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CHEMISTRY
STANDARD LEVEL
PAPER 1

Monday 9 May 2011 (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.

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The Periodic Table

Atomic number

Element

Relative atomic mass

1	2											3	4	5	6	7	0
1 **H** 1.01																	2 **He** 4.00
3 **Li** 6.94	4 **Be** 9.01											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
11 **Na** 22.99	12 **Mg** 24.31											13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.06	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	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. What is the sum of all coefficients when the following equation is balanced using the smallest possible whole numbers?

$$__\ C_2H_2 + __O_2 \rightarrow __CO_2 + __H_2O$$

A. 5

B. 7

C. 11

D. 13

2. 1.7 g of $NaNO_3$ ($M_r = 85$) is dissolved in water to prepare 0.20 dm^3 of solution. What is the concentration of the resulting solution in mol dm^{-3}?

A. 0.01

B. 0.1

C. 0.2

D. 1.0

3. How many molecules are present in a drop of ethanol, C_2H_5OH, of mass 2.3×10^{-3} g? ($L = 6.0\times10^{23}$ mol^{-1})

A. 3.0×10^{19}

B. 3.0×10^{20}

C. 6.0×10^{20}

D. 6.0×10^{26}

4. Which sample has the greatest mass?

A. 1 mol of SO_2

B. 2 mol of N_2O

C. 2 mol of Ar

D. 4 mol of NH_3

5. The relative molecular mass of a gas is 56 and its empirical formula is CH_2. What is the molecular formula of the gas?

A. CH_2

B. C_2H_4

C. C_3H_6

D. C_4H_8

6. Which statement about the numbers of protons, electrons and neutrons in an atom is always correct?

A. The number of neutrons minus the number of electrons is zero.

B. The number of protons plus the number of neutrons equals the number of electrons.

C. The number of protons equals the number of electrons.

D. The number of neutrons equals the number of protons.

7. Which property generally **decreases** across period 3?

A. Atomic number

B. Electronegativity

C. Atomic radius

D. First ionization energy

8. Which property **increases** down group 1?

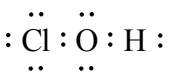
A. First ionization energy

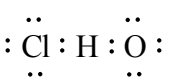
B. Melting point

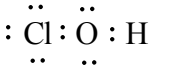
C. Reactivity

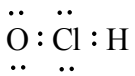
D. Electronegativity

9. What is the correct Lewis structure for hypochlorous acid, a compound containing chlorine, hydrogen and oxygen?

A. 

B. 

C. 

D. 

10. Which compound forms hydrogen bonds in the liquid state?

A. C_2H_5OH

B. $CHCl_3$

C. CH_3CHO

D. $(CH_3CH_2)_3N$

11. How do the bond angles in CH_4, NH_3 and H_2O compare?

A. $CH_4 = NH_3 = H_2O$

B. $CH_4 < NH_3 < H_2O$

C. $NH_3 < CH_4 < H_2O$

D. $H_2O < NH_3 < CH_4$

12. Which combination of the characteristics of element X, a metal, and element Y, a non metal, is most likely to lead to ionic bonding?

	X	**Y**
A.	low ionization energy	high electronegativity value
B.	low ionization energy	low electronegativity value
C.	high ionization energy	high electronegativity value
D.	high ionization energy	low electronegativity value

13. Which particles are responsible for electrical conductivity in metals?

A. Anions

B. Cations

C. Electrons

D. Protons

14. When 100 cm^3 of 1.0 mol dm^{-3} HCl is mixed with 100 cm^3 of 1.0 mol dm^{-3} NaOH, the temperature of the resulting solution increases by 5.0 °C. What will be the temperature change, in °C, when 50 cm^3 of these two solutions are mixed?

A. 2.5

B. 5.0

C. 10

D. 20

15. Which statement about bonding is correct?

A. Bond breaking is endothermic and requires energy.

B. Bond breaking is endothermic and releases energy.

C. Bond making is exothermic and requires energy.

D. Bond making is endothermic and releases energy.

16. Consider the following reactions.

$$Cu_2O(s) + \tfrac{1}{2}O_2(g) \rightarrow 2CuO(s) \qquad \Delta H^{\ominus} = -144 \text{ kJ}$$

$$Cu_2O(s) \rightarrow Cu(s) + CuO(s) \qquad \Delta H^{\ominus} = +11 \text{ kJ}$$

What is the value of $\Delta H^{\ominus}$, in kJ, for this reaction?

$$Cu(s) + \tfrac{1}{2}O_2(g) \rightarrow CuO(s)$$

A. –144 + 11

B. +144 – 11

C. –144 – 11

D. +144 + 11

17. Which statements describe the action of a catalyst?

I. It does **not** alter the ΔH for a reaction.

II. It increases the E_a for the reaction.

III. It alters the mechanism (pathway) of a reaction.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

18. Consider the reaction between gaseous iodine and gaseous hydrogen.

$$I_2(g) + H_2(g) \rightleftharpoons 2HI(g) \qquad \Delta H^{\ominus} = -9 \text{ kJ}$$

Why do some collisions between iodine and hydrogen **not** result in the formation of the product?

A. The I_2 and H_2 molecules do not have sufficient energy.

B. The system is in equilibrium.

C. The temperature of the system is too high.

D. The activation energy for this reaction is very low.

19. The equilibrium between nitrogen dioxide, NO_2, and dinitrogen tetroxide, N_2O_4, is shown below.

$$2NO_2(g) \rightleftharpoons N_2O_4(g) \qquad K_c = 0.01$$

What happens when the volume of a mixture at equilibrium is decreased at a constant temperature?

I. The value of K_c increases

II. More N_2O_4 is formed

III. The ratio of $\frac{[NO_2]}{[N_2O_4]}$ decreases

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

20. Which statement about chemical equilibria implies they are dynamic?

A. The position of equilibrium constantly changes.

B. The rates of forward and backward reactions change.

C. The reactants and products continue to react.

D. The concentrations of the reactants and products continue to change.

21. Which statement explains why ammonia can act as a Lewis base?

A. Ammonia can donate a lone pair of electrons.

B. Ammonia can accept a lone pair of electrons.

C. Ammonia can donate a proton.

D. Ammonia can accept a proton.

22. Consider the equilibrium below.

$$CH_3CH_2COOH\,(aq) + H_2O\,(l) \rightleftharpoons CH_3CH_2COO^-\,(aq) + H_3O^+\,(aq)$$

Which species represent a conjugate acid-base pair?

A. CH_3CH_2COOH and H_2O

B. H_2O and $CH_3CH_2COO^-$

C. H_3O^+ and H_2O

D. $CH_3CH_2COO^-$ and H_3O^+

23. Which species could be reduced to form NO_2?

A. N_2O

B. NO_3^-

C. HNO_2

D. NO

24. Consider the overall reaction taking place in a voltaic cell.

$$Ag_2O\,(s) + Zn\,(s) + H_2O\,(l) \rightarrow 2Ag\,(s) + Zn(OH)_2\,(s)$$

What is the role of zinc in the cell?

A. The positive electrode and the oxidizing agent.

B. The positive electrode and the reducing agent.

C. The negative electrode and the oxidizing agent.

D. The negative electrode and the reducing agent.

25. What happens to the manganese in the following reaction?

$$2MnO_4^-(aq) + 5H_2O_2(aq) + 6H^+(aq) \rightarrow 2Mn^{2+}(aq) + 8H_2O(l) + 5O_2(g)$$

A. It is oxidized and its oxidation number increases.

B. It is oxidized and its oxidation number decreases.

C. It is reduced and its oxidation number increases.

D. It is reduced and its oxidation number decreases.

26. Which of the following statements about alkenes is **not** correct?

A. They have reactive double bonds.

B. They can form addition polymers.

C. They react mainly by substitution.

D. They can react with water to form alcohols.

27. What is the type of mechanism and an important feature of the reaction between $C(CH_3)_3Br$ and aqueous NaOH?

	Mechanism	**Feature**
A.	S_N1	a transition state
B.	S_N1	an intermediate
C.	S_N2	a transition state
D.	S_N2	an intermediate

28. Which of the following are isomers of pentane?

I. 2-methylpentane

II. methylbutane

III. dimethylpropane

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

29. Which of the following pairs are members of the same homologous series?

A. $CH_3CH_2CH_2OH$ and CH_3CH_2CHO

B. $CH_3CH(OH)CH_3$ and $CH_3CH_2CH(OH)CH_3$

C. CH_3COCH_3 and CH_3CH_2COOH

D. $CH_3COCH_2CH_3$ and CH_3CH_2CHO

30. A burette reading is recorded as $27.70 \pm 0.05\ cm^3$. Which of the following could be the actual value?

I. $27.68\ cm^3$

II. $27.78\ cm^3$

III. $27.74\ cm^3$

A. I and II only

B. I and III only

C. II and III only

D. I, II and III