



**CHEMISTRY**  
**STANDARD LEVEL**  
**PAPER 1**

Wednesday 12 May 2010 (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 is provided for reference on page 2 of this examination paper.

### The Periodic Table

1 2 3 4 5 6 7 0

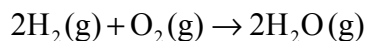
Atomic Number		Element										Atomic Mass																																									
1	H	1.01											2	He	4.00																																						
3	Li	6.94	4	Be	9.01											9	F	19.00	10	Ne	20.18																																
11	Na	22.99	12	Mg	24.31											15	P	30.97	16	S	32.06	17	Cl	35.45	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
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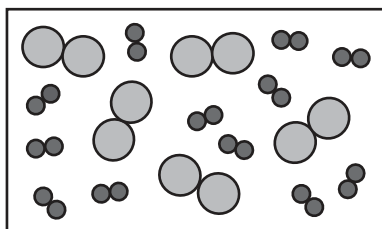
‡	90	Th	232.04	91	Pa	231.04	92	U	238.03	93	Np	(237)	94	Pu	(242)	95	Am	(243)	96	Cm	(247)	97	Bk	(247)	98	Cf	(251)	99	Es	(254)	100	Fm	(257)	101	Md	(258)	102	No	(259)	103	Lr	(260)
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1. Which amount of the following compounds contains the **least** number of ions?
- A. 2 mol of NaOH
  - B. 1 mol of  $\text{NH}_4\text{Cl}$
  - C. 2 mol of  $\text{CaCl}_2$
  - D. 1 mol of  $\text{Al}_2\text{O}_3$
2. What is the approximate molar mass, in  $\text{g mol}^{-1}$ , of  $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ ?
- A. 120
  - B. 130
  - C. 138
  - D. 246
3. Which is both an empirical and a molecular formula?
- A.  $\text{C}_5\text{H}_{12}$
  - B.  $\text{C}_5\text{H}_{10}$
  - C.  $\text{C}_4\text{H}_8$
  - D.  $\text{C}_4\text{H}_{10}$



4. 12 molecules of hydrogen gas,  $\text{H}_2(\text{g})$ , and 5 molecules of oxygen gas,  $\text{O}_2(\text{g})$ , were mixed together under conditions which allowed the reaction to go to completion, according to the following equation.



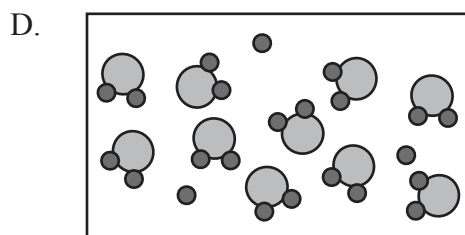
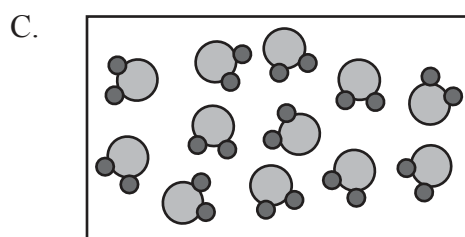
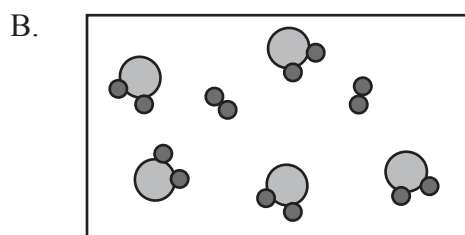
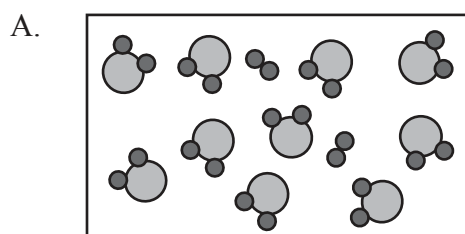
The following diagram represents the mixture of reactants.



Key:

-  Oxygen atom
-  Hydrogen atom

Which diagram represents the reaction mixture when the reaction was complete?



5. Which of the following is an isotope of  ${}^{24}_{12}\text{Mg}$ ?
- A.  ${}^{24}_{12}\text{Mg}^{2+}$
  - B.  ${}^{26}_{12}\text{Mg}$
  - C.  ${}^{42}_{13}\text{Mg}$
  - D.  ${}^{26}_{13}\text{Mg}$
6. Which describes the visible emission spectrum of hydrogen?
- A. A series of lines converging at longer wavelength
  - B. A series of regularly spaced lines
  - C. A series of lines converging at lower energy
  - D. A series of lines converging at higher frequency
7. Which statements about the periodic table are correct?
- I. Elements in period 3 have similar chemical properties.
  - II. Elements in group 7 show a gradual change in physical properties.
  - III. The position of an element in period 3 is related to the number of electrons in the highest occupied energy level.
- A. I and II only
  - B. I and III only
  - C. II and III only
  - D. I, II and III

8. Which statements about period 3 are correct?
- I. The electronegativity of the elements increases across period 3.
  - II. The atomic radii of the elements decreases across period 3.
  - III. The oxides of the elements change from acidic to basic across period 3.
- A. I and II only
  - B. I and III only
  - C. II and III only
  - D. I, II and III
9. Which is the best description of the bonding present in the ammonium ion,  $\text{NH}_4^+$ ?
- A. Sharing of electrons between atoms
  - B. Electrostatic attraction between ions
  - C. Electrostatic attraction between positive ions and delocalized electrons
  - D. Sharing of electrons between atoms and electrostatic attraction between ions
10. The formula of cerium(III) sulfate is  $\text{Ce}_2(\text{SO}_4)_3$ . What is the correct formula of cerium(III) phosphate?
- A.  $\text{CeP}$
  - B.  $\text{Ce}_2(\text{PO}_4)_3$
  - C.  $\text{Ce}_3(\text{PO}_4)_2$
  - D.  $\text{CePO}_4$

11. Which molecule has the shortest carbon-oxygen bond length?

- A.  $\text{CH}_3\text{COOH}$
- B.  $\text{CH}_3\text{CH}_2\text{OH}$
- C.  $\text{CO}_2$
- D.  $\text{CO}$

12. Which pair of compounds is arranged in correct order of relative boiling points?

	Lower Boiling Point	Higher Boiling Point
A.	$\text{H}_2\text{S}$	$\text{H}_2\text{O}$
B.	$\text{NH}_3$	$\text{PH}_3$
C.	$\text{HF}$	$\text{HCl}$
D.	$\text{CH}_3\text{COOH}$	$\text{CH}_3\text{CH}_2\text{OH}$

13. Which statement about the bonding between carbon atoms is correct?

- A. In  $\text{C}_{60}$  fullerene each carbon atom is covalently bonded to three other carbon atoms.
- B. In  $\text{C}_{60}$  fullerene each carbon atom is covalently bonded to four other carbon atoms.
- C. In graphite each carbon atom is covalently bonded to four other carbon atoms.
- D. In graphite each carbon atom forms a double covalent bond with three other carbon atoms.

14. Which intermolecular forces exist between molecules of carbon monoxide,  $\text{CO}$ ?

- A. Hydrogen bonds and van der Waals' forces
- B. Dipole-dipole attractions and van der Waals' forces
- C. Van der Waals' forces only
- D. Dipole-dipole attractions only

15. Which types of reaction are always exothermic?
- I. Neutralization
  - II. Decomposition
  - III. Combustion
- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III
16. A pure aluminium block with a mass of 10 g is heated so that its temperature increases from 20 °C to 50 °C. The specific heat capacity of aluminium is  $8.99 \times 10^{-1} \text{ J g}^{-1} \text{ K}^{-1}$ . Which expression gives the heat energy change in kJ?
- A.  $10 \times 8.99 \times 10^{-1} \times 303$
- B.  $10 \times 8.99 \times 10^{-1} \times 30$
- C.  $\frac{10 \times 8.99 \times 10^{-1} \times 303}{1000}$
- D.  $\frac{10 \times 8.99 \times 10^{-1} \times 30}{1000}$
17. Under which conditions will the reaction between 1.0 g calcium carbonate and excess hydrochloric acid be the fastest? Assume that all reactions are carried out at the same temperature.
- A. One large piece of calcium carbonate and  $2 \text{ mol dm}^{-3}$  hydrochloric acid
- B. One large piece of calcium carbonate and  $1 \text{ mol dm}^{-3}$  hydrochloric acid
- C. Powdered calcium carbonate and  $2 \text{ mol dm}^{-3}$  hydrochloric acid
- D. Powdered calcium carbonate and  $1 \text{ mol dm}^{-3}$  hydrochloric acid

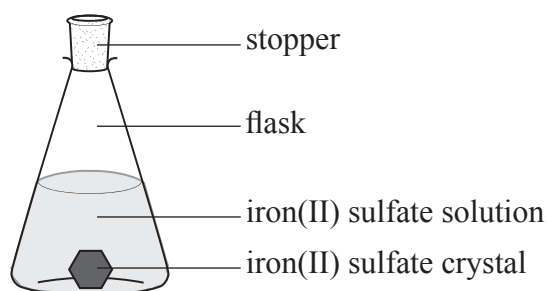


18. Powdered manganese(IV) oxide,  $\text{MnO}_2(\text{s})$ , increases the rate of the decomposition reaction of hydrogen peroxide,  $\text{H}_2\text{O}_2(\text{aq})$ . Which statements about  $\text{MnO}_2$  are correct?

- I. The rate is independent of the particle size of  $\text{MnO}_2$ .
- II.  $\text{MnO}_2$  provides an alternative reaction pathway for the decomposition with a lower activation energy.
- III. All the  $\text{MnO}_2$  is present after the decomposition of the hydrogen peroxide is complete.

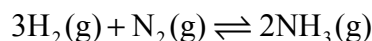
- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

19. Which statement is correct for a crystal of iron(II) sulfate in a state of equilibrium with a saturated solution of iron(II) sulfate?



- A. The colour of the solution darkens as the crystal continues to dissolve.
- B. The concentration of the iron(II) sulfate solution increases as the water evaporates.
- C. The shape of the iron(II) sulfate crystal does not change.
- D. The colour of the solution does not change but the shape of the crystal may change.

20. The Haber process uses an iron catalyst to convert hydrogen gas,  $\text{H}_2(\text{g})$ , and nitrogen gas,  $\text{N}_2(\text{g})$ , to ammonia gas,  $\text{NH}_3(\text{g})$ .



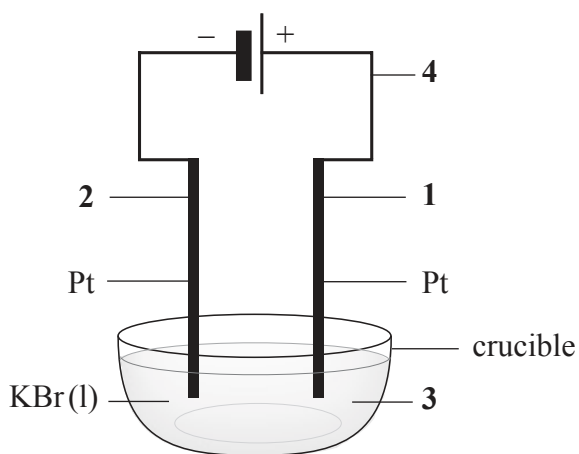
Which statements are correct for this equilibrium system?

- I. The iron catalyst increases the rates of the forward and reverse reactions equally.
  - II. The iron catalyst does not affect the value of the equilibrium constant,  $K_c$ .
  - III. The iron catalyst increases the yield of ammonia gas,  $\text{NH}_3(\text{g})$ .
- A. I and II only
  - B. I and III only
  - C. II and III only
  - D. I, II and III
21. Which property is characteristic of acids in aqueous solution?
- A. Acids react with ammonia solution to produce hydrogen gas and a salt.
  - B. Acids react with metal oxides to produce oxygen gas, a salt and water.
  - C. Acids react with reactive metals to produce hydrogen gas and a salt.
  - D. Acids react with metal carbonates to produce hydrogen gas, a salt and water.
22. A student has equal volumes of  $1.0 \text{ mol dm}^{-3}$  sodium hydroxide and ammonia solutions. Which statement about the solutions is correct?
- A. Sodium hydroxide has a lower electrical conductivity than ammonia.
  - B. Sodium hydroxide has a higher hydrogen ion concentration than ammonia.
  - C. Sodium hydroxide has a higher pH than ammonia.
  - D. Sodium hydroxide has a higher hydroxide ion concentration than ammonia.

23. Which definition of oxidation is correct?
- A. Loss of electrons and a decrease in oxidation number
  - B. Loss of electrons and an increase in oxidation number
  - C. Gain of electrons and a decrease in oxidation number
  - D. Gain of electrons and an increase in oxidation number

24. What is the IUPAC name of  $\text{Fe}_2\text{O}_3$ ?
- A. Iron oxide
  - B. Iron(II) oxide
  - C. Iron(III) oxide
  - D. Di-iron trioxide

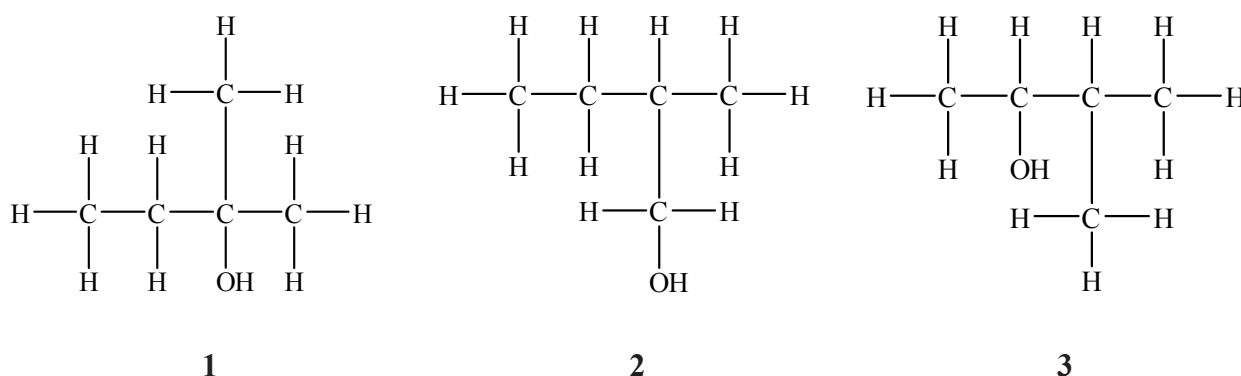
25. Which labels of the electrolytic cell are correct?



	1	2	3	4
A.	site of reduction	site of oxidation	conductor	electrolyte
B.	site of oxidation	site of reduction	electrolyte	conductor
C.	site of reduction	site of oxidation	electrolyte	conductor
D.	site of oxidation	site of reduction	conductor	electrolyte

26. Which is the best definition of structural isomers?
- Compounds which have atoms with the same atomic numbers but different mass numbers
  - Compounds which have the same general formula but differ by a  $\text{CH}_2$  group
  - Compounds which have the same empirical formula but different molecular formulas
  - Compounds which have the same molecular formula but different arrangements of atoms

27. Which is the correct classification of these alcohols?



	<b>1</b>	<b>2</b>	<b>3</b>
A.	tertiary	secondary	primary
B.	tertiary	primary	secondary
C.	tertiary	tertiary	secondary
D.	secondary	primary	secondary

28. Which substances are possible products of the incomplete combustion of octane?
- Carbon dioxide and hydrogen gas
  - Carbon monoxide and water vapour
  - Carbon monoxide and hydrogen gas
  - Methane and hydrogen gas

29. Which structure could represent a repeating unit of a polymer formed from propene?
- A.  $-(\text{CH}_2-\text{CH}(\text{CH}_3))-$
  - B.  $-(\text{CH}_2-\text{CH}_2-\text{CH}_2)-$
  - C.  $-(\text{CH}(\text{CH}_3)-\text{CH}(\text{CH}_3))-$
  - D.  $-(\text{CH}_2-\text{CH}_2)-$
30. Which experimental procedure is most likely to lead to a large systematic error?
- A. Determining the concentration of an alkali by titration with a burette
  - B. Measuring the volume of a solution using a volumetric pipette
  - C. Determining the enthalpy change of neutralization in a beaker
  - D. Measuring the volume of a gas produced with a gas syringe
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