INTERNATIONAL BACCALAUREATE
BACCALAURÉAT INTERNATIONAL
BACHILLERATO INTERNACIONAL

CHEMISTRY
STANDARD LEVEL
PAPER 1

Tuesday 7 November 2000 (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. The mass (in grams) of one molecule of water is

A. 3.0×10^{-23}

B. 1.8×10^{-22}

C. 3.0

D. 18.0

2. The formula for molybdenum(III) sulfate is

A. $MoSO_4$

B. $Mo(SO_4)_3$

C. $Mo_3(SO_4)_2$

D. $Mo_2(SO_4)_3$

3. $$w\,C_4H_9OH + x\,O_2 \rightarrow y\,CO_2 + z\,H_2O$$

When this equation is balanced correctly, the coefficient, *x*, for O_2 is

A. 6

B. 9

C. $\frac{13}{2}$

D. 13

4. $$H_2 + Cl_2 \rightarrow 2HCl$$

Hydrogen and chlorine react according to the equation above. What will be the result of the reaction of 2.0 moles of H_2 and 1.5 moles of Cl_2?

A. 3.5 mol of HCl

B. 1.5 mol of HCl and 0.5 mol of H_2

C. 2.0 mol of HCl and 0.5 mol of Cl_2

D. 3.0 mol of HCl and 0.5 mol of H_2

5. 25.0 cm^3 of sulfuric acid solution reacts with 36.2 cm^3 of 0.225 $mol\,dm^{-3}$ sodium hydroxide solution. The concentration of the acid is

A. $\dfrac{36.2 \times 0.225}{25.0}$

B. $\dfrac{2 \times 36.2 \times 0.225}{25.0}$

C. $\dfrac{36.2 \times 0.225}{2 \times 25.0}$

D. $\dfrac{25.0}{2 \times 36.2 \times 0.225}$

6. The correct number of protons and the electron configuration for chlorine is

	number of protons	electron configuration
A.	17	2, 8, 7
B.	17	2, 8, 8
C.	18	2, 8, 7
D.	18	2, 8, 8

7. The relative masses and charges of protons, neutrons and electrons are:

	mass	charge
proton	1	+1
neutron	1	0
electron	negligible	−1

Using these data, what are the values for the mass and charge of the helium nucleus?

	mass	charge
A.	2	+2
B.	2	0
C.	4	+2
D.	4	0

8. When the elements below are arranged in order of **increasing** ionisation energy, what is the correct order?

A. Li, Na, K

B. Na, K, Li

C. Na, Li, K

D. K, Na, Li

9. Equal numbers of moles of each of the following substances are added to 1 dm^3 of water. Which produces the solution with the lowest pH?

A. Na_2O

B. MgO

C. Al_2O_3

D. SO_2

10. Most of the oxides of non-metallic elements are

A. ionic and basic.

B. ionic and acidic.

C. covalent and basic.

D. covalent and acidic.

11. What is the formula of a compound formed between element A (from Group 2) and element B (from Group 5)?

A. AB

B. AB_2

C. A_2B_5

D. A_3B_2

12. As atomic number increases within a Group, the electronegativity of the elements

A. decreases because the atomic number increases.

B. decreases because the atomic size increases.

C. increases because the number of energy levels increases.

D. increases because the atomic number increases.

13. Which molecule has polar bonds but is nonpolar?

A. N_2

B. O_3

C. CO_2

D. NH_3

14. Which molecule has the largest bond angle?

A. BF_3

B. CF_4

C. NF_3

D. OF_2

15. The volume of a gas increases when its temperature is raised at constant pressure. This can be explained by an increase in which of the following?

I. Average speed of the molecules

II. Average size of the molecules

A. I only

B. II only

C. Both I and II

D. Neither I nor II

16.

$$C(s) + O_2(g) \rightarrow CO_2(g) \qquad \Delta H^{\ddot{O}} = -393 \text{ kJ mol}^{-1}$$
$$2CO(g) + O_2(g) \rightarrow 2CO_2(g) \qquad \Delta H^{\ddot{O}} = -588 \text{ kJ mol}^{-1}$$

According to the data above, what is the enthalpy change (in kJ) for the reaction:

$$C(s) + \tfrac{1}{2}O_2(g) \rightarrow CO(g)$$

A. –87

B. –99

C. –173

D. –220

17.

$$C_2H_4(g) + H_2(g) \rightarrow C_2H_6(g) \qquad \Delta H^{\ddot{O}} = -137 \text{ kJ}$$

Which statement about the information above is correct?

A. The total energy of the bonds broken in the reactants is **greater** than the total energy of the bonds formed in the product

B. The bonds broken and the bonds made are of the same strength

C. The total energy of the bonds broken in the reactants is **less** than the total energy of the bonds formed in the product

D. No conclusion can be made about the sums of the bond enthalpies in the product compared with the reactants

18. When 50 cm^3 of 1 $mol\,dm^{-3}$ HCl is mixed with 50 cm^3 of 1 $mol\,dm^{-3}$ NaOH, the temperature of the resulting solution increases by 6 °C. What will be the temperature change when 100 cm^3 of each of these solutions are mixed?

A. 3 °C

B. 6 °C

C. 12 °C

D. 24 °C

19. As the temperature of a reaction between two gases is increased, the rate of the reaction increases. This is **mainly** because

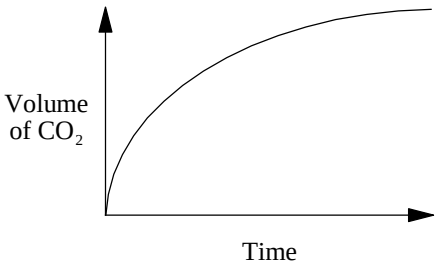
A. the concentrations of the reactants increase.

B. the molecules collide more frequently.

C. the pressure exerted by the molecules increases.

D. the fraction of molecules with the energy needed to react increases.

20.



The curve above is obtained for the reaction of an excess of $CaCO_3$ with hydrochloric acid. How and why does the rate of reaction change with time?

	Rate of reaction	Reason
A.	decreases	the HCl becomes more dilute
B.	decreases	the pieces of $CaCO_3$ become smaller
C.	increases	the temperature increases
D.	increases	the CO_2 produced acts as a catalyst

21. $$2H_2(g) + CO(g) \rightleftharpoons CH_3OH(g)$$

Methanol is made in industry by means of the reaction above. The equilibrium expression for this reaction is

A. $\dfrac{[CH_3OH]}{2[H_2][CO]}$

B. $\dfrac{[CH_3OH]}{[H_2]^2[CO]}$

C. $\dfrac{2[H_2][CO]}{[CH_3OH]}$

D. $\dfrac{[H_2]^2[CO]}{[CH_3OH]}$

22. $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \qquad \Delta H = -91.8 \text{ kJ}$

The industrial synthesis of ammonia is based on the reaction above. Which factor(s) will increase the equilibrium concentration of ammonia?

I. Increase in pressure

II. Increase in temperature

A. I only

B. II only

C. Both I and II

D. Neither I nor II

23. When the pH of a solution changes from 2.0 to 4.0, the hydrogen ion concentration

A. increases by a factor of 100.

B. increases by a factor of 2.

C. decreases by a factor of 2.

D. decreases by a factor of 100.

24. Which will be the same for separate 1 mol dm^{-3} solutions of a strong acid and a weak acid?

I. Electrical conductivity

II. Concentration of H^+ ions

A. I only

B. II only

C. Both I and II

D. Neither I nor II

25. The oxidation number of sulfur in the $HS_2O_5^-$ ion is

A. -1

B. $+3$

C. $+4$

D. $+5$

26.

$$2AgNO_3(aq) + Zn(s) \rightarrow 2Ag(s) + Zn(NO_3)_2(aq)$$
$$Zn(NO_3)_2(aq) + Co(s) \rightarrow \text{No reaction}$$
$$2AgNO_3(aq) + Co(s) \rightarrow Co(NO_3)_2(aq) + 2Ag(s)$$

Using the above information, the order of **increasing** activity of the metals is

A. $Ag < Zn < Co$

B. $Co < Ag < Zn$

C. $Co < Zn < Ag$

D. $Ag < Co < Zn$

27. How many different structural isomers have the formula C_4H_9Cl?

A. 2

B. 3

C. 4

D. 5

28. What will be formed when $CH_2 = CH_2$ reacts with Br_2 in the dark?

A. $CH_2Br - CH_2Br$

B. $CH_3 - CHBr_2$

C. $CH_2 = CHBr + HBr$

D. $CHBr = CHBr + H_2$

29. Which compound can show optical activity?

A. CH_3COOH

B. H_2NCH_2COOH

C. $HOCH(CH_3)COOH$

D. $(CH_3)_3CCOOH$

30. When the compounds below are listed in order of **decreasing** boiling point (highest to lowest) what is the correct order?

1. ethane 2. fluoroethane 3. ethanol 4. ethanoic acid

A. 4, 3, 1, 2

B. 4, 3, 2, 1

C. 3, 4, 1, 2

D. 2, 1, 3, 4