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

N06/4/CHEMI/SPM/ENG/TZ0/XX+

88066104

CHEMISTRY
STANDARD LEVEL
PAPER 1

Wednesday 8 November 2006 (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
1 **H** 1.01				Atomic Number **Element** Atomic Mass													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. The empirical formula of a compound is C_2H_4O. Which molecular formulas are possible for this compound?

I. CH_3COOH

II. $CH_3CH_2CH_2COOH$

III. $CH_3COOCH_2CH_3$

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

2. Calcium carbonate decomposes on heating as shown below.

$$CaCO_3 \rightarrow CaO + CO_2$$

When 50 g of calcium carbonate are decomposed, 7 g of calcium oxide are formed. What is the percentage yield of calcium oxide?

A. 7 %

B. 25 %

C. 50 %

D. 75 %

3. Sodium reacts with water as shown below.

$$\_\_\,Na + \_\_\,H_2O \rightarrow \_\_\,NaOH + \_\_\,H_2$$

What is the total of **all** the coefficients when the equation is balanced using the smallest possible whole numbers?

A. 3

B. 4

C. 6

D. 7

4. What is the total number of ions present in the formula, $Al_2(SO_4)_3$?

A. 2

B. 3

C. 5

D. 6

5. Which statement is correct about the isotopes of an element?

A. They have the same mass number

B. They have the same electron arrangement

C. They have more protons than neutrons

D. They have the same numbers of protons and neutrons

6. What are *valence electrons*?

A. Electrons in the energy level closest to the nucleus

B. Electrons in the highest main energy level

C. The number of electrons required to complete the highest main energy level

D. The total number of electrons in the atom

7. Which equation represents the first ionization energy of fluorine?

A. $F(g) + e^- \rightarrow F^-(g)$

B. $F^-(g) \rightarrow F(g) + e^-$

C. $F^+(g) \rightarrow F(g) + e^-$

D. $F(g) \rightarrow F^+(g) + e^-$

8. Why do the boiling points of the halogens increase down the group?

A. There is an increase in bond enthalpy.

B. There is an increase in bond polarity.

C. There is an increase in the strength of temporary dipoles.

D. There is a decrease in electronegativity.

9. Which compound dissolves in water to form a solution that does **not** conduct electricity?

A. HCl

B. NaCl

C. CH_3CH_2OH

D. CH_3COOH

10. What intermolecular forces are present in gaseous hydrogen?

A. Hydrogen bonds

B. Covalent bonds

C. Dipole-dipole attractions

D. Van der Waals' forces

11. Which molecule is polar?

A. CO_2

B. PF_3

C. CH_4

D. BF_3

12. What are responsible for the high electrical conductivity of metals?

A. Delocalized positive ions

B. Delocalized valence electrons

C. Delocalized atoms

D. Delocalized negative ions

13. Which decreases as a liquid is heated to become a gas?

A. Attractive forces between particles

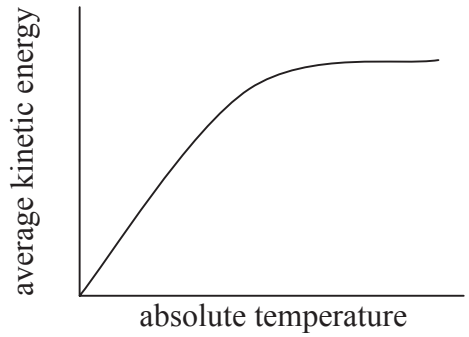
B. Motion of the particles

C. Size of the particles

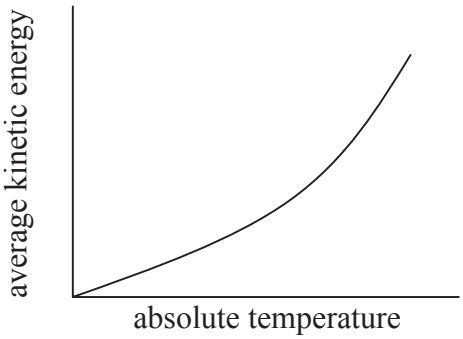
D. Space between the particles

14. Which graph shows how the average kinetic energy of the particles varies with absolute temperature for an ideal gas?

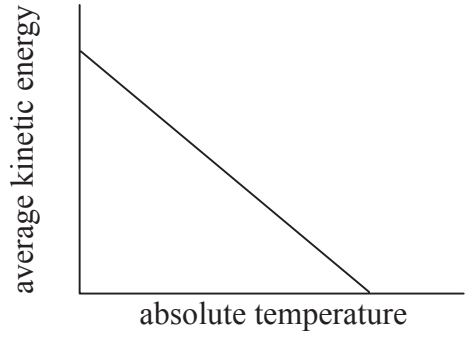
A.



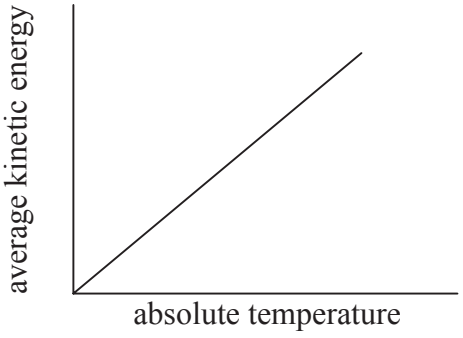
B.



C.



D.



15. Which equation represents a change with a negative value for ΔS?

A. $2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$

B. $H_2O(s) \rightarrow H_2O(g)$

C. $H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$

D. $2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$

16. The expression for the standard free energy change of a reaction is given by

$$\Delta G^{\ominus} = \Delta H^{\ominus} - T\Delta S^{\ominus}$$

What are the signs for $\Delta H^{\ominus}$ and $\Delta S^{\ominus}$ for a reaction that is spontaneous at all temperatures?

	$\Delta H^{\ominus}$	$\Delta S^{\ominus}$
A.	+	–
B.	–	+
C.	+	+
D.	–	–

17. Which statement is correct for an endothermic reaction?

A. The products are more stable than the reactants and ΔH is positive.

B. The products are less stable than the reactants and ΔH is negative.

C. The reactants are more stable than the products and ΔH is positive.

D. The reactants are less stable than the products and ΔH is negative.

18. Which equation represents an exothermic process?

A. $F^-(g) \rightarrow F(g) + e^-$

B. $F_2(g) \rightarrow 2F(g)$

C. $Na(g) \rightarrow Na^+(g) + e^-$

D. $I_2(g) \rightarrow I_2(s)$

19. Some reactions occur in a series of steps. Which is the best description of the rate-determining step in a reaction mechanism?

A. The step involving the greatest number of reactant particles

B. The step involving the smallest number of reactant particles

C. The step releasing the most energy

D. The step with the highest activation energy

20. Zinc reacts with sulfuric acid as shown below.

$$Zn(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + H_2(g)$$

Two identical samples of zinc were reacted with separate samples of excess acid as follows:

Reaction 1. zinc added to 1 mol dm^{-3} sulfuric acid

Reaction 2. zinc added to 2 mol dm^{-3} sulfuric acid

What is the same for reactions 1 and 2?

A. Total mass of hydrogen formed

B. Total reaction time

C. Initial reaction rate

D. Average rate of evolution of gas

21. Which changes cause an increase in the equilibrium yield of $SO_3(g)$ in this reaction?

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g) \quad \Delta H^{\ominus} = -196\ \text{kJ}$$

I. increasing the pressure

II. decreasing the temperature

III. adding oxygen

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

22. What is the magnitude of the equilibrium constant, K_c, for a reversible reaction which goes almost to completion?

A. $K_c = 1$

B. $K_c = 0$

C. $K_c \gg 1$

D. $K_c \ll 1$

23. Which is **not** a strong acid?

A. Nitric acid

B. Sulfuric acid

C. Carbonic acid

D. Hydrochloric acid

24. Lime is added to a lake to neutralize the effects of acid rain. The pH value of the lake water rises from 4 to 7. What is the change in concentration of H^+ ions in the lake water?

A. An increase by a factor of 3

B. An increase by a factor of 1000

C. A decrease by a factor of 3

D. A decrease by a factor of 1000

25. Which are examples of reduction?

I. Fe^{3+} becomes Fe^{2+}

II. Cl^- becomes Cl_2

III. CrO_3 becomes Cr^{3+}

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

26. Which statement is correct for the electrolysis of a molten salt?

A. Positive ions move toward the positive electrode.

B. A gas is produced at the negative electrode.

C. Only electrons move in the electrolyte.

D. Both positive and negative ions move toward electrodes.

27. Which statement about the following reaction is correct?

$$2Br^-(aq) + Cl_2(aq) \rightarrow Br_2(aq) + 2Cl^-(aq)$$

A. $Br^-(aq)$ is reduced and gains electrons.

B. $Cl_2(aq)$ is reduced and loses electrons.

C. $Br^-(aq)$ is oxidized and loses electrons.

D. $Cl_2(aq)$ is oxidized and gains electrons.

28. Which of the following products could be formed from the oxidation of ethanol?

I. ethanal

II. ethanoic acid

III. ethane

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

29. Which polymerize to form proteins?

A. Amides

B. Amino acids

C. Amines

D. Alkenes

30. Which pair of compounds can be used to prepare CH_3COOCH_3?

A. Ethanol and methanoic acid

B. Methanol and ethanoic acid

C. Ethanol and ethanoic acid

D. Methanol and methanoic acid