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Test contains 15 questions, 2 marks each. **No negative marks.**

$N_A = 6 \times 10^{23} \text{ mol}^{-1}$ ; Ar: Na-23; S-32; O-16; H-1; Br-80; K-39.

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1. Mass number (A) of the element E is 32 and electron configuration of its  $E^{2-}$  ion is  $1s^2 2s^2 2p^6 3s^2 3p^6$ . Which one of the following statements is correct?
  - 1) Neutral atom of the element E contains 20 electrons
  - 2) Neutral atom of the element E contains 18 protons
  - 3) Element E is a noble gas
  - 4) Neutral atom of the element E contains 16 neutrons
  
2. Given:  $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g})$ 

Initially, 1 mol  $\text{SO}_2$  and 2 mol  $\text{O}_2$  are placed in a 1 L vessel. After equilibrium has been established, 0.5 mol  $\text{SO}_3$  is present in the vessel. The vessel contains:

  - 1) 0.5 mol/L  $\text{SO}_2$ , 1 mol/L  $\text{O}_2$  and 0.5 mol/L  $\text{SO}_3$
  - 2) 1 mol/L  $\text{O}_2$  and 0.5 mol/L  $\text{SO}_3$
  - 3) 0.5 mol/L  $\text{SO}_2$ , 1.75 mol/L  $\text{O}_2$  and 0.5 mol/L  $\text{SO}_3$
  - 4) 0.5 mol/L  $\text{SO}_2$ , 0.25 mol/L  $\text{O}_2$  and 0.5 mol/L  $\text{SO}_3$
  
3. Calculate the mass percent of  $\text{Na}_2\text{SO}_3$  in a solution prepared by adding 10 g of  $\text{Na}_2\text{SO}_3 \cdot 7\text{H}_2\text{O}$  and 10 g of  $\text{Na}_2\text{SO}_3$  to 100 g of water.
  - 1) 20
  - 2) 16.7
  - 3) 15
  - 4) 12.5
  
4. In oxidation-reduction reaction between potassium bromide and potassium bromate ( $\text{KBrO}_3$ ) in acidic solution ( $\text{H}_2\text{SO}_4$ ) produce elemental bromine, potassium sulfate and water. What volume of 2 mol/L of reduction agent, in milliliters, is required to give 4.8 g bromine?
  - 1) 25
  - 2) 12.5
  - 3) 15
  - 4) 50

5. Which of the following has the lowest pH value?

- 1) Solution which in 1 L contains  $10^{-2}$  mol  $H^+$
- 2) Solution which in 1 L contains  $6 \times 10^{10}$   $OH^-$
- 3) Solution of  $H_2SO_4$  has a  $pOH=11.5$
- 4) Solution of  $H_3PO_4$  has a  $pH=3$

6. Which one of the following sets is arranged in order of increasing pH of aqueous solutions of compounds?

- 1)  $NaCl, SO_2, NaCH_3COO$
- 2)  $HCl, NaNO_3, NH_4Cl$
- 3)  $N_2O_3, NaNO_3, Na_2CO_3$
- 4)  $NaNO_2, Na_2SO_4, AlCl_3$

7. Which of the following reactions is **not possible**?

- 1)  $2Ag + 2HNO_3 \rightarrow 2AgNO_3 + H_2$
- 2)  $CaCO_3 + 2HNO_3 \rightarrow Ca(NO_3)_2 + CO_2 + H_2O$
- 3)  $CuO + 2HCl \rightarrow CuCl_2 + H_2O$
- 4)  $ZnO + 2NaOH + H_2O \rightarrow Na_2[Zn(OH)_4]$

8. Tertiary alcohol can be prepared in the reaction of:

- 1) aldehyde and alkyl-magnesium-chloride following acidic hydrolysis
- 2) cyclohexanone and methyl-magnesium-chloride following acidic hydrolysis
- 3) reduction of propanone with  $\text{LiAlH}_4$  following acidic hydrolysis
- 4) reduction of ethyl-propanoate with  $\text{LiAlH}_4$  following acidic hydrolysis

9. Esterification is a reversible process. In order to increase the yield of the product as much as possible it is necessary:

- 1) to avoid the use of inorganic acid as the catalyst
- 2) to remove  $\text{H}_2\text{O}$  from the reaction
- 3) to use reactants (carboxylic acid and alcohol) in 1:1 ratio
- 4) to add a reducing agent to the reaction mixture

10. 1,2,3,4-Tetrabromohexane is formed in the reaction of unknown starting compound and bromine. What is the structure of the unknown starting compound:

- 1) 1,5-hexadiene
- 2) 1,2-hexadiene
- 3) 1-hexyne
- 4) 1,3-hexadiene

11. The axial bonds in cyclohexane at positions 1 and 3 have the following relationship:

- 1) they are *cis* to each other
- 2) they are *trans* to each other
- 3) they do not have any defined relationship
- 4) their relationship can be either *cis* or *trans*

12. Which of the following statements is false:

- 1) substitution reactions are typical transformations of benzene
- 2) the length of C-C bond in benzene is between the length of the single (C-C) bond and the double (C=C) bond
- 3) all atoms in the benzene ring are in the same plane
- 4) the most stable conformation of benzene is the chair conformation

13. The reaction of anilinium-chloride and potassium hydroxide affords:

- 1) phenol
- 2) potassium salt of phenol and ammonium-chloride
- 3) chlorobenzene and ammonia
- 4) aniline

14. Schiff base can be prepared in the reaction of:

- 1) histamine and ammonia
- 2) phenylalanine and formaldehyde
- 3) histidine and ammonia
- 4) reduction of cystine

15. Which functional groups participate in the formation of the D-ribose pyranose structure:

- 1) the alcohol group at position 4 and the aldehyde group
- 2) the alcohol group at position 2 and the alcohol group at position 5
- 3) the alcohol group at position 5 and the aldehyde group
- 4) the primary alcohol group and any of the secondary alcohol group