INTERNATIONAL BACCALAUREATE
BACCALAURÉAT INTERNATIONAL
BACHILLERATO INTERNACIONAL

CHEMISTRY
STANDARD LEVEL
PAPER 1

Tuesday 16 May 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. How many molecules are there in 180 g of H_2O?

A. 6.0×10^{22}

B. 6.0×10^{23}

C. 6.0×10^{24}

D. 6.0×10^{25}

2. Which of the following compounds has the greatest **empirical** formula mass?

A. C_6H_6

B. C_4H_{10}

C. C_3H_6

D. C_2H_6

3.

$$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$$

When heated, $CaCO_3$ ($M_r = 100$) decomposes as shown above. When 20 g of impure $CaCO_3$ is heated, 0.15 moles of CO_2 are obtained. What is the percentage purity of the $CaCO_3$? (Assume that none of the impurities produce CO_2 upon heating.)

A. 15

B. 25

C. 55

D. 75

4.

$$vC_2H_3Cl(g) + wO_2(g) \rightarrow xCO_2(g) + yH_2O(g) + zHCl(g)$$

Chloroethene can be burned in oxygen as shown above. What is the value of w when $v = 2$?

A. 2

B. 3

C. 4

D. 5

5. What volume (in cm^3) of 0.200 $mol\,dm^{-3}$ NaOH is required to neutralise 20.0 cm^3 of 0.100 $mol\,dm^{-3}$ H_2SO_4?

A. 5.0

B. 10.0

C. 20.0

D. 40.0

6. Which of the following particles contain more electrons than **neutrons**?

I. ${}^{1}_{1}H$

II. ${}^{35}_{17}Cl^{-}$

III. ${}^{39}_{19}K^{+}$

A. I only

B. II only

C. I and II only

D. II and III only

7. What information about the structure of a hydrogen atom can be gained from its emission spectrum?

A. Most of the mass of the atom is in its nucleus.

B. A hydrogen atom contains one proton and one electron.

C. The electron in the hydrogen atom is held near the nucleus.

D. The electron may exist in any of several energy levels.

8. An element has the electron configuration 2, 8, 6. What is the element?

A. C

B. Si

C. S

D. Ne

9. Which one of the following increases in value from Li to Cs?

A. Atomic radius

B. Electronegativity

C. Ionisation energy

D. Melting point

10. Which set of reactants below is expected to produce the most vigorous reaction?

A. $Na(s) + Cl_2(g)$

B. $Na(s) + Br_2(g)$

C. $K(s) + Cl_2(g)$

D. $K(s) + Br_2(g)$

11. A Group 1 element, *X*, bonds with a Group 7 element, *Y*. What is the most likely formula and type of bonding in this compound?

A. X_2Y ionic

B. XY ionic

C. XY covalent

D. XY_2 covalent

12. In which of the following is there at least one double bond?

I. O_2

II. CO_2

III. C_2H_4

A. I only

B. III only

C. II and III only

D. I, II and III

13. According to VSEPR theory, which molecule would be expected to have the **smallest** bond angle?

A. H_2O

B. H_2CO

C. CH_4

D. NH_3

14. In which of the following substances would hydrogen bonding be expected to occur?

I. CH_4

II. CH_3COOH

III. CH_3OCH_3

A. II only

B. I and III only

C. II and III only

D. I, II and III

15. Which of the following best accounts for the observation that gases are easily compressed?

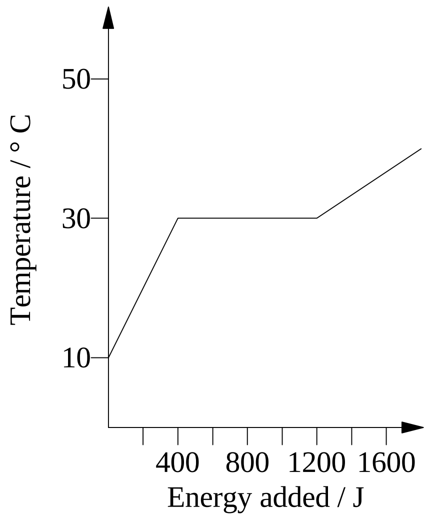
A. Gas molecules have negligible attractive forces for one another.

B. The volume occupied by the gas is much greater than that occupied by the molecules.

C. The average energy of the molecules in a gas is proportional to the absolute temperature of the gas.

D. The collisions between gas molecules are elastic.

16.



The heating curve for 10 g of a substance is given above. How much energy would be required to melt completely 20 g of the substance that is initially at 10° C?

A. 2400 J

B. 1200 J

C. 800 J

D. 400 J

17. The bond enthalpies of H_2, Br_2 and HBr are 436, 192, and 366 kJ mol^{-1} respectively. Use these values to calculate ΔH in kJ for the reaction;

$$H_2(g) + Br_2(g) \rightarrow 2HBr(g)$$

A. +262

B. –104

C. –208

D. –262

18.

$$N_2(g) + O_2(g) \rightarrow 2NO(g) \qquad \Delta H = 180.4 \text{ kJ}$$
$$N_2(g) + 2O_2(g) \rightarrow 2NO_2(g) \qquad \Delta H = 66.4 \text{ kJ}$$

Use the enthalpy values above to calculate ΔH for the reaction;

$$NO(g) + \tfrac{1}{2}O_2(g) \rightarrow NO_2(g)$$

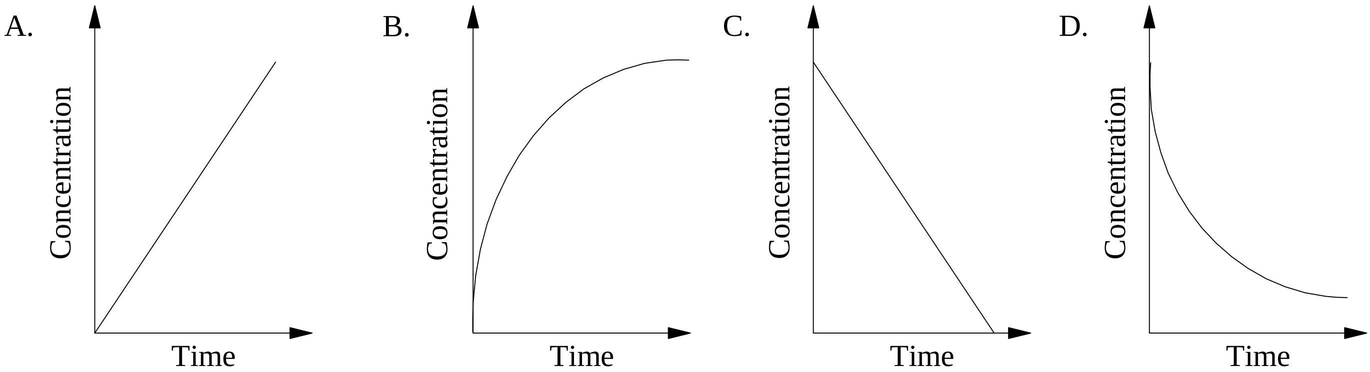
A. –57 kJ

B. –114 kJ

C. 57 kJ

D. 114 kJ

19. Which graph best represents the change in concentration of products with time for a reaction as it goes to completion?



20. Some collisions between reactant molecules do not form products. This is most likely because

A. the molecules do not collide in the proper ratio.

B. the molecules do not have enough energy.

C. the concentration is too low.

D. the reaction is at equilibrium.

21. Which statement is true about chemical reactions at equilibrium?

A. The forward and backward reactions proceed at equal rates

B. The forward and backward reactions have stopped

C. The concentrations of the reactants and products are equal

D. The forward reaction is exothermic

22. $$2H_2O(l) \rightleftharpoons H_3O^+(aq) + OH^-(aq)$$

The equilibrium constant for the reaction above is 1.0×10^{-14} at 25° C and 2.1×10^{-14} at 35° C. What can be concluded from this information?

A. $[H_3O^+]$ decreases as the temperature is raised.

B. $[H_3O^+]$ is greater than $[OH^-]$ at 35° C.

C. Water is a stronger electrolyte at 25° C.

D. The ionisation of water is endothermic.

23. Which of the following statements about aqueous solutions of most weak acids is/are correct?

I. They react with carbonates to produce carbon dioxide

II. They conduct electricity better than strong acids

A. I only

B. II only

C. Both I and II

D. Neither I nor II

24. 10 cm^3 of an HCl solution with a pH value of 2 was mixed with 90 cm^3 of water. What will be the pH of the resulting solution?

A. 1

B. 3

C. 5

D. 7

25. $$MnO_2 + 4HCl \rightarrow Mn^{2+} + 2Cl^- + Cl_2 + 2H_2O$$

Which substance is produced by oxidation in the equation above?

A. Mn^{2+}

B. Cl^-

C. Cl_2

D. H_2O

26. In the electrolysis of molten sodium chloride, the sodium ion goes to the

A. positive electrode where it undergoes oxidation.

B. negative electrode where it undergoes oxidation.

C. positive electrode where it undergoes reduction.

D. negative electrode where it undergoes reduction.

27. Which formula represents an amide?

A. $CH_3CH_2NH_2$

B. $CH_3CH_2N(CH_3)_2$

C. $H_2NCH_2CO_2H$

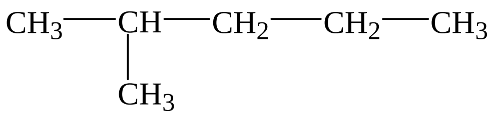
D. CH_3CONH_2

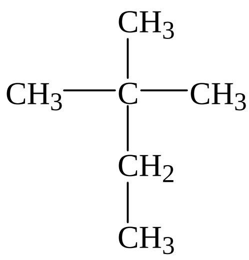
28. What is the correct order of reaction types in the following sequence?

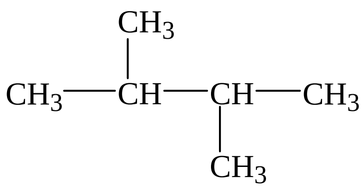
$$C_2H_5Cl \xrightarrow{\text{I}} C_2H_5OH \xrightarrow{\text{II}} CH_3COOH \xrightarrow{\text{III}} CH_3COOCH_3$$

	I	II	III
A.	substitution	oxidation	esterification
B.	addition	substitution	substitution
C.	oxidation	substitution	addition
D.	substitution	oxidation	substitution

29. Which names are correct for the following isomers of C_6H_{14}?

I.  2-methylpentane

II.  2-ethyl-2-methylpropane

III.  2,3-dimethylbutane

A. I only

B. I and II only

C. I and III only

D. I, II and III

30. Which carbon-containing product is most likely from the reaction of C_2H_4 and Br_2?

A. C_2H_5Br

B. $C_2H_4Br_2$

C. C_2H_3Br

D. $C_2H_2Br_2$