

**CHEMISTRY
STANDARD LEVEL
PAPER 1**

Tuesday 18 May 2004 (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

| | | | | | | | | | | | | | | | | | |
|--------------------|--------------------|----------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|-------------------|--------------------|
| | | Atomic Number | | | | | | | | | | | | 2 He 4.00 | | | |
| | | Element | | | | | | | | | | | | | | | |
| | | Atomic Mass | | | | | | | | | | | | | | | |
| 1 H 1.01 | | | | | | | | | | | | | | | | | |
| 3 Li 6.94 | 4 Be 9.01 | | | | | | | | | | | | | | | | |
| 11 Na 22.99 | 12 Mg 24.31 | | | | | | | | | | | | | | | | |
| 19 K 39.10 | 20 Ca 40.08 | 21 Sc 44.96 | 22 Ti 47.90 | 23 V 50.94 | 24 Cr 52.00 | 25 Mn 54.94 | 26 Fe 55.85 | 27 Co 58.93 | 28 Ni 58.71 | 29 Cu 63.55 | 30 Zn 65.37 | 31 Ga 69.72 | 32 Ge 72.59 | 33 As 74.92 | 34 Se 78.96 | 35 Br 79.90 | 36 Kr 83.80 |
| 37 Rb 85.47 | 38 Sr 87.62 | 39 Y 88.91 | 40 Zr 91.22 | 41 Nb 92.91 | 42 Mo 95.94 | 43 Tc 98.91 | 44 Ru 101.07 | 45 Rh 102.91 | 46 Pd 106.42 | 47 Ag 107.87 | 48 Cd 112.40 | 49 In 114.82 | 50 Sn 118.69 | 51 Sb 121.75 | 52 Te 127.60 | 53 I 126.90 | 54 Xe 131.30 |
| 55 Cs 132.91 | 56 Ba 137.34 | 57 † La 138.91 | 72 Hf 178.49 | 73 Ta 180.95 | 74 W 183.85 | 75 Re 186.21 | 76 Os 190.21 | 77 Ir 192.22 | 78 Pt 195.09 | 79 Au 196.97 | 80 Hg 200.59 | 81 Tl 204.37 | 82 Pb 207.19 | 83 Bi 208.98 | 84 Po (210) | 85 At (210) | 86 Rn (222) |
| 87 Fr (223) | 88 Ra (226) | 89 ‡ Ac (227) | | | | | | | | | | | | | | | |
| † | | | | | | | | | | | | | | | | | |
| | | 58 Ce 140.12 | 59 Pr 140.91 | 60 Nd 144.24 | 61 Pm 146.92 | 62 Sm 150.35 | 63 Eu 151.96 | 64 Gd 157.25 | 65 Tb 158.92 | 66 Dy 162.50 | 67 Ho 164.93 | 68 Er 167.26 | 69 Tm 168.93 | 70 Yb 173.04 | 71 Lu 174.97 | | |
| | | 90 Th 232.04 | 91 Pa 231.04 | 92 U 238.03 | 93 Np (237) | 94 Pu (242) | 95 Am (243) | 96 Cm (247) | 97 Bk (247) | 98 Cf (251) | 99 Es (254) | 100 Fm (257) | 101 Md (258) | 102 No (259) | 103 Lr (260) | | |
| ‡ | | | | | | | | | | | | | | | | | |

1. How many hydrogen atoms are contained in one mole of ethanol, $\text{C}_2\text{H}_5\text{OH}$?

- A. 5
- B. 6
- C. 1.0×10^{23}
- D. 3.6×10^{24}

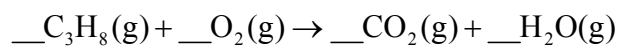
2. The percentage by mass of the elements in a compound is

$$\text{C} = 72\%, \quad \text{H} = 12\%, \quad \text{O} = 16\%.$$

What is the mole ratio of C : H in the empirical formula of this compound?

- A. 1 : 1
- B. 1 : 2
- C. 1 : 6
- D. 6 : 1

3. What is the coefficient for $\text{O}_2(\text{g})$ when the equation below is balanced?

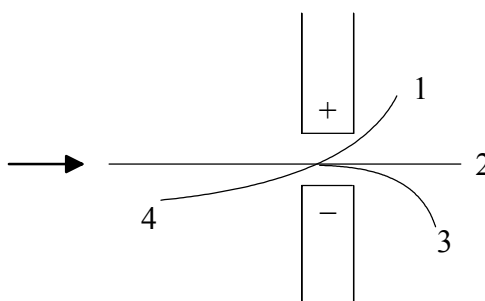


- A. 2
- B. 3
- C. 5
- D. 7

4. What amount of NaCl (in moles) is required to prepare 250 cm^3 of a $0.200 \text{ mol dm}^{-3}$ solution?

- A. 50.0
- B. 1.25
- C. 0.800
- D. 0.0500

5. Electrons are directed into an electric field from left to right as indicated by the arrow in the diagram below. Which path is most probable for these electrons?



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

6. How many valence electrons are present in an atom of an element with atomic number 16?

- A. 2
- B. 4
- C. 6
- D. 8

7. For which element are the group number and the period number the same?
- A. Li
 - B. Be
 - C. B
 - D. Mg
8. Which of the physical properties below decrease with increasing atomic number for both the alkali metals and the halogens?
- I. Atomic radius
 - II. Ionization energy
 - III. Melting point
- A. I only
 - B. II only
 - C. III only
 - D. I and III only
9. What is the formula of an ionic compound formed by element X (group 2) and element Y (group 6)?
- A. X_3Y
 - B. X_2Y
 - C. XY_2
 - D. XY

10. Based on electronegativity values, which bond is the most polar?

- A. B—C
- B. C—O
- C. N—O
- D. O—F

11. What is the Lewis (electron dot) structure for sulfur dioxide?

- A. $\text{:}\ddot{\text{O}}\text{:S}::\ddot{\text{O}}\text{:}$
- B. $\text{:}\ddot{\text{O}}\text{:}\ddot{\text{S}}\text{:}\ddot{\text{O}}\text{:}$
- C. $\text{:}\ddot{\text{O}}::\text{S}::\ddot{\text{O}}\text{:}$
- D. $\text{:}\ddot{\text{O}}::\ddot{\text{S}}\text{:}\ddot{\text{O}}\text{:}$

12. Which substance is most soluble in water (in mol dm^{-3}) at 298 K ?

- A. CH_3CH_3
- B. CH_3OCH_3
- C. $\text{CH}_3\text{CH}_2\text{OH}$
- D. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$

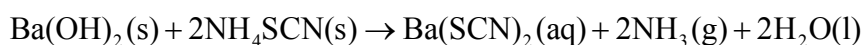
13. For which set of conditions does a fixed mass of an ideal gas have the greatest volume?

| | Temperature | Pressure |
|----|-------------|----------|
| A. | low | low |
| B. | low | high |
| C. | high | high |
| D. | high | low |

14. Which of the following is (are) altered when a liquid at its boiling point is converted to a gas at the same temperature?

- I. The size of the molecules
- II. The distance between the molecules
- III. The average kinetic energy of the molecules

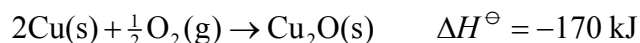
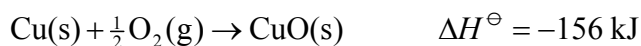
- A. I only
 - B. II only
 - C. III only
 - D. I and II only
15. When the solids Ba(OH)_2 and NH_4SCN are mixed, a solution is produced and the temperature drops.



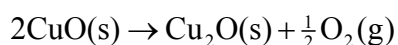
Which statement about the energetics of this reaction is correct?

- A. The reaction is endothermic and ΔH is negative.
- B. The reaction is endothermic and ΔH is positive.
- C. The reaction is exothermic and ΔH is negative.
- D. The reaction is exothermic and ΔH is positive.

16. Using the equations below



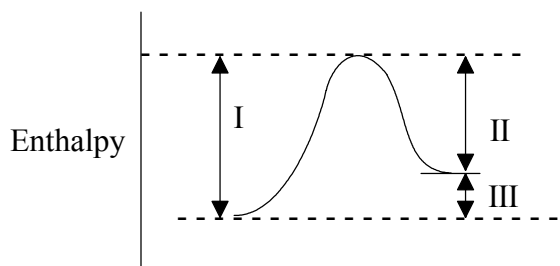
what is the value of ΔH^\ominus (in kJ) for the following reaction?



- A. 142
- B. 15
- C. -15
- D. -142

17. Which reaction occurs with the largest increase in entropy?
- A. $\text{Pb}(\text{NO}_3)_2(\text{s}) + 2\text{KI}(\text{s}) \rightarrow \text{PbI}_2(\text{s}) + 2\text{KNO}_3(\text{s})$
 - B. $\text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$
 - C. $3\text{H}_2(\text{g}) + \text{N}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g})$
 - D. $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightarrow 2\text{HI}(\text{g})$
18. The ΔH^\ominus and ΔS^\ominus values for a certain reaction are both positive. Which statement is correct about the spontaneity of this reaction at different temperatures?
- A. It will be spontaneous at all temperatures.
 - B. It will be spontaneous at high temperatures but not at low temperatures.
 - C. It will be spontaneous at low temperatures but not at high temperatures.
 - D. It will not be spontaneous at any temperature.
19. Based on the definition for rate of reaction, which units are used for a rate?
- A. mol dm^{-3}
 - B. mol time^{-1}
 - C. $\text{dm}^3 \text{ time}^{-1}$
 - D. $\text{mol dm}^{-3} \text{ time}^{-1}$

20. Which of the quantities in the enthalpy level diagram below is (are) affected by the use of a catalyst?



- A. I only
- B. III only
- C. I and II only
- D. II and III only
21. Which statement concerning a chemical reaction at equilibrium is **not** correct?
- A. The concentrations of reactants and products remain constant.
- B. Equilibrium can be approached from both directions.
- C. The rate of the forward reaction equals the rate of the reverse reaction.
- D. All reaction stops.
22. In the reaction below

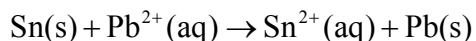
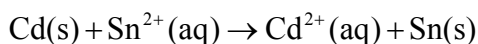
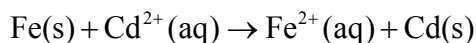


which of the following changes will increase the amount of ammonia at equilibrium?

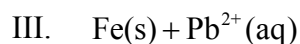
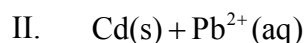
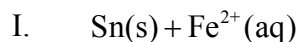
- I. Increasing the pressure
- II. Increasing the temperature
- III. Adding a catalyst
- A. I only
- B. II only
- C. I and II only
- D. II and III only

23. Which substance can be dissolved in water to give a 0.1 mol dm^{-3} solution with a high pH and a high electrical conductivity?
- A. HCl
 - B. NaCl
 - C. NH_3
 - D. NaOH
24. A buffer solution can be prepared by adding which of the following to 50 cm^3 of 0.10 mol dm^{-3} $\text{CH}_3\text{COOH(aq)}$?
- I. 50 cm^3 of 0.10 mol dm^{-3} $\text{CH}_3\text{COONa(aq)}$
 - II. 25 cm^3 of 0.10 mol dm^{-3} NaOH(aq)
 - III. 50 cm^3 of 0.10 mol dm^{-3} NaOH(aq)
- A. I only
 - B. I and II only
 - C. II and III only
 - D. I, II and III
25. What happens to the $\text{Cr}^{3+}(\text{aq})$ ion when it is converted to $\text{CrO}_4^{2-}(\text{aq})$?
- A. Its oxidation number decreases and it undergoes reduction.
 - B. Its oxidation number decreases and it undergoes oxidation.
 - C. Its oxidation number increases and it undergoes reduction.
 - D. Its oxidation number increases and it undergoes oxidation.

26. The following reactions are spontaneous as written.



Which of the following pairs will react spontaneously?



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

27. What species are produced at the positive and negative electrodes during the electrolysis of molten sodium chloride?

| | Positive electrode | Negative electrode |
|----|-------------------------|-------------------------|
| A. | $\text{Na}^+(\text{l})$ | $\text{Cl}_2(\text{g})$ |
| B. | $\text{Cl}^-(\text{l})$ | $\text{Na}^+(\text{l})$ |
| C. | $\text{Na}(\text{l})$ | $\text{Cl}_2(\text{g})$ |
| D. | $\text{Cl}_2(\text{g})$ | $\text{Na}(\text{l})$ |

28. Which statement about neighbouring members of all homologous series is correct?

- A. They have the same empirical formula.
- B. They differ by a CH_2 group.
- C. They possess different functional groups.
- D. They differ in their degree of unsaturation.

29. Which type of compound must contain a minimum of three carbon atoms?

- A. An aldehyde
- B. A carboxylic acid
- C. An ester
- D. A ketone

30. What is the IUPAC name for $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)_2$?

- A. 1,1-dimethylpropane
 - B. 2-methylbutane
 - C. isopentane
 - D. ethyldimethylmethane
-