M07/4/CHEMI/SPM/ENG/TZ0/XX

22076104

CHEMISTRY
STANDARD LEVEL
PAPER 1

Thursday 10 May 2007 (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

Key
Atomic Number **Element** Atomic Mass

1	2											3	4	5	6	7	0
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)															
		†	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. Methane, CH_4, burns in oxygen gas to form carbon dioxide and water. How many moles of carbon dioxide will be formed from 8.0 g of methane?

A. 0.25

B. 0.50

C. 1.0

D. 2.0

2. What is the empirical formula of a compound containing 50 % by mass of element X ($A_r = 20$) and 50 % by mass of element Y ($A_r = 25$)?

A. XY

B. X_3Y_2

C. X_4Y_5

D. X_5Y_4

3. Assuming complete reaction, what volume of $0.200\ \text{mol dm}^{-3}$ potassium hydroxide solution $(KOH(aq))$, is required to neutralize $25.0\ \text{cm}^3$ of $0.200\ \text{mol dm}^{-3}$ aqueous sulfuric acid, $(H_2SO_4(aq))$?

A. $12.5\ \text{cm}^3$

B. $25.0\ \text{cm}^3$

C. $50.0\ \text{cm}^3$

D. $75.0\ \text{cm}^3$

4. Consider the following reaction.

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

If the reaction is made to go to completion, what volume of ammonia (in dm^3) can be prepared from 25 dm^3 of nitrogen and 60 dm^3 of hydrogen? All volumes are measured at the same temperature and pressure.

A. 40

B. 50

C. 85

D. 120

5. What is the difference between two neutral atoms represented by the symbols $^{210}_{84}Po$ and $^{210}_{85}At$?

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.

6. Which statements are correct for the emission spectrum of the hydrogen atom?

I. The lines converge at lower energies.
II. Electron transitions to $n = 1$ are responsible for lines in the UV region.
III. Lines are produced when electrons move from higher to lower energy levels.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

7. Which statement is correct for the halogen group?

A. Halide ions are all reducing agents, with iodide ions being the weakest.

B. Halogens are all oxidizing agents, with chlorine being the strongest.

C. Chloride ions can be oxidized to chlorine by bromine.

D. Iodide ions can be oxidized to iodine by chlorine.

8. Which of the following statements are correct?

I. The melting points decrease from Li $\rightarrow$ Cs for the alkali metals.
II. The melting points increase from F $\rightarrow$ I for the halogens.
III. The melting points decrease from Na $\rightarrow$ Ar for the period 3 elements.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

9. When C_2H_4, C_2H_2 and C_2H_6 are arranged in order of **increasing** C–C bond length, what is the correct order?

A. C_2H_6, C_2H_2, C_2H_4

B. C_2H_4, C_2H_2, C_2H_6

C. C_2H_2, C_2H_4, C_2H_6

D. C_2H_4, C_2H_6, C_2H_2

10. Which compound contains **both** ionic and covalent bonds?

A. $MgCl_2$

B. HCl

C. H_2CO

D. NH_4Cl

11. When the species BF_2^+, BF_3 and BF_4^- are arranged in order of **increasing** F – B – F bond angle, what is the correct order?

A. BF_3 , BF_4^- , BF_2^+

B. BF_4^- , BF_3 , BF_2^+

C. BF_2^+ , BF_4^- , BF_3

D. BF_2^+ , BF_3 , BF_4^-

12. Which species has a trigonal planar shape?

A. CO_3^{2-}

B. SO_3^{2-}

C. NF_3

D. PCl_3

13. The temperature in Kelvin of 1.0 dm^3 of an ideal gas is doubled and its pressure is tripled. What is the final volume of the gas in dm^3?

A. $\frac{1}{3}$

B. $\frac{2}{3}$

C. $\frac{3}{2}$

D. $\frac{1}{6}$

14. 1 mole of hydrogen, 2 moles of oxygen and 3 moles of carbon dioxide are placed in a closed container at 298 K. What is the ratio of **average** kinetic energies of each gas under these conditions?

A. 1 : 2 : 3

B. 3 : 2 : 1

C. 1 : 1 : 1

D. 1 : 2 : 1

15. Consider the specific heat capacity of the following metals.

Metal	Specific heat capacity / J kg^{-1} K^{-1}
Cu	385
Ag	234
Au	130
Pt	134

Which metal will show the greatest temperature increase if 50 J of heat is supplied to a 0.001 kg sample of each metal at the same initial temperature?

A. Cu

B. Ag

C. Au

D. Pt

16. Consider the following reactions.

$$S(s) + 1\tfrac{1}{2}O_2(g) \rightarrow SO_3(g) \qquad \Delta H^\ominus = -395 \text{ kJ mol}^{-1}$$

$$SO_2(g) + \tfrac{1}{2}O_2(g) \rightarrow SO_3(g) \qquad \Delta H^\ominus = -98 \text{ kJ mol}^{-1}$$

What is the $\Delta H^\ominus$ value (in kJ mol^{-1}) for the following reaction?

$$S(s) + O_2(g) \rightarrow SO_2(g)$$

A. –297

B. +297

C. –493

D. +493

17. The following reaction is spontaneous only at temperatures above 850 °C.

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

Which combination is correct for this reaction at 1000 °C?

	ΔG	ΔH	ΔS
A.	–	–	–
B.	+	+	+
C.	–	+	+
D.	+	–	–

18. Which statement is correct for an endothermic reaction?

A. Bonds in the products are stronger than the bonds in the reactants.

B. Bonds in the reactants are stronger than the bonds in the products.

C. The enthalpy of the products is less than that of the reactants.

D. The reaction is spontaneous at low temperatures but becomes non-spontaneous at high temperatures.

19. In general, the rate of a reaction can be increased by all of the following **except**

A. increasing the temperature.

B. increasing the activation energy.

C. increasing the concentration of reactants.

D. increasing the surface area of the reactants.

20. At 25 °C, 100 cm^3 of 1.0 mol dm^{-3} hydrochloric acid is added to 3.5 g of magnesium carbonate. If the sample of magnesium carbonate is kept constant, which conditions will **not** increase the initial rate of reaction?

	Volume of HCl / cm^3	Concentration of HCl / mol dm^{-3}	Temperature / °C
A.	200	1.0	25
B.	100	2.0	25
C.	100	1.0	35
D.	200	2.0	25

21. Consider the following equilibrium reaction in a closed container at 350 °C.

$$SO_2(g) + Cl_2(g) \rightleftharpoons SO_2Cl_2(g) \qquad \Delta H^{\ominus} = -85 \text{ kJ}$$

Which statement is correct?

A. Decreasing the temperature will increase the amount of $SO_2Cl_2(g)$.

B. Increasing the volume of the container will increase the amount of $SO_2Cl_2(g)$.

C. Increasing the temperature will increase the amount of $SO_2Cl_2(g)$.

D. Adding a catalyst will increase the amount of $SO_2Cl_2(g)$.

22. Which of the following equilibria would **not** be affected by pressure changes at constant temperature?

A. $4HCl(g) + O_2(g) \rightleftharpoons 2H_2O(g) + 2Cl_2(g)$

B. $CO(g) + H_2O(g) \rightleftharpoons H_2(g) + CO_2(g)$

C. $C_2H_4(g) + H_2O(g) \rightleftharpoons C_2H_5OH(g)$

D. $PF_3Cl_2(g) \rightleftharpoons PF_3(g) + Cl_2(g)$

23. Which mixture would produce a buffer solution when dissolved in 1.0 dm^3 of water?

A. 0.30 mol of NH_3(aq) and 0.30 mol of HCl(aq)

B. 0.30 mol of NH_3(aq) and 0.15 mol of HCl(aq)

C. 0.30 mol of NH_3(aq) and 0.60 mol of HCl(aq)

D. 0.30 mol of NH_3(aq) and 0.15 mol of H_2SO_4(aq)

24. Solutions of hydrochloric acid (HCl(aq)) and ethanoic acid (CH_3COOH(aq)) of the same concentration reacted completely with 5.0 g of calcium carbonate in separate containers. Which statement is correct?

A. CH_3COOH(aq) reacted slower because it has a lower pH than HCl(aq).

B. A smaller volume of CO_2(g) was produced with CH_3COOH(aq) than with HCl(aq).

C. A greater volume of CO_2(g) was produced with CH_3COOH(aq) than with HCl(aq).

D. The same volume of CO_2(g) was produced with both CH_3COOH(aq) and HCl(aq).

25. Consider the following spontaneous reactions.

$$Fe(s) + Cu^{2+}(aq) \rightarrow Fe^{2+}(aq) + Cu(s)$$
$$Cu(s) + 2Ag^{+}(aq) \rightarrow Cu^{2+}(aq) + 2Ag(s)$$
$$Zn(s) + Fe^{2+}(aq) \rightarrow Zn^{2+}(aq) + Fe(s)$$

Which is the correct combination of strongest oxidizing agent and strongest reducing agent?

	Strongest oxidizing agent	Strongest reducing agent
A.	$Ag(s)$	$Zn(s)$
B.	$Ag^{+}(aq)$	$Zn(s)$
C.	$Zn^{2+}(aq)$	$Ag(s)$
D.	$Zn(s)$	$Ag^{+}(aq)$

26. In which change does nitrogen undergo oxidation?

A. $NO_2 \rightarrow N_2O_4$

B. $NO_3^- \rightarrow NO_2$

C. $N_2O_5 \rightarrow NO_3^-$

D. $NH_3 \rightarrow N_2$

27. Which statement is correct?

A. Spontaneous redox reactions produce electricity in an electrolytic cell.

B. Electricity is used to carry out a non-spontaneous redox reaction in a voltaic cell.

C. Oxidation takes place at the negative electrode in a voltaic cell and the positive electrode in an electrolytic cell.

D. Oxidation takes place at the negative electrode in a voltaic cell and reduction takes place at the positive electrode in an electrolytic cell.

28. Nylon is a condensation polymer made up of hexanedioic acid and 1,6-diaminohexane. Which type of linkage is present in nylon?

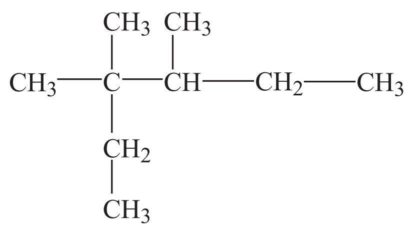
A. Amide

B. Ester

C. Amine

D. Carboxyl

29. What is the IUPAC name of the following compound?



A. 3,3,4-trimethylhexane

B. 3,4,4-trimethylhexane

C. 4-ethyl-3,4-dimethylpentane

D. 2-ethyl-2,3-dimethylpentane

30. How many chiral carbon atoms are present in a molecule of glucose?

$$\begin{array}{l} CHO \\ | \\ CHOH \\ | \\ CHOH \\ | \\ CHOH \\ | \\ CHOH \\ | \\ CH_2OH \end{array}$$

A. 1

B. 2

C. 3

D. 4