Organic Chemistry

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1. How many π electrons are present in benzene?

- 8
- 4
- 10
- 6

2. What type of polymerisation is used in the industrial production of poly(ethene), usually known as polythene or polyethylene, from ethene?

- Condensation polymerisation
- Addition polymerisation
- Ionic polymerisation
- Ring-opening polymerisation

3. What is the typical by-product in condensation polymerisation reactions?

- Water
- Hydrogen gas
- Carbon dioxide
- Ammonia

4. Which of these techniques is most useful for identifying the functional groups present in an organic molecule?

- NMR spectroscopy
- IR spectroscopy
- Thin Layer Chromatography (TLC)

- Mass spectrometry

5. In proton NMR spectroscopy, what does a doublet signal usually indicate about a proton?

- Not being split at all
- Being split by three protons
- Being split by two protons
- Being split by one proton

6. Which of the following is NOT a recognised type of isomerism in organic chemistry?

- Optical isomerism
- Electronic isomerism
- Geometric isomerism
- Structural isomerism

7. What is the primary difference between optical isomers?

- Have different densities
- Boil at different temperatures
- Have different molar masses
- Rotate plane-polarised light in opposite directions

8. Which of the following compounds will exhibit cis-trans isomerism?

- 1-chloroprop-1-ene
- 1-chloro-2-bromopropane
- Ethene
- 1-chloro-2-methylprop-1-ene

9. Which of the following is a term used to describe one of a pair of molecules which are non-superimposable mirror images?

- Racemate
- Diastereomer
- Asymmetrer
- Enantiomer

10. In the acid-catalysed hydration of alkenes, what is the key intermediate formed?

- A free radical
- An alkane
- A carbocation
- A carbanion

11. Why does benzene, unlike alkenes, resist electrophilic addition reactions?

- Because benzene experiences an additional stabilisation energy due to its aromaticity.
- Because benzene does not contain any π bonding.
- Because benzene can only act as an electrophile, not a nucleophile.
- Because benzene has a much lower electron density.

12. What is the product formed when propanone reacts with $\mathrm{NaBH_4}$?

- Propan-1-ol
- Propene
- Propane
- Propan-2-ol

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Stoichiometry

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13. How many moles of water are produced when $16\,\mathrm{g}$ of methane undergo complete combustion?

- $2.0\,\mathrm{mol}$
- $3.0\,\mathrm{mol}$
- $1.0\,\mathrm{mol}$
- $4.0\,\mathrm{mol}$

14. How many grams of $\mathrm{O_2}$ are required to completely combust $10\,\mathrm{g}$ of propane?

- $36\,\mathrm{g}$
- $10\,\mathrm{g}$
- $16\,\mathrm{g}$
- $18\,\mathrm{g}$

15. What is likely to be the empirical formula of an organic compound containing $40\,\%$ carbon and 53% oxygen by mass, assuming the only other element it contains is hydrogen?

- CHO
- $\mathrm{CH_4O}$
- $\mathrm{CH_2O}$
- $\mathrm{C_2H_6O_3}$

16. $5.0\,\mathrm{g}$ of calcium carbonate are added to $65\,\mathrm{cm^3}$ of $1.5\,\mathrm{mol\,dm^{-3}}$ hydrochloric acid and $5.0\,\mathrm{g}$ of calcium chloride are isolated from the solution. What is the percentage yield of calcium chloride?

- $90\,\%$
- $46\,\%$
- $92\,\%$

- $100\,\%$

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17. In the reaction $\mathrm{A} + 2\,\mathrm{B} \longrightarrow \mathrm{C}$, if $3.0\,\mathrm{mol}$ of A and $4.0\,\mathrm{mol}$ of B are used, which is the limiting reagent?

- Both A and B.
- B is the limiting reagent.
- A is the limiting reagent.
- Neither A nor B

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18. In a titration, $25.0\,\mathrm{cm^3}$ of $0.150\,\mathrm{mol\,dm^{-3}}$ acid is neutralised by $30.0\,\mathrm{cm^3}$ of a sodium hydroxide solution. If the acid is diprotic, what is the concentration of the sodium hydroxide solution?

- $0.200\,\mathrm{mol\,dm^{-3}}$
- $0.125\,\mathrm{mol\,dm^{-3}}$
- $0.250\,\mathrm{mol\,dm^{-3}}$
- $0.150\,\mathrm{mol\,dm^{-3}}$

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19. A $46\,\mathrm{g}$ sample of $\mathrm{Fe_2O_3}$ reacts with excess CO to produce iron and carbon dioxide. Calculate the mass of iron produced.

- $32\,\mathrm{g}$
- $16\,\mathrm{g}$
- $36\,\mathrm{g}$
- $18\,\mathrm{g}$

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20. Calculate the mass of $\mathrm{CaCl_2}$ needed to prepare $500.0\,\mathrm{cm^3}$ of a $0.250\,\mathrm{mol\,dm^{-3}}$ solution.

- $27.8\,\mathrm{g}$
- $13.9\,\mathrm{g}$
- $111.2\,\mathrm{g}$
- $55.6\,\mathrm{g}$

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21. If $100\,\mathrm{g}$ of $\mathrm{CaCO_3}$ is heated and fully decomposes, what (approximately) is the volume of gas produced at RTP?

- $12\,\mathrm{dm^3}$
- $30\,\mathrm{dm^3}$

- $48\,\mathrm{dm}^3$
- $24\,\mathrm{dm}^3$

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22. In a controlled combustion experiment, $5.00\,\mathrm{g}$ of hydrogen gas reacted with excess chlorine to form hydrogen chloride, with the conditions remaining constant throughout. The temperature was held at $50\,^\circ\mathrm{C}$ while the pressure remained at $2.5 \times 10^5\,\mathrm{Pa}$. Calculate the volume of hydrogen chloride that was produced under these conditions, assuming it can be modelled as an ideal gas.

- $54\,\mathrm{dm}^3$
- $60\,\mathrm{dm}^3$
- $27\,\mathrm{dm}^3$
- $120\,\mathrm{dm}^3$

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23. Which of the following statements about atom economy is correct?

- Atom economy can take negative values.
- An addition reaction producing a desirable product has an atom economy of $100\,\%$.
- Atom economy is calculated by dividing the mass of all by-products by the mass of all reactants.
- If a reaction has an atom economy of $50\,\%$, it means that half of the molecules formed are useful products.

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24. A student has calculated the percentage yield of a reaction producing **X** and obtained an answer of $110\,\%$. Which of the following is NOT usually a possible explanation?

- The conditions were not controlled leading to an incorrect quantification of **X** (e.g. **X** quantified by gas volume not accounting for a change in temperature).
- The product sample was still contaminated with solvent.
- The student carried out the percentage yield calculation incorrectly.
- The amount of **X** formed is greater than the theoretical amount possible based on the limiting reagent quantity

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