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CHEMISTRY
STANDARD LEVEL
PAPER 1

Thursday 8 May 2008 (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. What is the amount of **atoms**, in moles, in 88 g of carbon dioxide?

A. 6.02×10^{23}

B. 1.204×10^{24}

C. 6

D. 1

2. The isotopic abundances for an element, X, are ${}^{28}_{14}X = 20\%$ and ${}^{29}_{14}X = 80\%$. What is the relative atomic mass of element X?

A. 14

B. 28.2

C. 28.5

D. 28.8

3. Which statement is correct about the molecular formula of a compound?

A. It is an integer multiple of the empirical formula.

B. It shows how the atoms are bonded together in the molecule.

C. It is the smallest ratio between the atoms present in a molecule.

D. It is the percentage composition of a molecule.

4. A sample of a hydrocarbon contains 84 g of carbon and 14 g of hydrogen. Which of the following statements are correct?

I. The empirical formula of the compound is CH_2.
II. The molecular formula of the compound is C_2H_4.
III. There is not enough information to confirm that the molecular formula of the compound is C_2H_4.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

5. An isotope of uranium has a mass number of 235. What is the number of neutrons in the nucleus and the atomic number for this isotope?

	Number of neutrons	**Atomic number**
A.	143	235
B.	92	235
C.	143	92
D.	238	92

6. Which process is responsible for the lines in the visible emission spectrum of hydrogen?

A. The release of energy by the electron

B. The release of energy by the excited nucleus

C. The excitation of the electron

D. The absorption of energy by the electron

7. Which reactions are spontaneous?

I. $Cl_2(aq) + 2KBr(aq) \rightarrow Br_2(aq) + 2KCl(aq)$
II. $I_2(aq) + 2KBr(aq) \rightarrow Br_2(aq) + 2KI(aq)$
III. $Cl_2(aq) + 2NaI(aq) \rightarrow I_2(aq) + 2NaCl(aq)$

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

8. Which statements support the description of aluminium oxide as amphoteric?

I. It can show acidic behaviour in the presence of strong alkalis.
II. It can show alkaline behaviour in the presence of strong acids.
III. It dissolves in water to form a neutral solution.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

9. Which species has the same electron arrangement as a Ca^{2+} ion?

A. Al^{3+} ion

B. Br^{-} ion

C. Ar atom

D. K atom

10. What are the correct formulas of magnesium nitride and aluminium sulfide?

A. Mg_2N_3 and Al_2S_3

B. Mg_3N_2 and Al_2S_3

C. Mg_2N_3 and Al_3S_2

D. Mg_3N_2 and Al_3S_2

11. Which molecule is the most polar?

A. CH_4

B. CCl_4

C. CF_4

D. $CHCl_3$

12. What is the shape of PCl_3?

A. Trigonal planar

B. Trigonal pyramidal

C. Tetrahedral

D. V-shaped (bent)

13. Which changes occur when a liquid boils?

I. The spacing between the particles increases.
II. The average energy of the particles increases.
III. The attractive forces between the particles become weaker.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

14. A gas sample occupies a volume V_1 at a pressure P_1 and a Kelvin temperature T_1. What would be the temperature, T_2, of the gas if both its pressure and volume are doubled?

A. $T_2 = \frac{1}{2} T_1$

B. $T_2 = T_1$

C. $T_2 = 2T_1$

D. $T_2 = 4T_1$

15. Which of the following is correct about the energy changes during bond breaking and bond formation?

	Bond breaking	**Bond formation**
A.	exothermic	endothermic
B.	exothermic	exothermic
C.	endothermic	endothermic
D.	endothermic	exothermic

16. A possible method of preparing hydrogen peroxide is:

$$H_2(g) + \tfrac{1}{2}O_2(g) \rightarrow H_2O(l) \qquad \Delta H^{\ominus} = x$$

$$H_2O(l) + \tfrac{1}{2}O_2(g) \rightarrow H_2O_2(l) \quad \Delta H^{\ominus} = y$$

Which expression can be used to calculate the enthalpy change for the decomposition of hydrogen peroxide using this data?

$$H_2O_2(l) \rightarrow H_2(g) + O_2(g)$$

A. $-x - y$

B. $x + y$

C. $-x + y$

D. $x - y$

17. What should be the signs of ΔG, ΔH and ΔS for a chemical reaction to be spontaneous at any temperature?

	ΔG	ΔH	ΔS
A.	positive	negative	positive
B.	negative	negative	negative
C.	negative	negative	positive
D.	negative	positive	negative

18. Which of the following reactions is likely to have the largest **negative** entropy change, ΔS?

A. $C(s) + O_2(g) \rightarrow CO_2(g)$

B. $N_2O_4(g) \rightarrow 2NO_2(g)$

C. $2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$

D. $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

19. Which statement explains why increasing the temperature increases the rate of a chemical reaction?

A. More molecules have energy equal to or greater than the activation energy.

B. At a higher temperature the activation energy for the reaction is lower.

C. More molecules have the correct collision geometry.

D. The reaction proceeds according to Le Chatelier’s principle.

20. What is the best way to describe the rate-determining step in a reaction mechanism?

A. The fastest step of a chemical reaction

B. The slowest step of a chemical reaction

C. The step where the fewest molecules interact

D. The step where most molecules have the highest energy

21. Consider the reaction:

$$2A(g) + 3B(g) \rightleftharpoons C(g) + 2D(g)$$

What is the expression for the equilibrium constant, K_c?

A. $K_c = \frac{[C]\,2[D]}{2[A]\,3[B]}$

B. $K_c = \frac{2[A]\,3[B]}{[C]\,2[D]}$

C. $K_c = \frac{[C][D]^2}{[A]^2[B]^3}$

D. $K_c = \frac{[A]^2[B]^3}{[C][D]^2}$

22. Consider the following reaction:

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \qquad \Delta H^{\ominus} = -92\,kJ$$

Which of the following affects the value of K_c?

A. Adding a catalyst

B. Increasing the pressure

C. Increasing the concentrations of nitrogen and hydrogen

D. Increasing the temperature

23. Which compound will produce a solution with a pH greater than 7 when added to water?

A. $NaHCO_3(s)$

B. $SiO_2(s)$

C. $SO_3(g)$

D. $CH_3CO_2H(aq)$

24. Which pair of solutions can be used to prepare a buffer solution?

A. $CH_3COONa\,(aq)\,/\,NaOH\,(aq)$

B. $NH_3\,(aq)\,/\,NH_4NO_3\,(aq)$

C. $NH_4Cl\,(aq)\,/\,HCl\,(aq)$

D. $HNO_3\,(aq)\,/\,NaNO_3\,(aq)$

25. What is the oxidation number of vanadium in the compound $NaVO_3$?

A. –1

B. 0

C. +2

D. +5

26. Which statement about electrochemical cells is correct?

A. The reaction in a voltaic cell is spontaneous.

B. The reaction in an electrolytic cell is spontaneous.

C. The reaction in a voltaic cell uses electrical energy.

D. The reaction in an electrolytic cell produces electrical energy.

27. Consider the following reaction:

$$Sn^{4+}(aq) + Fe^{2+}(aq) \rightarrow Sn^{3+}(aq) + Fe^{3+}(aq)$$

What is the correct combination of statements?

	Species	**Undergoes**	**Acts as**
A.	Sn^{4+}	oxidation	oxidizing agent
B.	Fe^{2+}	reduction	reducing agent
C.	Sn^{4+}	reduction	oxidizing agent
D.	Fe^{2+}	reduction	oxidizing agent

28. Which molecule has a chiral carbon atom?

A. $CH_2CClCH_2CH_3$

B. $CH_3CHOHCH_2CH_3$

C. $(CH_3)_2CHCH_2CH_3$

D. H_2NCH_2COOH

29. The polymerization of ethene $H_2C{=}CH_2$ produces polythene as shown below.

$$nH_2C=CH_2 \rightarrow \left[CH_2-CH_2\right]_n$$

What type of reaction has ethene undergone?

A. Hydrogenation

B. Addition

C. Isomerisation

D. Condensation

30. What type of linkage forms between two amino acids, when they react with each other?

A. Ketone

B. Amine

C. Amide

D. Ester