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**CHEMISTRY
STANDARD LEVEL
PAPER 1**

Tuesday 18 November 2014 (afternoon)

45 minutes

INSTRUCTIONS TO CANDIDATES

- Do not open this examination paper until instructed to do so.
- Answer all the questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.
- The periodic table is provided for reference on page 2 of this examination paper.
- The maximum mark for this examination paper is [30 marks].

1. 0.040 mol of $(\text{NH}_4)_2\text{Ni}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$ is dissolved in water to give 200 cm^3 of aqueous solution. What is the concentration, in mol dm^{-3} , of ammonium ions?

- A. 0.00040
- B. 0.0080
- C. 0.20
- D. 0.40

2. When sodium bromate(V), NaBrO_3 , is heated, it reacts according to the equation below.



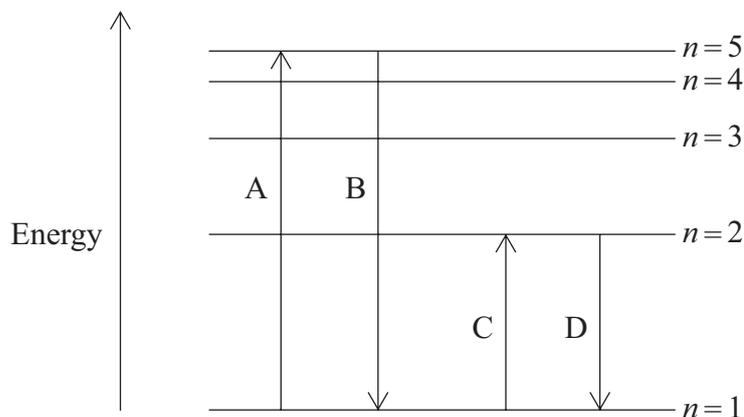
What amount, in mol, of NaBrO_3 produces 2.4 dm^3 of oxygen gas, measured at room temperature and pressure? (Molar volume of gas = $24\text{ dm}^3\text{ mol}^{-1}$ at room temperature and pressure.)

- A. 0.017
 - B. 0.067
 - C. 0.10
 - D. 0.15
3. Aluminium carbide reacts with water according to the equation below. What is the **sum** of all the coefficients when the equation is balanced?



- A. 13
- B. 14
- C. 19
- D. 20

4. At which temperature, in K, assuming constant pressure, is the volume of a fixed mass of gas at 127 °C doubled?
- A. 200 K
 B. 254 K
 C. 400 K
 D. 800 K
5. Which ion will show the **least** deflection in a mass spectrometer?
- A. $^{35}\text{Cl}^+$
 B. $^{35}\text{Cl}^{2+}$
 C. $^{35}\text{Cl} \ ^{35}\text{Cl}^+$
 D. $^{35}\text{Cl} \ ^{37}\text{Cl}^+$
6. Some possible electron transitions in a hydrogen atom are shown below. Which letter represents the electron transition with the highest energy in the emission spectrum?



7. Which properties decrease down both group 1 **and** group 7?
- I. Melting point
 - II. First ionization energy
 - III. Electronegativity
- A. I and II only
 - B. I and III only
 - C. II and III only
 - D. I, II and III
8. Which period 3 oxide, when added to water, forms an acidic solution?
- A. SO_3
 - B. MgO
 - C. Na_2O
 - D. Al_2O_3
9. Which species contains a dative covalent (coordinate) bond?
- A. HCN
 - B. C_2H_2
 - C. CO_2
 - D. CO

10. Which diatomic molecule has the strongest bonding between its atoms?

- A. H_2
- B. N_2
- C. O_2
- D. F_2

11. Which molecule is non-polar?

- A. CCl_4
- B. CH_2Cl_2
- C. CH_3Cl
- D. CO

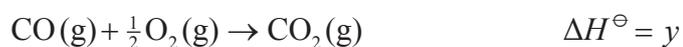
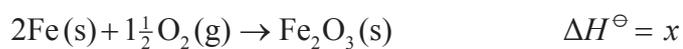
12. Which process involves the breaking of hydrogen bonds?

- A. $2\text{HI}(\text{g}) \rightarrow \text{H}_2(\text{g}) + \text{I}_2(\text{g})$
- B. $\text{CH}_4(\text{g}) \rightarrow \text{C}(\text{g}) + 4\text{H}(\text{g})$
- C. $\text{H}_2(\text{l}) \rightarrow \text{H}_2(\text{g})$
- D. $\text{NH}_3(\text{l}) \rightarrow \text{NH}_3(\text{g})$

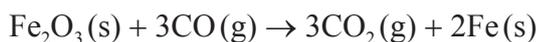
13. Which species contains a bond angle of approximately 107° ?

- A. H_2O
- B. CF_4
- C. NCl_3
- D. BF_3

14. The enthalpy change for the reaction between zinc metal and copper(II) sulfate solution is -217 kJ mol^{-1} . Which statement about this reaction is correct?
- A. The reaction is endothermic and the temperature of the reaction mixture initially rises.
- B. The reaction is endothermic and the temperature of the reaction mixture initially drops.
- C. The reaction is exothermic and the temperature of the reaction mixture initially rises.
- D. The reaction is exothermic and the temperature of the reaction mixture initially drops.
15. Consider the following equations.



What is the enthalpy change of the reaction below?



- A. $3y - x$
- B. $3y + x$
- C. $-3y - x$
- D. $-3y + x$

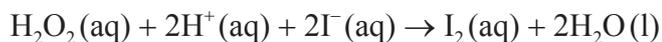
16. Consider the following bond enthalpy data.

Bond	Bond enthalpy / kJ mol^{-1}
H-H	436
Cl-Cl	243
H-Cl	432

What is the enthalpy change, in kJ mol^{-1} , of this reaction?



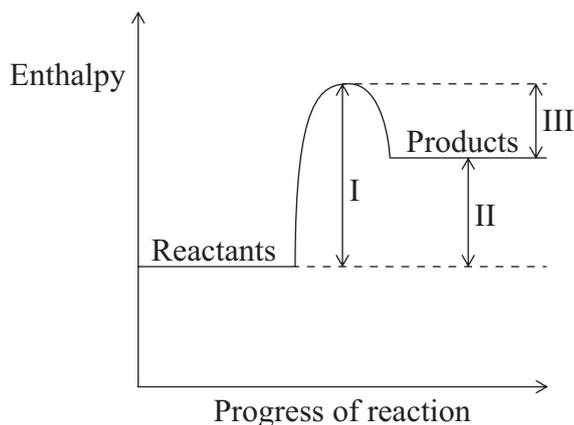
- A. +247
- B. -247
- C. -185
- D. +185
17. Consider the following reaction between hydrogen peroxide, hydrogen ions and iodide ions.



Which changes could be used to investigate the rate of this reaction?

- I. Electrical conductivity
- II. Mass of solution
- III. Colour intensity
- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

18. Which quantity can be changed by the use of a catalyst?



- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III
19. Which equilibrium reaction shifts to the product side when the temperature is increased at constant pressure **and** to the reactant side when the total pressure is increased at constant temperature?

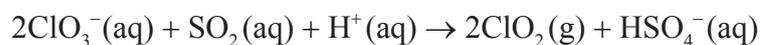
- A. $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g}) \quad \Delta H^\ominus < 0$
- B. $\text{N}_2\text{O}_4(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g}) \quad \Delta H^\ominus > 0$
- C. $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g}) \quad \Delta H^\ominus < 0$
- D. $\text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g}) \rightleftharpoons \text{PCl}_5(\text{g}) \quad \Delta H^\ominus > 0$

20. Which statement correctly describes the effect of a catalyst on the equilibrium below?



- A. It increases the rates of both forward and reverse reactions equally.
- B. It increases the rate of the forward reaction but decreases the rate of the reverse reaction.
- C. It increases the value of the equilibrium constant.
- D. It increases the yield of NH_3 .

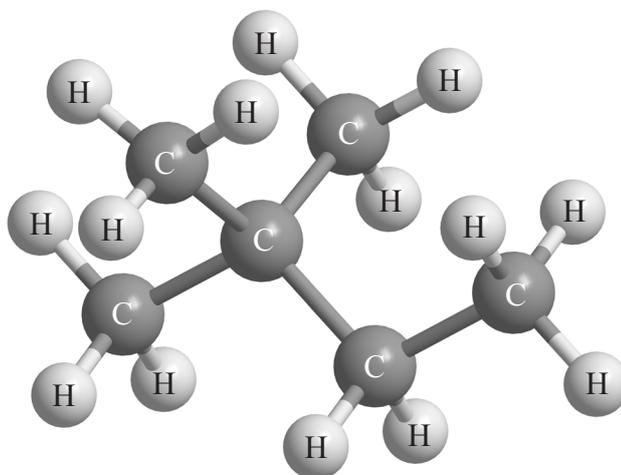
21. Which definition of a base is correct?
- A. A Lewis base accepts a proton.
 - B. A Brønsted–Lowry base accepts an electron pair.
 - C. A Brønsted–Lowry base donates an electron pair.
 - D. A Lewis base donates an electron pair.
22. A student adds 0.3 g of magnesium metal to equal volumes of hydrochloric acid and ethanoic acid of the same concentrations in separate flasks. Which statement is correct?
- A. Hydrochloric acid reacts more rapidly as it has a higher pH than ethanoic acid.
 - B. A greater total volume of H₂ gas is produced with hydrochloric acid than with ethanoic acid.
 - C. The same total volume of H₂ gas is produced with both hydrochloric acid and ethanoic acid.
 - D. Ethanoic acid reacts more slowly because it has a lower pH than hydrochloric acid.
23. Which species of vanadium has a different oxidation number from the rest?
- A. VO₂⁺
 - B. VO₃⁻
 - C. V₂O₅
 - D. VO²⁺
24. Which statement is correct for the following reaction?



- A. ClO₃⁻ is the oxidizing agent and it undergoes reduction.
- B. ClO₃⁻ is the reducing agent and it undergoes oxidation.
- C. SO₂ is the oxidizing agent and it undergoes oxidation.
- D. SO₂ is the reducing agent and it undergoes reduction.

25. Which statement about an electrolytic cell is correct?
- A. Chemical energy is converted to electrical energy.
 - B. Electrons move through the electrolyte.
 - C. The cathode is the negative electrode.
 - D. The negative ions move towards the negative electrode.

26. What is the name of the alkane shown in the diagram below, applying IUPAC rules?



- A. Hexane
 - B. 1,1,1-trimethylpropane
 - C. Ethylmethylpropane
 - D. 2,2-dimethylbutane
27. Which structural formula represents a secondary halogenoalkane?
- A. $\text{CH}_3\text{CHBrCH}_2\text{CH}_3$
 - B. $(\text{CH}_3)_3\text{CBr}$
 - C. $\text{CH}_3(\text{CH}_2)_3\text{Br}$
 - D. $(\text{CH}_3)_2\text{CHCH}_2\text{Br}$

28. Which equation represents a propagation step in the reaction of methane with bromine?
- A. $\text{CH}_4 \rightarrow \text{CH}_3\cdot + \text{H}\cdot$
 - B. $\text{CH}_4 + \text{Br}\cdot \rightarrow \text{CH}_3\cdot + \text{HBr}$
 - C. $\text{CH}_4 + \text{Br}\cdot \rightarrow \text{CH}_3\text{Br} + \text{H}\cdot$
 - D. $\text{CH}_3\cdot + \text{Br}\cdot \rightarrow \text{CH}_3\text{Br}$
29. Chloroethane, $\text{C}_2\text{H}_5\text{Cl}$, reacts with aqueous sodium hydroxide, NaOH , to form ethanol, $\text{C}_2\text{H}_5\text{OH}$. Which statement about the mechanism of this reaction is correct?
- A. The reaction follows an $\text{S}_{\text{N}}1$ mechanism.
 - B. Homolytic fission of the carbon-chlorine bond occurs in chloroethane.
 - C. The reaction is unimolecular.
 - D. The transition state formed is negatively charged.
30. In an experiment to determine a specific quantity, a student calculated that her experimental uncertainty was 0.9% and her experimental error was 3.5%. Which statement is correct?
- A. Only random uncertainties are present in this experiment.
 - B. Both random uncertainties and systematic errors are present in this experiment.
 - C. Repeats of this experiment would reduce the systematic errors.
 - D. Repeats of this experiment would reduce both systematic errors and random uncertainties.
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