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

CHEMISTRY
STANDARD LEVEL
PAPER 1

Monday 20 May 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

Atomic Number Atomic Mass

1 **H** 1.01																	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. A compound that contains only carbon, hydrogen and oxygen has the following percentage by mass:

carbon 60 %, hydrogen 8 %, oxygen 32 %.

What is a possible molecular formula?

A. $C_5H_8O_2$

B. C_5H_4O

C. C_6HO_3

D. C_7HO_4

2. Which sample contains the smallest amount of oxygen?

A. 0.3 mol H_2SO_4

B. 0.6 mol O_3

C. 0.7 mol HCOOH

D. 0.8 mol H_2O

3. When the equation $C_4H_{10} + O_2 \rightarrow CO_2 + H_2O$ is balanced correctly, what is the coefficient for O_2?

A. 9

B. 13

C. 18

D. 24

4. 6.4 g of copper wire is added to 0.10 dm^3 of 1.0 $mol\,dm^{-3}$ aqueous $AgNO_3$ to form metallic silver and aqueous copper(II) nitrate. When the reaction is complete

A. excess copper wire remains.

B. all the copper wire dissolves and some silver ions are left in solution.

C. all the copper wire dissolves and no silver ions are left in solution.

D. the mass of metallic silver formed is equal to the mass of copper wire that reacts.

5. 2.02 g of KNO_3 ($M_r = 101$) is dissolved in sufficient water to prepare 0.500 dm^3 of solution. What is the concentration of this solution in $mol\,dm^{-3}$?

A. 0.02

B. 0.04

C. 0.10

D. 0.20

6. Copper consists of the isotopes ^{63}Cu and ^{65}Cu and has a relative atomic mass of 63.55. What is the most likely composition?

	^{63}**Cu**	^{65}**Cu**
A.	30 %	70 %
B.	50 %	50 %
C.	55 %	45 %
D.	70 %	30 %

7. What is the electron arrangement of the ion ${}^{16}_{8}O^{2-}$?

A. 2,6

B. 2,8

C. 2,8,6

D. 2,8,8

8. An element is in group 3 and period 2. How many electrons are present in its outer shell?

A. 2

B. 3

C. 5

D. 6

9. Which property increases with increasing atomic number for both the alkali metals and the halogens?

A. Atomic radius

B. Electronegativity

C. Ionisation energy

D. Melting point

10. Which of the following reactions is/are spontaneous?

I. $Cl_2 + 2Br^- \rightarrow Br_2 + 2Cl^-$

II. $Br_2 + 2I^- \rightarrow I_2 + 2Br^-$

A. I only

B. II only

C. Both I and II

D. Neither I nor II

11. What formula would result from the combination of element *A* (group 2) and element *B* (group 7)?

A. AB

B. AB_2

C. A_2B_7

D. A_7B_2

12. When the Lewis structure for $HCOOCH_3$ is drawn, how many bonding and how many lone pairs of electrons are present?

	Bond pairs	**Lone pairs**
A.	8	4
B.	7	5
C.	7	4
D.	5	5

13. The carbon–carbon–carbon bond angle in CH_3CHCH_2 is closest to

A. 180°.

B. 120°.

C. 109°.

D. 90°.

14. The compounds **A**, **B**, **C**, have approximately the same molar mass.

A	**B**	**C**
C_4H_{10}	$CH_3CH_2CH_2OH$	$CH_3OCH_2CH_3$

When these compounds are arranged in order of increasing boiling points (lowest boiling point first), the correct order is

A. **A**, **C**, **B**.

B. **A**, **B**, **C**.

C. **B**, **C**, **A**.

D. **C**, **B**, **A**.

15. What occurs during the change from a liquid to a solid at a fixed temperature?

A. The particles become smaller and heat is released.

B. The particles get closer together and heat is absorbed.

C. The particles become more ordered and heat is released.

D. The attractive forces between the particles become stronger and heat is absorbed.

16. When the solids $Ba(OH)_2 \cdot 8H_2O$ and NH_4SCN are mixed, a solution is formed and the temperature decreases. Which statement about this reaction is correct?

A. The reaction is exothermic and ΔH is negative.

B. The reaction is exothermic and ΔH is positive.

C. The reaction is endothermic and ΔH is negative.

D. The reaction is endothermic and ΔH is positive.

17. Using the information below:

$$H_2(g) + O_2(g) \rightarrow H_2O_2(l) \qquad \Delta H = -187.6 \text{ kJ}$$
$$2H_2(g) + O_2(g) \rightarrow 2H_2O(l) \qquad \Delta H = -571.6 \text{ kJ}$$

what is the value of ΔH (in kJ) for the following reaction?

$$2H_2O_2(l) \rightarrow 2H_2O(l) + O_2(g)$$

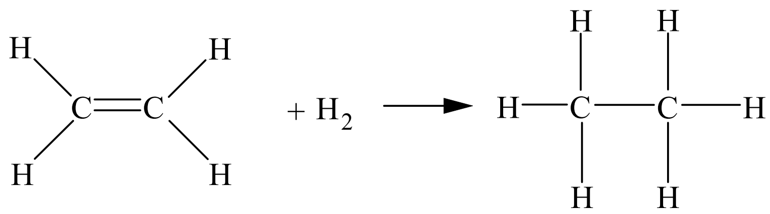
A. –196.4

B. – 384.0

C. – 759.2

D. – 946.8

18. What is the value of ΔH (in kJ mol^{-1}) for the reaction below?



Bond Energies / kJ mol^{-1}	H—H	C—C	C$=$C	C—H
	436	348	612	412

A. 124

B. 101

C. –101

D. –124

19. $$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$$

Which change will increase the rate of the reaction when 50 cm^3 of 1.0 $mol\,dm^{-3}$ HCl is added to 1.0 g of $CaCO_3$?

A. The volume of HCl is increased.

B. The concentration of HCl is decreased.

C. The size of the $CaCO_3$ solid particles is decreased.

D. The pressure of the CO_2 is increased.

20. Which statement(s) about the following reaction at 100 $^\circ C$ is/are correct?

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

I. Every collision between N_2 and H_2 molecules is expected to produce NH_3.

II. This reaction must involve a collision between one N_2 and three H_2 molecules.

A. I only

B. II only

C. Both I and II

D. Neither I nor II

21. For a gaseous reaction, the equilibrium constant expression is:

$$K_c = \frac{[O_2]^5[NH_3]^4}{[NO]^4[H_2O]^6}.$$

Which equation corresponds to this equilibrium expression?

A. $4NH_3 + 5O_2 \rightleftharpoons 4NO + 6H_2O$

B. $4NO + 6H_2O \rightleftharpoons 4NH_3 + 5O_2$

C. $8NH_3 + 10O_2 \rightleftharpoons 8NO + 12H_2O$

D. $2NO + 3H_2O \rightleftharpoons 2NH_3 + \frac{5}{2}O_2$

22. The reaction

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

is exothermic. Which of the following could be used to shift the equilibrium to the right?

I. Increasing the pressure

II. Increasing the temperature

A. I only

B. II only

C. Both I and II

D. Neither I nor II

23. Solutions **P**, **Q**, **R** and **S** have the following properties:

P: $pH = 8$ **Q**: $[H^+] = 1 \times 10^{-3}$ $mol\,dm^{-3}$ **R**: $pH = 5$ **S**: $[H^+] = 2 \times 10^{-7}$ $mol\,dm^{-3}$

When these solutions are arranged in order of increasing acidity (least acidic first), the correct order is

A. **P**, **S**, **R**, **Q**.

B. **Q**, **R**, **S**, **P**.

C. **S**, **R**, **P**, **Q**.

D. **R**, **P**, **Q**, **S**.

24. The ionisation of sulfuric acid is represented by the equations below:

$$H_2SO_4(aq) + H_2O(l) \rightarrow H_3O^+(aq) + HSO_4^-(aq)$$
$$HSO_4^-(aq) + H_2O(l) \rightarrow H_3O^+(aq) + SO_4^{2-}(aq)$$

What is the conjugate base of $HSO_4^-(aq)$?

A. $H_2O(l)$

B. $H_3O^+(aq)$

C. $H_2SO_4(aq)$

D. $SO_4^{2-}(aq)$

25. Which of the following changes represents a reduction reaction?

A. $Mn^{2+}(aq) \rightarrow MnO_4^-(aq)$

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

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

D. $Zn(s) \rightarrow Zn^{2+}(aq)$

26. During the electrolysis of a molten salt, the cation moves toward the …**I**… and undergoes …**II**….

	I	**II**
A.	negative electrode	reduction
B.	negative electrode	oxidation
C.	positive electrode	oxidation
D.	positive electrode	reduction

27. When one mole of ethene reacts with two moles of oxygen gas

A. ΔH is positive.

B. the oxidation number of carbon is unchanged.

C. an alcohol is formed.

D. carbon monoxide is produced.

28. What is the name of the compound $CH_3CH_2CH_2COOCH_3$?

A. Butyl methanoate

B. Methyl butanoate

C. Methyl propanoate

D. Pentanone

29. Which molecule possesses a chiral centre?

A. NH_2CH_2COOH

B. $CH_3CH(NH_2)COOH$

C. $CH_3C(NH_2)_2COOH$

D. $(CH_3)_2C(NH_2)COOH$

30. What is the product of the reaction between bromine and ethene?

A. $CH_2 = CHBr$

B. $CHBr = CHBr$

C. CH_3CH_2Br

D. CH_2BrCH_2Br