

## Paper 1 – 30 questions – 45 minutes

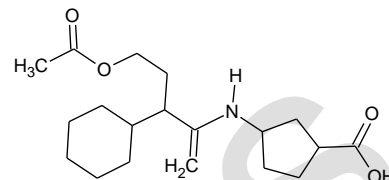
1. Consider the process:  $I_2(g) \rightarrow I_2(s)$   
The name of this process is
- A. condensation  
C. deposition  
B. sublimation  
D. vaporization
2. Which of the following contains an element, a compound and a mixture?
- A.  $H_2O(l)$ ,  $H_2(g)$ ,  $FeS(s)$   
C.  $CH_4(g)$ ,  $I_2(l)$ ,  $CO_2(l)$   
B.  $Cl_2(aq)$ ,  $Br_2(g)$ ,  $NaBr(l)$   
D.  $NaCl(aq)$ ,  $CO(g)$ ,  $H_2S(g)$
3. A room contained  $40.0 \text{ m}^3$  of air. The concentration of  $H_2S(g)$  in the room is 0.500 ppm. The volume of  $H_2S$  in the room is
- A.  $20.0 \text{ cm}^3$   
C.  $2.00 \text{ cm}^3$   
B.  $2.00 \times 10^{-5} \text{ cm}^3$   
D.  $8.00 \text{ cm}^3$
4. The behaviour and properties of a real gas differs most from those of an ideal gas at
- A. low temperature and low pressure  
C. high temperature and low pressure  
B. low temperature and high pressure  
D. high temperature and high pressure
5. A student carried out an experiment to determine the value of x in the formula  $MgSO_4 \cdot xH_2O$ . They weighed a sample of  $MgSO_4 \cdot xH_2O$ , heated it to drive off the water and then weighed it again. The experimental data is shown in the table:
- |                                    |      |
|------------------------------------|------|
| Mass of $MgSO_4 \cdot xH_2O$ / g   | 2.46 |
| Mass of $MgSO_4$ after heating / g | 1.20 |
- The value of x is
- A. 2  
B. 4  
C. 5  
D. 7
6. Which of the following is the symbol of an actinoid?
- A. Cd  
B. Co  
C. Cf  
D. Ce
7. The condensed electron configuration for a copper atom is:
- A.  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^9$   
C.  $[Ar] 4s^2 3d^9$   
B.  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^{10}$   
D.  $[Ar] 4s^1 3d^{10}$
8. Which of the following atoms does not contain any unpaired electrons?
- A. F  
B. Mg  
C. Na  
D. O
9. Which of the following has the most exothermic value of electron affinity?
- A. F  
B. Cl  
C. Br  
D. I
10. In which of the following does the central atom have an expanded octet?
- A.  $Cl_2O$   
B.  $H_2S$   
C.  $NO_2^+$   
D.  $SF_6$

11. What is the shape and electron domain geometry of  $\text{NO}_2^+$ ?

- |    | shape           | electron domain geometry |
|----|-----------------|--------------------------|
| A. | linear          | trigonal planar          |
| B. | trigonal planar | trigonal planar          |
| C. | trigonal planar | bent                     |
| D. | linear          | linear                   |

12. Which functional group is not present in the molecule shown?

- A. phenyl  
B. secondary amine  
C. carboxyl  
D. ester



13. Some standard heats of formation,  $\Delta H_f^\ominus$ , are as follows:

Compound	$\Delta H_f / \text{kJ mol}^{-1}$	Compound	$\Delta H_f / \text{kJ mol}^{-1}$
$\text{CH}_4(\text{g})$	-74.8	$\text{H}_2\text{O}(\text{g})$	-242
$\text{CO}_2(\text{g})$	-394	$\text{O}_3(\text{g})$	+143

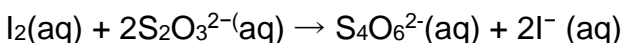
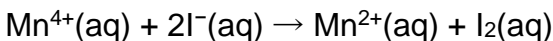
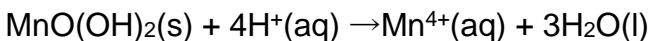
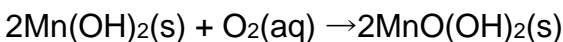
What is  $\Delta H^\ominus$ , in kJ for the reaction



- A.  $-(3 \times 394) - (6 \times 242) + (4 \times 143) - (3 \times 74.8)$   
 B.  $-(3 \times 394) - (6 \times 242) - (4 \times 143) - (3 \times 74.8)$   
 C.  $-(3 \times 394) - (6 \times 242) - (4 \times 143) + (3 \times 74.8)$   
 D.  $(3 \times 394) + (6 \times 242) + (4 \times 143) + (3 \times 74.8)$
14. A  $0.01 \text{ mol dm}^{-3}$  solution of a weak acid, HA, has a pH of 4. The concentration of  $\text{H}^+(\text{aq})$  in this solution is
- A.  $1 \times 10^{-2} \text{ mol dm}^{-3}$   
 B.  $1 \times 10^{-12} \text{ mol dm}^{-3}$   
 C.  $1 \times 10^{-4} \text{ mol dm}^{-3}$   
 D.  $1 \times 10^{-6} \text{ mol dm}^{-3}$
15. The  $^1\text{H}$  NMR spectrum of propanoic acid will consist of
- A. 1 peak  
 B. 2 peaks  
 C. 3 peaks  
 D. 6 peaks
16. Which of the following does not have an IHD of 1?
- A. ethyl ethanoate  
 B. but-2-ene  
 C. cyclopropane  
 D. 2-methoxypropane
17. The IUPAC name of  $\text{HCCCH}(\text{CH}_3)_2$  is
- A. 2-methylbutane  
 B. 3-methylbut-1-yne  
 C. 1,2-dimethylpropyne  
 D. 2-methylbut-3-yne
18. The half equations for the reaction of manganate(VII) with  $\text{Fe}^{2+}$  ions are
- $$\text{Fe}^{2+}(\text{aq}) \rightarrow \text{Fe}^{3+}(\text{aq}) + \text{e}^-$$
- $$\text{MnO}_4^-(\text{aq}) + 8\text{H}^+(\text{aq}) + 5\text{e}^- \rightarrow \text{Mn}^{2+}(\text{aq}) + 4\text{H}_2\text{O}(\text{l})$$
- The number of moles of  $\text{Fe}^{2+}$  that would be oxidised by  $50.0 \text{ cm}^3$  of  $0.0200 \text{ mol dm}^{-3} \text{ MnO}_4^-$  is
- A.  $5.00 \times 10^{-3} \text{ mol}$   
 B.  $1.00 \times 10^{-3} \text{ mol}$   
 C.  $5.00 \text{ mol}$   
 D.  $2.00 \times 10^{-4} \text{ mol}$

19. The Winkler method was used to measure the concentration of dissolved oxygen in a sample of water. Manganese(II) sulfate, sulfuric acid and potassium iodide were added to 50.0 cm<sup>3</sup> of the water. The iodine that was formed was titrated against a sodium thiosulfate solution with a concentration of  $2.00 \times 10^{-3} \text{ mol dm}^{-3}$ . It was found that 10.00 cm<sup>3</sup> of sodium thiosulfate was required for the titration.

The equations for the reactions are:



The concentration of dissolved oxygen in ppm is given by

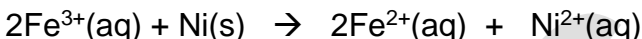
A.  $\frac{10.00 \times 32.00 \times 2.00}{4 \times 50.0}$

B.  $\frac{10.00 \times 32.00 \times 2.00}{50.0}$

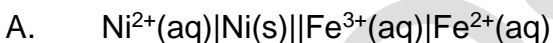
C.  $\frac{10.00 \times 32.00 \times 2.00 \times 10^6}{1000 \times 4 \times 50.0}$

D.  $\frac{10.00 \times 2.00}{32.00 \times 4 \times 50.0}$

20. A voltaic cell can be set up using Fe<sup>2+</sup>, Fe<sup>3+</sup>, Ni and Ni<sup>2+</sup>. The equation for the overall reaction that occurs is



The cell notation is



21. The oxidation state of oxygen in hydrogen peroxide, H<sub>2</sub>O<sub>2</sub> is

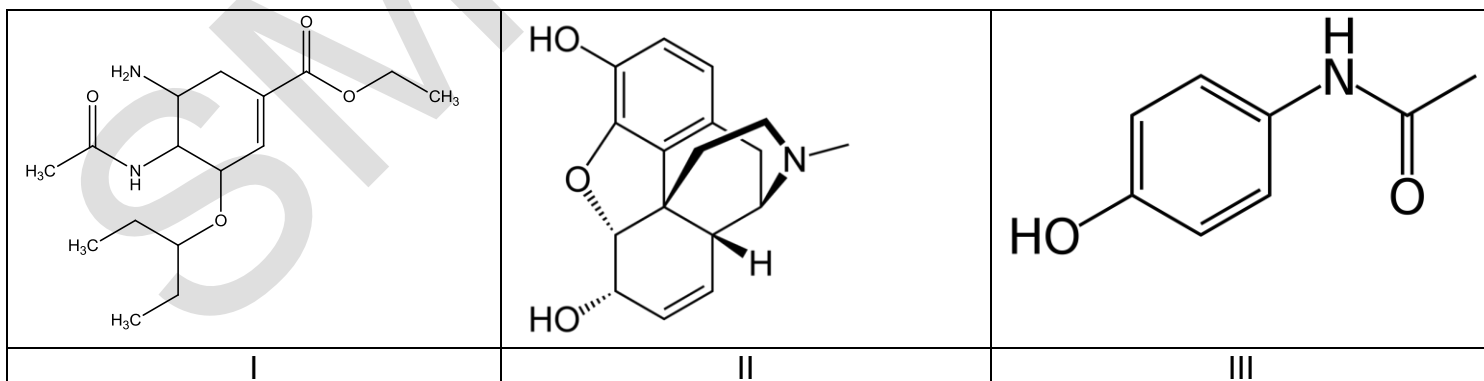
A. -2

B. 2-

C. 1-

D. -1

22. Three organic molecules are shown below

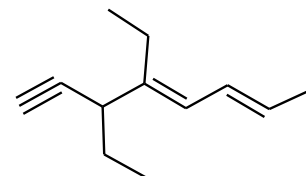


Which of the following statements are correct?

- A. All three molecules contain a tertiary carboxamide group
- B. Only II contains an amine group
- C. I and III contain a carbonyl group
- D. I and II contain an ether group

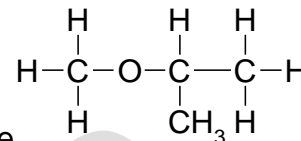
23. The diagram shows the skeletal formula of an organic molecule. The empirical formula of the compound is

- A.  $C_{12}H_{18}$       B.  $CH_{1.5}$       C.  $C_6H_{13}$       **D.  $C_2H_3$**



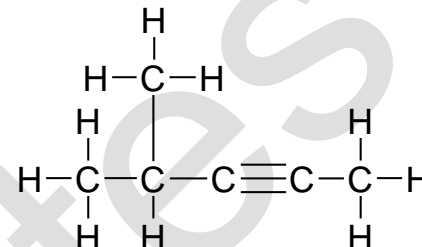
24. The IUPAC name of the compound shown is

- A. 2-methylmethoxyethane      **B. 2-methoxypropane**  
 C. 2-methylethoxymethane      D. 1,1-dimethylmethoxymethane



25. The IUPAC name of the compound shown is?

- A. 2-methylpent-3-yne  
**B. 4-methylpent-2-yne**  
 C. 2-methylpent-2-yne  
 D. 1,1-dimethylbut-2-yne



26. Ethanol reacts with ethanoic acid under suitable conditions. The type of reaction is

- A. electrophilic addition      B. free radical substitution  
**C. nucleophilic substitution**      D. redox

27. Which of the following compounds has the highest index of hydrogen deficiency (IHD)?

- A.  $C_6H_5CH_3$       B.  $CH_3COOCH_2CH_3$   
**C.  $C_6H_5COOH$**       D.  $C_3H_4$

28. Which of the following statements is not correct about the mass spectrum of ethylbenzene,  $C_6H_5CH_2CH_3$

- A. the molecular ion peak occurs at  $m/z=106$   
**B. the peak at  $m/z=29$  is due to the  $CH_2CH_3$  fragment**  
 C. there will be a peak at  $m/z=77$  due to the loss of the  $CH_3CH_2$  group  
 D. the mass spectrum will contain a peak at  $m/z=15$

29. Which of the following molecules has an IHD of 1 and 3 peaks in the low resolution nmr spectrum

- A. propan-2-ol      B. propanone  
**C. butanone**      D. butanoic acid

30. A student carried out an experiment to measure the enthalpy change of solution of barium nitrate and obtained the value  $-32 \text{ kJ mol}^{-1}$ . The literature value for this quantity is  $-40 \text{ kJ mol}^{-1}$ . The percentage error in the student's experiment was

- A. 8 %      **B. 20 %**      C. 25 %      D. 80 %