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

N04/4/CHEMI/SPM/ENG/TZ0/XX

88046104

CHEMISTRY
STANDARD LEVEL
PAPER 1

Wednesday 17 November 2004 (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 of the following contains the greatest number of molecules?

A. 1 g of CH_3Cl

B. 1 g of CH_2Cl_2

C. 1 g of $CHCl_3$

D. 1 g of CCl_4

2. Which of the following compounds has/have the empirical formula CH_2O?

I. CH_3COOH

II. $C_6H_{12}O_6$

III. $C_{12}H_{22}O_{11}$

A. II only

B. III only

C. I and II only

D. II and III only

3. Consider the equation below.

$$Fe(s) + S(s) \rightarrow FeS(s)$$

If 10.0 g of iron is heated with 10.0 g of sulfur to form iron(II) sulfide, what is the theoretical yield of FeS in grams?

A. 10.0 + 10.0

B. $\frac{87.91 \times 10.0}{55.85}$

C. $\frac{87.91 \times 10.0}{32.06}$

D $\frac{55.85 \times 10.0}{32.06}$

4. Assuming complete reaction, what volume of 0.200 mol dm^{-3} HCl(aq) is required to neutralize 25.0 cm^3 of 0.200 mol dm^{-3} $Ba(OH)_2(aq)$?

A. 12.5 cm^3

B. 25.0 cm^3

C. 50.0 cm^3

D. 75.0 cm^3

5. A certain sample of element *Z* contains 60% of ^{69}Z and 40% of ^{71}Z. What is the relative atomic mass of element *Z* in this sample?

A. 69.2

B. 69.8

C. 70.0

D. 70.2

6. What is the difference between two neutral atoms represented by the symbols $^{59}_{27}\text{Co}$ and $^{59}_{28}\text{Ni}$?

A. The number of neutrons only.

B. The number of protons and electrons only.

C. The number of protons and neutrons only.

D. The number of protons, neutrons and electrons.

7. Rubidium is an element in the same group of the periodic table as lithium and sodium. It is likely to be a metal which has a

A. high melting point and reacts slowly with water.

B. high melting point and reacts vigorously with water.

C. low melting point and reacts vigorously with water.

D. low melting point and reacts slowly with water.

8. When the following species are arranged in order of **increasing** radius, what is the correct order?

A. Cl^-, Ar, K^+

B. K^+, Ar, Cl^-

C. Cl^-, K^+, Ar

D. Ar, Cl^-, K^+

9. According to VSEPR theory, repulsion between electron pairs in a valence shell decreases in the order

A. lone pair-lone pair > lone pair-bond pair > bond pair-bond pair.

B. bond pair-bond pair > lone pair- bond pair > lone pair-lone pair.

C. lone pair-lone pair > bond pair-bond pair > bond pair-lone pair.

D. bond pair-bond pair > lone pair-lone pair > lone pair-bond pair.

10. Which molecule is linear?

A. SO_2

B. CO_2

C. H_2S

D. Cl_2O

11. Why is the boiling point of PH_3 lower than that of NH_3?

A. PH_3 is non-polar whereas NH_3 is polar.

B. PH_3 is not hydrogen bonded whereas NH_3 is hydrogen bonded.

C. Van der Waals' forces are weaker in PH_3 than in NH_3.

D. The molar mass of PH_3 is greater than that of NH_3.

12. Which molecule is non-polar?

A. H_2CO

B. SO_3

C. NF_3

D. $CHCl_3$

13. Under what conditions would one mole of methane gas, CH_4, occupy the smallest volume?

A. 273 K and 1.01×10^5 Pa

B. 273 K and 2.02×10^5 Pa

C. 546 K and 1.01×10^5 Pa

D. 546 K and 2.02×10^5 Pa

14. The temperature in Kelvin of 2.0 dm^3 of an ideal gas is doubled and its pressure is increased by a factor of four. What is the final volume of the gas?

A. 1.0 dm^3

B. 2.0 dm^3

C. 3.0 dm^3

D. 4.0 dm^3

15. Consider the following equations.

$$\mathrm{Mg(s)} + \tfrac{1}{2}\mathrm{O_2(g)} \rightarrow \mathrm{MgO(s)} \qquad \Delta H^{\ominus} = -602 \text{ kJ}$$
$$\mathrm{H_2(g)} + \tfrac{1}{2}\mathrm{O_2(g)} \rightarrow \mathrm{H_2O(g)} \qquad \Delta H^{\ominus} = -242 \text{ kJ}$$

What is the $\Delta H^{\ominus}$ value (in kJ) for the following reaction?

$$\mathrm{MgO(s) + H_2(g) \rightarrow Mg(s) + H_2O(g)}$$

A. – 844

B. – 360

C. + 360

D. + 844

16. For which of the following is the sign of the enthalpy change different from the other three?

A. $\mathrm{CaCO_3(s) \rightarrow CaO(s) + CO_2(g)}$

B. $\mathrm{Na(g) \rightarrow Na^+(g) + e^-}$

C. $\mathrm{CO_2(s) \rightarrow CO_2(g)}$

D. $\mathrm{2Cl(g) \rightarrow Cl_2(g)}$

17. Which reaction has a positive entropy change, $\Delta S^{\ominus}$?

A. $\mathrm{H_2O(g) \rightarrow H_2O(l)}$

B. $\mathrm{2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)}$

C. $\mathrm{CaCO_3(s) \rightarrow CaO(s) + CO_2(g)}$

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

18. Separate solutions of HCl(aq) and $H_2SO_4(aq)$ of the same concentration and same volume were completely neutralized by $NaOH(aq)$. X kJ and Y kJ of heat were evolved respectively. Which statement is correct?

A. $X = Y$

B. $Y = 2X$

C. $X = 2Y$

D. $Y = 3X$

19. For a given reaction, why does the rate of reaction increase when the concentrations of the reactants are increased?

A. The frequency of the molecular collisions increases.

B. The activation energy increases.

C. The average kinetic energy of the molecules increases.

D. The rate constant increases.

20. Which statement is correct for the reaction below?

$$4P + Q \rightarrow 2R + 2S$$

A. The rate of formation of R is one half the rate of the disappearance of Q.

B. The rate of disappearance of Q is one quarter of the rate of disappearance of P.

C. The rates of formation of R and S are not equal.

D. The rate of formation of S is double the rate of disappearance of P.

21. In the Haber process for the synthesis of ammonia, what effects does the catalyst have?

	Rate of formation of $NH_3(g)$	**Amount of $NH_3(g)$ formed**
A.	Increases	Increases
B.	Increases	Decreases
C.	Increases	No change
D.	No change	Increases

22. What will happen if $CO_2(g)$ is allowed to escape from the following reaction mixture at equilibrium?

$$CO_2(g) + H_2O(l) \rightleftharpoons H^+(aq) + HCO_3^-(aq)$$

A. The pH will decrease.

B. The pH will increase.

C. The pH will remain constant.

D. The pH will become zero.

23. Consider the following equilibria in 0.10 $mol\,dm^{-3}$ carbonic acid.

$$H_2CO_3(aq) \rightleftharpoons H^+(aq) + HCO_3^-(aq)$$
$$HCO_3^-(aq) \rightleftharpoons H^+(aq) + CO_3^{2-}(aq)$$

Which species is present in the highest concentration?

A. $H_2CO_3(aq)$

B. $H^+(aq)$

C. $HCO_3^-(aq)$

D. $CO_3^{2-}(aq)$

24. The pH of a solution is 2. If its pH is increased to 6, how many times greater is the $[H^+]$ of the original solution?

A. 3

B. 4

C. 1000

D. 10 000

25. Consider the following reaction.

$$H_2SO_3\,(aq) + Sn^{4+}\,(aq) + H_2O\,(l) \rightarrow Sn^{2+}\,(aq) + HSO_4^-\,(aq) + 3H^+\,(aq)$$

Which statement is correct?

A. H_2SO_3 is the reducing agent because it undergoes reduction.

B. H_2SO_3 is the reducing agent because it undergoes oxidation.

C. Sn^{4+} is the oxidizing agent because it undergoes oxidation.

D. Sn^{4+} is the reducing agent because it undergoes oxidation.

26. In which change does oxidation occur?

A. $CH_3CHO \rightarrow CH_3CH_2OH$

B. $CrO_4^{2-} \rightarrow Cr_2O_7^{2-}$

C. $SO_4^{2-} \rightarrow SO_3^{2-}$

D. $NO_2^- \rightarrow NO_3^-$

27. What happens at the positive electrode in a voltaic cell and in an electrolytic cell?

	Voltaic cell	**Electrolytic cell**
A.	Oxidation	Reduction
B.	Reduction	Oxidation
C.	Oxidation	Oxidation
D.	Reduction	Reduction

28. Which compound has the lowest boiling point?

A. $CH_3CH_2CH(CH_3)CH_3$

B. $(CH_3)_4C$

C. $CH_3CH_2CH_2CH_2CH_3$

D. $CH_3CH_2OCH_2CH_3$

29. Which species will show optical activity?

A. 1-chloropentane

B. 3-chloropentane

C. 1-chloro-2-methylpentane

D. 2-chloro-2-methylpentane

30. What type of reaction does the equation below represent?

$$CH_2{=}CH_2 + Br_2 \rightarrow BrCH_2CH_2Br$$

A. substitution

B. condensation

C. reduction

D. addition