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CHEMISTRY
STANDARD LEVEL
PAPER 1

Thursday 16 May 2013 (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. Which contains the largest number of ions?

A. 1 mol of $Al_2(SO_4)_3$

B. 1 mol of $Mg_3(PO_4)_2$

C. 2 mol of K_3PO_4

D. 3 mol of $NaNO_3$

2. How many atoms are present in 0.10 mol of $PtCl_2(NH_3)_2$?

A. 6.0×10^{22}

B. 3.0×10^{23}

C. 6.6×10^{23}

D. 6.6×10^{24}

3. Which is the best description of relative atomic mass, A_r?

A. The number of neutrons and protons present in the nucleus of an atom

B. The average number of neutrons and protons in all isotopes of an element

C. The weighted mean mass of naturally occurring isotopes of an element compared to the mass of an atom of carbon-12

D. The weighted mean mass of naturally occurring isotopes of an element compared to $1/12^{th}$ of the mass of an atom of carbon-12

4. What mass of carbon dioxide, $CO_2(g)$, in g, is produced when 5.0 g of calcium carbonate, $CaCO_3(s)$, reacts completely with hydrochloric acid, $HCl(aq)$?

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$$

A. 0.050

B. 2.2

C. 4.4

D. 5.0

5. What volume of carbon dioxide, $CO_2(g)$, in dm^3, is produced when 1 dm^3 of octane, $C_8H_{18}(g)$, undergoes complete combustion?

$$2C_8H_{18}(g) + 25O_2(g) \rightarrow 16CO_2(g) + 18H_2O(g)$$

A. 1

B. 4

C. 8

D. 9

6. Which is an isotope of ^{24}Mg?

A. $^{24}_{11}Na$

B. $^{24}_{12}Mg^{2+}$

C. $^{26}_{12}Mg$

D. $^{22}_{10}Ne$

7. Which is the correct order of the stages of operation in the mass spectrometer?

A. vaporization, ionization, acceleration, deflection, detection

B. vaporization, ionization, detection, deflection, acceleration

C. ionization, vaporization, acceleration, deflection, detection

D. ionization, deflection, acceleration, detection, vaporization

8. Element X is in group 5 and period 4 of the periodic table. Which statement is correct?

A. X has 5 occupied energy levels.

B. X can form ions with 3– charge.

C. X is a transition element.

D. X has 4 valence electrons.

9. Which statements are correct for the halogens F to I?

I. Melting point increases

II. First ionization energy increases

III. Ionic radius increases

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

10. Which is the best description of a metallic bond?

A. Electrostatic attraction between oppositely charged ions

B. Electrostatic attraction between a pair of electrons and positively charged nuclei

C. Electrostatic attraction between a lattice of positive ions and delocalized electrons

D. Electrostatic attraction for a bonding pair of electrons which have been supplied by one of the atoms

11. Which statements about graphite are correct?

I. Carbon atoms are held in layers with weak attractions between layers.

II. Graphite is a non-metal which conducts electricity.

III. Each carbon atom is covalently bonded to three other carbon atoms.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

12. Which statements are correct for the bonds between two carbon atoms?

I. Single bonds are longer than triple bonds.

II. Single bonds are stronger than double bonds.

III. Triple bonds are stronger than double bonds.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

13. Which statements about the structure and bonding of silicon dioxide are correct?

	Structure	Bonding
A.	Silicon dioxide forms a giant covalent network.	Each oxygen atom is covalently bonded to two silicon atoms.
B.	Silicon dioxide molecules are V-shaped or bent.	Each silicon atom is covalently bonded to two oxygen atoms.
C.	Silicon dioxide molecules are linear.	A double covalent bond exists between silicon and oxygen atoms.
D.	Silicon dioxide forms a giant covalent network.	Each oxygen atom is covalently bonded to four silicon atoms.

14. Which series shows **increasing** boiling points?

A. $CH_3CH_2CH_3 < CH_3CH_2OH < CH_3CHO$

B. $CH_3CHO < CH_3CH_2CH_3 < CH_3CH_2OH$

C. $CH_3CH_2OH < CH_3CHO < CH_3CH_2CH_3$

D. $CH_3CH_2CH_3 < CH_3CHO < CH_3CH_2OH$

15. Which statements are correct for an exothermic reaction?

I. The products are more stable than the reactants.

II. The enthalpy change, ΔH , is negative.

III. The temperature of the surroundings increases.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

16. The specific heat capacity of aluminium is $0.900\,J\,g^{-1}\,K^{-1}$. What is the heat energy change, in J, when 10.0 g of aluminium is heated and its temperature increases from 15.0 °C to 35.0 °C?

A. +180

B. +315

C. +1800

D. +2637

17. The reaction between methane and oxygen is exothermic.

$$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$$

Which statement is correct?

A. The total bond enthalpies of the reactants are less than the total bond enthalpies of the products.

B. The total bond enthalpies of the reactants are greater than the total bond enthalpies of the products.

C. The total energy released during bond formation is less than the total energy absorbed during bond breaking.

D. The activation energy is the difference between the total bond enthalpies of the products and the total bond enthalpies of the reactants.

18. Which statements explain the increase in the rate of a reaction when the temperature is increased?

I. More particles have energy greater than the activation energy.

II. The frequency of collisions increases.

III. The activation energy decreases.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

Questions 19 and 20 both refer to the following reaction.

Hydrogen and iodine react in a closed vessel to form hydrogen iodide.

$$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$$

At 350 °C $K_c = 60$
At 445 °C $K_c = 47$

19. Which statement is correct when the system is at equilibrium at 350 °C?

A. The concentrations of all reactants and products are equal.

B. The concentrations of the reactants are greater than the concentration of the product.

C. The reaction, as written, barely proceeds at this temperature.

D. The reaction, as written, goes almost to completion at this temperature.

20. Which statement describes and explains the conditions that favour the formation of hydrogen iodide?

A. Increased temperature as the forward reaction is exothermic, and increased pressure as there are two gaseous reactants and only one gaseous product

B. Increased temperature as the forward reaction is endothermic, and pressure has no effect as there are equal amounts, in mol, of gaseous reactants and products

C. Decreased temperature as the forward reaction is exothermic, and decreased pressure as there are two moles of gaseous product but only one mole of each gaseous reactant

D. Decreased temperature as the forward reaction is exothermic, and pressure has no effect as there are equal amounts, in mol, of gaseous reactants and products

21. Which list contains only strong bases?

A. ammonia, sodium hydroxide, ethylamine

B. potassium hydroxide, ammonia, sodium hydroxide

C. lithium hydroxide, potassium hydroxide, barium hydroxide

D. ammonia, ethylamine, barium hydroxide

22. Which products would be formed when hydrochloric acid reacts with magnesium oxide?

A. magnesium chloride and carbon dioxide

B. magnesium chloride, hydrogen gas and water

C. magnesium, hydrogen gas and water

D. magnesium chloride and water

23. Which statement describes a reducing agent?

A. It is reduced and gains electrons.

B. It is reduced and loses electrons.

C. It is oxidized and gains electrons.

D. It is oxidized and loses electrons.

24. Which is the oxidizing agent in the following reaction?

$$5SO_2(g) + 2IO_3^-(aq) + 4H_2O(l) \rightarrow 5SO_4^{2-}(aq) + I_2(aq) + 8H^+(aq)$$

A. SO_2

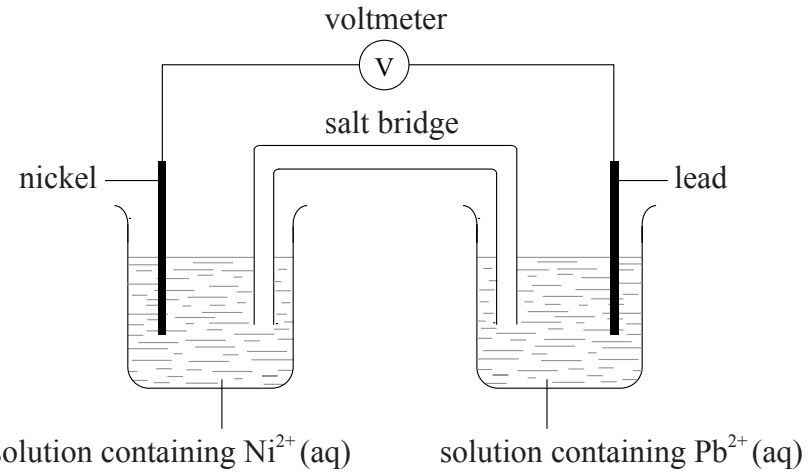
B. IO_3^-

C. H_2O

D. SO_4^{2-}

25. The overall reaction in the voltaic cell below is:

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



Which statement is correct for the nickel half-cell?

A. Nickel is the positive electrode (cathode) and is reduced.

B. Nickel is the negative electrode (anode) and is reduced.

C. Nickel is the positive electrode (cathode) and is oxidized.

D. Nickel is the negative electrode (anode) and is oxidized.

26. Which three compounds can be considered to be a homologous series?

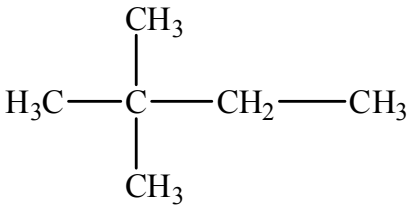
A. CH_3NH_2 $CH_3CH_2NH_2$ $CH_3CH_2CH_2NH_2$

B. $CH_3CH_2CH_2NH_2$ $CH_3CH(NH_2)CH_3$ $CH_3(NH)CH_2CH_3$

C. $C(CH_3)_4$ $CH_3CH_2CH_2CH_2CH_3$ $(CH_3)_2CHCH_2CH_3$

D. CH_3CH_2COOH CH_3COOCH_3 $HCOOCH_2CH_3$

27. What is the name of the following compound applying IUPAC rules?



A. 1,1,1-trimethylpropane

B. 2,2-dimethylbutane

C. 3,3-dimethylbutane

D. 2-methyl-2-ethylpropane

28. What are possible products of the incomplete combustion of propane?

A. carbon monoxide, hydrogen and carbon

B. carbon dioxide, carbon and hydrogen

C. carbon, carbon monoxide and water

D. carbon dioxide and water only

29. Which equation represents a propagation step in the mechanism for the reaction between ethane, C_2H_6, and chlorine, Cl_2, in the presence of sunlight/UV?

A. $C_2H_6 + Cl\bullet \rightarrow C_2H_5\bullet + HCl$

B. $C_2H_6 + Cl\bullet \rightarrow C_2H_5Cl + H\bullet$

C. $Cl_2 \rightarrow 2Cl\bullet$

D. $C_2H_5\bullet + Cl\bullet \rightarrow C_2H_5Cl$

30. Using an accurate pH meter, the pH of lemonade was found to be 2.30. Some students deduced the pH of the lemonade after titration with a 0.10 mol dm^{-3} sodium hydroxide solution. Their determined values of pH were 2.4, 2.5, 2.4 and 2.4. What is the best description of the precision and accuracy of these measurements?

	Precision	Accuracy
A.	precise	inaccurate
B.	not precise	inaccurate
C.	precise	accurate
D.	not precise	accurate