



**CHEMISTRY  
STANDARD LEVEL  
PAPER 1**

Wednesday 4 May 2005 (afternoon)

45 minutes

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**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

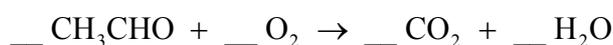
		Atomic Number										2					
		Element															
		Atomic Mass															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 <b>H</b> 1.01												5 <b>B</b> 10.81	6 <b>C</b> 12.01	7 <b>N</b> 14.01	8 <b>O</b> 16.00	9 <b>F</b> 19.00	10 <b>Ne</b> 20.18
3 <b>Li</b> 6.94	4 <b>Be</b> 9.01											13 <b>Al</b> 26.98	14 <b>Si</b> 28.09	15 <b>P</b> 30.97	16 <b>S</b> 32.06	17 <b>Cl</b> 35.45	18 <b>Ar</b> 39.95
11 <b>Na</b> 22.99	12 <b>Mg</b> 24.31											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
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	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
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	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)
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	204.37	207.19	208.98	(210)	(210)	(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)	

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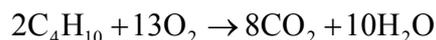
1. Which is a correct definition of the term *empirical formula*?
- A. formula showing the numbers of atoms present in a compound
  - B. formula showing the numbers of elements present in a compound
  - C. formula showing the actual numbers of atoms of each element in a compound
  - D. formula showing the simplest ratio of numbers of atoms of each element in a compound

2. The reaction of ethanal and oxygen can be represented by the unbalanced equation below.



When the equation is balanced using the smallest possible integers, what is the coefficient for  $\text{O}_2$ ?

- A. 3
  - B. 4
  - C. 5
  - D. 6
3. The equation for the complete combustion of butane is



What is the amount (in mol) of carbon dioxide formed by the complete combustion of three moles of butane?

- A. 4
- B. 8
- C. 12
- D. 24

4. Which solution contains the greatest amount (in mol) of solute?
- A. 10.0 cm<sup>3</sup> of 0.500 mol dm<sup>-3</sup> NaCl
  - B. 20.0 cm<sup>3</sup> of 0.400 mol dm<sup>-3</sup> NaCl
  - C. 30.0 cm<sup>3</sup> of 0.300 mol dm<sup>-3</sup> NaCl
  - D. 40.0 cm<sup>3</sup> of 0.200 mol dm<sup>-3</sup> NaCl
5. How many electrons are there in one  ${}_{12}^{24}\text{Mg}^{2+}$  ion?
- A. 10
  - B. 12
  - C. 14
  - D. 22
6. The electron arrangement of sodium is 2.8.1. How many occupied main electron energy levels are there in an atom of sodium?
- A. 1
  - B. 3
  - C. 10
  - D. 11
7. What increases **in equal steps of one** from left to right in the periodic table for the elements lithium to neon?
- A. the number of occupied electron energy levels
  - B. the number of neutrons in the most common isotope
  - C. the number of electrons in the atom
  - D. the atomic mass

8. Which property decreases down group 7 in the periodic table?
- A. atomic radius
  - B. electronegativity
  - C. ionic radius
  - D. melting point
9. What happens when sodium and oxygen combine together?
- A. Each sodium atom gains one electron.
  - B. Each sodium atom loses one electron.
  - C. Each oxygen atom gains one electron.
  - D. Each oxygen atom loses one electron.
10. Which statement is correct about **two** elements whose atoms form a covalent bond with each other?
- A. The elements are metals.
  - B. The elements are non-metals.
  - C. The elements have very low electronegativity values.
  - D. The elements have very different electronegativity values.
11. In ethanol,  $C_2H_5OH(l)$ , there are covalent bonds, hydrogen bonds and van der Waals' forces. Which bonds or forces are broken when ethanol is vaporized?
- A. only hydrogen bonds
  - B. covalent bonds and hydrogen bonds
  - C. covalent bonds and van der Waals' forces
  - D. hydrogen bonds and van der Waals' forces

12. Which substance has the lowest electrical conductivity?
- A. Cu(s)
  - B. Hg(l)
  - C. H<sub>2</sub>(g)
  - D. LiOH(aq)
13. In which of the following changes is there a large increase in the spacing between particles?
- A. boiling and condensing
  - B. condensing and diffusing
  - C. diffusing and evaporating
  - D. evaporating and freezing
14. A fixed mass of an ideal gas has a volume of 800 cm<sup>3</sup> under certain conditions. The pressure (in kPa) and temperature (in K) are both doubled. What is the volume of the gas after these changes with other conditions remaining the same?
- A. 200 cm<sup>3</sup>
  - B. 800 cm<sup>3</sup>
  - C. 1600 cm<sup>3</sup>
  - D. 3200 cm<sup>3</sup>

15. Which statements are correct for an endothermic reaction?
- I. The system absorbs heat.
  - II. The enthalpy change is positive.
  - III. The bond enthalpy total for the reactants is greater than for the products.
- A. I and II only
  - B. I and III only
  - C. II and III only
  - D. I, II and III
16. The mass  $m$  (in g) of a substance of specific heat capacity  $c$  (in  $\text{J g}^{-1} \text{K}^{-1}$ ) increases by  $t$  °C. What is the heat change in J?
- A.  $mct$
  - B.  $mc(t + 273)$
  - C.  $\frac{mct}{1000}$
  - D.  $\frac{mc(t + 273)}{1000}$
17. The average bond enthalpy for the C—H bond is  $412 \text{ kJ mol}^{-1}$ . Which process has an enthalpy change closest to this value?
- A.  $\text{CH}_4(\text{g}) \rightarrow \text{C}(\text{s}) + 2\text{H}_2(\text{g})$
  - B.  $\text{CH}_4(\text{g}) \rightarrow \text{C}(\text{g}) + 2\text{H}_2(\text{g})$
  - C.  $\text{CH}_4(\text{g}) \rightarrow \text{C}(\text{s}) + 4\text{H}(\text{g})$
  - D.  $\text{CH}_4(\text{g}) \rightarrow \text{CH}_3(\text{g}) + \text{H}(\text{g})$

18. For a certain reaction at 298 K the values of both  $\Delta H^\ominus$  and  $\Delta S^\ominus$  are negative. Which statement about the sign of  $\Delta G^\ominus$  for this reaction must be correct?
- A. It is negative at all temperatures.
  - B. It is positive at all temperatures.
  - C. It is negative at high temperatures and positive at low temperatures.
  - D. It cannot be determined without knowing the temperature.

19. The reaction between calcium carbonate and hydrochloric acid, carried out in an open flask, can be represented by the following equation.



Which of the measurements below could be used to measure the rate of the reaction?

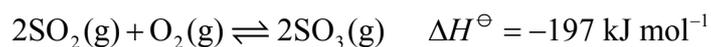
- I. the mass of the flask and contents
  - II. the pH of the reaction mixture
  - III. the volume of carbon dioxide produced
- A. I and II only
  - B. I and III only
  - C. II and III only
  - D. I, II and III
20. Which step is included in the definition of the term *rate determining step*?
- A. the step with the slowest moving particles
  - B. the step with the fewest reactant particles
  - C. the slowest step in a reaction
  - D. the last step in a reaction

21. Which statements are correct for a reaction at equilibrium?

- I. The forward and reverse reactions both continue.
- II. The rates of the forward and reverse reactions are equal.
- III. The concentrations of reactants and products are equal.

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

22. The manufacture of sulfur trioxide can be represented by the equation below.



What happens when a catalyst is added to an equilibrium mixture from this reaction?

- A. The rate of the forward reaction increases and that of the reverse reaction decreases.
- B. The rates of both forward and reverse reactions increase.
- C. The value of  $\Delta H^\ominus$  increases.
- D. The yield of sulfur trioxide increases.

23. The pH of solution X is 1 and that of Y is 2. Which statement is correct about the hydrogen ion concentrations in the two solutions?

- A.  $[\text{H}^+]$  in X is half that in Y.
- B.  $[\text{H}^+]$  in X is twice that in Y.
- C.  $[\text{H}^+]$  in X is one tenth of that in Y.
- D.  $[\text{H}^+]$  in X is ten times that in Y.

24. Which substances could be added to a solution of ethanoic acid to prepare an acidic buffer solution?

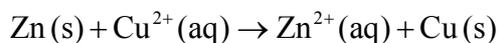
- I. Hydrochloric acid
- II. Sodium ethanoate
- III. Sodium hydroxide

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

25. What are the oxidation numbers of the elements in sulfuric acid,  $\text{H}_2\text{SO}_4$ ?

	Hydrogen	Sulfur	Oxygen
A.	+1	+6	-2
B.	+1	+4	-2
C.	+2	+1	+4
D.	+2	+6	-8

26. A voltaic cell is made from copper and zinc half-cells. The equation for the reaction occurring in the cell is



Which statement is correct when the cell produces electricity?

- A. Electrons are lost from zinc atoms.
- B. The mass of the copper electrode decreases.
- C. Electrons flow from the copper half-cell to the zinc half-cell.
- D. Negative ions flow through the salt bridge from the zinc half-cell to the copper half-cell.

27. What happens when molten sodium chloride is electrolysed in an electrolytic cell?
- A. Chlorine is produced at the positive electrode.
  - B. Sodium ions lose electrons at the negative electrode.
  - C. Electrons flow through the liquid from the negative electrode to the positive electrode.
  - D. Oxidation occurs at the negative electrode and reduction at the positive electrode.
28. Which compound is a member of the same homologous series as 1-chloropropane?
- A. 1-chloropropene
  - B. 1-chlorobutane
  - C. 1-bromopropane
  - D. 1,1-dichloropropane
29. Which formula is a correct representation of pentane?
- A.  $\text{CH}_3\text{CH}_2\text{CHCH}_2\text{CH}_3$
  - B.  $(\text{CH}_3\text{CH}_2)_2\text{CH}_3$
  - C.  $\text{CH}_3(\text{CH}_2)_3\text{CH}_3$
  - D.  $\text{CH}_3(\text{CH}_3)_3\text{CH}_3$
30. What is the organic product of the reaction between ethanol and ethanoic acid?
- A.  $\text{CH}_3\text{CHO}$
  - B.  $\text{CH}_3\text{COOCH}_3$
  - C.  $\text{CH}_3\text{CH}_2\text{COOCH}_3$
  - D.  $\text{CH}_3\text{COOCH}_2\text{CH}_3$
-