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**CHEMISTRY
STANDARD LEVEL
PAPER 1**

Monday 19 May 2014 (afternoon)

45 minutes

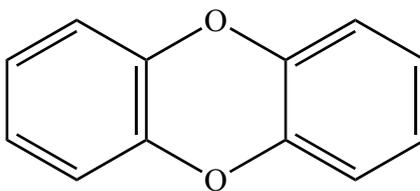
INSTRUCTIONS TO CANDIDATES

- 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. How many atoms are present in 0.500 mol of NH_3 ?

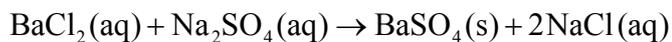
- A. 1.20×10^{23}
- B. 3.01×10^{23}
- C. 6.02×10^{23}
- D. 1.20×10^{24}

2. The structural formula of a dioxin is shown below.



What is its empirical formula?

- A. C_6O
 - B. $\text{C}_6\text{H}_4\text{O}$
 - C. $\text{C}_6\text{H}_6\text{O}$
 - D. $\text{C}_{12}\text{H}_8\text{O}_2$
3. 100.0 cm^3 of a 0.50 mol dm^{-3} solution of BaCl_2 is added to 50.0 cm^3 of a 0.10 mol dm^{-3} solution of Na_2SO_4 . A precipitate of BaSO_4 is formed according to the equation below.

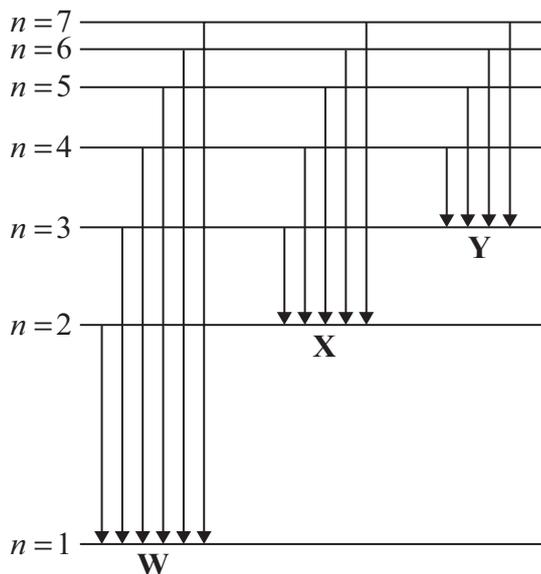


What is the amount, in mol, of BaSO_4 produced?

- A. 0.0050
- B. 0.010
- C. 0.050
- D. 0.10

4. Which volumes of gases at standard temperature and pressure have the same mass as 100 cm³ of O₂?
- I. 50 cm³ of SO₂
 - II. 100 cm³ of CH₄
 - III. 100 cm³ of SiH₄
- A. I and II only
 - B. I and III only
 - C. II and III only
 - D. I, II and III

5. The diagram represents the emission spectrum of hydrogen. Groups of arrows are labelled **W**, **X** and **Y**.



Which statement is correct?

- A. The arrows represent the transition of electrons to different energy levels when heat is supplied.
- B. The arrows of **W** represent emission in the UV region.
- C. The smallest arrow of **X** represents a violet line in the emission spectrum.
- D. The arrows of **Y** represent emission of electromagnetic waves with higher energy than those represented by **X** and **W**.

6. Which species have the same electron arrangements?

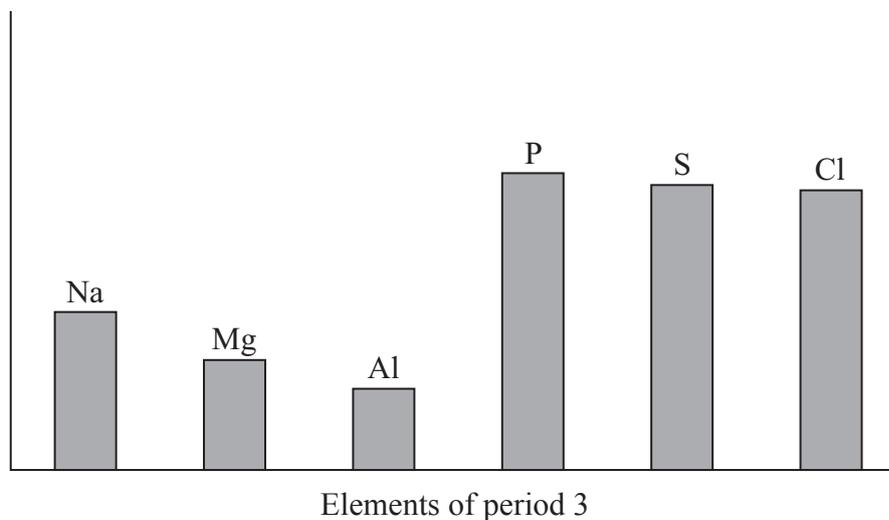
- I. O^{2-} , F^- , Ne
- II. Li^+ , Na^+ , K^+
- III. S^{2-} , Ar, K^+

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

7. Which statement about the periodic table is correct?

- A. The elements with atomic numbers 8, 16 and 34 have the same number of main energy levels.
- B. The elements with atomic numbers 8, 9 and 10 have similar chemical properties.
- C. The elements with atomic numbers 20, 21 and 22 are in the same group.
- D. The elements with atomic numbers 20, 38 and 56 have the same number of electrons in their outer energy level.

8. The horizontal axis of the bar chart represents the elements of period 3 from sodium to chlorine (excluding silicon). What could the vertical axis represent?



- A. Melting point of the element
- B. Electronegativity of the bonded atom
- C. Ionic radius of the most common ion
- D. First ionization energy in the gaseous state
9. The electronegativities of four elements are given in the table.

Element	W	X	Y	Z
Electronegativity	0.9	1.1	3.4	4.0

Which statement is correct?

- A. W and X form an ionic compound.
- B. W and X form a covalent compound.
- C. Y and Z form an ionic compound.
- D. Y and Z form a covalent compound.

10. Which combination of length and strength of the carbon-to-carbon bonds in C_2H_2 and C_2H_4 is correct?

	Bond length	Bond strength
A.	$C_2H_2 > C_2H_4$	$C_2H_2 < C_2H_4$
B.	$C_2H_2 > C_2H_4$	$C_2H_2 > C_2H_4$
C.	$C_2H_2 < C_2H_4$	$C_2H_2 < C_2H_4$
D.	$C_2H_2 < C_2H_4$	$C_2H_2 > C_2H_4$

11. What is the shape and the bond angle of the molecule BF_3 ?

	Shape	Bond angle
A.	Trigonal pyramidal	109.5°
B.	Trigonal planar	109.5°
C.	Trigonal pyramidal	120°
D.	Trigonal planar	120°

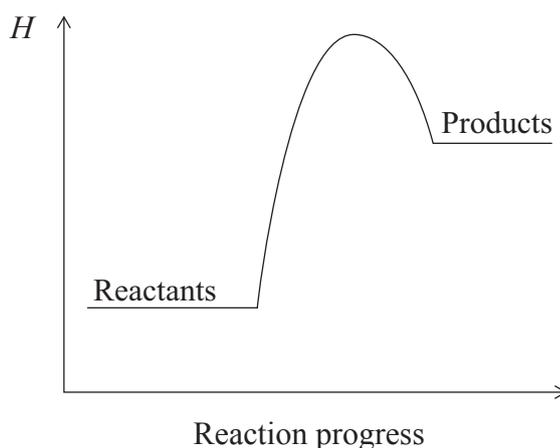
12. What is the correct order of **increasing** boiling point?

- A. $C_2H_6 < HCHO < CH_3OH$
 B. $HCHO < C_2H_6 < CH_3OH$
 C. $CH_3OH < HCHO < C_2H_6$
 D. $C_2H_6 < CH_3OH < HCHO$

13. Which particles are present in the lattice of a metal?

- A. Negative ions
 B. Positive and negative ions
 C. Positive ions
 D. Molecules

14. Which statement is correct for the reaction with this enthalpy level diagram?



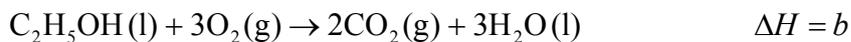
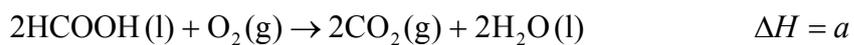
- A. Heat energy is released during the reaction and the reactants are more stable than the products.
- B. Heat energy is absorbed during the reaction and the reactants are more stable than the products.
- C. Heat energy is released during the reaction and the products are more stable than the reactants.
- D. Heat energy is absorbed during the reaction and the products are more stable than the reactants.
15. The specific heat capacities of two substances are given in the table below.

Substance	Specific heat capacity / $\text{J g}^{-1} \text{K}^{-1}$
Ethanol	2.43
Water	4.18

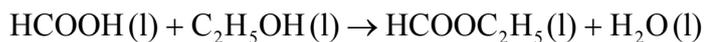
Which statement is correct?

- A. More heat is needed to increase the temperature of 50 g of water by 50°C than 50 g of ethanol by 50°C .
- B. If the same heat is supplied to equal masses of ethanol and water, the temperature of the water increases more.
- C. If equal masses of water at 20°C and ethanol at 50°C are mixed, the final temperature is 35°C .
- D. If equal masses of water and ethanol at 50°C cool down to room temperature, ethanol liberates more heat.

16. The enthalpy changes of three reactions are given below.



What is the enthalpy change for the following reaction?

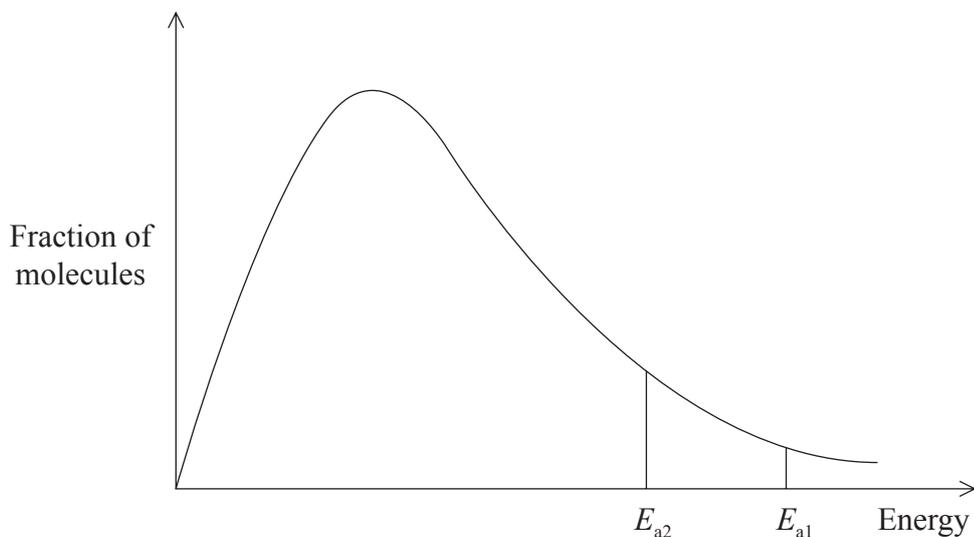


- A. $a + b + c$
- B. $a + 2b - c$
- C. $\frac{1}{2}a + b + \frac{1}{2}c$
- D. $\frac{1}{2}a + b - \frac{1}{2}c$

17. Why does the rate of a reaction increase when the temperature is increased?

- I. The activation energy decreases.
 - II. There are more particles with energy equal to or greater than the activation energy.
 - III. The frequency of collisions between particles increases.
- A. I and II only
 - B. I and III only
 - C. II and III only
 - D. I, II and III

18. The diagram represents the Maxwell–Boltzmann energy distribution curve of the reactants for a chemical reaction with different activation energies, E_{a1} and E_{a2} .



What is the reason why the rate of the reaction with activation energy E_{a2} is greater?

- A. More frequent collisions between the particles occur.
 - B. More energetic collisions between the particles occur.
 - C. A catalyst has been added.
 - D. The temperature is higher.
19. Which statement is correct for a reversible reaction when $K_c \gg 1$?
- A. The reaction almost goes to completion.
 - B. The reaction hardly occurs.
 - C. Equilibrium is reached in a very short time.
 - D. At equilibrium, the rate of the forward reaction is much higher than the rate of the backward reaction.

20. Consider this reaction at equilibrium.



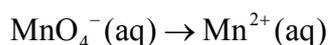
Which change shifts the equilibrium position to the right?

- A. Adding sodium hydroxide
 - B. Decreasing pressure
 - C. Adding a catalyst
 - D. Increasing temperature
21. Which are acid-base pairs according to the Brønsted–Lowry theory?

- I. $\text{HNO}_3/\text{NO}_3^-$
- II. $\text{H}_3\text{O}^+/\text{OH}^-$
- III. $\text{HCOOH}/\text{HCOO}^-$

- A. I and II only
 - B. I and III only
 - C. II and III only
 - D. I, II and III
22. A solution of 50 cm^3 hydrochloric acid has a pH of 4. What is the final pH if 450 cm^3 of water is added?
- A. 3
 - B. 4
 - C. 5
 - D. 6

23. At which side of the equation are electrons, H⁺ ions and H₂O needed to complete the half-equation?



	Electrons	H⁺ ions	H₂O
A.	reactant side	reactant side	product side
B.	reactant side	product side	reactant side
C.	product side	reactant side	product side
D.	product side	product side	reactant side

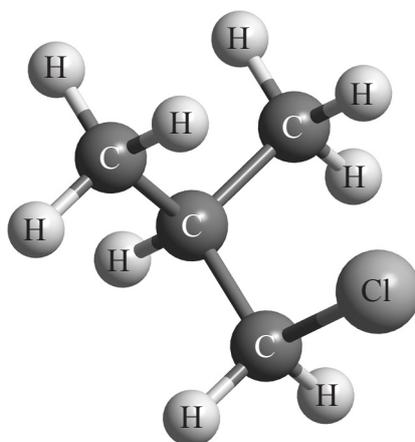
24. What are the correct names for KMnO₄ and K₂Cr₂O₇, using oxidation numbers?

- A. Potassium permanganate and potassium dichromate
- B. Potassium manganate(IV) and potassium chromate(VII)
- C. Potassium permanganate(IV) and potassium dichromate(VII)
- D. Potassium manganate(VII) and potassium dichromate(VI)

25. At which electrodes does oxidation occur in a voltaic cell and in an electrolytic cell?

	Voltaic cell	Electrolytic cell
A.	positive	positive
B.	positive	negative
C.	negative	positive
D.	negative	negative

26. Which statement is correct for members of the same homologous series?
- They have the same empirical formula and a gradual change in chemical properties.
 - They have the same empirical formula and a gradual change in physical properties.
 - They have the same general formula and a gradual change in chemical properties.
 - They have the same general formula and a gradual change in physical properties.
27. Which classes of functional groups are present in $\text{CH}_3\text{CHOHCH}_2\text{COOH}$?
- Aldehyde and carboxylic acid
 - Alcohol and carboxylic acid
 - Alcohol and ketone
 - Alcohol, aldehyde and ketone
28. Which type of halogenoalkane is the substance shown below, and which type of nucleophilic reaction does it undergo with an aqueous sodium hydroxide solution?



	Type of halogenoalkane	Type of nucleophilic reaction
A.	primary	$\text{S}_{\text{N}}1$
B.	tertiary	$\text{S}_{\text{N}}1$
C.	primary	$\text{S}_{\text{N}}2$
D.	tertiary	$\text{S}_{\text{N}}2$

29. For the reaction pathway below, what are the names for the first and second steps?



	First step	Second step
A.	nucleophilic substitution	oxidation
B.	addition	nucleophilic substitution
C.	nucleophilic substitution	nucleophilic substitution
D.	addition	oxidation

30. A student carries out a titration three times and obtains the following volumes: $3.0 \pm 0.1 \text{ cm}^3$, $3.2 \pm 0.1 \text{ cm}^3$ and $3.2 \pm 0.1 \text{ cm}^3$. What is the average volume?
- A. $3.1 \pm 0.1 \text{ cm}^3$
- B. $3.13 \pm 0.1 \text{ cm}^3$
- C. $3.1 \pm 0.3 \text{ cm}^3$
- D. $3.13 \pm 0.3 \text{ cm}^3$
-