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CHEMISTRY
STANDARD LEVEL
PAPER 1

Monday 18 May 2009 (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 is provided for reference on page 2 of this examination paper.

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. The molar mass of a compound is approximately 56 g mol^{-1}. Which formula is possible for this compound?

A. $NaNO_3$

B. AgOH

C. MgO

D. KOH

2. Which compound has the empirical formula with the largest mass?

A. C_2H_6

B. C_2H_4

C. C_2H_2

D. C_3H_6

3. What is the coefficient for $O_2(g)$ when the equation for the combustion of 1 mole of pentane is balanced?

$$C_5H_{12}(g) + \_O_2(g) \rightarrow \_CO_2(g) + \_H_2O(g)$$

A. 5

B. 6

C. 8

D. 16

4. What is the maximum mass, in g, of magnesium oxide that can be obtained from the reaction of oxygen with 2.4 g of magnesium?

A. 2.4

B. 3.0

C. 4.0

D. 5.6

5. 5 dm^3 of carbon monoxide, CO(g), and 2 dm^3 of oxygen, $O_2(g)$, at the same temperature and pressure are mixed together. Assuming complete reaction according to the equation given, what is the maximum volume of carbon dioxide, $CO_2(g)$, in dm^3, that can be formed?

$$2CO(g) + O_2(g) \rightarrow 2CO_2(g)$$

A. 3

B. 4

C. 5

D. 7

6. Which statement about solutions is correct?

A. When vitamin D dissolves in fat, vitamin D is the solvent and fat is the solute.

B. In a solution of NaCl in water, NaCl is the solute and water is the solvent.

C. An aqueous solution consists of water dissolved in a solute.

D. The concentration of a solution is the amount of solvent dissolved in 1 dm^3 of solution.

7. How many protons, neutrons and electrons are present in each atom of ^{31}P?

	Protons	Neutrons	Electrons
A.	16	15	16
B.	15	16	15
C.	15	31	15
D.	16	31	16

8. Which is correct for the following regions of the electromagnetic spectrum?

	UV		IR	
A.	high energy	short wavelength	low energy	low frequency
B.	high energy	low frequency	low energy	long wavelength
C.	high frequency	short wavelength	high energy	long wavelength
D.	high frequency	long wavelength	low frequency	low energy

9. An element is in group 4 and period 3 of the periodic table. How many electrons are in the highest occupied energy level of an atom of this element?

A. 3

B. 4

C. 12

D. 14

10. Which is the best definition of *electronegativity*?

A. Electronegativity is the energy required for a gaseous atom to gain an electron.

B. Electronegativity is the attraction of an atom for a bonding pair of electrons.

C. Electronegativity is the attraction between the nucleus and the valence electrons of an atom.

D. Electronegativity is the ability of an atom to attract electrons from another atom.

11. What are the correct formulas of the following ions?

	Ammonium	Hydrogencarbonate	Phosphate
A.	NH_4^+	HCO_3^{2-}	PO_4^-
B.	NH_3^+	HCO_3^-	PO_4^{3-}
C.	NH_4^+	HCO_3^{2-}	PO_4^{2-}
D.	NH_4^+	HCO_3^-	PO_4^{3-}

12. What happens when magnesium metal reacts with chlorine gas?

A. Each magnesium atom loses two electrons and each chlorine atom gains two electrons.

B. Each magnesium atom gains one electron and each chlorine atom loses one electron.

C. Each magnesium atom loses two electrons and each chlorine atom gains one electron.

D. Each magnesium atom gains one electron and each chlorine atom loses two electrons.

13. Which is the best description of ionic bonding?

A. The electrostatic attraction between positively charged nuclei and an electron pair

B. The electrostatic attraction between positive ions and delocalized negative ions

C. The electrostatic attraction between positive ions and delocalized electrons

D. The electrostatic attraction between oppositely charged ions

14. Which is the best description of the bonding present in silicon dioxide, SiO_2?

A. Each silicon atom forms four single covalent bonds to oxygen atoms.

B. Each silicon atom forms two double covalent bonds to oxygen atoms.

C. Each silicon atom forms two single covalent bonds to oxygen atoms.

D. Each silicon atom forms four double covalent bonds to oxygen atoms.

15. When some solid barium hydroxide and solid ammonium thiosulfate were reacted together, the temperature of the surroundings was observed to decrease from 15 °C to −4 °C. What can be deduced from this observation?

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.

16. Which process represents the C–Cl bond enthalpy in tetrachloromethane?

A. $CCl_4(g) \rightarrow C(g) + 4Cl(g)$

B. $CCl_4(g) \rightarrow CCl_3(g) + Cl(g)$

C. $CCl_4(l) \rightarrow C(g) + 4Cl(g)$

D. $CCl_4(l) \rightarrow C(s) + 2Cl_2(g)$

17. Some water is heated using the heat produced by the combustion of magnesium metal. Which values are needed to calculate the enthalpy change of reaction?

I. The mass of magnesium

II. The mass of the water

III. The change in temperature of the water

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

18. What is the best definition of *rate of reaction*?

A. The time it takes to use up all the reactants

B. The rate at which all the reactants are used up

C. The time it takes for one of the reactants to be used up

D. The increase in concentration of a product per unit time

19. According to the collision theory, which factors affect reaction rate?

I. The state of the reactants

II. The frequency of the collisions between particles

III. The average kinetic energy of the particles

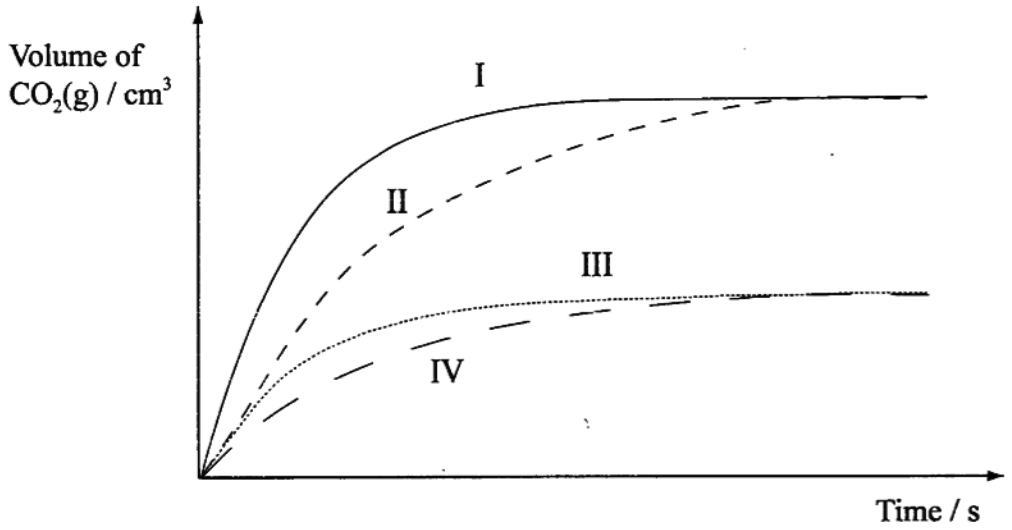
A. I and II only

B. I and III only

C. II and III only

D. I, II and III

20. Equal masses of powdered calcium carbonate were added to separate solutions of hydrochloric acid. The calcium carbonate was in excess. The volume of carbon dioxide produced was measured at regular intervals. Which curves best represent the evolution of carbon dioxide against time for the acid solutions shown in the table below.



	25 cm^3 of 2 mol dm^{-3} HCl	50 cm^3 of 1 mol dm^{-3} HCl	25 cm^3 of 1 mol dm^{-3} HCl
A.	I	III	IV
B.	I	IV	III
C.	I	II	III
D.	II	I	III

21. Consider the following equilibrium reaction.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g) \qquad \Delta H^{\ominus} = -197 \text{ kJ}$$

Which change in conditions will increase the amount of SO_3 present when equilibrium is re-established?

A. Decreasing the concentration of SO_2

B. Increasing the volume

C. Decreasing the temperature

D. Adding a catalyst

22. For equal volumes of 1.0 mol dm^{-3} solutions of hydrochloric acid, HCl(aq), and methanoic acid, HCOOH(aq), which statements are correct?

I. HCl dissociates more than HCOOH

II. HCl is a better electrical conductor than HCOOH

III. HCl will neutralize more NaOH than HCOOH

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

23. When equal volumes of four 0.1 mol dm^{-3} solutions are arranged in order of increasing pH (lowest pH first), what is the correct order?

A. $CH_3COOH < HNO_3 < CH_3CH_2NH_2 < KOH$

B. $HNO_3 < CH_3COOH < CH_3CH_2NH_2 < KOH$

C. $CH_3CH_2NH_2 < HNO_3 < CH_3COOH < KOH$

D. $KOH < CH_3CH_2NH_2 < CH_3COOH < HNO_3$

24. What happens at the negative 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

25. Consider how current is conducted in an electrolytic cell. Which statement is correct?

A. Electrons move through the electrolyte and the external circuit.

B. Ions move through the electrolyte and the external circuit.

C. Electrons move through the external circuit and ions move through the electrolyte.

D. Electrons move through the electrolyte and ions move through the external circuit.

26. Which three compounds can be considered to be a homologous series?

A. CH_3OH, CH_3CH_2OH, $CH_3CH_2CH_2OH$

B. CH_3CH_2OH, CH_3CHO, CH_3COOH

C. $CH_3CH_2CH(OH)CH_3$, $CH_3CH_2CH_2CH_2OH$, $(CH_3)_3COH$

D. $CH_3CH_2CH_2CH_2OH$, $CH_3CH_2OCH_2CH_3$, $(CH_3)_2CH_2CHO$

27. What is the IUPAC name for $CH_3CH_2CH(CH_3)CH_3$?

A. 1,1-dimethylpropane

B. 2-ethylpropane

C. 2-methylbutane

D. 3-methylbutane

28. When bromine water is shaken with a liquid organic compound, it is rapidly decolourized. What can be determined from this test?

A. The compound is an alcohol.

B. The compound is an alkane.

C. The compound is an alkene.

D. The compound is an iodoalkane.

29. Which conditions are required to obtain a good yield of a carboxylic acid when ethanol is oxidized using potassium dichromate(VI), $K_2Cr_2O_7(aq)$?

I. Add sulfuric acid

II. Heat the reaction mixture under reflux

III. Distil the product as the oxidizing agent is added

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

30. A student recorded the volume of a gas as 0.01450 dm^3. How many significant figures are there in this value?

A. 3

B. 4

C. 5

D. 6