M08/4/CHEMI/HPM/ENG/TZ1/XX

22086107

CHEMISTRY
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PAPER 1

Thursday 8 May 2008 (afternoon)

1 hour

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

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. How many molecules are present in a 9.0 g sample of water?

A. 0.5

B. 1.0

C. 6.0×10^{23}

D. 3.0×10^{23}

2. What is the coefficient for oxygen when this equation is balanced using the lowest whole number?

$$C_4H_{10} + O_2 \rightarrow CO + H_2O$$

A. 4

B. 5

C. 9

D. 13

3. What is the maximum mass of iron that can be produced from the reduction of 80 tonnes of iron(III) oxide ($M_r = 160$), based on this equation?

$$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$$

A. 28 tonnes

B. 56 tonnes

C. 84 tonnes

D. 112 tonnes

4. Which species represent a pair of isotopes?

Species	Number of protons	Number of electrons	Number of neutrons
L	12	12	12
M	13	13	13
P	13	10	13
Q	12	12	14

A. L and M

B. L and P

C. P and Q

D. L and Q

5. How many unpaired electrons are there in the Co^{2+} ion?

A. 7

B. 5

C. 3

D. 2

6. Which processes occur in the mass spectrometer?

I. Ionization by electron bombardment
II. Acceleration by a magnetic field
III. Deflection by a magnetic field

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

7. Which properties decrease in value when descending group 1?

I. Atomic radius
II. Ionization energy
III. Electronegativity

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

8. The ionization energies of three consecutive elements in the periodic table are 1680, 2080 and 494 $kJ\,mol^{-1}$ respectively. Which of the following shows the elements with these values?

A. O F Ne

B. F Ne Na

C. Ne Na Mg

D. Na Mg Al

9. Which comparison of radii of atoms and ions is correct?

A. $Cl^{-} > Cl$

B. $H^{+} > H^{-}$

C. $Na^{+} > Na$

D. $Mg^{2+} > Mg^{+}$

10. Which trend is correct when the elements are considered from left to right across period 3?

A. The acidic character of the oxides decreases.

B. The electrical conductivity of the elements increases.

C. The bonding of the chlorides changes from ionic to covalent.

D. Electronegativity decreases.

11. Which substance will **not** conduct an electric current?

A. C (s) (graphite)

B. NaF (l)

C. CaO (s)

D. KI (aq)

12. Which of the following liquids is non-polar?

A. Water

B. Hexane

C. Propanone

D. Ethanol

13. The following substances all contain a nitrogen to nitrogen bond: N_2, N_2H_4, N_2H_2. Which shows them in **increasing** order of nitrogen to nitrogen bond length (smallest first)?

A. N_2H_4 , N_2H_2 , N_2

B. N_2 , N_2H_2 , N_2H_4

C. N_2H_2 , N_2H_4 , N_2

D. N_2H_4 , N_2 , N_2H_2

14. What is the bond angle in NO_3^-?

A. 107°

B. 109.5°

C. 120°

D. 180°

15. The temperature of 1 dm^3 of a gas is increased from 32°C to 64°C at constant pressure. What is the new volume in dm^3?

A. 1.1

B. 1.3

C. 1.6

D. 2.0

16. Which change does **not** lead to an increase in entropy?

A. Mixing nitrogen and oxygen gases at room temperature

B. Cooling steam so that it condenses to water

C. Heating hexane to its boiling point

D. Dissolving sugar in water

17. The enthalpy changes for two reactions are shown below.

$$S(s) + O_2(g) \rightarrow SO_2(g) \qquad \Delta H^{\ominus} = -300 \text{ kJ}$$
$$2S(s) + 3O_2(g) \rightarrow 2SO_3(g) \qquad \Delta H^{\ominus} = -800 \text{ kJ}$$

What is the enthalpy change for this reaction in kJ?

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

A. –200

B. –500

C. –1100

D. –1400

18. Which process is exothermic?

A. $Na(s) \rightarrow Na(g)$

B. $Ca(g) \rightarrow Ca^{+}(g) + e^{-}$

C. $Br(g) + e^{-} \rightarrow Br^{-}(g)$

D. $I_2(g) \rightarrow 2I(g)$

19. Which equation represents the standard enthalpy of formation of calcium fluoride?

A. $Ca(g) + F_2(g) \rightarrow CaF_2(g)$

B. $Ca(s) + F_2(g) \rightarrow CaF_2(s)$

C. $Ca^{2+}(g) + 2F^{-}(g) \rightarrow CaF_2(s)$

D. $Ca^{2+}(s) + 2F^{-}(g) \rightarrow CaF_2(s)$

20. 25 cm^3 of 1.0 mol dm^{-3} NaOH is added to 25 cm^3 of 1.0 mol dm^{-3} HCl. The temperature rise is 6°C. Which reactants will also give a temperature rise of 6°C?

A. 25 cm^3 of 2.0 mol dm^{-3} NaOH and 25 cm^3 of 2.0 mol dm^{-3} HCl.

B. 50 cm^3 of 1.0 mol dm^{-3} NaOH and 50 cm^3 of 1.0 mol dm^{-3} HCl.

C. 50 cm^3 of 0.5 mol dm^{-3} NaOH and 50 cm^3 of 0.5 mol dm^{-3} HCl.

D. 100 cm^3 of 0.25 mol dm^{-3} NaOH and 100 cm^3 of 0.25 mol dm^{-3} HCl.

21. Which reaction is the most exothermic?

A. $Li^{+}(g) + F^{-}(g) \rightarrow LiF(s)$

B. $Na^{+}(g) + Cl^{-}(g) \rightarrow NaCl(s)$

C. $Mg^{2+}(g) + O^{2-}(g) \rightarrow MgO(s)$

D. $Ca^{2+}(g) + S^{2-}(g) \rightarrow CaS(s)$

22. The table shows data for a reaction between X and Y.

Experiment	[X] mol dm^{-3}	[Y] mol dm^{-3}	Rate of reaction mol $dm^{-3}s^{-1}$
1	0.4	0.24	1.2×10^{-4}
2	0.8	0.24	2.4×10^{-4}
3	0.4	0.12	3.0×10^{-5}

The overall order of reaction is:

A. 1

B. 2

C. 3

D. 4

23. Which units could be used for the rate of a chemical reaction?

A. $mol\,dm^{-3}\,min$

B. $mol^{-1}\,min^{-1}$

C. $dm^{3}\,min$

D. $mol\,dm^{-3}\,min^{-1}$

24. $10\,cm^3$ of liquid hexane is placed in a closed $1\,dm^3$ container at 298K. Which change would increase the equilibrium vapour pressure of the hexane in the container?

A. Putting the container in a refrigerator

B. Adding 10 cm^3 of hexane to the container

C. Reducing the volume of the container to 0.5 dm^3

D. Putting the container in a water bath at 308 K

25. Which change will increase the equilibrium concentration of sulfur trioxide in this reaction?

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

A. Decreasing the concentration of oxygen

B. Increasing the pressure

C. Using a catalyst

D. Increasing the temperature

26. Which species act as Brønsted – Lowry bases in the following reactions?

$$CH_3NH_2 + H_2O \rightleftharpoons CH_3NH_3^+ + OH^-$$
$$NH_2^- + H_2O \rightleftharpoons NH_3 + OH^-$$

I. CH_3NH_2

II. $CH_3NH_3^+$

III. NH_2^-

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

27. The ionic product constant of water at 45°C is $4 \times 10^{-14}\,mol^2\,dm^{-6}$. Which statement is correct about pure water at 45°C?

A. $pH = 7$

B. $[H^+] = [OH^-]$

C. $[OH^-] > [H^+]$

D. $[H^+] > [OH^-]$

28. A weak monoprotic acid is 10 % dissociated in a solution of concentration 0.01 $mol\,dm^{-3}$. What is the pH value of the solution?

A. 0.1

B. 1.0

C. 2.0

D. 3.0

29. Which change increases the pH of a solution from 3 to 6?

A. Doubling the $[H^+]$

B. Halving the $[OH^-]$

C. Decreasing the $[H^+]$ by a factor of 1000

D. Decreasing the $[OH^-]$ by a factor of 1000

30. Which pair of compounds, in aqueous solution, could be used to make a buffer solution?

A. CH_3COOH and HCl

B. HCl and NaOH

C. HCl and NH_4Cl

D. HCOOH and NaOH

31. During the electrolysis of aqueous sulfuric acid, 1g of hydrogen gas forms at the negative electrode. What mass in grams of oxygen forms at the positive electrode in the same time?

A. 4

B. 8

C. 16

D. 32

32. Which is the strongest oxidizing agent?

A. I_2

B. I^-

C. F_2

D. F^-

33. The following are standard electrode potentials.

$$Zn^{2+}(aq) + 2e^{-} \rightleftharpoons Zn(s) \quad E^{\ominus} = -0.76\,V$$
$$Mn^{2+}(aq) + 2e^{-} \rightleftharpoons Mn(s) \quad E^{\ominus} = -1.18\,V$$

What is the $E^{\ominus}$ for this reaction?

$$Mn(s) + ZnSO_4(aq) \rightarrow MnSO_4(aq) + Zn(s)$$

A. $-0.42\,V$

B. $+0.42\,V$

C. $-1.94\,V$

D. $+1.94\,V$

34. Which compound cannot be easily oxidized using acidified potassium dichromate(VI) solution?

A. $CH_3CH_2CH_2OH$

B. $CH_3CH(OH)CH_3$

C. $(CH_3)_2CHCH_2OH$

D. $(CH_3)_3COH$

35. In which reaction does hydrogen act as an oxidizing agent?

A. $Ca + H_2 \rightarrow CaH_2$

B. $F_2 + H_2 \rightarrow 2HF$

C. $C_2H_2 + H_2 \rightarrow C_2H_4$

D. $O_2 + 2H_2 \rightarrow 2H_2O$

36. Which species **cannot** act as a nucleophile?

A. H_2O

B. NH_3

C. CN^-

D. CH_4

37. Which compounds show three main peaks in their ^1H NMR spectra?

I. $CH_3CH_2CH_2CH_3$

II. CH_3CH_2COOH

III. $(CH_3)_3CCH_2CH_2Br$

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

38. Which halogenoalkane reacts most rapidly with silver nitrate solution to form a precipitate?

A. 1-bromobutane

B. 1-iodobutane

C. 2-bromo-2-methylpropane

D. 2-iodo-2-methylpropane

39. Which is the correct formula of 2,3-dichloro-2-methylpentane?

A. $CH_3CCl(CH_3)CHClCH_2CH_3$

B. $CH_3CH(CH_3)CCl_2CH_2CH_3$

C. $CH_3CCl_2CH(CH_3)CH_2CH_3$

D. $CH_3CH_2CH_2CHClCHClCH_3$

40. What type of reaction occurs when hexanedioic acid and 1,6-diaminohexane react together to form nylon?

A. Addition

B. Condensation

C. Esterification

D. Substitution