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

M06/4/CHEMI/SPM/ENG/TZ0/XX+

22066104

CHEMISTRY
STANDARD LEVEL
PAPER 1

Thursday 18 May 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

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. Which contains the same number of ions as the value of Avogadro's constant?

A. 0.5 mol NaCl

B. 0.5 mol $MgCl_2$

C. 1.0 mol Na_2O

D. 1.0 mol MgO

2. A reaction occurring in the extraction of lead from its ore can be represented by this unbalanced equation:

$$\_\_ PbS + \_\_ O_2 \rightarrow \_\_ PbO + \_\_ SO_2$$

When the equation is balanced using the smallest possible whole numbers, what is the coefficient for O_2?

A. 1

B. 2

C. 3

D. 4

3. The equation for a reaction occurring in the synthesis of methanol is

$$CO_2 + 3H_2 \rightarrow CH_3OH + H_2O$$

What is the maximum amount of methanol that can be formed from 2 mol of carbon dioxide and 3 mol of hydrogen?

A. 1 mol

B. 2 mol

C. 3 mol

D. 5 mol

4. Which solution contains 0.1 mol of sodium hydroxide?

A. 1 cm^3 of 0.1 mol dm^{-3} NaOH

B. 10 cm^3 of 0.1 mol dm^{-3} NaOH

C. 100 cm^3 of 1.0 mol dm^{-3} NaOH

D. 1000 cm^3 of 1.0 mol dm^{-3} NaOH

5. How many neutrons are there in the ion $^{18}O^{2-}$?

A. 8

B. 10

C. 16

D. 20

6. What is the electron arrangement of silicon?

A. 2.4

B. 2.8

C. 2.8.4

D. 2.8.8

7. Which statement is correct for a periodic trend?

A. Ionization energy increases from Li to Cs.

B. Melting point increases from Li to Cs.

C. Ionization energy increases from F to I.

D. Melting point increases from F to I.

8. Which reaction results in the formation of a coloured substance?

A. $2Li(s) + 2H_2O(l) \rightarrow 2LiOH(aq) + H_2(g)$

B. $2Na(s) + Cl_2(g) \rightarrow 2NaCl(s)$

C. $Cl_2(g) + 2NaI(aq) \rightarrow 2NaCl(aq) + I_2(s)$

D. $Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$

9. Which statement is a correct description of electron loss in this reaction?

$$2Al + 3S \rightarrow Al_2S_3$$

A. Each aluminium atom loses two electrons.

B. Each aluminium atom loses three electrons.

C. Each sulfur atom loses two electrons.

D. Each sulfur atom loses three electrons.

10. Which molecule has the smallest bond angle?

A. CO_2

B. NH_3

C. CH_4

D. C_2H_4

11. In which substance is hydrogen bonding present?

A. CH_4

B. CH_2F_2

C. CH_3CHO

D. CH_3OH

12. Which is a correct description of metallic bonding?

A. Positively charged metal ions are attracted to negatively charged ions.

B. Negatively charged metal ions are attracted to positively charged metal ions.

C. Positively charged metal ions are attracted to delocalized electrons.

D. Negatively charged metal ions are attracted to delocalized electrons.

13. In which changes is there an increase in the spacing between particles?

I. boiling
II. condensing
III. diffusion

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

14. A cylinder of gas is at a pressure of 40 kPa. The volume and temperature (in K) are both doubled. What is the pressure of the gas after these changes?

A. 10 kPa

B. 20 kPa

C. 40 kPa

D. 80 kPa

15. Which statement about bond enthalpies is correct?

A. Bond enthalpies have positive values for strong bonds and negative values for weak bonds.

B. Bond enthalpy values are greater for ionic bonds than for covalent bonds.

C. Bond breaking is endothermic and bond making is exothermic.

D. The carbon–carbon bond enthalpy values are the same in ethane and ethene.

16. An equation for a reaction in which hydrogen is formed is

$$CH_4 + H_2O \rightarrow 3H_2 + CO \qquad \Delta H^{\ominus} = +210 \text{ kJ}$$

Which energy change occurs when 1 mol of hydrogen is formed in this reaction?

A. 70 kJ of energy are absorbed from the surroundings.

B. 70 kJ of energy are released to the surroundings.

C. 210 kJ of energy are absorbed from the surroundings.

D. 210 kJ of energy are released to the surroundings.

17. The equations and enthalpy changes for two reactions used in the manufacture of sulfuric acid are:

$$S(s) + O_2(g) \rightarrow SO_2(g) \quad \Delta H^{\ominus} = -300 \text{ kJ}$$
$$2SO_2(g) + O_2(g) \rightarrow 2SO_3(g) \quad \Delta H^{\ominus} = -200 \text{ kJ}$$

What is the enthalpy change, in kJ, for the reaction below?

$$2S(s) + 3O_2(g) \rightarrow 2SO_3(g)$$

A. –100

B. –400

C. –500

D. –800

18. Which reaction has the largest positive value of $\Delta S^{\ominus}$?

A. $CO_2(g) + 3H_2(g) \rightarrow CH_3OH(g) + H_2O(g)$

B. $2Al(s) + 3S(s) \rightarrow Al_2S_3(s)$

C. $CH_4(g) + H_2O(g) \rightarrow 3H_2(g) + CO(g)$

D. $2S(s) + 3O_2(g) \rightarrow 2SO_3(g)$

19. The table shows the concentrations of reactants and products during this reaction.

$$2A + B \rightarrow C + 2D$$

	[A] / mol dm^{-3}	[B] / mol dm^{-3}	[C] / mol dm^{-3}	[D] / mol dm^{-3}
at the start	6	3	0	0
after 1 min	4	2	1	2

The rate of reaction can be measured by reference to any reactant or product. Which rates are correct for this reaction?

I. rate = -2 mol dm^{-3} min^{-1} for A
II. rate = -1 mol dm^{-3} min^{-1} for B
III. rate = -1 mol dm^{-3} min^{-1} for C

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

20. A reaction occurs in four steps. The steps and their rates are shown in the table

Step	Rate
1	0.01 mol $dm^{-3}s^{-1}$
2	0.10 mol $dm^{-3}s^{-1}$
3	0.01 mol dm^{-3} min^{-1}
4	0.10 mol dm^{-3} min^{-1}

Which is the rate-determining step?

A. Step 1

B. Step 2

C. Step 3

D. Step 4

21. The equation for a reversible reaction used in industry to convert methane to hydrogen is shown below.

$$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g) \qquad \Delta H^{\ominus} = +210 \text{ kJ}$$

Which statement is always correct about this reaction when equilibrium has been reached?

A. The concentrations of methane and carbon monoxide are equal.

B. The rate of the forward reaction is greater than the rate of the reverse reaction.

C. The amount of hydrogen is three times the amount of methane.

D. The value of $\Delta H^{\ominus}$ for the reverse reaction is –210 kJ.

22. The equation for a reaction used in the manufacture of nitric acid is

$$4NH_3(g) + 5O_2(g) \rightleftharpoons 4NO(g) + 6H_2O(g) \qquad \Delta H^{\ominus} = -900 \text{ kJ}$$

Which changes occur when the temperature of the reaction is increased?

	Position of equilibrium	Value of K_c
A.	shifts to the left	increases
B.	shifts to the left	decreases
C.	shifts to the right	increases
D.	shifts to the right	decreases

23. Which substance reacts with dilute hydrochloric acid to produce hydrogen gas?

A. Mg

B. MgO

C. $Mg(OH)_2$

D. $MgCO_3$

24. Which change in $[H^+]$ causes the biggest increase in pH?

A. A change in $[H^+(aq)]$ from 1×10^{-3} to 1×10^{-2} mol dm^{-3}

B. A change in $[H^+(aq)]$ from 1×10^{-3} to 1×10^{-4} mol dm^{-3}

C. A change in $[H^+(aq)]$ from 1×10^{-4} to 1×10^{-2} mol dm^{-3}

D. A change in $[H^+(aq)]$ from 1×10^{-4} to 1×10^{-6} mol dm^{-3}

25. What are the oxidation numbers of the elements in the compound phosphoric acid, H_3PO_4?

	Hydrogen	Phosphorus	Oxygen
A.	+1	+1	–2
B.	+1	+5	–2
C.	+3	+1	–4
D.	+3	+5	–8

26. A voltaic cell is made from magnesium and iron half-cells. Magnesium is a more reactive metal than iron. Which statement is correct when the cell produces electricity?

A. Electrons are lost from magnesium atoms.

B. The concentration of Fe^{2+} ions increases.

C. Electrons flow from the iron half-cell to the magnesium half-cell.

D. Negative ions flow through the salt bridge from the magnesium half-cell to the iron half-cell.

27. A metallic object is electroplated with copper using a solution of copper(II) sulfate. Which statement is correct?

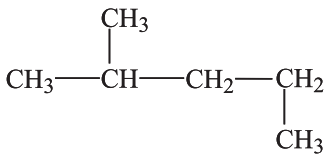
A. The positive electrode increases in mass.

B. The concentration of Cu^{2+} ions in the solution decreases.

C. Reduction occurs at the positive electrode.

D. The reaction occurring at the negative electrode is $Cu^{2+} + 2e^- \rightarrow Cu$.

28. What is the correct name of this compound?



A. 1,3-dimethylbutane

B. 2,4-dimethylbutane

C. 2-methylbutane

D. 2-methylpentane

29. Propane, C_3H_8, undergoes incomplete combustion in a limited amount of air. Which products are most likely to be formed during this reaction?

A. Carbon monoxide and water

B. Carbon monoxide and hydrogen

C. Carbon dioxide and hydrogen

D. Carbon dioxide and water

30. What is/are the product(s) of the reaction between ethene and hydrogen bromide?

A. CH_3CH_2Br

B. CH_3CH_2Br and H_2

C. CH_2BrCH_2Br

D. CH_2BrCH_2Br and H_2