Chem!stry

Name: …… **( )**

Class: ……

Date: …… **/** …… **/** ……

Multiple-Choice Questions on Enthalpy Changes

1. The burning of hydrogen is an exothermic reaction. Which statement explains this?

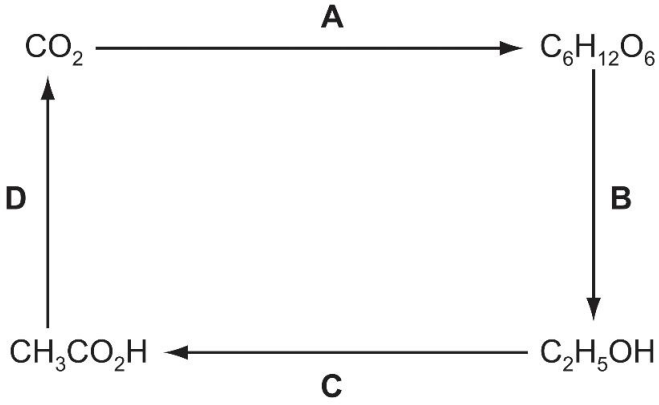
A More bonds are broken than are formed.

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.

2. 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?



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

1 $2H_2(g) + O_2(g) \rightarrow 4H(g) + 2O(g)$

2 $4H(g) + 2O(g) \rightarrow 2H_2O(g)$

3 $2H_2O(g) \rightarrow 2H_2O(l)$

Which stages would be exothermic?

A 1, 2 and 3 **B** 1 and 2 only

C 1 only **D** 2 and 3 only

4. Which process is endothermic?

A Atoms bonding to form molecules.

B The chemical reaction occurring in a fuel cell.

C The reaction of carbon dioxide and water to produce glucose and oxygen.

D The reaction of methane with oxygen to produce water and carbon dioxide.

5. The equation shows the reaction for the manufacture of ammonia.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

Which change will decrease the activation energy of the reaction?

A Addition of a catalyst

B Decrease in temperature

C Increase in concentration

D Increase in pressure

6. Which change is endothermic?

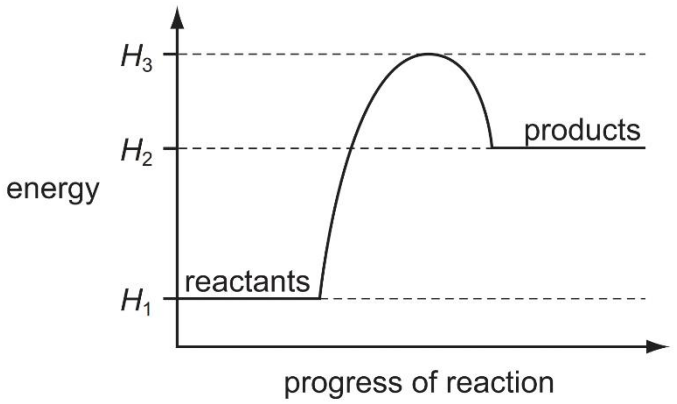
A $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$

B $H(g) + Cl(g) \rightarrow HCl(g)$

C $H_2O(g) \rightarrow 2H(g) + O(g)$

D $H_2O(l) \rightarrow H_2O(s)$

7. 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 ($H_1 - H_3$).

8. Which two processes are both endothermic?

A Combustion and cracking hydrocarbons.

B Combustion and fermentation.

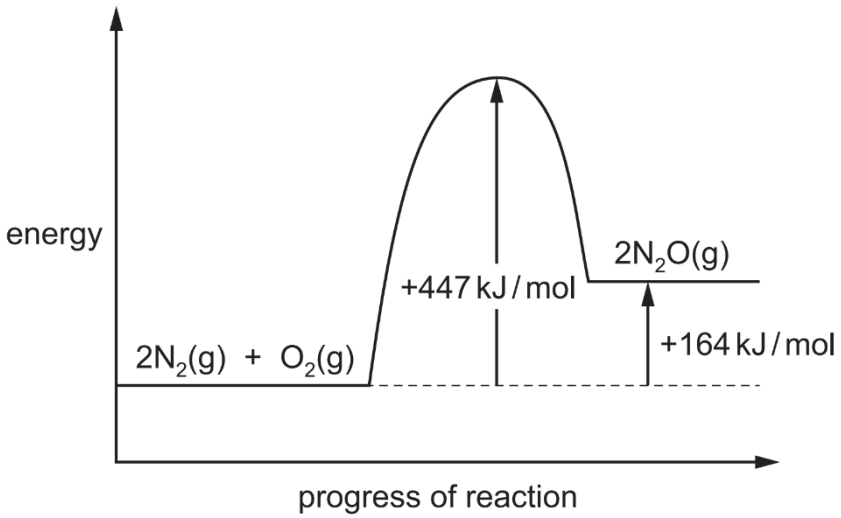
C Cracking hydrocarbons and photosynthesis.

D Respiration and photosynthesis.

9. Under certain conditions nitrogen reacts with oxygen to form N_2O.

$$2N_2(g) + O_2(g) \rightleftharpoons 2N_2O(g)$$

The energy profile diagram for this reaction is shown.



What is the activation energy of the reverse reaction?

A –447 kJ/mol **B** –283 kJ/mol

C +141.5 kJ/mol **D** +283 kJ/mol

10. Which statements about endothermic reactions are correct?

1 Energy is absorbed from the surroundings.

2 Energy is released to the surroundings.

3 The temperature of the reaction mixture falls.

4 The temperature of the reaction mixture rises.

A 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

11. Which statement about exothermic and endothermic reactions is correct?

A In an endothermic reaction, energy is used to break bonds but no energy is released when bonds form.

B In an endothermic reaction, energy is released when bonds form but more energy is used to break bonds.

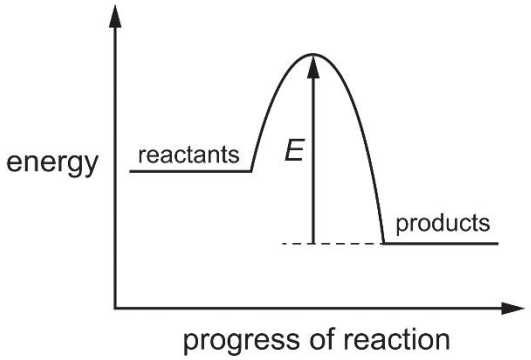
C In an exothermic reaction, energy is released both by breaking and by forming bonds.

D In an exothermic reaction, energy is released when bonds form but no energy is needed to break bonds.

12. The equation represents the reaction between two gases, X_2 and Y_2 , to form compound XY.

$$X_2(g) + Y_2(g) \rightarrow 2XY(g)$$

The energy profile diagram for the reaction is shown.



Which statement about this reaction is correct?

A The activation energy for the reaction is equal to *E*.

B The enthalpy change for the reaction is equal to *E*.

C The reaction is exothermic.

D The total energy needed to break bonds is greater than the total energy needed to form bonds.

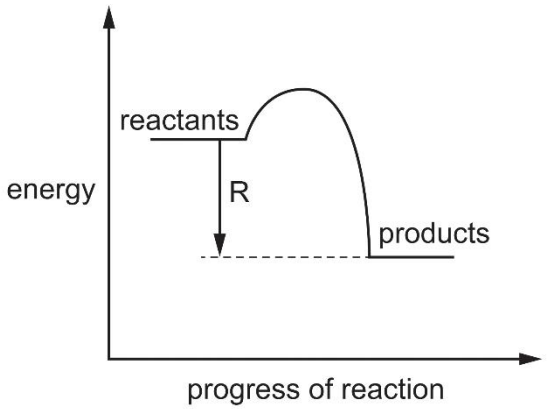
13. The enthalpy changes when methane, butane and octane are burned completely in oxygen are shown below.

hydrocarbon	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

14. An energy profile diagram is shown.



What does the arrow R on the diagram represent?

A An endothermic energy change.

B The activation energy.

C The energy taken in by the reactants.

D The enthalpy change of the reaction.

15. Sulfuric acid is manufactured using the contact process. The equations for the reactions in the process are shown.

Reaction 1 $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ $\Delta H = -198$ kJ/mol

Reaction 2 $SO_3(g) + H_2O(l) \rightarrow H_2SO_4(aq)$

Which statements are correct?

1 Reaction 1 is reversible.

2 Reaction 1 is exothermic.

3 In reaction 2, sulfur dioxide reacts with water to form sulfuric acid.

A 1 and 2 only **B** 1 and 3 only

C 2 and 3 only **D** 1, 2 and 3

16. When water is liquid, it ionises slightly.

$$H_2O(l) \rightleftharpoons H^+(aq) + OH^-(aq)$$

The forward reaction is endothermic.

When the temperature of water is increased, which changes take place?

1 The water becomes acidic.

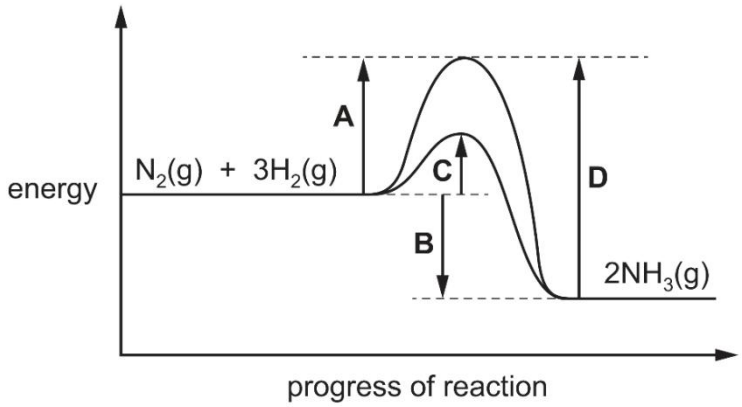
2 The water becomes alkaline.

3 More water molecules form ions.

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

17. The energy profile diagram for both the catalysed and uncatalysed reactions between N_2 and H_2, in the Haber process, is shown.

What is the activation energy for the formation of NH_3 in the presence of a catalyst?



18. The reaction of hydrogen with chlorine to form gaseous hydrogen chloride is exothermic.

Which statement is correct?

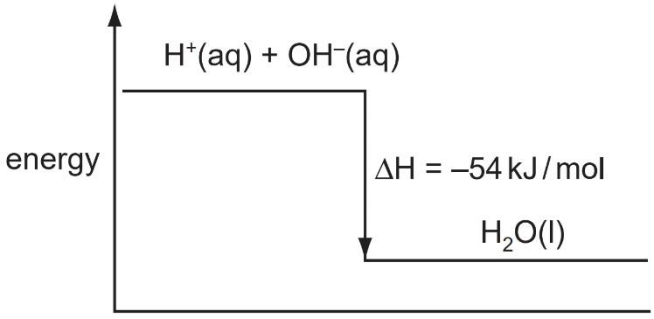
A The total energy of bond formation is greater than the total energy of bond breaking.

B The total energy of bond breaking is greater than the total energy of bond formation.

C The temperature of the reaction mixture falls during the reaction.

D The temperature of the reaction mixture remains unchanged during the reaction.

19. The energy diagram for the reaction between sodium hydroxide and hydrochloric acid is shown.



Which quantity of heat is liberated when 100 cm^3 of 1 mol/dm^3 hydrochloric acid reacts with 100 cm^3 of 1 mol/dm^3 sodium hydroxide?

A 0.54 kJ **B** 2.70 kJ **C** 5.40 kJ **D** 10.8 kJ

20. Nitrogen and oxygen react according to the equation.

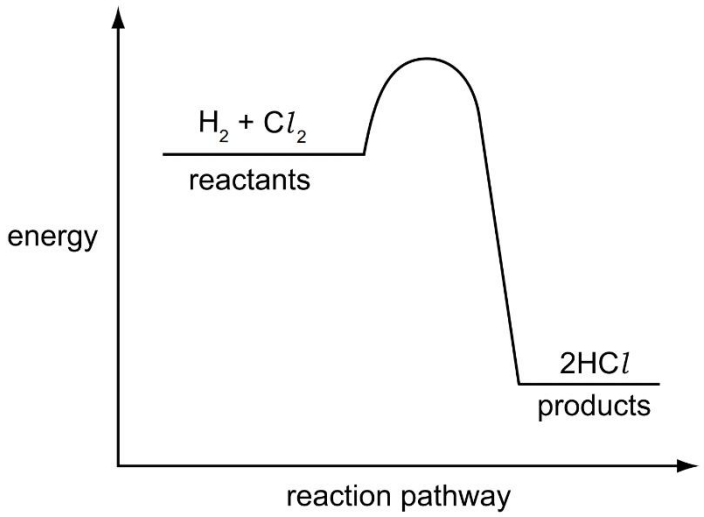
$$N_2(g) + 2O_2(g) \rightarrow 2NO_2(g)$$

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

21. 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

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

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

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.

23. The usual conditions for the Haber process are 250 atm pressure, 450°C and an iron catalyst.

Which change in conditions would give the reactants more energy?

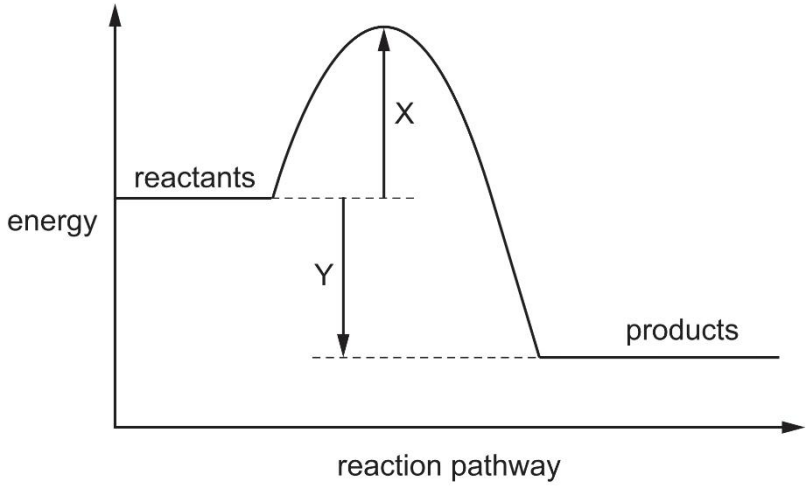
A Addition of more catalyst.

B A decrease in pressure.

C An increase in concentration of the reactants.

D An increase in temperature.

24. 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?

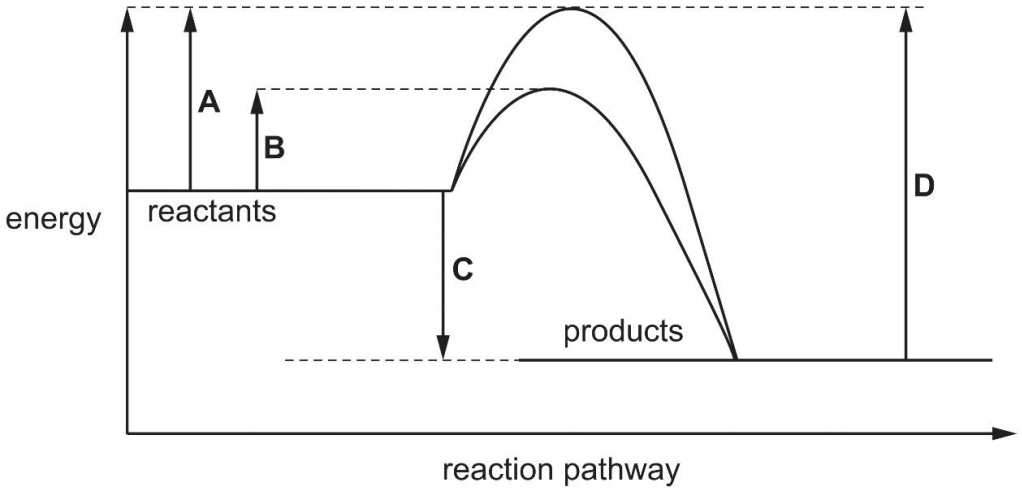
A The activation energy of the reaction is X + Y.

B The enthalpy change of the reaction is X.

C The enthalpy change of the reaction is X + Y.

D The enthalpy change of the reaction is Y.

25. 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?



26. Which statement is correct?

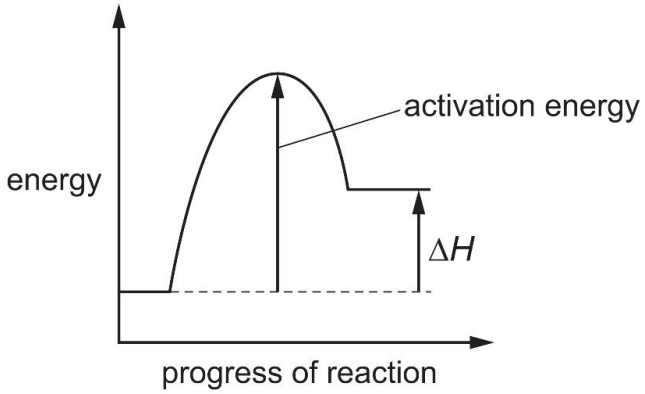
A An enzyme is a biological catalyst that decreases the activation energy of a reaction.

B An enzyme is a biological catalyst that increases the activation energy of a reaction.

C An enzyme is a compound of a transition element that decreases the activation energy of a reaction.

D An enzyme is a compound of a transition element that increases the activation energy of a reaction.

27. The energy profile diagram for the **forward** direction of a reversible reaction is shown.



For the **reverse** reaction, which row correctly shows the sign of the activation energy and the type of enthalpy change?

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

28. Compound **Y** reacts with oxygen. This reaction has a positive enthalpy change of reaction, ΔH.
What information can be deduced about **Y** and its reaction with oxygen?

A Compound **Y** can be used as a fuel.

B Compound **Y** could be a hydrocarbon.

C In the reaction the energy needed to break bonds is greater than the energy released when bonds are made.

D In the reaction the products are at a lower energy level than the reactants.

29. The table shows the energy released by the complete combustion of some compounds.

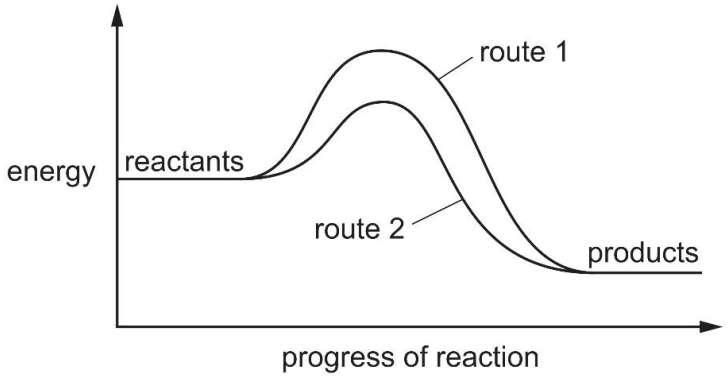
compound	formula	M_r	ΔH_c in kJ/mol
benzene	C_6H_6	78	–3270
heptane	C_7H_{16}	100	–4800
octane	C_8H_{18}	114	–5510
propane	C_3H_8	44	–2200

Which compound releases the least energy when 1 g of the compound is burned?

A Benzene **B** Heptane

C Octane **D** Propane

30. The diagram shows the energy profile for a reaction.



Which statements are correct?

1 More energy is needed to break the bonds than is released when new bonds are formed.

2 Route 1 and route 2 give the same overall equation for the reaction.

3 Route 2 involves the use of a catalyst.

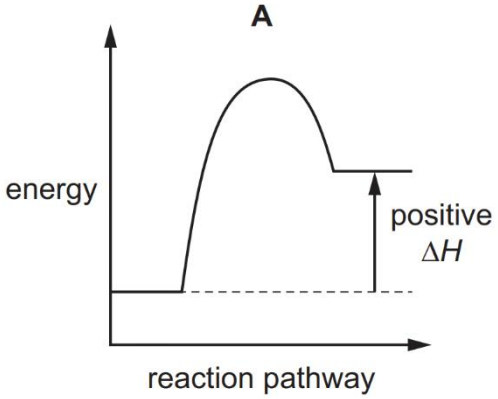
4 The reaction is exothermic.

A 1, 2 and 3 **B** 1 and 2 only **C** 2, 3 and 4 **D** 3 and 4 only

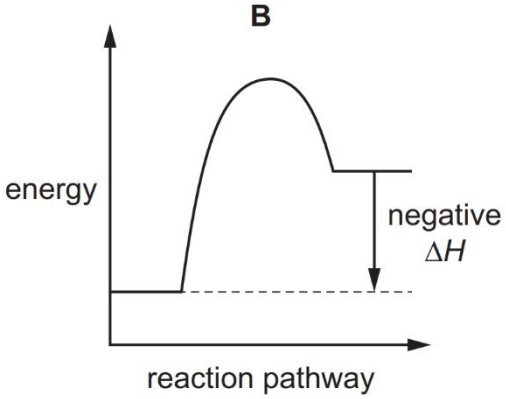
31. A reaction is exothermic.

Which diagram shows the correct energy profile diagram for the reaction and the correct enthalpy change?

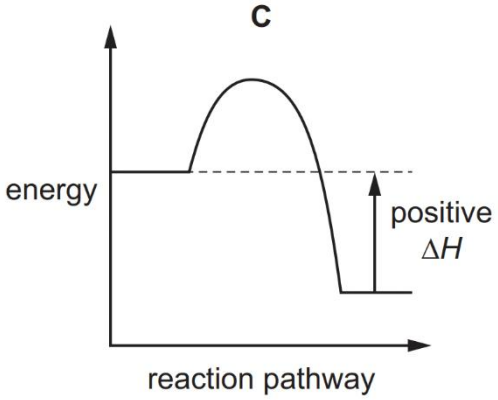
A



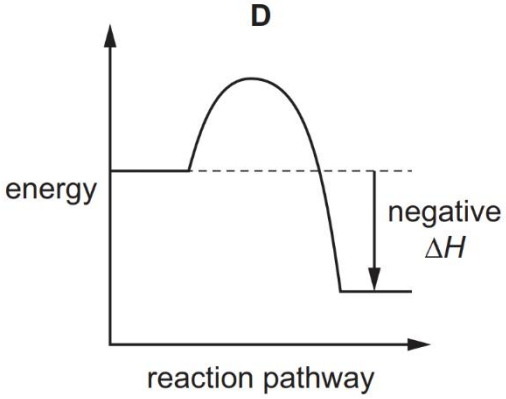
B



C



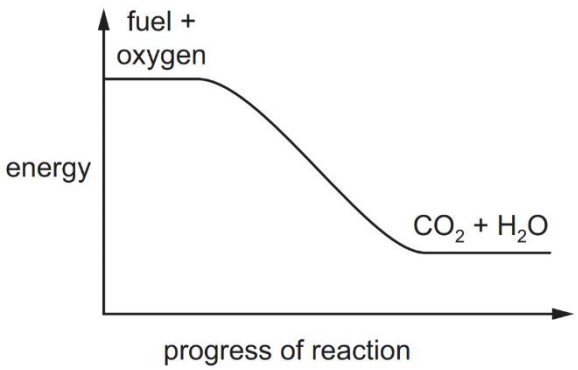
D



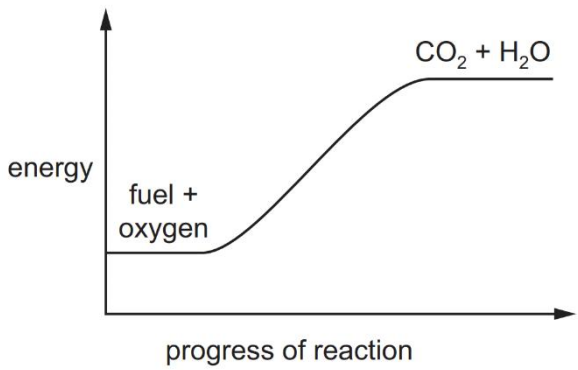
32. A fuel is completely burned in air. Carbon dioxide, water and heat are produced.

Which energy profile diagram is correct for burning a fuel?

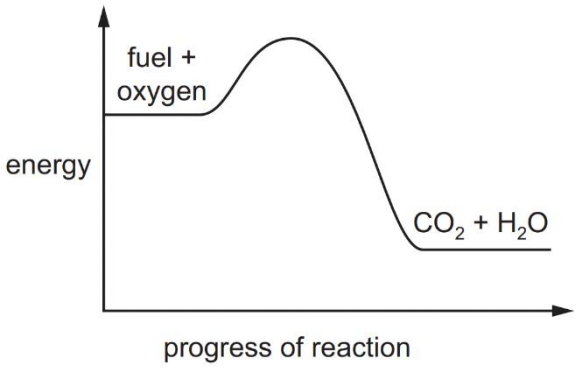
A



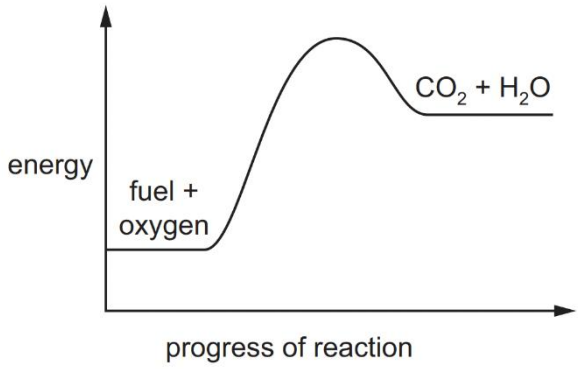
B



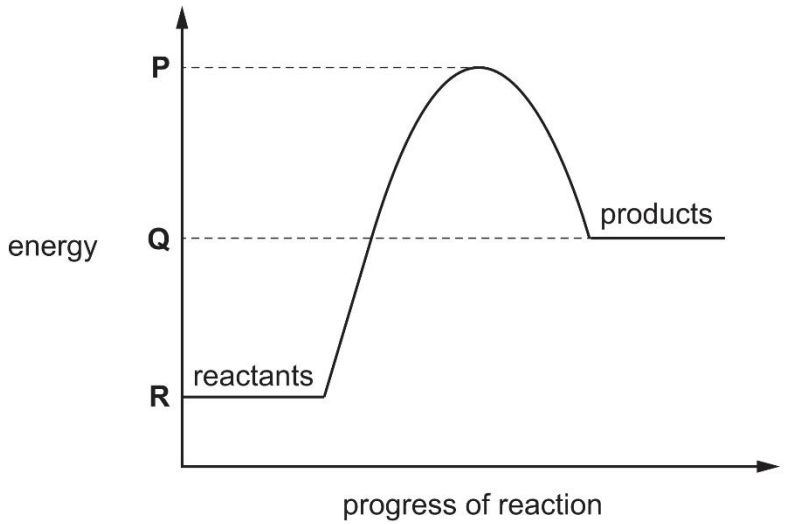
C



D



33. The diagram shows the energy profile for a reaction.



Which statement about this reaction is correct?

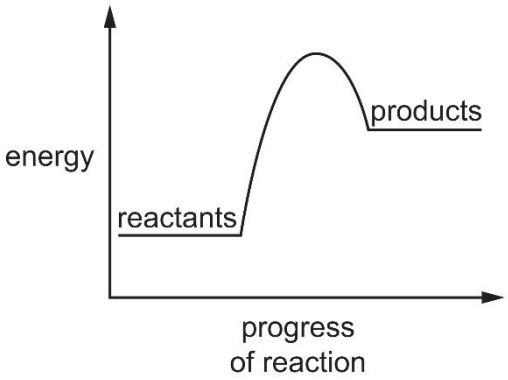
A It is endothermic and the activation energy is **P** – **Q**.

B It is endothermic and the activation energy is **P** – **R**.

C It is exothermic and the activation energy is **P** – **Q**.

D It is exothermic and the activation energy is **P** – **R**.

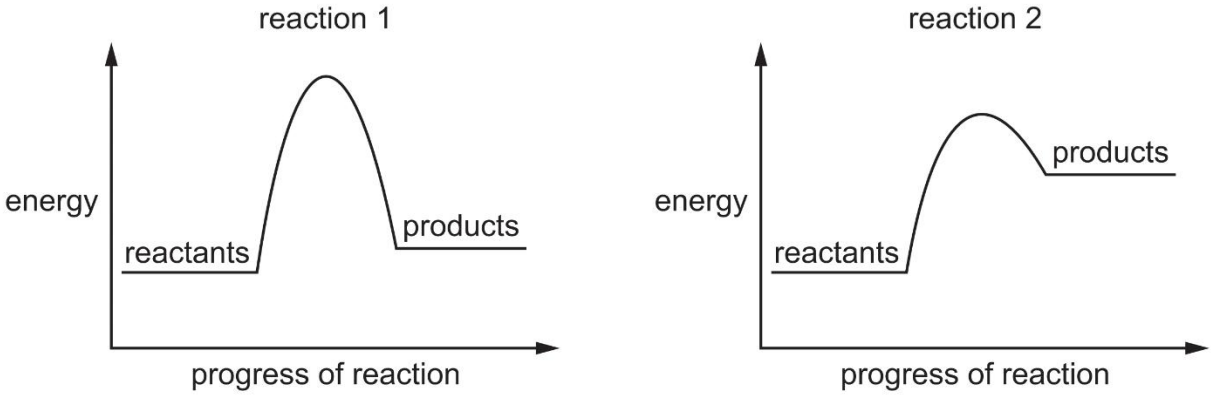
34. The diagram shows the energy profile of a chemical reaction.



Which row is correct?

	the reaction that is endothermic	the reaction with greater activation energy
A	backward reaction	backward reaction
B	backward reaction	forward reaction
C	forward reaction	backward reaction
D	forward reaction	forward reaction

35. Two energy profile diagrams are shown. The scale on the *y*-axis is the same for both diagrams.



Which statement is correct?

A Both reactions are exothermic.

B Only one reaction is endothermic.

C The activation energy of reaction 1 is smaller than the activation energy of reaction 2.

D The enthalpy change of reaction 2 is larger than the enthalpy change of reaction 1.

36. Ammonium nitrate dissolves in water.

$$NH_4NO_3(s) \xrightarrow{H_2O} NH_4NO_3(aq) \qquad \Delta H = +25\ kJ/mol$$

Which statements are correct?

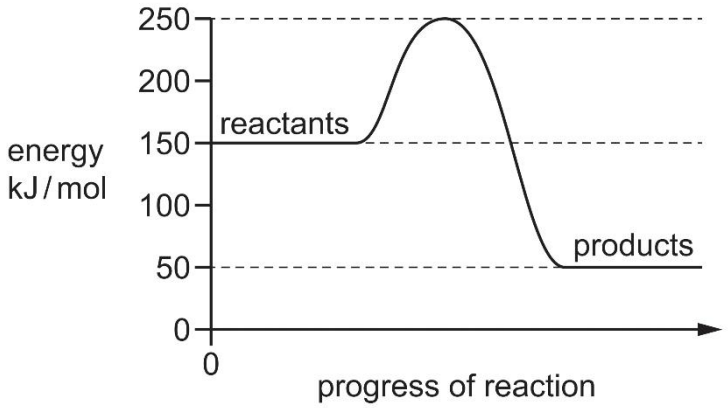
1 The reaction is endothermic.

2 The water gets colder during the reaction.

2 Heat energy is absorbed by the ammonium nitrate from the water.

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

37. The energy profile diagram of a chemical reaction is shown.



What is the value of the activation energy of the reaction?

A –200 kJ/mol **B** –100 kJ/mol **C** +100 kJ/mol **D** +200 kJ/mol

38. These statements refer to hydrogen and its use as a fuel.

1 Both water and hydrocarbons can be used as a source of hydrogen.

2 In a fuel cell hydrogen reacts with oxygen to generate electricity.

3 The reaction taking place in a fuel cell is a redox reaction.

Which statements are correct?

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

39. Ethanol is produced by the fermentation of glucose from sugar cane. In some countries ethanol is used as a fuel.

Which statements are correct?

1 Sugar cane is a non-renewable (finite) resource.

2 When sugar cane is growing it removes carbon dioxide from the atmosphere.

A 1 only **B** 2 only **C** Both 1 and 2 **D** Neither 1 nor 2

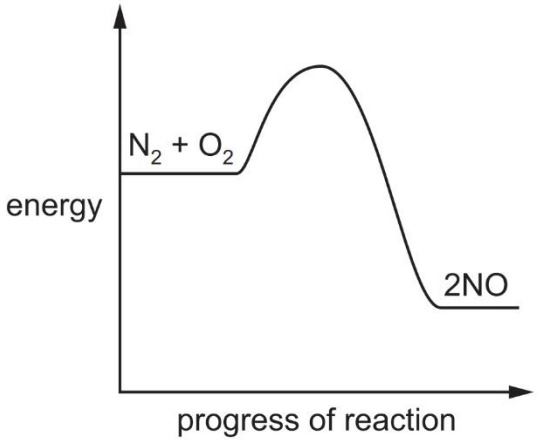
40. Nitrogen oxides may form in the atmosphere during lightning activity.

$$N_2 + O_2 \rightarrow 2NO$$

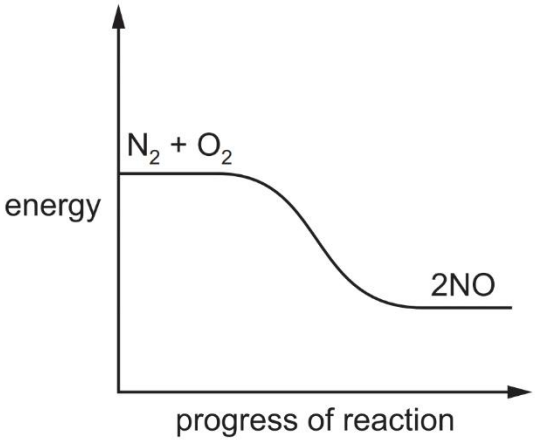
The reaction is endothermic.

Which energy profile diagram is correct for this reaction?

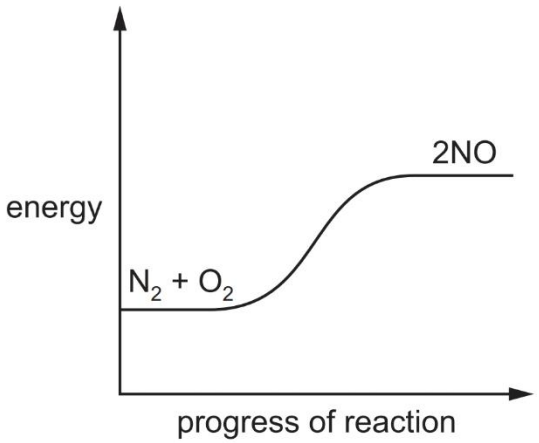
A



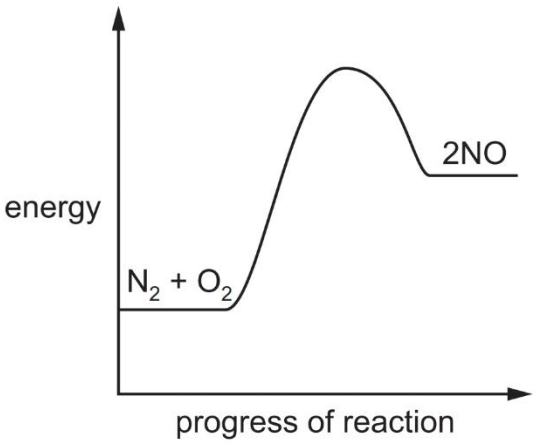
B



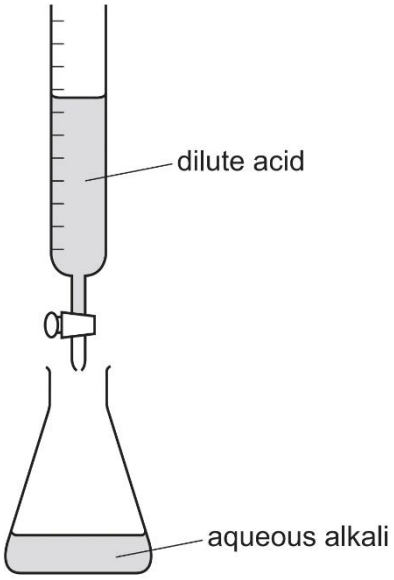
C



D



41. The diagram shows a titration experiment.



Which row about the reaction in the conical flask is correct?

	the reaction is	the value of ΔH is
A	endothermic	negative
B	endothermic	positive
C	exothermic	negative
D	exothermic	positive

- Scan the QR Code below to view the answers to this assignment.

https://www.chemist.sg/energy_changes/energy_from_chemicals_mcq_ans.pdf