Paper 1 – 30 questions – 45 minutes. You will need a Periodic Table.
All questions can be done without a calculator.

1. Consider the process: $I_2(g) \rightarrow I_2(s)$
The name of this process is

A. condensation
B. sublimation
C. deposition
D. vaporization

2. Which of the following contains an element, a compound and a mixture?

A. $H_2O(l)$, $H_2(g)$, $FeS(s)$
B. $Cl_2(aq)$, $Br_2(g)$, $NaBr(l)$
C. $CH_4(g)$, $I_2(l)$, $CO_2(l)$
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
B. 2.00×10^{-5} cm^3
C. 2.00 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
B. low temperature and high pressure
C. high temperature and low pressure
D. high temperature and high pressure

5. A student carried out an experiment to determine the value of x in the formula $MgSO_4.xH_2O$. They weighed a sample of $MgSO_4.xH_2O$, heated it to drive off the water and then weighed it again. The experimental data is shown in the table:

Mass of $MgSO_4.xH_2O$ / 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. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^9$
B. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1\ 3d^{10}$
C. $[Ar]\ 4s^2\ 3d^9$
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

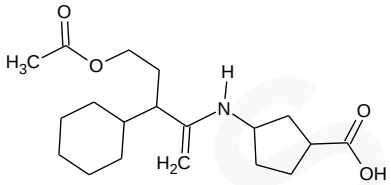
10. In which of the following does the central atom have an expanded octet?

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, $\Delta H_f^{\ominus}$, are as follows:

Compound	ΔH_f / kJ mol^{-1}	Compound	ΔH_f / kJ mol^{-1}
$CH_{4(g)}$	-74.8	$H_2O_{(g)}$	-242
$CO_{2(g)}$	-394	$O_{3(g)}$	+143

What is $\Delta H^{\ominus}$, in kJ for the reaction $3CH_{4(g)} + 4O_{3(g)} \rightarrow 3CO_{2(g)} + 6H_2O_{(g)}$

A. -(3x394) - (6x242) + (4x143) - (3x74.8)
B. -(3x394) - (6x242) - (4x143) - (3x74.8)
C. -(3x394) - (6x242) - (4x143) + (3x74.8)
D. (3x394) + (6x242) + (4x143) + (3x74.8)

14. A 0.01 mol dm^{-3} solution of a weak acid, HA, has a pH of 4. The concentration of $H^+(aq)$ in this solution is

A. 1x10^{-2} mol dm^{-3}
B. 1x10^{-12} mol dm^{-3}
C. 1x10^{-4} mol dm^{-3}
D. 1x10^{-6} mol dm^{-3}

15. The ^{1}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 $HCCCH(CH_3)_2$ 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

$Fe^{2+}_{(aq)} \rightarrow Fe^{3+}_{(aq)} + e^-$
$MnO_4^-{}_{(aq)} + 8H^+_{(aq)} + 5e^- \rightarrow Mn^{2+}_{(aq)} + 4H_2O_{(l)}$

The number of moles of Fe^{2+} that would be oxidised by 50.0 cm^3 of 0.0200 mol dm^{-3} MnO_4^- is

A. 5.00x10^{-3} mol
B. 1.00x10^{-3} mol
C. 5.00 mol
D. 2.00x10^{-4} 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^3 of the water. The iodine that was formed was titrated against a sodium thiosulfate solution with a concentration of 2.00×10^{-3} mol dm^{-3}. It was found that 10.00 cm^3 of sodium thiosulfate was required for the titration.

The equations for the reactions are:

$2Mn(OH)_2(s) + O_2(aq) \rightarrow 2MnO(OH)_2(s)$

$MnO(OH)_2(s) + 4H^+(aq) \rightarrow Mn^{4+}(aq) + 3H_2O(l)$

$Mn^{4+}(aq) + 2I^-(aq) \rightarrow Mn^{2+}(aq) + I_2(aq)$

$I_2(aq) + 2S_2O_3^{2-}(aq) \rightarrow S_4O_6^{2-}(aq) + 2I^-(aq)$

The concentration of dissolved oxygen in ppm is given by

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

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

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

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

20. A voltaic cell can be set up using Fe^{2+}, Fe^{3+}, Ni and Ni^{2+}. The equation for the overall reaction that occurs is

$2Fe^{3+}(aq) + Ni(s) \rightarrow 2Fe^{2+}(aq) + Ni^{2+}(aq)$

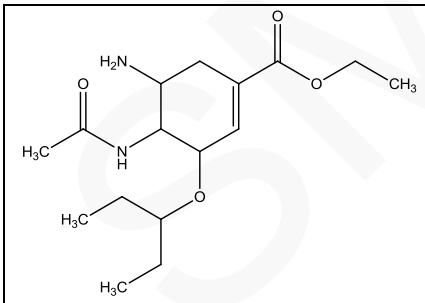
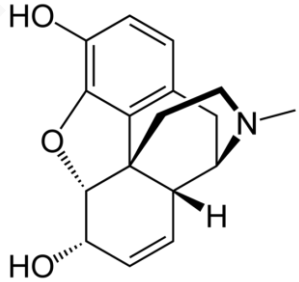
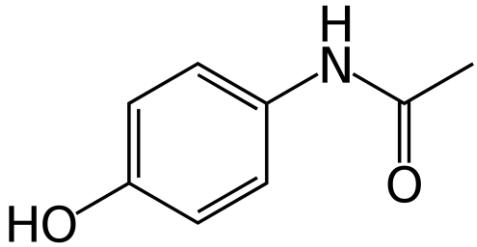
The cell notation is

A. $Ni^{2+}(aq)|Ni(s)||Fe^{3+}(aq)|Fe^{2+}(aq)$
B. $Ni(s)|Ni^{2+}(aq)\ ||Fe^{3+}(aq)|Fe^{2+}(aq)|Pt(s)$
C. $Ni(s)|Ni^{2+}(aq)\ ||Fe^{3+}(aq),Fe^{2+}(aq)|Pt(s)$
D. $Ni(s),Ni^{2+}(aq)\ ||Fe^{3+}(aq),Fe^{2+}(aq)$

21. The oxidation state of oxygen in hydrogen peroxide, H_2O_2 is

A. -2 B. 2- C. 1- D. -1

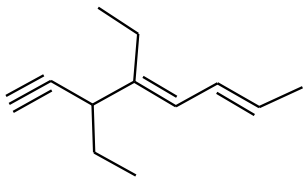
22. Three organic molecules are shown below

		
I	II	III

Which of the following statements is correct?

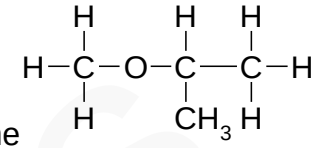
A. All three molecules contain a tertiary carboxamide group
B. Only II contains an amine group
C. I and III contain a carbonyl group
D. I and II contain an ether group

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



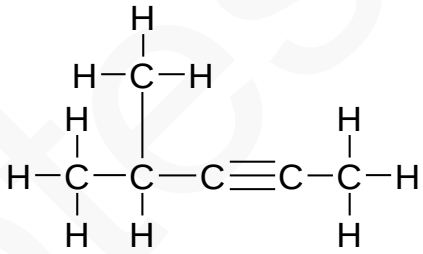
A. $C_{12}H_{18}$ B. $CH_{1.5}$ C. C_6H_{13} D. C_2H_3

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 %