

**CHEMISTRY  
STANDARD LEVEL  
PAPER 1**

Wednesday 14 May 2003 (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

Atomic Number		Element																
Atomic Mass																		
1 <b>H</b> 1.01																		2 <b>He</b> 4.00
3 <b>Li</b> 6.94	4 <b>Be</b> 9.01																	9 <b>F</b> 19.00
11 <b>Na</b> 22.99	12 <b>Mg</b> 24.31																	17 <b>Cl</b> 35.45
19 <b>K</b> 39.10	20 <b>Ca</b> 40.08	21 <b>Sc</b> 44.96	22 <b>Ti</b> 47.90	23 <b>V</b> 50.94	24 <b>Cr</b> 52.00	25 <b>Mn</b> 54.94	26 <b>Fe</b> 55.85	27 <b>Co</b> 58.93	28 <b>Ni</b> 58.71	29 <b>Cu</b> 63.55	30 <b>Zn</b> 65.37	31 <b>Ga</b> 69.72	32 <b>Ge</b> 72.59	33 <b>As</b> 74.92	34 <b>Se</b> 78.96	35 <b>Br</b> 79.90	36 <b>Kr</b> 83.80	
37 <b>Rb</b> 85.47	38 <b>Sr</b> 87.62	39 <b>Y</b> 88.91	40 <b>Zr</b> 91.22	41 <b>Nb</b> 92.91	42 <b>Mo</b> 95.94	43 <b>Tc</b> 98.91	44 <b>Ru</b> 101.07	45 <b>Rh</b> 102.91	46 <b>Pd</b> 106.42	47 <b>Ag</b> 107.87	48 <b>Cd</b> 112.40	49 <b>In</b> 114.82	50 <b>Sn</b> 118.69	51 <b>Sb</b> 121.75	52 <b>Te</b> 127.60	53 <b>I</b> 126.90	54 <b>Xe</b> 131.30	
55 <b>Cs</b> 132.91	56 <b>Ba</b> 137.34	57 † <b>La</b> 138.91	72 <b>Hf</b> 178.49	73 <b>Ta</b> 180.95	74 <b>W</b> 183.85	75 <b>Re</b> 186.21	76 <b>Os</b> 190.21	77 <b>Ir</b> 192.22	78 <b>Pt</b> 195.09	79 <b>Au</b> 196.97	80 <b>Hg</b> 200.59	81 <b>Tl</b> 204.37	82 <b>Pb</b> 207.19	83 <b>Bi</b> 208.98	84 <b>Po</b> (210)	85 <b>At</b> (210)	86 <b>Rn</b> (222)	
87 <b>Fr</b> (223)	88 <b>Ra</b> (226)	89 ‡ <b>Ac</b> (227)																
†																		
		58 <b>Ce</b> 140.12	59 <b>Pr</b> 140.91	60 <b>Nd</b> 144.24	61 <b>Pm</b> 146.92	62 <b>Sm</b> 150.35	63 <b>Eu</b> 151.96	64 <b>Gd</b> 157.25	65 <b>Tb</b> 158.92	66 <b>Dy</b> 162.50	67 <b>Ho</b> 164.93	68 <b>Er</b> 167.26	69 <b>Tm</b> 168.93	70 <b>Yb</b> 173.04	71 <b>Lu</b> 174.97			
‡																		
		90 <b>Th</b> 232.04	91 <b>Pa</b> 231.04	92 <b>U</b> 238.03	93 <b>Np</b> (237)	94 <b>Pu</b> (242)	95 <b>Am</b> (243)	96 <b>Cm</b> (247)	97 <b>Bk</b> (247)	98 <b>Cf</b> (251)	99 <b>Es</b> (254)	100 <b>Fm</b> (257)	101 <b>Md</b> (258)	102 <b>No</b> (259)	103 <b>Lr</b> (260)			

1. What amount of oxygen,  $\text{O}_2$ , (in moles) contains  $1.8 \times 10^{22}$  molecules?

- A. 0.0030
- B. 0.030
- C. 0.30
- D. 3.0

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

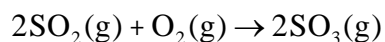
- A.  $\text{C}_2\text{H}_6$
- B.  $\text{C}_4\text{H}_{10}$
- C.  $\text{C}_5\text{H}_{10}$
- D.  $\text{C}_6\text{H}_6$

3.  $\text{___ C}_2\text{H}_2(\text{g}) + \text{___ O}_2(\text{g}) \rightarrow \text{___ CO}_2(\text{g}) + \text{___ H}_2\text{O}(\text{g})$

When the equation above is balanced, what is the coefficient for oxygen?

- A. 2
- B. 3
- C. 4
- D. 5

4.  $3.0 \text{ dm}^3$  of sulfur dioxide is reacted with  $2.0 \text{ dm}^3$  of oxygen according to the equation below.



What volume of sulfur trioxide (in  $\text{dm}^3$ ) is formed? (Assume the reaction goes to completion and all gases are measured at the same temperature and pressure.)

- A. 5.0
- B. 4.0
- C. 3.0
- D. 2.0
5. Consider the composition of the species W, X, Y and Z below. Which species is an anion?

Species	Number of protons	Number of neutrons	Number of electrons
W	9	10	10
X	11	12	11
Y	12	12	12
Z	13	14	10

- A. W
- B. X
- C. Y
- D. Z
6. Energy levels for an electron in a hydrogen atom are
- A. evenly spaced.
- B. farther apart near the nucleus.
- C. closer together near the nucleus.
- D. arranged randomly.

7. Which is related to the number of electrons in the outer main energy level of the elements from the alkali metals to the halogens?
- I. Group number
  - II. Period number
- A. I only
  - B. II only
  - C. Both I and II
  - D. Neither I nor II
8. Which pair of elements reacts most readily?
- A.  $\text{Li} + \text{Br}_2$
  - B.  $\text{Li} + \text{Cl}_2$
  - C.  $\text{K} + \text{Br}_2$
  - D.  $\text{K} + \text{Cl}_2$
9. What is the formula for the compound formed by calcium and nitrogen?
- A.  $\text{CaN}$
  - B.  $\text{Ca}_2\text{N}$
  - C.  $\text{Ca}_2\text{N}_3$
  - D.  $\text{Ca}_3\text{N}_2$

10. How do bond length and bond strength change as the number of bonds between two atoms increases?

	Bond length	Bond strength
A.	increases	increases
B.	increases	decreases
C.	decreases	increases
D.	decreases	decreases

11. Which of the following is true for  $\text{CO}_2$ ?

	C=O bond	$\text{CO}_2$ molecule
A.	polar	non-polar
B.	non-polar	polar
C.	polar	polar
D.	non-polar	non-polar

12. The molar masses of  $\text{C}_2\text{H}_6$ ,  $\text{CH}_3\text{OH}$  and  $\text{CH}_3\text{F}$  are very similar. How do their boiling points compare?

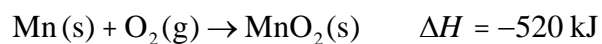
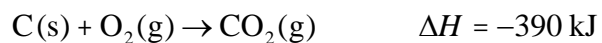
- A.  $\text{C}_2\text{H}_6 < \text{CH}_3\text{OH} < \text{CH}_3\text{F}$
- B.  $\text{CH}_3\text{F} < \text{CH}_3\text{OH} < \text{C}_2\text{H}_6$
- C.  $\text{CH}_3\text{OH} < \text{CH}_3\text{F} < \text{C}_2\text{H}_6$
- D.  $\text{C}_2\text{H}_6 < \text{CH}_3\text{F} < \text{CH}_3\text{OH}$

13. Solid, liquid and gaseous water are all present at very low pressure near  $0^\circ\text{C}$ . How do the distances between the molecules in the three states compare under these conditions?

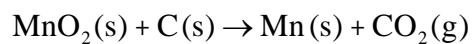
- A. The distances are equal in all three states.
- B. Distances are similar in the solid and liquid, which are smaller than that in the gas.
- C. Distances are smallest in the solid, and similar in the liquid and gas.
- D. Distances are smallest in the liquid, and similar in the solid and the gas.

14. What will happen to the volume of a fixed mass of gas when its pressure and temperature (in Kelvin) are both doubled?
- A. It will not change.
  - B. It will increase.
  - C. It will decrease.
  - D. The change cannot be predicted.
15. What energy changes occur when chemical bonds are formed and broken?
- A. Energy is absorbed when bonds are formed and when they are broken.
  - B. Energy is released when bonds are formed and when they are broken.
  - C. Energy is absorbed when bonds are formed and released when they are broken.
  - D. Energy is released when bonds are formed and absorbed when they are broken.
16. The temperature of a 2.0 g sample of aluminum increases from 25°C to 30°C. How many joules of heat energy were added? (Specific heat of Al =  $0.90 \text{ J g}^{-1} \text{ K}^{-1}$ )
- A. 0.36
  - B. 2.3
  - C. 9.0
  - D. 11

17. Using the equations below:



what is  $\Delta H$  (in kJ) for the following reaction?



- A. 910
- B. 130
- C. -130
- D. -910

18. Under what circumstances is a reaction spontaneous at all temperatures?

	$\Delta H^\ominus$	$\Delta S^\ominus$
A.	+	+
B.	+	–
C.	–	–
D.	–	+

19. Which of the following is (are) important in determining whether a reaction occurs?

- I. Energy of the molecules
- II. Orientation of the molecules

- A. I only
- B. II only
- C. Both I and II
- D. Neither I nor II



20. Consider the reaction between solid  $\text{CaCO}_3$  and aqueous  $\text{HCl}$ . The reaction will be speeded up by an increase in which of the following conditions?

- I. Concentration of the  $\text{HCl}$
- II. Size of the  $\text{CaCO}_3$  particles
- III. Temperature

- A. I only
- B. I and III only
- C. II and III only
- D. I, II and III

21.  $\text{I}_2(\text{g}) + 3\text{Cl}_2(\text{g}) \rightleftharpoons 2\text{ICl}_3(\text{g})$

What is the equilibrium constant expression for the reaction above?

- A.  $K_c = \frac{[\text{ICl}_3]}{[\text{I}_2][\text{Cl}_2]}$
- B.  $K_c = \frac{2[\text{ICl}_3]}{3[\text{I}_2][\text{Cl}_2]}$
- C.  $K_c = \frac{2[\text{ICl}_3]}{[\text{I}_2] + 3[\text{Cl}_2]}$
- D.  $K_c = \frac{[\text{ICl}_3]^2}{[\text{I}_2][\text{Cl}_2]^3}$

22.  $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g}) \quad \Delta H^\ominus = -200 \text{ kJ}$

According to the above information, what temperature and pressure conditions produce the greatest amount of  $\text{SO}_3$ ?

	Temperature	Pressure
A.	low	low
B.	low	high
C.	high	high
D.	high	low

**23.** An aqueous solution of which of the following reacts with magnesium metal?

- A. Ammonia
- B. Hydrogen chloride
- C. Potassium hydroxide
- D. Sodium hydrogencarbonate

**24.** Which is a buffer solution?

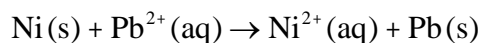
- I.  $0.01 \text{ mol dm}^{-3} \text{ HCl}, 0.01 \text{ mol dm}^{-3} \text{ NaCl}$
- II.  $0.01 \text{ mol dm}^{-3} \text{ CH}_3\text{COOH}, 0.01 \text{ mol dm}^{-3} \text{ CH}_3\text{COONa}$

- A. I only
- B. II only
- C. Both I and II
- D. Neither I nor II

**25.** Which statement is correct?

- A. Oxidation involves loss of electrons and a decrease in oxidation state.
- B. Oxidation involves gain of electrons and an increase in oxidation state.
- C. Reduction involves loss of electrons and an increase in oxidation state.
- D. Reduction involves gain of electrons and a decrease in oxidation state.

26. What occurs during the operation of a voltaic cell based on the following reaction?

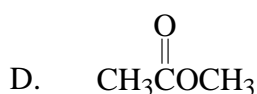
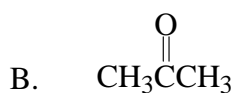
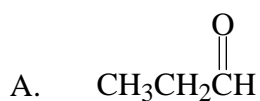


	External circuit	Ion movement in solution
A.	electrons move from Ni to Pb	$\text{Pb}^{2+}(\text{aq})$ move away from Pb(s)
B.	electrons move from Ni to Pb	$\text{Pb}^{2+}(\text{aq})$ move toward Pb(s)
C.	electrons move from Pb to Ni	$\text{Ni}^{2+}(\text{aq})$ move away from Ni(s)
D.	electrons move from Pb to Ni	$\text{Ni}^{2+}(\text{aq})$ move toward Ni(s)

27. Which is a member of the same homologous series as  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$ ?

- A.  $\text{CH}_3\text{CH}_2\text{CH}_3$
- B.  $\text{CH}_3\text{CHCHCH}_3$
- C.  $\text{CH}_3\text{CH}(\text{CH}_3)_2$
- D.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$

28. Which of the structures below is an aldehyde?



29. What product results from the reaction of  $\text{CH}_2=\text{CH}_2$  with  $\text{Br}_2$  ?
- A.  $\text{CHBrCHBr}$
  - B.  $\text{CH}_2\text{CHBr}$
  - C.  $\text{CH}_3\text{CH}_2\text{Br}$
  - D.  $\text{CH}_2\text{BrCH}_2\text{Br}$
30. What is the final product formed when  $\text{CH}_3\text{CH}_2\text{OH}$  is refluxed with acidified potassium dichromate(VI)?
- A.  $\text{CH}_3\text{CHO}$
  - B.  $\text{CH}_2=\text{CH}_2$
  - C.  $\text{CH}_3\text{COOH}$
  - D.  $\text{HCOOCH}_3$
-