



**CHEMISTRY
STANDARD LEVEL
PAPER 1**

Monday 18 May 2009 (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 Periodic Table

1 2 3 4 5 6 7 0

Atomic Number		Element		Atomic Mass	
1 H 1.01				2 He 4.00	
3 Li 6.94	4 Be 9.01			9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31			17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.90	23 V 50.94	24 Cr 52.00
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94
55 Cs 132.91	56 Ba 137.34	57 † La 138.91	72 Hf 178.49	73 Ta 180.95	74 W 183.85
87 Fr (223)	88 Ra (226)	89 ‡ Ac (227)			
			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
			43 Tc 98.91	44 Ru 101.07	45 Rh 102.91
			46 Pd 106.42	47 Ag 107.87	48 Cd 112.40
			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
			51 Sb 121.75	52 Te 127.60	53 I 126.90
			84 Po (210)	85 At (210)	86 Rn (222)

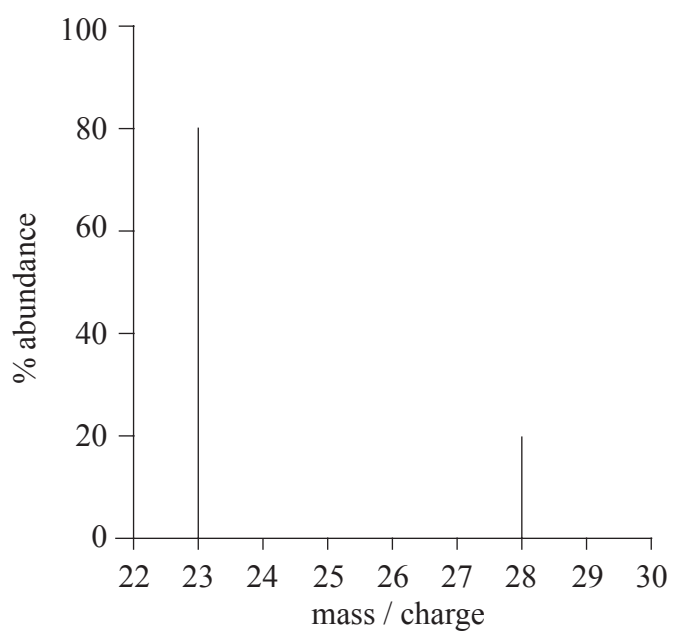
†	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm 146.92	62 Sm 150.35	63 Eu 151.96	64 Gd 157.25	65 Tb 158.92	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04	71 Lu 174.97
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‡	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np (237)	94 Pu (242)	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)
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1. What is the number of oxygen atoms in one mole of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$?
- A. 5
B. 9
C. 6.0×10^{23}
D. 5.4×10^{24}
2. Which sample has the greatest mass?
- A. 6.0×10^{25} molecules of hydrogen
B. 5.0 mol of neon atoms
C. 1.2×10^{24} atoms of silver
D. 1.7×10^2 g of iron
3. What volume of sulfur trioxide, in cm^3 , can be prepared using 40 cm^3 sulfur dioxide and 20 cm^3 oxygen gas by the following reaction? Assume all volumes are measured at the same temperature and pressure.
- $$2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{SO}_3(\text{g})$$
- A. 20
B. 40
C. 60
D. 80
4. Which sample of nitrogen gas, N_2 , contains the greatest number of nitrogen molecules?
- A. 1.4 g N_2
B. 1.4 dm^3 of N_2 at $1.01 \times 10^5 \text{ Pa}$ and 273 K
C. 1.4×10^{23} N_2 molecules
D. 1.4 mol N_2

5. What is the atomic number of a neutral atom which has 51 neutrons and 40 electrons?
- A. 40
 - B. 51
 - C. 91
 - D. 131

6. What is the relative atomic mass of an element with the following mass spectrum?



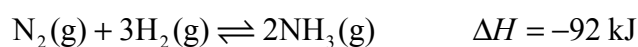
- A. 24
- B. 25
- C. 26
- D. 27

7. Which is the correct definition of the mass number of an atom?
- A. The total mass of neutrons and protons in the nucleus of the atom
 - B. The total mass of neutrons, protons and electrons in the atom
 - C. The number of protons in the nucleus of the atom
 - D. The total number of neutrons and protons in the nucleus of the atom
8. Which statement describes the trends of electronegativity values in the periodic table?
- A. Values increase from left to right across a period and increase down a group.
 - B. Values increase from left to right across a period and decrease down a group.
 - C. Values decrease from left to right across a period and increase down a group.
 - D. Values decrease from left to right across a period and decrease down a group.
9. Which statement is correct for all elements in the same period?
- A. They have the same number of electrons in the highest occupied energy level.
 - B. They have the same chemical reactivity.
 - C. They have the same number of occupied energy levels.
 - D. They have the same number of neutrons.
10. Which statement best describes the **intramolecular** bonding in HCN(l)?
- A. Electrostatic attractions between H^+ and CN^- ions
 - B. Only van der Waals' forces
 - C. Van der Waals' forces and hydrogen bonding
 - D. Electrostatic attractions between pairs of electrons and positively charged nuclei

11. Which statement best describes metallic bonding?
- A. Electrostatic attractions between oppositely charged ions
 - B. Electrostatic attractions between a lattice of positive ions and delocalized electrons
 - C. Electrostatic attractions between a lattice of negative ions and delocalized protons
 - D. Electrostatic attractions between protons and electrons
12. Metal M has only one oxidation number and forms a compound with the formula MCO_3 . Which formula is correct?
- A. MNO_3
 - B. MNH_4
 - C. MSO_4
 - D. MPO_4
13. Which molecule has the shortest bond between carbon atoms?
- A. C_2H_6
 - B. C_2H_4
 - C. C_2H_2
 - D. $C_2H_4Cl_2$
14. What is the energy, in kJ, released when 1.00 mol of carbon monoxide is burned according to the following equation?
- $$2CO(g) + O_2(g) \rightarrow 2CO_2(g) \quad \Delta H^\ominus = -564 \text{ kJ}$$
- A. 141
 - B. 282
 - C. 564
 - D. 1128

15. The specific heat of iron is $0.450 \text{ J g}^{-1} \text{ K}^{-1}$. What is the energy, in J, needed to increase the temperature of 50.0 g of iron by 20.0 K?
- A. 9.00
B. 22.5
C. 45.0
D. 450
16. Which of the following reactions are exothermic?
- I. $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$
II. $\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$
III. $\text{Br}_2 \rightarrow 2\text{Br}$
- A. I and II only
B. I and III only
C. II and III only
D. I, II and III
17. Consider the reaction between magnesium and hydrochloric acid. Which factors will affect the reaction rate?
- I. The collision frequency of the reactant particles
II. The number of reactant particles with $E \geq E_a$
III. The number of reactant particles that collide with the appropriate geometry
- A. I and II only
B. I and III only
C. II and III only
D. I, II and III

18. What is the function of iron in the Haber process?
- A. It shifts the position of equilibrium towards the products.
 - B. It decreases the rate of the reaction.
 - C. It provides an alternative reaction pathway with a lower activation energy.
 - D. It reduces the enthalpy change of the reaction.
19. What effect will an increase in temperature have on the K_c value and the position of equilibrium in the following reaction?



	K_c	Equilibrium position
A.	increases	shifts to the right
B.	decreases	shifts to the left
C.	increases	shifts to the left
D.	decreases	shifts to the right

20. Which statement is always correct for a chemical reaction at equilibrium?
- A. The rate of the forward reaction equals the rate of the reverse reaction.
 - B. The amounts of reactants and products are equal.
 - C. The concentration of the reactants and products are constantly changing.
 - D. The forward reaction occurs to a greater extent than the reverse reaction.

21. Which are definitions of an acid according to the Brønsted-Lowry and Lewis theories?

	Brønsted-Lowry theory	Lewis theory
A.	proton donor	electron pair acceptor
B.	proton acceptor	electron pair acceptor
C.	proton acceptor	electron pair donor
D.	proton donor	electron pair donor

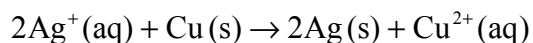
22. Which list contains only strong acids?

- A. CH_3COOH , H_2CO_3 , H_3PO_4
- B. HCl , HNO_3 , H_2CO_3
- C. CH_3COOH , HNO_3 , H_2SO_4
- D. HCl , HNO_3 , H_2SO_4

23. An example of a strong acid solution is perchloric acid, HClO_4 , in water. Which statement is correct for this solution?

- A. HClO_4 is completely dissociated in the solution.
- B. HClO_4 exists mainly as molecules in the solution.
- C. The solution reacts only with strong bases.
- D. The solution has a pH value greater than 7.

24. Which species is oxidized in the following reaction?



- A. Ag^+
- B. Cu
- C. Ag
- D. Cu^{2+}

25. Which list represents the halogens in **increasing** order of oxidizing strength (weakest oxidizing agent first)?

- A. Cl_2 I_2 Br_2
- B. I_2 Br_2 Cl_2
- C. I_2 Cl_2 Br_2
- D. Cl_2 Br_2 I_2

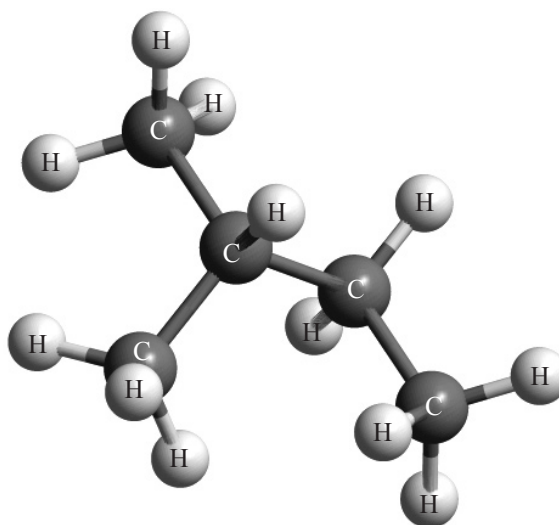
26. What is the product of the oxidation of butan-2-ol?

- A. But-2-ene
- B. Butanoic acid
- C. Butanal
- D. Butanone

27. Which is a tertiary halogenoalkane?

- A. $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$
- B. $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{Cl}$
- C. $\text{C}(\text{CH}_3)_3\text{Br}$
- D. $\text{CH}_3\text{CHClCH}_2\text{CH}_3$

28. What is the IUPAC name of the following compound?



- A. 2-methylbutane
- B. Ethylpropane
- C. 3-methylbutane
- D. Pentane
29. Which equations represent the incomplete combustion of methane?
- I. $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$
- II. $\text{CH}_4(\text{g}) + 1\frac{1}{2}\text{O}_2(\text{g}) \rightarrow \text{CO}(\text{g}) + 2\text{H}_2\text{O}(\text{g})$
- III. $\text{CH}_4(\text{g}) + \text{O}_2(\text{g}) \rightarrow \text{C}(\text{s}) + 2\text{H}_2\text{O}(\text{g})$
- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

30. Which would be the best method to decrease the **random** uncertainty of a measurement in an acid-base titration?
- A. Repeat the titration
 - B. Ensure your eye is at the same height as the meniscus when reading from the burette
 - C. Use a different burette
 - D. Use a different indicator for the titration
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