

- 1 The arrangements of particles in solids, liquids and gases are different.

Which statement about the molecules in ice, water or steam is correct?

- A The  $\text{H}_2\text{O}$  molecules are on average closest together in steam.
- B The  $\text{H}_2\text{O}$  molecules are on average furthest apart in water.
- C The  $\text{H}_2\text{O}$  molecules in steam have the second highest average velocity.
- D The  $\text{H}_2\text{O}$  molecules in ice are able to vibrate.

- 2 A sealed glass container contains  $200\text{ cm}^3$  of oxygen at  $100^\circ\text{C}$ .

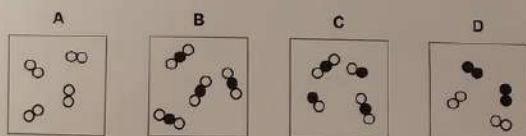
The container is cooled to  $25^\circ\text{C}$ .

Which row shows how the average kinetic energy of the oxygen molecules and the pressure inside the container change?

|   | average kinetic energy | pressure  |
|---|------------------------|-----------|
| A | decreases              | decreases |
| B | decreases              | increases |
| C | increases              | decreases |
| D | increases              | increases |

- 3  $\circ$  and  $\bullet$  represent atoms of different elements.

Which diagram represents a mixture of compounds?



- 4 Which statement explains why water is a compound?

- A Hydrogen and oxygen in water can only be separated using a chemical change.
- B Hydrogen and oxygen in water can be separated using a physical change.
- C The masses of hydrogen and oxygen combined in water are variable.
- D Water has the same properties as both hydrogen and oxygen.

- 5 The table shows the number of protons, neutrons and electrons in four different particles.

| particle | protons | neutrons | electrons |
|----------|---------|----------|-----------|
| W        | 17      | 18       | 17        |
| X        | 16      | 18       | 18        |
| Y        | 17      | 20       | 17        |
| Z        | 18      | 20       | 18        |

Which two particles have the same chemical properties?

- A W and X
- B W and Y
- C X and Z
- D Y and Z

- 6 Which statement explains why sodium chloride,  $\text{NaCl}$ , has a high melting point?

- A  $\text{NaCl}$  contains strong ionic bonds.
- B  $\text{NaCl}$  contains strong covalent bonds.
- C  $\text{NaCl}$  contains strong intermolecular forces.
- D  $\text{NaCl}$  contains strong metallic bonds.

- 7 Different forms of an element G are used as lubricants and in cutting tools.

What is the structure of G?

- A giant covalent
- B ionic
- C metallic
- D simple covalent

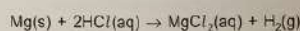
- 8 Which row shows the correct formulae of iron(II) bromide and zinc nitrate?

|   | iron(II) bromide       | zinc nitrate               |
|---|------------------------|----------------------------|
| A | $\text{FeBr}_2$        | $\text{ZnNO}_3$            |
| B | $\text{FeBr}_2$        | $\text{Zn}(\text{NO}_3)_2$ |
| C | $\text{Fe}_2\text{Br}$ | $\text{ZnNO}_3$            |
| D | $\text{Fe}_2\text{Br}$ | $\text{Zn}(\text{NO}_3)_2$ |

9 Which statement defines relative molecular mass?

- A the sum of the relative atomic masses
- B the simplest whole number ratio of the different atoms in a molecule
- C the number and type of different atoms in a molecule
- D the average mass of the isotopes of an element compared to 1/12th of the mass of an atom of  $^{12}\text{C}$

10 The equation for the reaction between magnesium and dilute hydrochloric acid is shown.



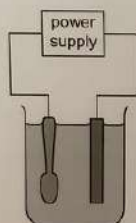
0.10 mol Mg is added to 100 cm<sup>3</sup> of 1.0 mol/dm<sup>3</sup> HCl(aq).

The hydrogen produced is collected and its volume measured at room temperature and pressure.

What is the maximum volume of hydrogen produced?

- A 0.05 dm<sup>3</sup>
- B 1.2 dm<sup>3</sup>
- C 2.4 dm<sup>3</sup>
- D 4.8 dm<sup>3</sup>

11 The apparatus shown is used to electroplate a copper spoon with silver.



Which row is correct?

|   | anode        | cathode      | electrolyte                 |
|---|--------------|--------------|-----------------------------|
| A | silver       | copper spoon | aqueous silver nitrate      |
| B | silver       | copper spoon | aqueous copper(II) chloride |
| C | copper spoon | silver       | aqueous silver nitrate      |
| D | copper spoon | silver       | aqueous copper(II) nitrate  |

12 Dilute sulfuric acid is electrolysed using inert electrodes.

What is produced at the anode?

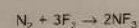
- A hydrogen
- B oxygen
- C sulfur
- D sulfur dioxide

13 Aqueous copper(II) sulfate is a blue solution. The solution is electrolysed using copper electrodes.

Which row describes the changes that take place during the electrolysis?

|   | mass of cathode | mass of anode | colour of solution |
|---|-----------------|---------------|--------------------|
| A | decreases       | increases     | becomes paler      |
| B | decreases       | increases     | stays the same     |
| C | increases       | decreases     | becomes paler      |
| D | increases       | decreases     | stays the same     |

14 Nitrogen trifluoride,  $\text{NF}_3$ , is used in the manufacture of certain types of solar panels. The equation for the formation of nitrogen trifluoride is shown.

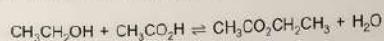


| type of bond        | bond energy in kJ/mol |
|---------------------|-----------------------|
| $\text{N}=\text{N}$ | +950                  |
| $\text{F}-\text{F}$ | +150                  |
| $\text{N}-\text{F}$ | +280                  |

Using the table of bond energies, what is the energy change for this reaction?

- A -560 kJ/mol
- B -280 kJ/mol
- C +280 kJ/mol
- D +3080 kJ/mol

- 15 Ethanol and ethanoic acid react to form ethyl ethanoate and water.



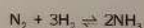
Which statement explains why concentrated sulfuric acid is added to the reaction mixture?

- A The position of equilibrium moves to the left-hand side.  
 B Sulfuric acid is a weaker acid than ethanoic acid.  
 C The total frequency of collisions decreases.  
 D Sulfuric acid acts as a catalyst for the reaction.
- 16 Which statement explains why increasing the concentration of a reactant increases the rate of reaction?

- A There is a higher percentage of successful collisions between particles.  
 B The activation energy of the reaction decreases.  
 C There is a higher percentage of collisions involving particles with energy greater than the activation energy.  
 D There are more collisions per second between particles.

- 17 The Haber process is used to make ammonia.

The equation for the reaction is shown.

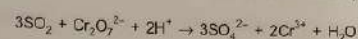


Which statements about the Haber process are correct?

- 1 The hydrogen used is made by reacting a metal with a dilute acid.
- 2 The nitrogen used is extracted from the air.
- 3 Hydrogen is extracted from methane.
- 4 The typical conditions for the Haber process are a pressure of 1.0 atm and an iron catalyst.

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

- 18 The equation represents the reaction between sulfur dioxide and acidified potassium dichromate(VI).



What is oxidised and what is the oxidising agent in this reaction?

|   | oxidised                     | oxidising agent              |
|---|------------------------------|------------------------------|
| A | $\text{Cr}_2\text{O}_7^{2-}$ | $\text{H}^+$                 |
| B | $\text{Cr}_2\text{O}_7^{2-}$ | $\text{Cr}_2\text{O}_7^{2-}$ |
| C | $\text{SO}_2$                | $\text{Cr}_2\text{O}_7^{2-}$ |
| D | $\text{SO}_2$                | $\text{H}^+$                 |

- 19 A known mass of magnesium is added to excess dilute hydrochloric acid.

The total volume of hydrogen produced is 70 cm<sup>3</sup>.

The experiment is repeated using dilute ethanoic acid in place of dilute hydrochloric acid.

All other conditions are the same.

Which row gives the relative rate of the reaction and the total volume of hydrogen produced in the second experiment?

|   | relative rate of reaction | total volume of hydrogen / cm <sup>3</sup> |
|---|---------------------------|--------------------------------------------|
| A | faster                    | 35                                         |
| B | faster                    | 70                                         |
| C | slower                    | 35                                         |
| D | slower                    | 70                                         |

- 20 Which products are formed when magnesium carbonate reacts with dilute hydrochloric acid?

- A carbon dioxide, hydrogen and magnesium chloride  
 B carbon dioxide and magnesium chloride only  
 C carbon dioxide, water and magnesium chloride  
 D water and magnesium chloride only

- C 21** Dilute hydrochloric acid is titrated against aqueous sodium hydroxide.

At the start of the titration, dilute hydrochloric acid is added to a conical flask using a .....1.....

A few drops of methyl orange indicator are added to the dilute hydrochloric acid in the conical flask.

Aqueous sodium hydroxide is added .....2..... until the colour of the indicator just .....3.....

Which row completes the gaps 1, 2 and 3?

|   | 1                  | 2                           | 3          |
|---|--------------------|-----------------------------|------------|
| A | burette            | dropwise                    | disappears |
| B | burette            | 1 cm <sup>3</sup> at a time | changes    |
| C | volumetric pipette | dropwise                    | changes    |
| D | volumetric pipette | 1 cm <sup>3</sup> at a time | disappears |

- A 22** Four aqueous substances are listed.

- 1 ammonium carbonate
- 2 calcium sulfate
- 3 potassium chloride
- 4 sodium nitrate

Which two substances, when added together, will give a precipitate?

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

- C 23** Which statements about the Periodic Table are correct?

- 1 The horizontal rows of the Periodic Table are called groups.
- 2 The Periodic Table is arranged in order of increasing proton number.
- 3 The elements in the second column from the left of the Periodic Table form ions with a charge of 2+.
- 4 Elements in a horizontal row of the Periodic Table become more metallic going from left to right.

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

- C 24** Which statement about alkali metals is correct?

- A Lithium is denser than sodium.  
 B Sodium is more reactive than potassium.  
 C Sodium has a higher melting point than potassium.  
 D Potassium has more outer-shell electrons than sodium.

- B 25** Which row describes the difference in malleability between alloys and pure metals and the difference?

|   | malleability of an alloy compared with pure metal | explanation                                             |
|---|---------------------------------------------------|---------------------------------------------------------|
| A | less malleable                                    | different-sized atoms slide more easily over each other |
| B | less malleable                                    | different-sized atoms slide less easily over each other |
| C | more malleable                                    | different-sized atoms slide more easily over each other |
| D | more malleable                                    | different-sized atoms slide less easily over each other |

- B 26** Aluminium does **not** react with dilute hydrochloric acid.

Zinc reacts with dilute hydrochloric acid to produce hydrogen gas.

Which statement explains these observations?

- A Aluminium has a greater tendency than zinc to form positive ions.  
 B Only aluminium is coated with a layer of its oxide.  
 C Aluminium is above zinc in the reactivity series.  
 D Zinc has a greater tendency than aluminium to form positive ions.

- A 27** Which equation represents the extraction of iron from hematite in a blast furnace?

- A  $\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$   
 B  $\text{FeO} + \text{CO} \rightarrow \text{Fe} + \text{CO}_2$   
 C  $2\text{Fe}_2\text{O}_3 \rightarrow 2\text{Fe} + 3\text{O}_2$   
 D  $\text{FeO} + \text{SiO}_2 \rightarrow \text{Fe} + \text{SiO}_3$

- 28** Aluminium is extracted from its ore by electrolysis using carbon electrodes. Aluminium, oxygen and carbon dioxide are all produced during this process. Which statement about this process is correct?

A Reduction of oxide ions happens at the carbon anode.  
 B Reduction of oxygen gas happens at the carbon anode.  
 C Reduction of oxide ions happens at the carbon cathode.  
 D Reduction of oxygen gas happens at the carbon cathode.

- 29** What is the equation for photosynthesis?

A  $\text{CO}_2 + 3\text{H}_2 \rightarrow \text{CH}_3\text{OH} + \text{H}_2\text{O}$   
 B  $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$   
 C  $\text{C}_6\text{H}_{12}\text{O}_6 \rightarrow 2\text{C}_2\text{H}_5\text{OH} + \text{CO}_2$   
 D  $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O}$

- 30** Modern cars are fitted with catalytic converters.

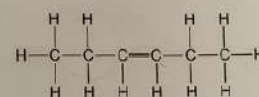
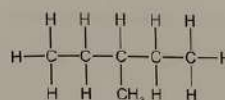
Which statement about the catalysts in catalytic converters is correct?

A They remove nitrogen from the car's exhaust so that it **cannot** combine with oxygen.  
 B They combine with oxygen from the engine to prevent the formation of oxides of nitrogen.  
 C They remove oxides of nitrogen that are produced in the car engine.  
 D They are replaced regularly because they are used up.

- 31** Which row describes a strategy for reducing global warming and a strategy for reducing acid rain?

|   | strategy for reducing global warming | strategy for reducing acid rain                 |
|---|--------------------------------------|-------------------------------------------------|
| A | burning more wood                    | flue gas desulfurisation                        |
| B | decrease use of petroleum            | increase use of coal for electricity generation |
| C | reduce livestock farming             | use catalytic converters in vehicles            |
| D | use low-sulfur fuels                 | reduce livestock farming                        |

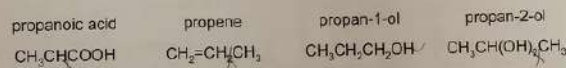
- 32** The formulas of two hydrocarbons are shown.



Which statement about these hydrocarbons is correct?

A They are both saturated. ✗  
 B They are structural isomers of each other. ✗  
 C They have the same general formula. ✗  
 D They produce the same volume of carbon dioxide during complete combustion. ✓

- 33** The names and structures of four organic compounds are shown.



Which compound has the correct structure?

A propanoic acid  
 B propene  
 C propan-1-ol ✓  
 D propan-2-ol

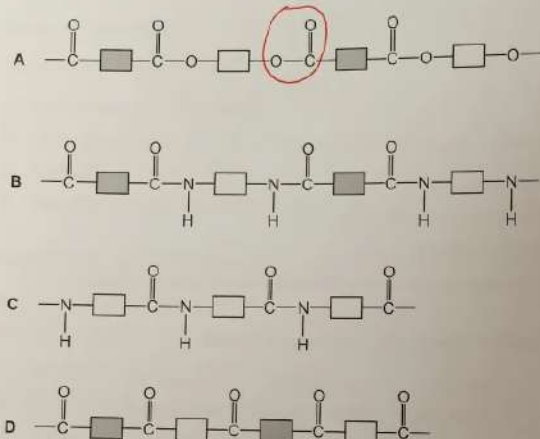
- 34** Which equation represents a substitution reaction?

A  $\text{CH}_3\text{CH}_2\text{Cl} + \text{Cl}_2 \rightarrow \text{CH}_3\text{CHClCl} + \text{HCl}$  ✓  
 B  $\text{CH}_3\text{CH}_2\text{OH} \rightarrow \text{CH}_2\text{CH}_2 + \text{H}_2\text{O}$   
 C  $\text{C}_2\text{H}_5\text{OH} + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 3\text{H}_2\text{O}$   
 D  $\text{CH}_2\text{CH}_2 + \text{HBr} \rightarrow \text{CH}_3\text{CH}_2\text{Br}$

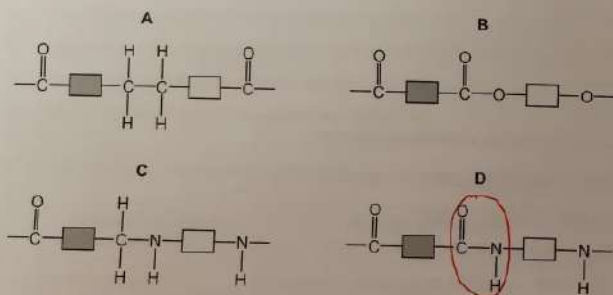
- 35** Which compound reacts rapidly with bromine to produce  $\text{CH}_3\text{CHBrCHBrCH}_3$ ?

A  $\text{CH}_3\text{CH}_2\text{Br}$   
 B  $\text{CH}_2=\text{CHCH}_2\text{CH}_3$   
 C  $\text{CH}_3\text{CH}=\text{CHCH}_3$  ✓  
 D  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$

**A** 36 Which structure represents the polymer PET?

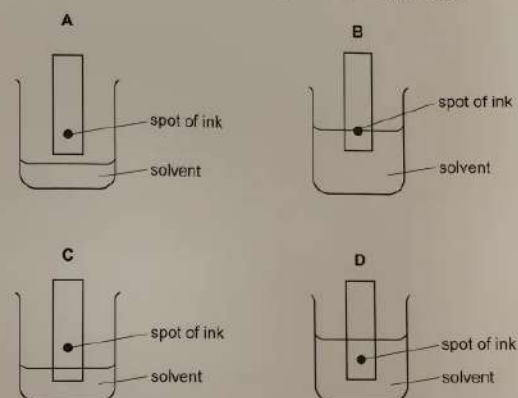


**D** 37 Which diagram shows the structure of nylon?



**C** 38 The colours in an ink can be separated by chromatography.

Which diagram shows the correct way to set up the apparatus?



**B** 39 Which process is used to produce drinking water from sea water?

- A crystallisation
- B distillation
- C filtration
- D chlorination

**D** 40 A sample of an ionic compound produces an orange-red flame test colour.

Which metal ion is present in the compound?

- A  $\text{Li}^+$
- B  $\text{Cu}^{2+}$
- C  $\text{K}^+$
- D  $\text{Ca}^{2+}$