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

CHEMISTRY
STANDARD LEVEL
PAPER 1

Monday 18 November 2002 (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.

Periodic Table

1 **H** 1.01				Atomic Number 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)	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (263)	107 **Bh** (262)	108 **Hs**	109 **Mt**									

†	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. How many molecules are present in a drop of water of mass 9.00×10^{-2} g?

A. 3.01×10^{21}

B. 3.01×10^{22}

C. 9.75×10^{23}

D. 1.20×10^{26}

2. What amount of $H_2(g)$ is produced when 12 g of magnesium reacts completely with dilute $HCl(aq)$?

$$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$$

A. $\frac{1}{4}$ mol

B. $\frac{1}{2}$ mol

C. 1 mol

D. 2 mol

3. What amount (in moles) of $FeS_2(s)$ are required to produce 64 g of $SO_2(g)$ according to the following equation?

$$4FeS_2(s) + 11O_2(g) \rightarrow 2Fe_2O_3(s) + 8SO_2(g)$$

A. 0.40

B. 0.50

C. 1.0

D. 2.0

4. An oxide of metal M contains 40 % by mass of oxygen. The metal has a relative atomic mass of 24. What is the empirical formula of the oxide?

A. M_2O_3

B. M_2O

C. MO_2

D. MO

5. $25.0\ cm^3$ of $2.00\ mol\ dm^{-3}$ $HNO_3(aq)$ reacts completely with $20.0\ cm^3$ of $Ba(OH)_2(aq)$. What is the concentration of barium hydroxide solution?

A. $0.800\ mol\ dm^{-3}$

B. $1.25\ mol\ dm^{-3}$

C. $2.00\ mol\ dm^{-3}$

D. $2.50\ mol\ dm^{-3}$

6. Isotopes are elements with

A. the same atomic number and the same number of neutrons.

B. the same mass number but a different number of neutrons.

C. the same atomic number but a different number of neutrons.

D. different atomic and mass numbers but the same number of neutrons.

7. Which two species contain the same number of neutrons?

A. ^{55}Mn and ^{56}Fe

B. ^{35}Cl and ^{37}Cl

C. ^{23}Na and ^{39}K

D. ^{32}S and ^{35}Cl

8. On descending a group in the periodic table,

I. all the atoms have the same number of valence electrons.

II. ionization energy increases.

III. electronegativity decreases.

Which of the above statements are correct?

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

9. Which of the following displacement reactions is possible?

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

B. $I_2(aq) + 2Cl^-(aq) \rightarrow 2I^-(aq) + Cl_2(aq)$

C. $Cl_2(aq) + 2I^-(aq) \rightarrow 2Cl^-(aq) + I_2(aq)$

D. $I_2(aq) + 2Br^-(aq) \rightarrow 2I^-(aq) + Br_2(aq)$

10. An element E of mass number 40 has the electronic configuration 2. 8. 8. 2. Which statement regarding this element is **not** correct?

A. It belongs to group 2 of the periodic table.

B. It has 20 neutrons.

C. It belongs to the period 4 of the periodic table.

D. The formula of its oxide is EO_2.

11. Which intermolecular forces exist in dry ice, $CO_2(s)$?

A. Covalent bonds

B. Dipole-dipole attractions

C. Van der Waals' forces

D. Hydrogen bonds

12. Which has the smallest bond angle?

A. NH_3

B. CO_2

C. H_2O

D. CH_4

13. Which of the compounds H_2O, H_2S, H_2Se and H_2Te has the highest boiling point?

A. H_2O

B. H_2S

C. H_2Se

D. H_2Te

14. Which molecule is non-polar?

A. ClF

B. PF_3

C. CF_4

D. $CFCl_3$

15. Under what conditions would a given mass of oxygen gas occupy the greatest volume?

A. High temperature and high pressure

B. High temperature and low pressure

C. Low temperature and low pressure

D. Low temperature and high pressure

16. Consider the following reaction:

$$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g) \qquad \Delta H^{\ominus} = ?$$

Bond enthalpies (in kJ mol^{-1}) involved in the reaction are

$N \equiv N$	x
H–H	y
N–H	z

Which calculation will give the value of $\Delta H^{\ominus}$?

A. $x + 3y - 6z$

B. $6z - x + 3y$

C. $x - 3y + 6z$

D. $x + 3y - 2z$

17. Consider the following reactions:

$$CH_3COOH + OH^- \rightarrow CH_3COO^- + H_2O \qquad \Delta H^{\ominus} = q_1 \text{ kJ}$$
$$H^+ + OH^- \rightarrow H_2O \qquad \Delta H^{\ominus} = q_2 \text{ kJ}$$

What is the enthalpy change for the reaction below?

$$CH_3COOH \rightarrow CH_3COO^- + H^+$$

A. $q_2 - q_1$

B. $q_1 - q_2$

C. $-q_1 - q_2$

D. $2q_2 - q_1$

18. If 3600 J of heat is added to 180 g of $C_2H_5OH(l)$, its temperature increases from 18.5 $^{\circ}C$ to 28.5 $^{\circ}C$. What is the specific heat capacity of $C_2H_5OH(l)$?

A. 0.500 $J\ g^{-1}\ {}^{\circ}C^{-1}$

B 2.00 $J\ g^{-1}\ {}^{\circ}C^{-1}$

C. 20.0 $J\ g^{-1}\ {}^{\circ}C^{-1}$

D. 200 $J\ g^{-1}\ {}^{\circ}C^{-1}$

19. In general, the rate of a reaction can be increased by all of the following **except**

A. increasing the temperature.

B. increasing the activation energy.

C. increasing the concentration of reactants.

D. increasing the surface area of the reactants.

20. Under what conditions is the rate of reaction of magnesium with HCl(aq) fastest?

A. 10 cm^3 of 1.0 mol dm^{-3} HCl(aq) at 25 $^{\circ}C$

B. 10 cm^3 of 2.0 mol dm^{-3} HCl(aq) at 25 $^{\circ}C$

C. 10 cm^3 of 2.0 mol dm^{-3} HCl(aq) at 35 $^{\circ}C$

D. 10 cm^3 of 1.0 mol dm^{-3} HCl(aq) at 35 $^{\circ}C$

21. The volume of the reaction vessel containing the following equilibrium mixture

$$SO_2Cl_2(g) \rightleftharpoons SO_2(g) + Cl_2(g)$$

is increased. When equilibrium is re-established, which of the following will occur?

A. The amount of $SO_2Cl_2(g)$ will have increased.

B. The amount of $SO_2Cl_2(g)$ will have decreased.

C. The amount of $Cl_2(g)$ will remain unchanged.

D. The amount of $Cl_2(g)$ will have decreased.

22. In which reaction does the position of equilibrium remain unaffected by change in pressure?

A. $2O_3(g) \rightleftharpoons 3O_2(g)$

B. $2NO_2(g) \rightleftharpoons N_2O_4(g)$

C. $2NO(g) + Cl_2(g) \rightleftharpoons 2NOCl(g)$

D. $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$

23. When the following $0.10\ \text{mol dm}^{-3}$ solutions are arranged in order of **increasing** pH (lowest first), what is the correct order?

$$NH_3(aq), \quad NaOH(aq), \quad HCl(aq), \quad CH_3COOH(aq)$$

A. $NaOH, NH_3, CH_3COOH, HCl$

B. $HCl, CH_3COOH, NH_3, NaOH$

C. $HCl, CH_3COOH, NaOH, NH_3$

D. $NaOH, NH_3, HCl, CH_3COOH$

24. Consider a weak acid HA dissolved in water:

$$HA(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + A^-(aq)$$

Which statements are correct?

I. $A^-(aq)$ is a much stronger base than $H_2O(l)$.

II. HA dissociates only to a very small extent in aqueous solution.

III. The concentration of $H_3O^+(aq)$ is much greater than the concentration of HA(aq).

A. I, II and III

B. II and III only

C. I and II only

D. I and III only

25. In the reaction

$$3Br_2 + 6CO_3^{2-} + 3H_2O \rightarrow 5Br^- + BrO_3^- + 6HCO_3^-$$

A. Br_2 is only oxidised.

B. Br_2 is only reduced.

C. Br_2 is neither oxidised nor reduced.

D. Br_2 is both oxidised and reduced.

26. Consider the following statements regarding electrolysis of molten lead(II) bromide.

I. Oxidation takes place at the anode where lead ions gain electrons.

II Reduction takes place at the cathode where lead ions gain electrons.

III Oxidation takes place at the anode where bromide ions lose electrons.

IV. Reduction takes place at the cathode where bromide ions lose electrons.

Which of the above statements are correct?

A. I and II only

B. I and IV only

C. II and III only

D. II and IV only

27. A compound with the empirical formula C_2H_4O has a relative molecular mass of 88. What is the formula of the compound?

A. $CH_3CH_2COCH_3$

B. CH_3COOH

C. $HCOOCH_3$

D. $CH_3CH_2CH_2COOH$

28. Consider the following reaction.

$$CH_3COOH + NH_3 \rightarrow CH_3COONH_4 \xrightarrow{\text{heat}} CH_3CONH_2$$

What will be the final product if aminoethane (ethylamine) is used instead of NH_3 ?

A. $CH_3CONHCH_2CH_3$

B. $CH_3CONHCH_3$

C. CH_3CONH_2

D. $CH_3CONH_2CH_2CH_3$

29. Statement (S): Solubility of alkanols in water decreases with increase in M_r.
Explanation (E): The relative proportion of the hydrocarbon part in alkanol increases with increasing M_r.

A. Both S and E are true.

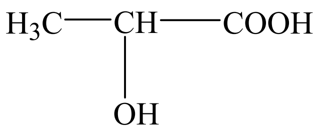
B. Both S and E are false.

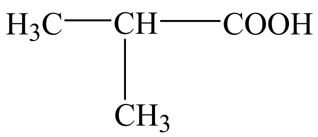
C. S is true but E is false.

D. S is false but E is true.

30. Which of the following compounds is optically active?

A. $HO—CH_2—COOH$

B. 

C. 

D.