



New Zealand Chemistry Olympiad Trust

Training Group Selection Examination

September 2023

40 Multiple choice questions

TIME ALLOWED: 60 minutes

Calculators may be used.

A periodic table with atomic masses may be provided by the school

1. Which molecule has a shape most similar to the NH_3 molecule?

- A. GaI_3 B. PBr_3 C. FeCl_3 D. SOCl_2 E. BF_3

2. Which of the following shows the order in which molecules have an

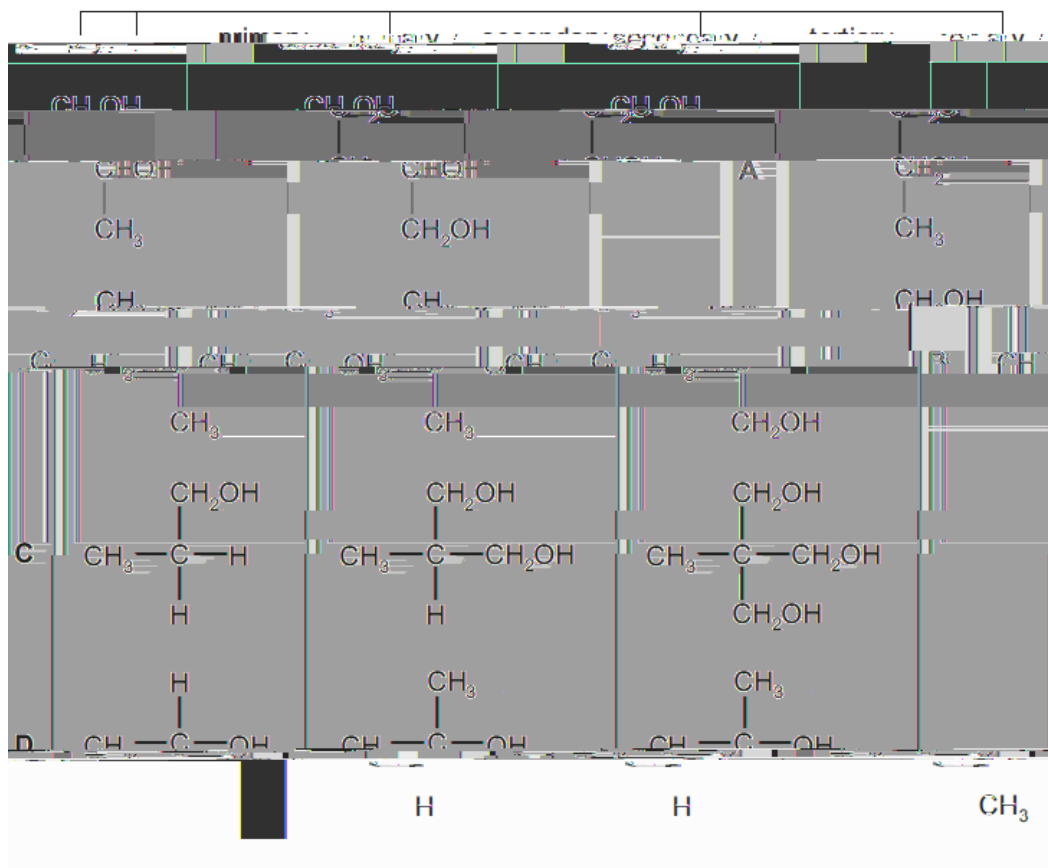
11. The average bond enthalpy for the C-H bond is 413 kJ mol^{-1} . Which reaction has an enthalpy change closest to this value?



26. Which compound has the shortest CN bond?

- A. CH_3NH_2 B. CH_3CN C. CH_3CHNH
 D. $(\text{CH}_3)_2\text{CHNH}_2$ E. $(\text{CH}_3)_3\text{CNH}_2$

27. Which row or rows correctly shows a primary, a secondary and a tertiary alcohol?



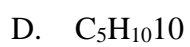
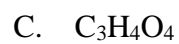
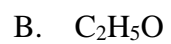
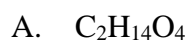
- A. Rows B and D B. Rows A and B C. Rows C and A
 D. Row D E. Row B

28. Which statement(s) are correct for metals?

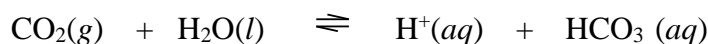
- I. They conduct electricity because they have free moving ions
 II. They consist of a close-packed lattice of positive ions with delocalised electrons
 III. They are malleable because the metallic bonds are non-directional

- A. I only B. I and II only C. I and III only
 D. II and III only E. I, II and III

29. A compound with molar mass $M = 102 \text{ g mol}^{-1}$ contains 58.8% carbon, 9.80% hydrogen and 31% oxygen by mass. What is its molecular formula?



31. The overall pressure is increased on the mixture below which is at equilibrium. Which will be true of the mixture once equilibrium is restored?



- A. Higher product concentrations, and lower pH
B. Higher product concentrations and higher pH
C. Lower product concentrations and higher pH.
D. Lower product concentrations and lower pH.
E. There will be no change in product concentrations or pH.
32. $\text{H}_2 + \text{Cl}_2 \rightleftharpoons 2\text{HCl}$
- Hydrogen and chlorine react according to the equation above. Which will be the result of reaction of 2.0 moles of H_2 and 1.5 moles of Cl_2 ?
- A. 3.5 mol of HCl
B. 4 mol HCl
C. 1.5 mol of HCl and 0.5 mol of H_2
D. 2.0 mol of HCl and 0.5 mol of Cl_2
E. 3.0 mol of HCl and 0.5 mol of H_2
33. Methylbuta-1,3-diene, $\text{CH}_2=\text{C}(\text{CH}_3)-\text{CH}=\text{CH}_2$ is a monomer in the manufacture of synthetic rubbers. Which compound would **NOT** produce this monomer on treatment with concentrated sulfuric acid at 170 °C?
- A. $(\text{CH}_3)_2\text{C}(\text{OH})\text{CH}_2\text{CH}_3$

35. For a titration of ammonia $\text{NH}_3(aq)$ with $\text{HCl}(aq)$,

