Chemistry SL P1

2007 November

School Level 12th IB Diploma Programme

Board Exam

International Baccalaureate (IB Board)

IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
PROGRAMA DEL DIPLOMA DEL BI

N07/4/CHEMI/SPM/ENG/TZ0/XX+

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CHEMISTRY
STANDARD LEVEL
PAPER 1

Wednesday 14 November 2007 (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
																	2 **He** 4.00
1 **H** 1.01												5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
3 **Li** 6.94	4 **Be** 9.01											13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.06	17 **Cl** 35.45	18 **Ar** 39.95
11 **Na** 22.99	12 **Mg** 24.31											31 **Ga** 69.72	32 **Ge** 72.59	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.90	36 **Kr** 83.80
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	49 **In** 114.82	50 **Sn** 118.69	51 **Sb** 121.75	52 **Te** 127.60	53 **I** 126.90	54 **Xe** 131.30
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	81 **Tl** 204.37	82 **Pb** 207.19	83 **Bi** 208.98	84 **Po** (210)	85 **At** (210)	86 **Rn** (222)
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						
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)

8807-6104

1. Which expression gives the amount (in mol) of a substance, if the mass is given in grams?

A. $\frac{\text{mass}}{\text{molar mass}}$

B. $\frac{\text{molar mass}}{\text{mass}}$

C. $\frac{1}{\text{molar mass}}$

D. mass × molar mass

2. What is the total number of atoms in 0.20 mol of propanone, CH_3COCH_3?

A. 1.2×10^{22}

B. 6.0×10^{23}

C. 1.2×10^{24}

D. 6.0×10^{24}

3. When the equation below is balanced for 1 mol of C_3H_4, what is the coefficient for O_2?

$$C_3H_4 + \_O_2 \rightarrow \_CO_2 + \_H_2O$$

A. 2

B. 3

C. 4

D. 5

4. Ethyne, C_2H_2, reacts with oxygen according to the equation below. What volume of oxygen (in dm^3) reacts with 0.40 dm^3 of C_2H_2?

$$2C_2H_2(g) + 5O_2(g) \rightarrow 4CO_2(g) + 2H_2O(g)$$

A. 0.40

B. 0.80

C. 1.0

D. 2.0

5. What is the symbol for a species that contains 15 protons, 16 neutrons and 18 electrons?

A. $^{31}_{16}S$

B. $^{31}_{16}S^{3-}$

C. $^{33}_{15}P^{-}$

D. $^{31}_{15}P^{3-}$

6. What is the electron arrangement of an Al^{3+} ion?

A. 2, 8

B. 2, 3

C. 2, 8, 3

D. 2, 8, 8

7. Which element is a transition metal?

A. Ca

B. Cr

C. Ge

D. Se

8. When Na, K, and Mg are arranged in **increasing** order of atomic radius (smallest first), which order is correct?

A. Na, K, Mg

B. Na, Mg, K

C. K, Mg, Na

D. Mg, Na, K

9. What is the formula for an ionic compound formed between an element, X, from group 2 and an element, Y, from group 6?

A. XY

B. X_2Y

C. XY_2

D. X_2Y_6

10. In the molecules N_2H_4, N_2H_2, and N_2, the nitrogen atoms are linked by single, double and triple bonds, respectively. When these molecules are arranged in increasing order of the lengths of their nitrogen to nitrogen bonds (shortest bond first) which order is correct?

A. N_2H_4, N_2, N_2H_2

B. N_2H_4, N_2H_2, N_2

C. N_2H_2, N_2, N_2H_4

D. N_2, N_2H_2, N_2H_4

11. The compounds listed have very similar molar masses. Which has the strongest intermolecular forces?

A. CH_3CHO

B. CH_3CH_2OH

C. CH_3CH_2F

D. $CH_3CH_2CH_3$

12. What is the shape of the CO_3^{2-} ion and the approximate O–C–O bond angle?

A. Linear, 180°

B. Trigonal planar, 90°

C. Trigonal planar, 120°

D. Pyramidal, 109°

13. What change occurs to the distance between molecules and to their kinetic energy when a liquid becomes a gas at its boiling point?

A. The distances between molecules and their kinetic energies both increase greatly.

B. The distances between molecules increases but their kinetic energies remain the same.

C. The distances between the molecules and their kinetic energies both remain the same.

D. The distances remain the same but their kinetic energies increase.

14. What will happen to the volume of a fixed mass of gas if the pressure and the Kelvin temperature are both doubled?

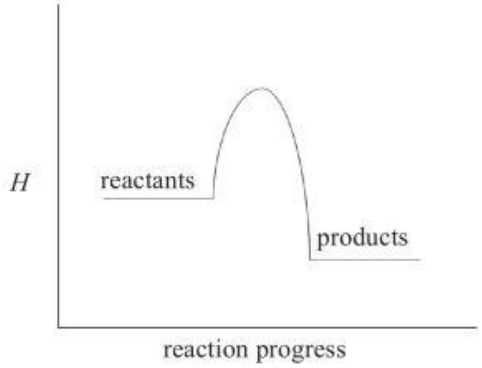
A. It will remain the same.

B. It will be double its initial volume.

C. It will be one-half its initial volume.

D. It will be four times its initial volume.

15. According to the enthalpy level diagram below, what is the sign for ΔH and what term is used to refer to the reaction?



	ΔH	reaction
A.	positive	endothermic
B.	negative	exothermic
C.	positive	exothermic
D.	negative	endothermic

16. When 40 joules of heat are added to a sample of solid H_2O at $-16.0\ °C$ the temperature increases to $-8.0\ °C$. What is the mass of the solid H_2O sample?

[Specific heat capacity of $H_2O(s) = 2.0\ J\ g^{-1}\ K^{-1}$]

A. 2.5 g

B. 5.0 g

C. 10 g

D. 160 g

17. The $\Delta H^{\ominus}$ values for the formation of two oxides of nitrogen are given below.

$$\tfrac{1}{2}N_2(g) + O_2(g) \rightarrow NO_2(g) \qquad \Delta H^{\ominus} = -57 \text{ kJ mol}^{-1}$$

$$N_2(g) + 2O_2(g) \rightarrow N_2O_4(g) \qquad \Delta H^{\ominus} = +9 \text{ kJ mol}^{-1}$$

Use these values to calculate $\Delta H^{\ominus}$ for the following reaction (in kJ):

$$2NO_2(g) \rightarrow N_2O_4(g)$$

A. –105

B. –48

C. +66

D. +123

18. The $\Delta H^{\ominus}$ and $\Delta S^{\ominus}$ values for a reaction are both negative. What will happen to the spontaneity of this reaction as the temperature is increased?

A. The reaction will become more spontaneous as the temperature is increased.

B. The reaction will become less spontaneous as the temperature is increased.

C. The reaction will remain spontaneous at all temperatures.

D. The reaction will remain non-spontaneous at any temperature.

19. Which statement is correct about the rate expression for a chemical reaction?

A. It can be determined from its chemical equation.

B. It can be predicted from the value of $\Delta H^{\ominus}$ for the reaction.

C. It can be calculated from the effect of temperature on the reaction.

D. It can be determined by measuring the change in concentration of a reactant or product over time.

20. Which changes increase the rate of a chemical reaction?

I. Increase in the concentration of an aqueous solution

II. Increase in particle size of the same mass of a solid reactant

III. Increase in the temperature of the reaction mixture

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

21. What is the equilibrium constant expression, K_c, for the reaction below?

$$N_2(g) + 2O_2(g) \rightleftharpoons 2NO_2(g)$$

A. $K_c = \dfrac{[NO_2]}{[N_2][O_2]}$

B. $K_c = \dfrac{2[NO_2]}{3[N_2][O_2]}$

C. $K_c = \dfrac{[NO_2]^2}{[N_2][O_2]^2}$

D. $K_c = \dfrac{[NO_2]^2}{[N_2]+[O_2]^2}$

22. Sulfur dioxide and oxygen react to form sulfur trioxide according to the equilibrium.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

How is the amount of SO_3 and the value of the equilibrium constant for the reaction affected by an increase in pressure?

A. The amount of SO_3 and the value of the equilibrium constant both increase.

B. The amount of SO_3 and the value of the equilibrium constant both decrease.

C. The amount of SO_3 increases but the value of the equilibrium constant decreases.

D. The amount of SO_3 increases but the value of the equilibrium constant does not change.

23. Which acids are strong?

I. $HCl(aq)$

II. $HNO_3(aq)$

III. $H_2SO_4(aq)$

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

24. The pH of a solution changes from pH = 1 to pH = 3. What happens to the $[H^+]$ during this pH change?

A. It increases by a factor of 100.

B. It decreases by a factor of 100.

C. It increases by a factor of 1000.

D. It decreases by a factor of 1000.

25. What happens to vanadium during the reaction $VO^{2+}(aq) \rightarrow VO_3^-(aq)$?

A. It undergoes oxidation and its oxidation number changes from +4 to +5.

B. It undergoes oxidation and its oxidation number changes from +2 to +4.

C. It undergoes reduction and its oxidation number changes from +2 to –1.

D. It undergoes reduction and its oxidation number changes from +4 to +2.

26. What occurs during the electrolysis of a molten salt?

A. Electricity is produced by a spontaneous redox reaction.

B. Electricity is used to cause a non-spontaneous redox reaction to occur.

C. Electrons flow through the molten salt.

D. Electrons are removed from both ions of the molten salt.

27. Which statement is correct about an oxidizing agent in a chemical reaction?

A. It reacts with oxygen.

B. It reacts with H^+ ions.

C. It loses electrons.

D. It undergoes reduction.

28. Which formula represents an aldehyde?

A. CH_3CH_2CHO

B. CH_3COCH_3

C. CH_3CH_2COOH

D. CH_3COOCH_3

29. Which reactions can ethene undergo?

I. addition

II. esterification

III. polymerization

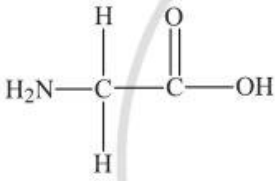
A. I and II only

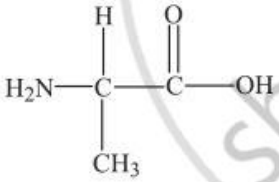
B. I and III only

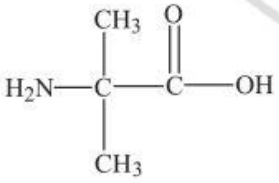
C. II and III only

D. I, II and III

30. Which amino acid can exist as optical isomers?

A. 

B. 

C. 

D.