Overall, the bonds broken are stronger than those formed.
- D Overall, the bonds formed are stronger than those broken.

25 Which process takes place during photosynthesis?

- A Carbohydrate is decomposed and oxygen is formed.
- B Carbon dioxide is taken in and oxygen is formed.
- C Oxygen is taken in and carbohydrate is formed.
- D Oxygen is taken in and carbon dioxide is formed.

26 When a covalent liquid boils its molecules become more widely spaced.

Which property of the molecules has the most influence on the energy required to boil a covalent liquid?

- A the forces of attraction between the molecules
- B the reactivity of the molecules
- C the shape of the molecules
- D the strength of the covalent bonds in the molecules

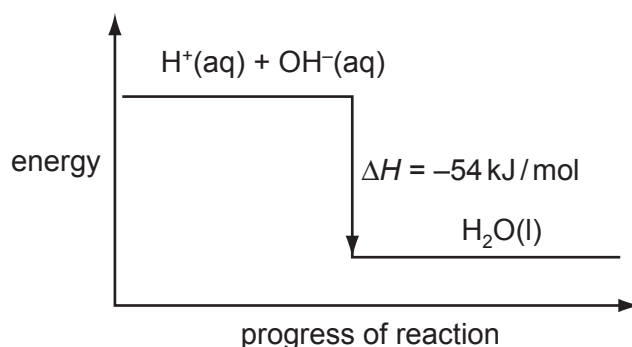
27 Which of the following is an endothermic reaction?

- A the combustion of ethanol in air
- B the formation of a carbohydrate and oxygen from carbon dioxide and water
- C the oxidation of carbon to carbon dioxide
- D the reaction between hydrogen and oxygen

- 28 When 20 cm^3 of a 2 mol/dm^3 solution of potassium hydroxide is mixed with 20 cm^3 of a 1 mol/dm^3 solution of sulphuric acid, the temperature of the mixture rises.

What best explains this?

- A Sulphuric acid is a strong acid.
 - B The potassium hydroxide solution is more concentrated than the sulphuric acid solution.
 - C The reactants have a higher energy content than the products.
 - D Potassium hydroxide is a very strong alkali.
- 29 The energy diagram for the reaction between sodium hydroxide and hydrochloric acid is shown.



What can be deduced from the diagram?

- A Heat is needed to start the reaction.
 - B The products contain less energy than the reactants.
 - C The reaction is rapid.
 - D The OH^- ions have more energy than the H^+ ions.
- 30 Which gas burns in air to form a single product?
- A ammonia
 - B carbon monoxide
 - C hydrogen chloride
 - D methane

- 31 A researcher notices that atoms of an element **X** are releasing energy.

Why does this happen?

- A The atoms are absorbing light.
- B The atoms are radioactive.
- C The atoms react with argon in the air.
- D The atoms are evaporating.

- 32 Which statement about the substance formed when a given mass of an element burns in excess oxygen is **always** correct?

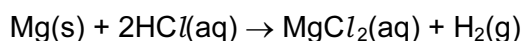
The substance formed is

- A denser than the element.
- B greater in mass than the element.
- C soluble in water.
- D white in colour.

- 33 In which process is energy released?

- A electrolysis of water to form hydrogen and oxygen
- B forming a hydrogen molecule from two hydrogen atoms
- C fractional distillation of crude oil
- D photosynthesis

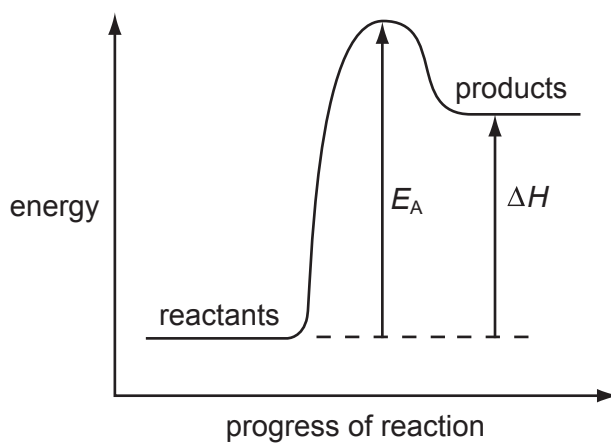
- 34 The equation below shows an exothermic reaction.



Which statement about this exothermic reaction is **not** correct?

- A Magnesium chloride is soluble in water.
- B Magnesium is above hydrogen in the reactivity series.
- C One mole of magnesium produces one mole of hydrogen gas.
- D The total energy of the products is greater than that of the reactants.

35 The diagram shows the energy profile for a chemical reaction.



What is the correct description of the reaction?

	sign of ΔH	overall energy change	sign of E_A
A	–	exothermic	–
B	+	endothermic	+
C	+	endothermic	–
D	+	exothermic	+

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- 36 The molar heat of combustion, i.e. the heat given out when one mole of the alcohol is completely burned in oxygen, of a number of alcohols is given below.

alcohol	formula	heat of combustion kJ/mol
methanol	CH ₃ OH	750
ethanol	C ₂ H ₅ OH	1380
propanol	C ₃ H ₇ OH	2010
butanol	C ₄ H ₉ OH	2640

How many carbon and hydrogen atoms would there be in an alcohol that has a molar heat of combustion of 3900 kJ/mol?

	number of carbon atoms	number of hydrogen atoms
A	5	11
B	5	12
C	6	13
D	6	14

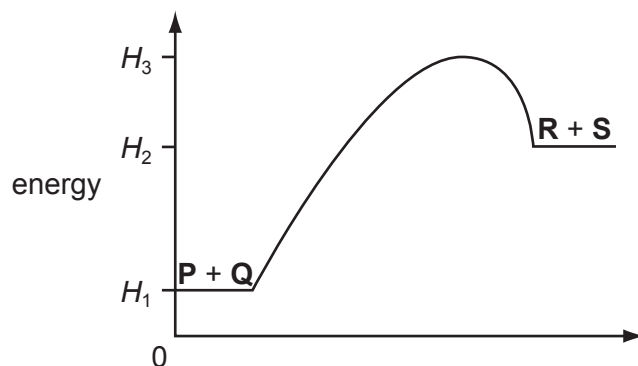
- 37 On combustion, which fuel **never** produces pollutants?

- A** diesel
- B** hydrogen
- C** methane
- D** petrol

- 38 The reaction $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$ is exothermic because

- A** more bonds are broken than are formed.
- B** more bonds are formed than are broken.
- C** the energy needed to break the bonds is greater than that released on forming new bonds.
- D** the energy needed to break the bonds is less than that released on forming new bonds.

39 The energy profile diagram below is for a reaction $\text{P} + \text{Q} \rightarrow \text{R} + \text{S}$.



Which statement is correct?

- A The activation energy of the reaction is $(H_3 - H_1)$.
- B The activation energy of the reaction is $(H_3 - H_2)$.
- C ΔH is $(H_1 - H_2)$.
- D ΔH is $(H_1 - H_3)$.

40 Which of the following changes is endothermic?

- A $\text{H}(\text{g}) + \text{Cl}(\text{g}) \rightarrow \text{HCl}(\text{g})$
- B $\text{H}_2\text{O}(\text{g}) \rightarrow 2\text{H}(\text{g}) + \text{O}(\text{g})$
- C $\text{H}_2\text{O}(\text{l}) \rightarrow \text{H}_2\text{O}(\text{s})$
- D $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{l})$

- 41 The table shows the energy released by the complete combustion of some compounds used as fuels.

compound	formula	M_r	ΔH in kJ/mol
methane	CH ₄	16	-880
ethanol	C ₂ H ₅ OH	46	-1380
propane	C ₃ H ₈	44	-2200
heptane	C ₇ H ₁₆	100	-4800

Which fuel produces the most energy when 1 g of the compound is completely burned?

- A ethanol
 - B heptane
 - C methane
 - D propane
- 42 The formation of hydrogen iodide from hydrogen and iodine is an endothermic reaction.



What may be deduced from this information?

- A The number of bonds broken is greater than the number of bonds formed.
- B The formation of H – I bonds absorbs energy.
- C The products possess less energy than the reactants.
- D The total energy change in bond formation is less than that in bond breaking.