

Paper 1 – 30 questions – 45 minutes

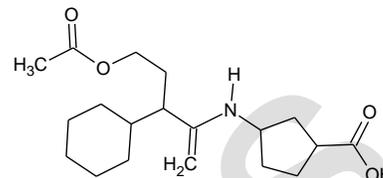
1. Consider the process: $I_2(g) \rightarrow I_2(s)$
The name of this process is
- A. condensation
C. deposition
B. sublimation
D. vaporization
2. Which of the following contains an element, a compound and a mixture?
- A. $H_2O(l)$, $H_2(g)$, $FeS(s)$
C. $CH_4(g)$, $I_2(l)$, $CO_2(l)$
B. $Cl_2(aq)$, $Br_2(g)$, $NaBr(l)$
D. $NaCl(aq)$, $CO(g)$, $H_2S(g)$
3. A room contained 40.0 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 cm^3
C. 2.00 cm^3
B. $2.00 \times 10^{-5} \text{ cm}^3$
D. 8.00 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 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, ΔH_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

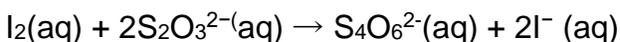
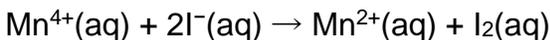
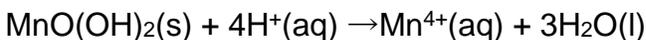
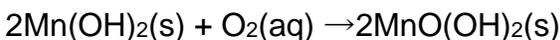
What is ΔH^\ominus , in kJ for the reaction



- 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 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 ^1H 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 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 Fe^{2+} that would be oxidised by 50.0 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 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 cm³ 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 cm³ 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. $\frac{10.00 \times 32.00 \times 2.00}{50.0}$

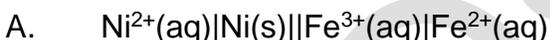
C. $\frac{10.00 \times 32.00 \times 2.00 \times 10^6}{1000 \times 4 \times 50.0}$

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

20. A voltaic cell can be set up using Fe²⁺, Fe³⁺, Ni and Ni²⁺. The equation for the overall reaction that occurs is



The cell notation is



21. The oxidation state of oxygen in hydrogen peroxide, H₂O₂ is

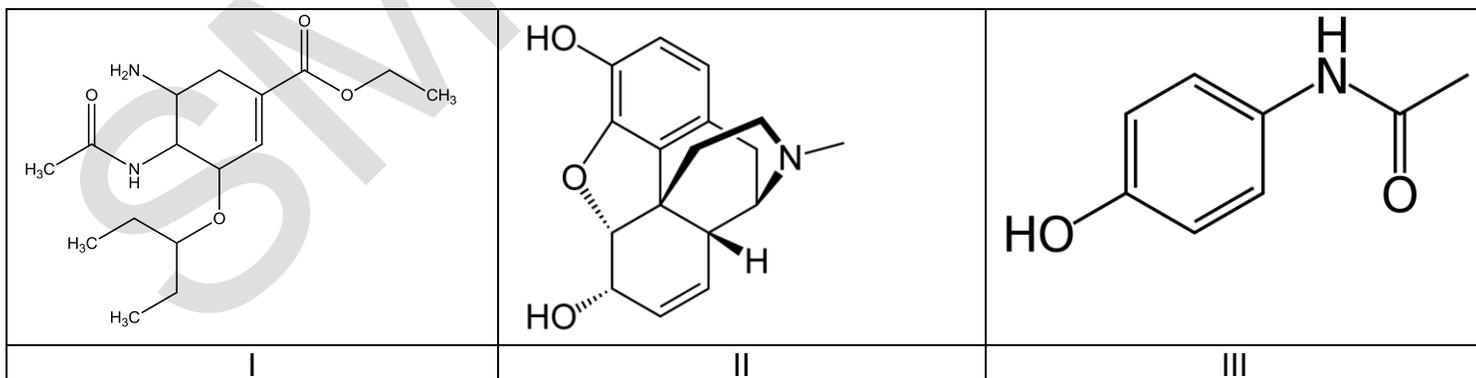
A. -2

B. 2-

C. 1-

D. -1

22. Three organic molecules are shown below

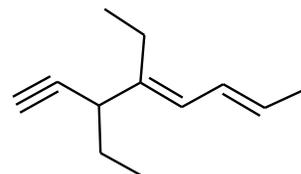


Which of the following statements are correct?

- 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

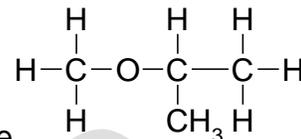
23. The diagram shows the skeletal formula of an organic molecule. The empirical formula of the compound is

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



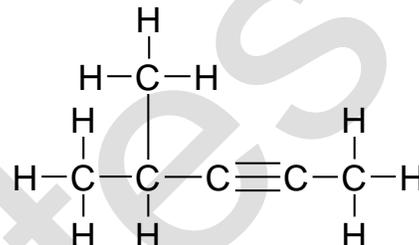
24. The IUPAC name of the compound shown is

- 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 kJ mol^{-1} . The literature value for this quantity is -40 kJ mol^{-1} . The percentage error in the student's experiment was

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