Cambridge Assessment International Education

Cambridge IGCSE™

CHEMISTRY **0620/23**

Paper 2 Multiple Choice (Extended) **May/June 2020**

45 minutes

You must answer on the multiple choice answer sheet.

You will need: Multiple choice answer sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)

INSTRUCTIONS

- There are **forty** questions on this paper. Answer **all** questions.
- For each question there are four possible answers **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice in soft pencil on the multiple choice answer sheet.
- Follow the instructions on the multiple choice answer sheet.
- Write in soft pencil.
- Write your name, centre number and candidate number on the multiple choice answer sheet in the spaces provided unless this has been done for you.
- Do **not** use correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.

INFORMATION

- The total mark for this paper is 40.
- Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
- Any rough working should be done on this question paper.
- The Periodic Table is printed in the question paper.

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This document has **16** pages. Blank pages are indicated.

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1 A mixture of ice and water is left to stand and the ice melts.

Which row describes what happens as the ice is melting?

	temperature of mixture	energy changes
A	increases	average kinetic energy of particles increases
B	increases	energy is used to overcome attractive forces
C	stays the same	average kinetic energy of particles increases
D ✓	stays the same	energy is used to overcome attractive forces

At m.p, the temp remains the same.

2 Which piece of apparatus is used to measure 13.7 cm^3 of dilute hydrochloric acid?

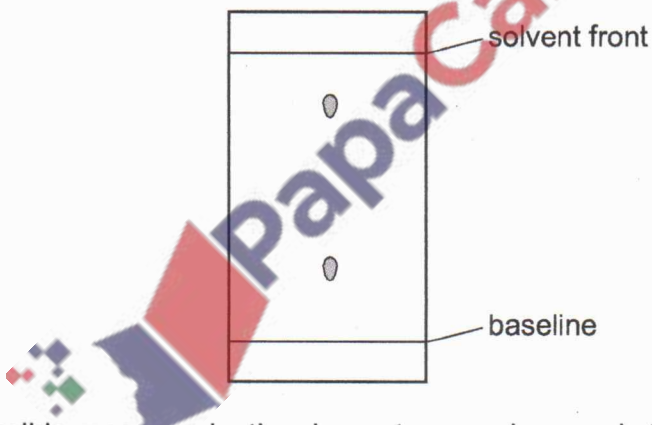
A balance ← measures mass and not volume.

B ✓ burette

C conical flask ← Not for measuring, but holding liquids.

D pipette ← measure a fixed volume of 25.0 cm^3

3 Chromatography is carried out on a mixture of three substances. The chromatogram is sprayed with a locating agent. The result is shown.



What are possible reasons why the chromatogram shows only two spots?

1 One of the substances in the mixture is insoluble in the solvent. ✗

2 The locating agent did not react with one of the substances in the mixture. ✓

3 Two of the substances in the mixture have the same R_f values. ✓

4 The R_f value of one of the substances is too small. ✗.

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

- Two substances with same R_f will be at the exactly same spot. So they appear as one.

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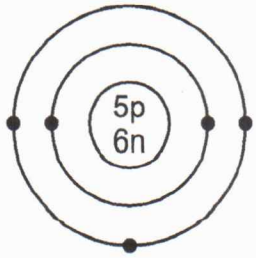
4 The structure of an atom of element X is shown.

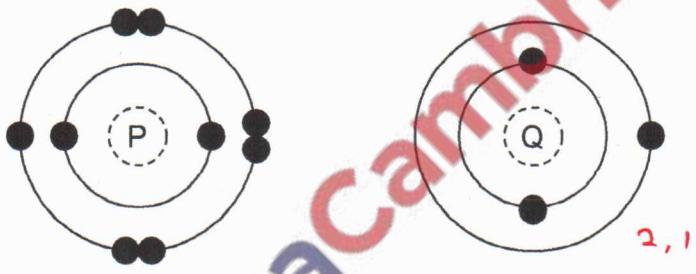


key
● = electron
n = neutron
p = proton

What is element X?

A boron
B carbon
C sodium
D sulfur

5 The electronic structures of two atoms, P and Q, are shown.



P and Q combine together to form a compound.

What is the type of bonding in the compound and what is the formula of the compound?

	type of bonding	formula
A	ionic	PQ
B	ionic	PQ_2
C	covalent	PQ_2
D	covalent	PQ

6 Caesium is a metal in Group I of the Periodic Table.

Which description of the bonding in caesium is correct?

A electrostatic attraction between oppositely charged ions
B electrostatic attraction between positive metal ions and mobile electrons
C neighbouring metal atoms sharing pairs of electrons
D strong attractive forces between atoms

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7 Why does magnesium oxide, MgO, have a very high melting point?

A There is a very strong double bond between magnesium and oxygen.

B There is a very strong attractive force between the magnesium oxide molecules.

C The oxide ions are strongly attracted to positive ions.

D The magnesium ions are strongly attracted to a sea of electrons.

$Mg^{2+} + O^{2-} \rightarrow MgO$

MgO is an ionic compd
- Has strong ionic bond.

8 Aluminium metal reacts with iron(III) oxide to form aluminium oxide and iron.

Which chemical equation for the reaction between aluminium and iron(III) oxide is correct?

A $FeO + Al \rightarrow AlO + Fe$

B $Fe_2O + 2Al \rightarrow Al_2O + 2Fe$

C $Fe_2O_3 + Al \rightarrow Al_2O_3 + Fe$

D $Fe_2O_3 + 2Al \rightarrow Al_2O_3 + 2Fe$

9 The Haber process is a reversible reaction.

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

mole ratio 1 : 3 : 2

$H_2 : NH_3$
3 : 2.
0.75 : ?

$\frac{0.75 \times 2}{3} = 0.5 mol$

The reaction has a 30% yield of ammonia.

Which volume of ammonia gas, NH_3, measured at room temperature and pressure, is obtained by reacting 0.75 moles of hydrogen with excess nitrogen?

A 3600 cm^3 B 5400 cm^3 C 12 000 cm^3 D 18 000 cm^3

0.5 mol → 100%
? — 30%

$\frac{0.5 mol \times 30}{100} = 0.15 mol$

1 mol → 24 000 cm^3
0.15 mol — ?

$\frac{0.15 \times 24000 cm^3}{1} = 3600 cm^3$

10 Which row describes the reactions during the electrolysis of dilute aqueous sodium chloride?

	anode (+) reaction	cathode (–) reaction
A	$H_2 \rightarrow 2H^+ + 2e^-$	$2H_2O + O_2 + 4e^- \rightarrow 4OH^-$
B	$2H^+ + 2e^- \rightarrow H_2$	$4OH^- \rightarrow 2H_2O + O_2 + 4e^-$
C	$2H_2O + O_2 + 4e^- \rightarrow 4OH^-$	$H_2 \rightarrow 2H^+ + 2e^-$
D	$4OH^- \rightarrow 2H_2O + O_2 + 4e^-$	$2H^+ + 2e^- \rightarrow H_2$

Ions present:
Na^+, H^+, Cl^-, OH^-

Cathode: Na^+, H^+
$2H^+ + 2e^- \rightarrow H_2$

Anode: Cl^-, OH
$4OH^- \rightarrow O_2 + 2H_2O + 4e^-$

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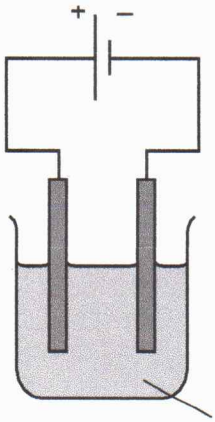
11 The electrolysis of aqueous copper(II) sulfate, using inert electrodes, is shown.

↑ carbon or Platinium



Ions present: Cu^{2+}, H^+, SO_4^{2-}, OH^-

Cathode: Cu^{2+}, H^+

$Cu^{2+} + 2e^- \rightarrow Cu$ ✓

Anode: SO_4^{2-}, OH^-

$4OH^- \rightarrow 2H_2O + O_2 + 4e^-$

Which statement about a reaction at an electrode is correct?

A Copper ions gain electrons at the negative electrode. ← cathode

B Copper ions gain electrons at the positive electrode.

C Hydrogen ions gain electrons at the negative electrode.

D Hydrogen ions gain electrons at the positive electrode.

12 Ethene gas, C_2H_4, is completely burned in excess oxygen to form carbon dioxide and water.

The equation for this exothermic reaction is shown.

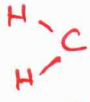
$$C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$$

The table shows the bond energies involved in the reaction.

$\Delta H = E_{bond\ breaking} - E_{bond\ making}$

bond	bond energy (kJ/mol)
C=C	614
C–H	413
O=O	495
C=O	799
O–H	467

Bond breaking:



C=C ⇒ 614

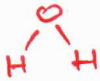
C–H ⇒ 4 × 413 = 1652

O=O ⇒ 3 × 495 = 1485

Total 3751

Bond making:

O=C=O ⇒ 4 × 799 = 3196



⇒ 4 × 467 = 1868

Total 5064.

What is the total energy change in this reaction?

$\Delta H = 3751 - 5064$

$= -1313$ kJ/mol

A –954 kJ/mol

B –1010 kJ/mol

C –1313 kJ/mol ✓

D –1369 kJ/mol

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13 Which statements about hydrogen fuel cells are correct?

1 Water is formed as the only waste product. ✓ $2H_2 + O_2 \rightarrow 2H_2O$ (water)

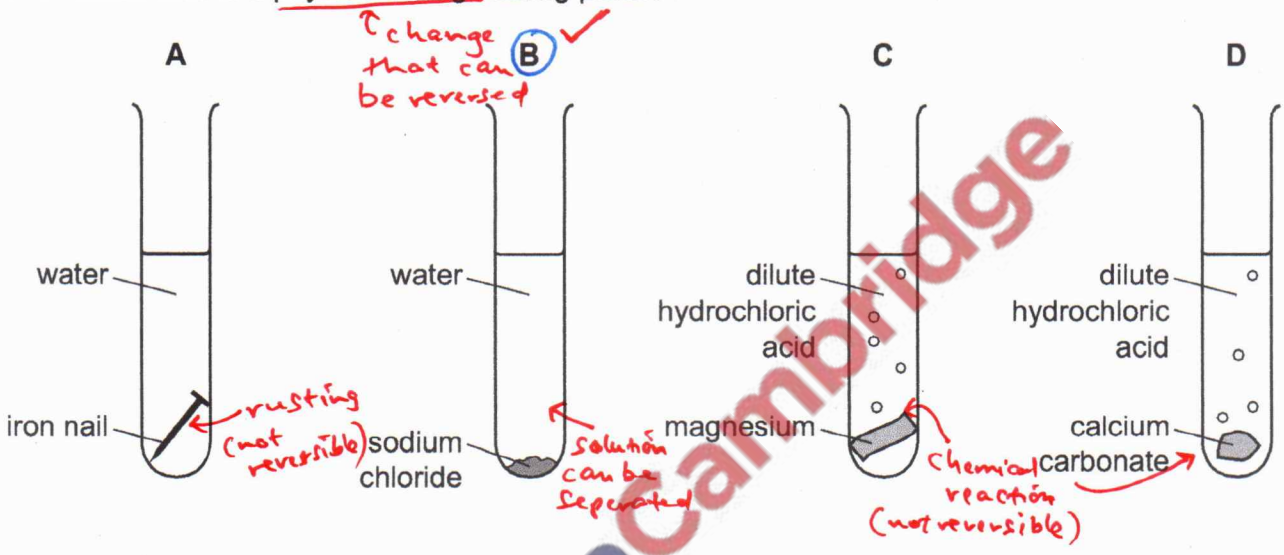
2 Both water and carbon dioxide are formed as waste products. ✗

3 The overall reaction is $2H_2 + O_2 \rightarrow 2H_2O$. ✓

4 The overall reaction is endothermic. ✗ exothermic.

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

14 In which tube is a physical change taking place?



change that can be reversed ✓

15 A chemical reaction occurs when the reacting particles collide.

Which reaction conditions would produce the greatest rate of particle collisions?

	concentration of acid	reaction temperature
A	decrease	decrease
B	no change	increase
C ✓	increase	increase
D	increase	no change

- High concentration means more particles
- High temp, the particle have great K.E and so move faster and collide more often.
- So rate of reaction increases.

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16 At room temperature, the conversion of nitrogen dioxide, NO_2, into dinitrogen tetroxide, N_2O_4, is reversible.

$$2NO_2(g) \rightleftharpoons N_2O_4(g)$$

brown gas — colourless gas

The forward reaction is exothermic.

2 mole at left, one mole at right

Which changes cause the equilibrium to shift to the left?

	pressure	temperature
A	decrease	decrease
B ✓	decrease	increase
C	increase	decrease
D	increase	increase

- At high pressure equilibrium will shift right, so at low pressure it shifts left.
- Forward reaction is exothermic, so at high temp, equilibrium shifts to the left in order to absorb the extra heat energy.

17 The equation for the reaction between zinc and aqueous copper(II) sulfate is shown.

$$\overset{0}{Zn} + \overset{+2\ -2}{CuSO_4} \rightarrow \overset{+2\ -2}{ZnSO_4} + \overset{0}{Cu}$$

oxidation states

Zn is the reducing agent, and so it gets oxidised

Which statement is correct?

A The oxidation state of the oxidising agent has changed from 0 to +2.

B ✓ The oxidation state of the reducing agent has changed from 0 to +2.

C The oxidation state of the reducing agent has changed from +2 to 0.

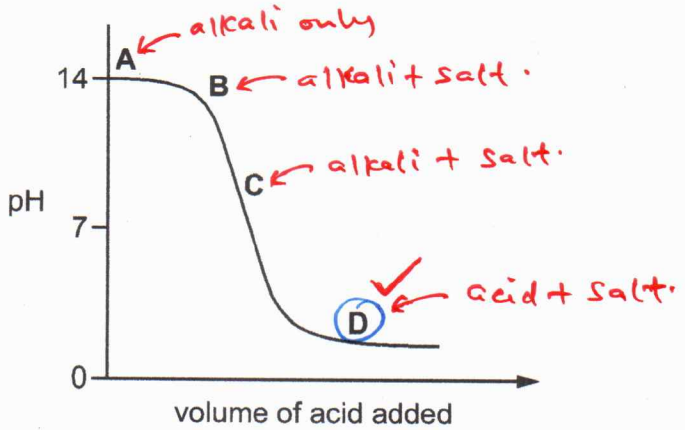
D This is not a redox reaction. The solution changes from colourless to blue.

- oxidation is loss of electrons
- Zn loses 2 electrons so its oxidation state increases from 0 to +2.

18 The graph shows how the pH of a solution changes as an acid is added to an alkali.

acid + alkali → salt + water

Which letter represents the area of the graph where both acid and salt are present?



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19 Which statement describes a weak acid?

is partially ionised.

A It is a proton acceptor and is fully ionised in aqueous solution.

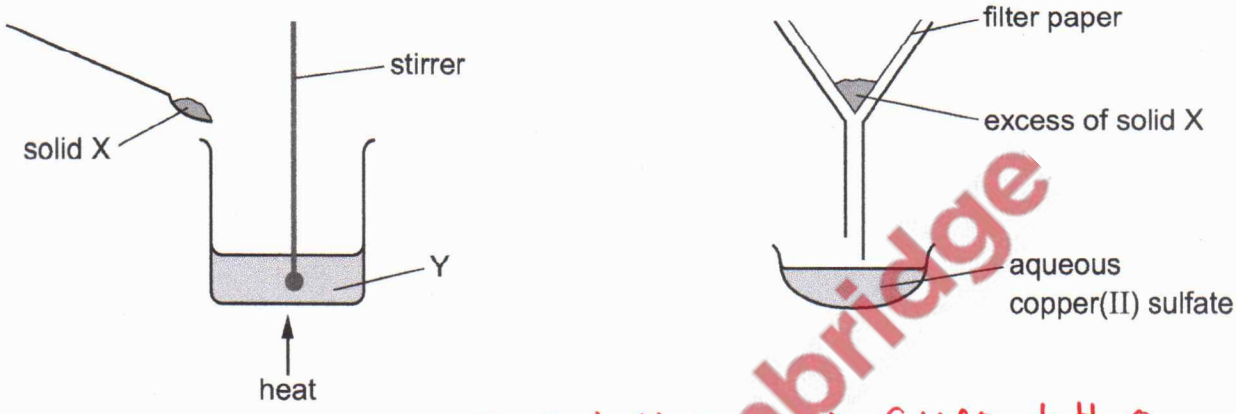
B It is a proton acceptor and is partially ionised in aqueous solution.

C It is a proton donor and is fully ionised in aqueous solution.

D It is a proton donor and is partially ionised in aqueous solution.

All acids are proton donors.

20 The apparatus shown is used to prepare aqueous copper(II) sulfate.



$CuO_{(s)} + H_2SO_{4(aq)} \rightarrow CuSO_{4(aq)} + H_2O_{(l)}$

copper(II) sulfate

What are X and Y?

	X	Y
A	copper	aqueous iron(II) sulfate
B	copper(II) chloride	dilute sulfuric acid
C	copper(II) oxide	dilute sulfuric acid
D	sulfur	aqueous copper(II) chloride

21 Which two compounds would react together to form the insoluble salt lead(II) chloride?

	compound	solubility in water
1	lead(II) nitrate	yes
2	lead(II) sulfate	no
3	silver chloride	no
4	sodium chloride	yes

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

$Pb(NO_3)_{2(aq)} + 2NaCl_{(aq)} \rightarrow PbCl_{2(s)} + 2NaNO_3$

Insoluble salt.

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22 The elements in Group I include lithium, sodium and potassium.

Which statements about these elements are correct?

1 Sodium is denser than lithium. ✓

2 Lithium has a lower melting point than potassium. ✗

3 Potassium is a relatively soft metal. ✓

4 Sodium is less reactive than lithium but more reactive than potassium. ✗

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

23 The properties of the element titanium, Ti, can be predicted from its position in the Periodic Table.

Which row identifies the properties of titanium?

← transition metal, have high density not low.

	can be used as a catalyst	conducts electricity when solid	has low density	forms coloured compounds
A	✓	✓	✓	✗
B	✓	✓	✗	✓
C	✓	✗	✓	✓
D	✗	✓	✓	✓

24 Which statement about the noble gases is correct?

← Argon, helium, neon, radon Krypton.

A Argon is used in light bulbs and balloons. ✗ ← helium

B Helium reacts with oxygen in the air. ← Not true

C They all have full outer electron shells. ✓

D They are all diatomic molecules. ← They all are monoatomic

25 Which property is shown by **all** metals?

A They are extracted from their ores by heating with carbon.

B They conduct electricity. ✓

C They form acidic oxides. ← metal oxides are basic oxides.

D They react with hydrochloric acid to form hydrogen.

$Cu + HCl \rightarrow$ No reaction

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26 A salt is heated strongly. The only products are a white solid and a colourless gas.

What is the salt?

A copper(II) carbonate ← $CuCO_3 \xrightarrow{\Delta} CuO + CO_2$

B potassium carbonate ← $K_2CO_3 \xrightarrow{\Delta}$ No reaction

C calcium nitrate ← $Ca(NO_3) \xrightarrow{\Delta} CaO + NO_2 + O_2$.

D sodium nitrate ← $2NaNO_3 \longrightarrow 2NaNO_2 + O_2$

27 Molten iron from the blast furnace contains impurities.

The process of turning the impure iron into steel involves blowing oxygen into the molten iron and adding calcium oxide.

What are the reasons for blowing in oxygen and adding calcium oxide?

	blowing in oxygen	adding calcium oxide
A	carbon is removed by reacting with oxygen	reacts with acidic impurities making slag
B	carbon is removed by reacting with oxygen	reacts with slag and so removes it
C	iron reacts with the oxygen	reacts with acidic impurities making slag
D	iron reacts with the oxygen	reacts with slag and so removes it

28 P, Q, R and S are four metals.

P displaces Q from a solution of its sulfate. P > Q

Q reacts with hydrochloric acid and can be extracted from its ore using carbon.

R does not react with hydrochloric acid. Q > R.

The carbonate of S does not decompose when heated strongly.
← group 1 S > P.

What is the order of reactivity of the metals, starting with the most reactive?

	most reactive → least reactive			
A	R	P	Q	S
B	R	Q	P	S
C	S	P	Q	R
D	S	Q	P	R

S > P > Q > R

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29 Which substances can be used to detect the presence of water?

1 cobalt(II) chloride ← water turns blue cobalt (II) chloride paper pink
2 copper(II) sulfate ← water turns white anhydrous copper (II) sulfate to blue hydrated copper (II) sulfate.
3 litmus
4 methyl orange } both detect either acid or bases.

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

30 Which processes increase the amount of carbon dioxide in the atmosphere?

1 burning ethanol ✓ $CH_3CH_2OH + 3O_2 \longrightarrow 2CO_2 + 3H_2O$
2 farming cattle ✓ ← produce methane, $CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$
3 growing trees ✗ ← trees take in CO_2 for photosynthesis from the atmosphere.

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

31 Hydrogen and nitrogen react to form ammonia in the Haber process.

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

The forward reaction is exothermic.

Which statements about the process are correct?

1 Nitrogen is obtained from the air. ✓
2 Increasing the temperature of the reaction increases the yield of ammonia. ✗
3 Increasing the reaction pressure increases the yield of ammonia. ✓
4 Vanadium(V) oxide is used as a catalyst. ← catalyst is iron.

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

- Increasing temp shifts equilibrium to the left, so it reduces ammonia yield.

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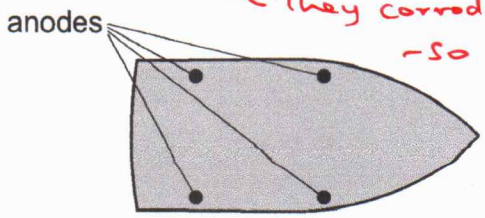
32 The diagram shows the positions of sacrificial anodes on the steel hull of a yacht.



↑ They corrode instead of iron - so iron does not rust.

Which metal is used to make the anodes?

A calcium

B copper

C sodium

D zinc ✓

- Sacrificial anode is usually zinc
- Sodium is not used, it will react with water violently.
- Copper is less reactive than iron, so it will not protect iron.

33 A student suggests three uses of calcium carbonate (limestone).

1 manufacture of cement ✓

2 manufacture of iron ✓

3 treating alkaline soils ✗ ← Acidic oxides are used to treat alkaline soil to neutralise the alkalinity.

Which suggestions are correct?

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

34 Which reaction in the Contact process is catalysed by vanadium(V) oxide?

A $S(s) + O_2(g) \rightarrow SO_2(g)$

B $2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$ ✓

C $SO_3(g) + H_2SO_4(l) \rightarrow H_2S_2O_7(l)$

D $H_2S_2O_7(l) + H_2O(l) \rightarrow 2H_2SO_4(l)$

$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$

- reaction is reversible
- catalyst used when reactions are reversible to quicken product formation.

35 Ethanol is produced by:

1 the catalytic addition of steam to ethene ← catalyst is phosphoric acid.

2 fermentation. ← catalysed by Enzymes (biological catalysts).

Which statement is correct?

A Both processes require similar amounts of energy.

B Both processes use a catalyst. ✓

C Process 1 uses a renewable resource. ← ethene is non-renewable

D Process 2 produces the purest ethanol. ← Process 1 produces pure ethanol. In process 2, ethanol is obtained by fractional distillation, so not pure ethanol.

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36 Which statement about a homologous series is correct?

A All members have the same general formula. ← eg alkanes C_nH_{2n+2}

B All members have the same molecular formula.

C All members have similar physical properties.

D Members show a trend in their chemical properties.

37 Increasing the number of atoms in one molecule of a hydrocarbon increases the amount of energy released when it burns.

What is the correct order?

methane – CH_4 5-atoms

ethene – C_2H_4 6-atoms

ethane – C_2H_6 8-atoms

$CH_4 < C_2H_4 < C_2H_6$

	less energy released ⟶		more energy released
A	ethene	ethane	methane
B	ethene	methane	ethane
C	methane	ethane	ethene
D	methane	ethene	ethane

38 A small quantity of a solid chemical is added to a large excess of aqueous ethanoic acid.

No bubbles of gas are seen and the solid dissolves to give a colourless solution.

What was the solid chemical?

Alkali + acid ⟶ salt + water

A calcium hydroxide ← Alkali

B copper(II) oxide ← This will give blue solution, since copper solution are blue.

C magnesium ← Mg + acid ⟶ salt + H_2, bubbles will be seen.

D sodium carbonate ← Na_2CO_3 + acid ⟶ salt + CO_2 + H_2O ↑ gas, so bubbles will be seen.

39 Alkanes undergo substitution reactions with chlorine in the presence of ultraviolet light.

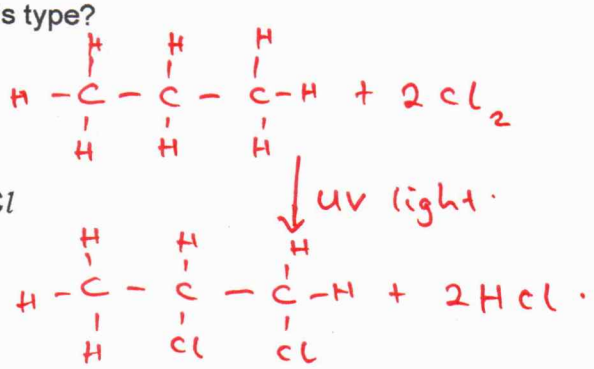
Which equation shows a reaction of this type?

A $C_3H_6 + Cl_2 \rightarrow C_3H_6Cl_2$

B $C_3H_8 + Cl_2 \rightarrow C_3H_6Cl_2 + H_2$

C $C_3H_8 + 2Cl_2 \rightarrow C_3H_6Cl_2 + 2HCl$

D $C_3H_6 + Cl_2 \rightarrow C_3H_5Cl + HCl$



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40 Which statement about carbohydrates and proteins is correct?

A Carbohydrates and proteins are constituents of food.

B Carbohydrates and proteins are natural polymers used to make larger molecules called monomers.

C Carbohydrates and proteins are synthetic polymers. ← They are natural polymers

D Carbohydrates and proteins cause pollution as they are non-biodegradable.

They are both biodegradable, they are broken down by bacteria.

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