Chemistry model answers **Paper 2**

Unit 6 The rate and extent of chemical change

Q.1 Explain how increased surface area/concentration/temperature/gas pressure increase the rate of reaction

For example, for temperature, for 3 marks:

- Particles move faster
- Greater **frequency** of collisions
- On average collisions are more energetic

For example, for surface area, for 2 marks

- More particles exposed
- So greater **frequency** of collisions

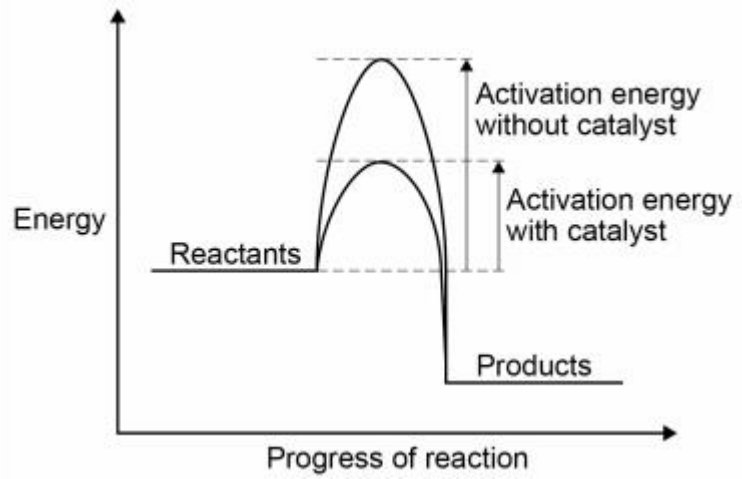
For example, for concentration/gas pressure

- more particles per unit volume
- so more **frequent** collisions

Q.2 Explain how a catalyst increases the rate of reaction (2 marks)

- Provides a different reaction pathway
- Which has a lower activation energy

Q.3 Draw a reaction profile for a reaction that is without a catalyst and one that has a catalyst. Label the axes, reactants, products and activation energies (4 marks)



Q.4 Explain what happens when equilibrium is reached in a closed system (2 marks)

- The forward and reverse reactions
- Occur at exactly the same rate

Q.5 Colourless dinitrogen tetroxide and brown nitrogen oxide reach an equilibrium

$$N_2O_4(g) \quad \rightleftharpoons \quad 2NO_2(g) \qquad \Delta H = +ve$$

$$Colourless \qquad Brown$$

(a) Explain what happens to the colour of the reaction mixture if temperature is increased (4 marks)

- The endothermic reaction/backward reaction is favoured
- To counteract the change
- So more N_2O_4 is formed as equilibrium moves to the left
- So paler colour

(b) Explain what happens to the colour of the reaction mixture if pressure is increased (4 marks)

- The left-hand side has fewer molecules (1 molecule on left, 2 molecules on right)
- So lower gas pressure to counteract change
- So more N_2O_4 is formed as equilibrium moves to the left
- So paler colour

(c) Explain what happens to the equilibrium position if more N_2O_4 is added (2 marks)

- More products are formed
- Until equilibrium is reached again

Unit 7 Organic chemistry

Q.1 Describe how crude oil may be separated into useful parts (4 marks)

- Fractional distillation
- Crude oil is heated and vaporised
- Each fraction passes up the column
- And condenses at a different temperature
- Lower boiling point condenses higher up

Q.2 Explain why octane, C_8H_{18} is a better fuel than octadecane, $C_{18}H_{38}$ (3 marks)

- More viscous so flows more easily
- Lower boiling point
- So more flammable

Q.3 (a) Write a balanced symbol equation for the reaction of butene with hydrogen and say two conditions that are needed (3 marks)

- $C_4H_8 + H_2 \rightarrow C_4H_{10}$
- Catalyst
- High temperature/pressure

(b) Write a balanced symbol equation for the reaction of butene with water and say two conditions that are needed (3 marks)

- $C_4H_8 + H_2O \rightarrow C_4H_9OH$
- Catalyst
- High temperature

Q.4 Describe reactions of ethanol with sodium and when burned in air (4 marks)

- Reacts with oxygen in air
- To make carbon dioxide and water
- Reacts with sodium
- To make hydrogen (and sodium ethoxide)

Q.5 Describe how ethanol is produced from sugar solution (3 marks)

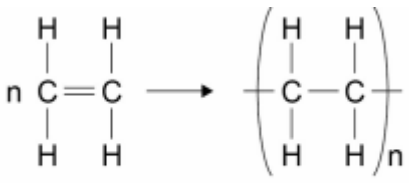
- **Fermentation**
- **Add yeast**
- **Anaerobic or warm**

Q.6 Describe reactions of ethanoic acid with calcium carbonate and with ethanol

(4 marks)

- Makes calcium ethanoate
- And carbon dioxide and water
- Makes the ester ethyl ethanoate
- And water
- Second reaction requires presence of sulfuric acid

Q.7 Draw a symbol equation to show the formation of poly(ethene) from the monomer ethene (3 marks)



Unit 8 Chemical analysis

Q.1 Describe a test to show the presence of H_2, O_2, Cl_2, CO_2, Li, Na, K, Ca, Cu, Al Ca, Mg, Cu^{2+}, Fe^{2+}, Fe^{3+}, C^{l-}, B^{r-}, I^-, SO_4^{2-}, CO_3^{2-}

For example, for sulfate ions, for 3 marks:

- Add barium chloride
- Add hydrochloric acid
- White precipitate produced.

Q. 2 Describe how to distinguish between solutions containing aluminium ions and magnesium ions (3 marks)

- Add sodium hydroxide
- Both give a white precipitate
- Aluminium hydroxide will dissolve in excess sodium hydroxide.

Q.3 An ethanol soluble ink is separated into its dyes using chromatography. Explain why the start line is drawn in pencil and not pen (2 marks)

- Ink from pen is soluble in ethanol
- And would move up the chromatography paper.

Q. 4 Describe how a sample is analysed using flame emission spectroscopy and the advantages compared to chemical tests (6 marks)

- The sample is placed in a flame
- The light given out is passed through a spectroscope
- The output is a line spectroscope
- That can be analysed to identify metal ions
- Very accurate
- Can tell concentrations of ions
- Only needs small sample amounts
- fast

Q.5 Describe a physical test to show that a sample of tap water is not pure water

- Boiling point
- Not 100 ^{O}C
- **OR** allow evaporation leaves solid residue

Q.6 A student has three different colourless and odourless gases in test tubes. They are carbon dioxide, oxygen and hydrogen. Describe how she can determine each gas correctly (6 marks)

- Carbon dioxide passed through lime water; colourless to cloudy
- Oxygen glowing splint; relights
- Hydrogen burning splint; (squeaky) pop

Unit 9 Chemistry of the atmosphere

Q.1 Explain how the percentages of carbon dioxide and oxygen in the earth's atmosphere have changed over time (6 marks)

- Carbon dioxide decreased
- Carbon dioxide dissolved in oceans
- Sediments produced carbonates
- Carbon locked up in sedimentary rocks/fossil fuels

- Oxygen increased
- Algae and plants evolved
- Absorbed carbon dioxide
- By photosynthesis
- Which produces oxygen.

Q.2 Explain how limestone was formed (4 marks)

- Skeletons of sea animals
- Accumulated at the bottom of oceans
- Mixed with silt/sand
- Created over time by immense pressure.

Q. 3 Explain how coal was formed (4 marks)

- Dead plants
- Decayed very slowly to form peat
- Covered by layers of sediment
- Over time changed by compression/heat into coal.

Q.4 Explain how greenhouse gases increase the temperature of the Earth (6 marks)

- Short wavelength radiation from the Sun
- Penetrates through the atmosphere
- Heats the surface of the Earth
- Longer wavelength infrared radiation
- Is emitted from the surface of the earth
- And is absorbed by greenhouse gases
- Heating up the lower atmosphere.

Q.5 Evaluate the causes of global climate change and its impact on future generations (6 marks)

- Melting ice caps cause rising sea levels which could lead to flooding of coastal areas. This is where much of the human population lives.
- Climate change could lead to droughts which may cause famines if rainfall patterns change
- More severe weather events such as hurricanes could lead to greater loss of life
- Extreme climate change could lead to animal/plant extinctions due to habitat change

Q.6 Describe how four different pollutants are made from burning fuels AND their negative impact (6 marks)

- Carbon monoxide – incomplete combustion – toxic and respiratory illnesses
- Soot - incomplete combustion – respiratory illnesses and global dimming
- Sulfur dioxide – sulfur compounds in fuels – acid rain – kills animal life in lakes, kills trees
- Oxides of nitrogen – car engines (where it is hot enough for nitrogen in air to react with oxygen) - acid rain

Unit 10 Using resources

Q.1 Copper is a rare metal. Evaluate the proceses of open cast mining, phytomining and bioleaching to obtain copper. (6 marks)

- Open cast mining destroys habitats, creates dust, noise
- Copper can be obtained quite quickly
- Phytomining uses plants that absorb copper compounds from low grade ores as they grow. Plants are harvested and burnt; copper is extracted from the ash.
- Takes many years
- Bioleaching uses bacteria to break down low grade ores to produce a solution containing copper ions which can then be extracted by displacement/electrolysis
- Produces toxic substances such as sulfuric acid
- **Q.2** $N_2 + 3H_2 \rightleftharpoons 2NH_3$

Q. 2 Ammonia is produced using a high temperature and pressure with an iron catalyst. Explain the effect of each condition on the rate of reaction and the yield of ammonia (6 marks)

- High temperature increases rate of reaction
- High temperature decreases yield because forward reaction is exothermic so backward reaction is favoured.
- High pressure increases rate of reaction
- High pressure increases yield because fewer molecules for forward reaction means lower pressure
- Catalyst increases rate of reaction
- Catalyst has no effect on yield as both forward and backward reactions speed up equally.

Q.3 Describe and explain how potable water is created from water in a resevoir.(4 marks)

- Water is passed through filter beds
- To remove insoluble solids
- Water is sterilised to kill bacteria/pathogens
- Using chlorine/ozone/uv light

Q.4 Describe how sewage can be treated to make it safe (4 marks)

- Screened to remove insoluble solids
- Sedimentation makes sewage sludge and effluent
- Anaerobic digestion of sewage sludge
- Aerobic treatment of effluent

Q.5 Explain why aluminium does not corrode easily (3 marks)

- Coated with a layer of aluminium oxide
- Which is very unreactive
- So the metal underneath is not exposed to oxygen/water

Q.6 Explain why a zinc block attached to the outside of a steel ship prevents the steel from rusting (3 marks)

- Sacrificial protection
- Zinc is more reactive
- So loses electrons (is oxidised) more easily