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CHEMISTRY
STANDARD LEVEL
PAPER 1

Friday 9 November 2012 (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 maximum mark for this examination paper is *[30 marks]*.

The Periodic Table

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. What is the number of ions in 0.20 mol of $(NH_4)_3PO_4$?

A. 8.0×10^{-1}

B. 1.2×10^{23}

C. 4.8×10^{23}

D. 2.4×10^{24}

2. What is the molar mass, in g mol^{-1}, of washing soda crystals, $Na_2CO_3 \cdot 10H_2O$?

A. 105.99

B. 124.00

C. 263.15

D. 286.19

3. The equation for the reduction of iron(III) oxide is:

$$Fe_2O_3(s) + 3CO(g) \rightarrow 2Fe(s) + 3CO_2(g)$$

What mass of carbon dioxide, in g, is produced by the complete reduction of 80 g of iron(III) oxide?

A. 44

B. 66

C. 88

D. 132

4. 3.0 dm^3 of ethyne, C_2H_2, is mixed with 3.0 dm^3 of hydrogen and ignited. The equation for the reaction that occurs is shown below.

$$C_2H_2(g) + 2H_2(g) \rightarrow C_2H_6(g)$$

Assuming the reaction goes to completion and all gas volumes are measured at the same temperature and pressure, what volume of ethane, C_2H_6, in dm^3, is formed?

A. 1.5

B. 2.0

C. 3.0

D. 6.0

5. What is the correct number of each particle in an oxygen ion, $^{18}O^{2-}$?

	Protons	Neutrons	Electrons
A.	8	8	10
B.	8	10	8
C.	8	8	6
D.	8	10	10

6. Which statement about the electromagnetic spectrum is correct?

A. Infrared light has a shorter wavelength than ultraviolet light.

B. Visible light has a shorter wavelength than ultraviolet light.

C. The frequency of visible light is higher than the frequency of infrared light.

D. The energy of infrared light is higher than the energy of visible light.

7. Which statements about atomic structure and the periodic table are correct?

I. An element in group 2 has 2 electrons in its valence (outer) energy level.

II. An element in period 3 has electrons in 3 energy levels.

III. The element in group 2 and period 3 has an atomic number of 12.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

8. Which combination is correct for the properties of the alkali metals from Li to Cs?

	Atomic radius	**Melting point**	**First ionization energy**
A.	increases	increases	increases
B.	increases	decreases	decreases
C.	increases	increases	decreases
D.	decreases	decreases	increases

9. Which oxides are acidic?

I. P_4O_{10}

II. SO_3

III. Na_2O

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

10. What is the formula of the ionic compound formed when calcium and nitrogen react together?

A. Ca_2N_3

B. Ca_3N_2

C. Ca_5N_2

D. Ca_2N_5

11. Which bond is the **least** polar?

A. C–H

B. F–H

C. O–H

D. N–H

12. Diamond, C_{60} fullerene and graphite are allotropes of carbon. Which statements are correct about these allotropes?

I. In diamond each carbon is held in a tetrahedral arrangement.

II. In C_{60} fullerene each carbon is held in a trigonal arrangement.

III. In graphite each carbon is held in a tetrahedral arrangement.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

13. Which statement about the physical properties of substances is correct?

A. The only solids that conduct electricity are metals.

B. All substances with covalent bonds have low melting points.

C. Ionic solids are always brittle.

D. All metals have high densities.

14. Which combination is correct for the exothermic reaction that occurs between zinc and copper sulfate solution.

	Temperature of solution	**Heat released to surroundings**	**Enthalpy of products greater than enthalpy of reactants**
A.	increases	yes	yes
B.	decreases	no	no
C.	increases	yes	no
D.	decreases	no	yes

15. A 5.00 g sample of a substance was heated from $25.0\,^{\circ}C$ to $35.0\,^{\circ}C$ using 2.00×10^2 J of energy. What is the specific heat capacity of the substance in J g^{-1} K^{-1}?

A. 4.00×10^{-3}

B. 2.50×10^{-1}

C. 2.00

D. 4.00

16. Using the equations below:

$$C(s) + O_2(g) \rightarrow CO_2(g) \qquad \Delta H^{\ominus} = -390 \text{ kJ}$$
$$H_2(g) + \tfrac{1}{2}O_2(g) \rightarrow H_2O(l) \qquad \Delta H^{\ominus} = -286 \text{ kJ}$$
$$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l) \qquad \Delta H^{\ominus} = -890 \text{ kJ}$$

what is $\Delta H^{\ominus}$, in kJ, for the following reaction?

$$C(s) + 2H_2(g) \rightarrow CH_4(g)$$

A. –214

B. –72

C. +72

D. +214

17. Which piece of equipment could **not** be used in an experiment to measure the rate of this reaction?

$$CH_3COCH_3(aq) + I_2(aq) \rightarrow CH_3COCH_2I(aq) + H^+(aq) + I^-(aq)$$

A. A colorimeter

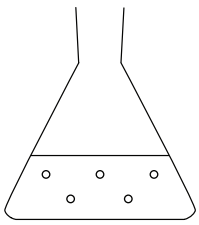
B. A gas syringe

C. A stopwatch

D. A pH meter

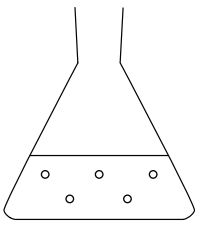
18. In which flask will the reaction between 2.0 g of magnesium carbonate and 25 cm^3 1.0 $mol\,dm^{-3}$ hydrochloric acid occur most rapidly?

A



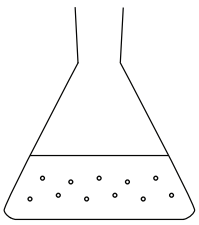
Large pellets
25 °C

B



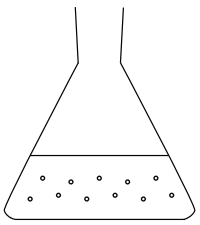
Large pellets
50 °C

C



Small pellets
25 °C

D



Small pellets
50 °C

19. Consider the following reaction:

$$2A \rightleftharpoons C \qquad K_c = 1.1$$

Which statement is correct when the reaction is at equilibrium?

A. [A] >> [C]

B. [A] > [C]

C. [A] = [C]

D. [A] < [C]

20. Iron(III) ions, Fe^{3+}, react with thiocyanate ions, SCN^-, in a reversible reaction to form a red solution. Which changes to the equilibrium will make the solution go red?

$$Fe^{3+}(aq) + SCN^-(aq) \rightleftharpoons [FeSCN]^{2+}(aq) \qquad \Delta H^{\ominus} = +ve$$

Yellow Red

I. Increasing the temperature

II. Adding $FeCl_3$

III. Adding a catalyst

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

21. Which substance can act as a Lewis acid but not as a Brønsted–Lowry acid?

A. HCl

B. CH_3COOH

C. BF_3

D. CF_3COOH

22. Which row correctly describes 1.0 $mol\,dm^{-3}$ $NaOH\,(aq)$?

	pH	Colour in universal indicator solution	Electrical conductivity
A.	14	purple	good
B.	10	green	poor
C.	14	red	good
D.	10	blue	poor

23. What is the correct systematic name of MnO_2?

A. Manganese(II) oxide

B. Manganese(IV) oxide

C. Magnesium(II) oxide

D. Magnesium(IV) oxide

24. A voltaic cell is made by connecting zinc and lead half-cells. The overall equation for the reaction occurring in the cell is shown below.

$$Zn\,(s) + Pb^{2+}\,(aq) \rightarrow Pb\,(s) + Zn^{2+}\,(aq)$$

Which statements are correct when the cell produces electricity?

I. The zinc is oxidized.

II. Electrons move from zinc to lead in the external circuit.

III. The mass of the lead electrode increases.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

25. Which process occurs during the electrolysis of molten sodium chloride?

A. Oxidation occurs at the positive electrode (anode).

B. Electrons move through the electrolyte.

C. Sodium ions move through the electrolyte to the positive electrode (anode).

D. Chloride ions move through the electrolyte and are reduced at the negative electrode (cathode).

26. Which statement about a homologous series is correct?

A. Members of the series differ by CH_3.

B. Members of the series have the same physical properties.

C. Members of the series have the same empirical formula.

D. Members of the series have similar chemical properties.

27. Which compound is **not** an isomer of hexane?

A. $CH_3CH(CH_3)CH_2CH_2CH_3$

B. $CH_3CHCHCH_2CH_2CH_3$

C. $(CH_3)_3CCH_2CH_3$

D. $CH_3CH_2CH(CH_3)CH_2CH_3$

28. Which compound would decolourize bromine water in the dark?

A. $CH_3COCH_2CH_3$

B. $CH_3(CH_2)_4OH$

C. $CH_3CHCHCH_3$

D. $CH_3(CH_2)_3CH_3$

29. Some methane gas is burned in a limited supply of oxygen. Which products could form?

I. $C(s)$

II. $CO(g)$

III. $CO_2(g)$

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

30. 50 cm^3 of copper(II) sulfate solution is measured into a plastic cup using a 100 cm^3 measuring cylinder. Excess zinc powder is added and the temperature rise that occurs is measured with a $-10\,°C$ to $+110\,°C$ thermometer. The enthalpy change for the reaction is then calculated. Which statement is correct?

A. Systematic error will be reduced by repeating the experiment several times and averaging the results.

B. Random error will be reduced by insulating the plastic cup.

C. Random error will be reduced by using a 50 cm^3 graduated pipette instead of a measuring cylinder.

D. Systematic error will be increased by using a larger volume of copper(II) sulfate solution.