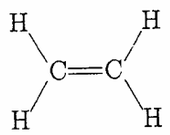
SECTION A: MULTIPLE CHOICE QUESTIONS

Five possible answers **A, B, C, D, E** are given for each of the thirty questions in this section. Choose the one you consider to be correct. Each question in this section is worth one mark, for a total of 30 marks.

ORGANIC

1 Which one of the following compounds can be made by an *addition reaction* of ethene?

A



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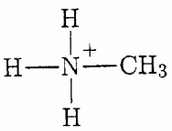

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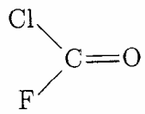

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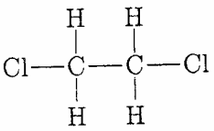
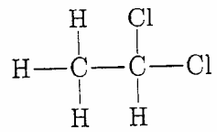


E



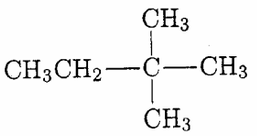
2 A gaseous hydrocarbon reacts slowly with bromine in sunlight to form a mixture of bromoalkanes and hydrogen bromide. Which one of the following formulae correctly represents the hydrocarbon?

A C_2H_4
B C_2H_6
C C_2H_2
D C_3H_6
E C_3H_4

3 The name of the ester obtained by the esterfication of ethanol with butanoic acid is

A ethyl butanoate
B butyl ethanoate
C propyl ethanoate
D butyl propanoate
E ethyl ethanoate

4 The correct systematic name for



is

A 3,3 dimethyl butane
B 2-ethyl-2-methyl propane
C 2,2-dimethyl butane
D 2-methyl pentane
E 4-methyl-1-pentene

5 Which one of the following statements about the homologous series of alcohols is correct?

A The general formula of the alcohols is $C_nH_{2n}OH$
B They all have the functional group $-COOH$
C They are all gases at room temperature and pressure
D Each member of the series is an isomer of the next member in the series
E Each member of the series differs from the next member in the series by CH_2

6 Ethene can be prepared from ethanol by dehydration with sulfuric acid. Which one of the following is likely to be an impurity?

A an alkyne
B an ether
C an aldehyde
D an alkane
E a carboxylic acid

THE MOLE CONCEPT

7 2 moles of silicon tetrachloride, $SiCl_4$ contain

A 4 moles of chlorine atoms
B 8 *molecules* of chlorine atoms
C 1 mole of silicon atoms
D 1 mole of chlorine gas
E 8 moles of chlorine atoms

8 Potassium chlorate decomposes with heat according to the equation,

$2\,KClO_3(s) \longrightarrow 2\,KCl(s) + 3\,O_2(g)$

How many moles of oxygen gas are produced if 1.2×10^{24} molecules of potassium chlorate decompose?

A 1 mol
B 1.5 mol
C 2 mol
D 3 mol
E 4 mol

9 A polymer of empirical formula CH_2 has a molar mass of $28,000\,g\,mol^{-1}$. What is its molecular formula? (RAM C=12, H=1)

A CH_2
B $C_{20}H_{40}$
C $C_{200}H_{400}$
D $C_{2000}H_{4000}$
E not possible to determine from the information given.

10 Which one of the following correctly expresses the number of *molecules* present in $5.6\,dm^3$ of sulphur dioxide gas, SO_2, at S.T.P.? (RAM S=32, O=32)

A 1.5×10^{23}
B 5.6×10^{23}
C 6×10^{23}
D 2.4×10^{24}
E 3.6×10^{24}

11 $30\,cm^3$ of water is added to $50\,cm^3$ of a solution with molarity M at a constant temperature. After dilution the molarity of the solution is

A 3/5 M
B 3/8 M
C 5/8 M
D 8/5 M
E 5/3 M

12 What mass in grams of the first reactant would be required to react completely with 1.0 g of the second reactant in the following chemical equation?

$C_5H_{12} + 8\,O_2 \longrightarrow 5\,CO_2 + 6\,H_2O$

(RAM C=12, H=1, O=16)

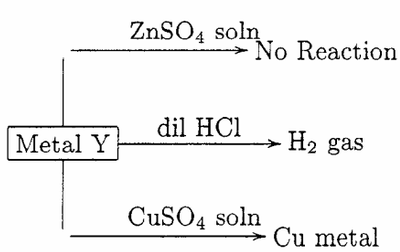
A 0.125 g
B 0.28 g
C 1 g
D 8 g
E 18 g

13 What mass of iron would contain the same number of atoms as 10 g of silicon? (RAM Fe=56, Si=28)

A 2.8 g
B 5.0 g
C 5.6 g
D 10 g
E 20 g

THE REACTIVITY SERIES

14 From the ***Reaction Scheme*** below, what is the most likely identity of Metal Y?



A Pb
B Na
C Zn
D Mg
E Ag

15 Which one of the following metals is least affected chemically when heated in air?

A Na
B Zn
C Ag
D Mg
E Fe

16 Which one of the following compounds does NOT decompose when heated in a bunsen flame?

A silver oxide
B lead(II) carbonate
C calcium oxide
D copper(II) nitrate
E sodium nitrate

17 Which one of the following compounds gives *only oxygen as a gaseous product* on heating?

A lead(II) nitrate
B copper(II) nitrate
C calcium nitrate
D potassium nitrate
E silver nitrate

18 A metal hydroxide decomposes readily on heating to give the metal and water vapour. The metal could be

A sodium
B potassium
C zinc
D copper
E silver

THE PERIOIC TABLE

19 Element W is an alkaline earth metal in period 3. What would the electron configuration of this element be?

A 2,8,1
B 2,8,2
C 2,8,8,2
D 2,8,3
E 2,8,8

20 Which oxide dissolves in water to give a strongly alkaline solution?

A carbon dioxide
B magnesium oxide
C sulphur dioxide
D copper(II) oxide
E sodium oxide

21 An element X in group **I**, forms a compound with an element Y in group **VI**. The most likely formula for this compound is

A XY
B XY_6
C X_2Y
D XY_2
E X_6Y

ELECTROCHEMISTRY

22 A weak electrolyte

A contains no ions
B contains covalent molecules only
C contains mobile electrons
D is totally dissociated
E contains few ions and many molecules

23 In electrolysis the cathode

A is the electrode where oxidation occurs.
B is the electrode where reduction occurs.
C is positive.
D dissolves during the electrolytic process.
E does not conduct electricity.

24 During the electrolysis of copper(II) sulphate solution using carbon electrodes

A the blue colour of the solution becomes paler.
B oxygen is liberated at the anode.
C the solution becomes alkaline.
D copper is deposited at the anode.
E the mass of the anode decreases.

25 Each of the following compounds is electrolysed, first molten, and then as a solution. For which one of the following compounds would the products of electroylsis most likely be the same?

A copper(II) iodide
B magnesium bromide
C potassium iodide
D sodium hydroxide
E sodium chloride

RATE AND EQUILIBRIUM

26 Which one of the following is the best explanation for the effect of an increase in temperature on the rate of a reaction?

A It increases the number of particles with the necessary activation energy.
B It enables the reacting particles to collide at the correct angle.
C It lowers the activation energy for the reaction.
D It enables the activated complex to be more easily converted to the products.
E It prevents product molecules from changing back into reactants.

27 The brown gas prepared by the action of concentrated nitric acid on copper is an equilibrium mixture of dinitrogen tetraoxide (pale yellow) and nitrogen dioxide (dark brown).

$N_2O_4(g) \rightleftharpoons 2\,NO_2(g)\ \Delta H = +ve$

Which one of the following changes to a sample of the gas at equilibrium would result in a *change from yellow to brown*?

A increase in pressure
B increase in temperature
C addition of a catalyst
D removal of dinitrogen tetraoxide by liquefaction
E lowering of the temperature

28 Which is the best explanation of product formation according to *Collision Theory*?

A All the collisions between the molecules result in product formation.
B All the molecules must have both the necessary activation energy and correct orientation for product formation.
C All the molecules must have either the correct orientation or activation energy for product formation.
D All the molecules must be heated for any reaction to occur.
E The reaction must be exothermic for any reaction to occur.

29 Which one of the following is a correct statement concerning the equilibrium state for a reversible reaction?

A the reaction has stopped.
B the rate of the forward reaction is decreasing.
C the rate of the forward and reverse reactions are equal.
D there is always more products than reactants.
E the reactants always have more potential energy than the products.

30 For which of the following systems at equilibrium at constant temperature will decreasing the volume cause no shift?

A $H_2(g) + I_2(g) \rightleftharpoons 2\,HI(g)$
B $2\,NO(g) + O_2(g) \rightleftharpoons 2\,NO_2(g)$
C $2\,NO_2(g) \rightleftharpoons N_2O_4(g)$
D $2\,SO_3(g) \rightleftharpoons 2\,SO_2(g) + O_2(g)$
E $N_2(g) + 3\,H_2(g) \rightleftharpoons 2\,NH_3(g)$

SECTION B: SHORT ANSWER QUESTIONS

Answer ***ALL OF THE FOLLOWING FIVE QUESTIONS*** in the space provided on your question paper. *Each question is worth 12 marks.* Indicate clearly how you arrive at your answers.

1 (a) The hydrocarbon, squalene, which is isolated from shark liver oil, shows that the mole ratio between carbon and hydrogen atoms is

$$\begin{array}{rcl} \text{mol C} & : & \text{mol H} \\ 1 & : & \frac{5}{3} \end{array}$$

i.) Determine the empirical formula of squalene.

.....

ii.) If the molar mass of squalene is $410.7\,\text{g mol}^{-1}$, calculate its molecular formula.

.....

iii.) Write a balanced chemical equation to show the combustion of squalene in a plentiful supply of air.

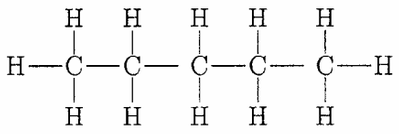
.....

(b) A 0.20 mol sample of pentane burns in excess oxygen gas to produce carbon dioxide and water. The balanced chemical equation for this reaction is,

$$C_5H_{12}(g) + 8\,O_2(g) \longrightarrow 5\,CO_2(g) + 6\,H_2O(l)$$

i.) Calculate the mass of carbon dioxide produced in this reaction.

ii.) The full structural formula for n-pentane is drawn below. Draw *two* other full structural isomers of pentane and give their IUPAC names.



2 (a) How many grams of sodium hydroxide are needed to make up 250 cm^3 of a 2 M solution of NaOH?

How many moles of sodium hydroxide are present in this solution?

.....

(b) What is the molarity of a solution containing 5.8 g of NaCl in 100 cm^3 of solution?

(c) 40 cm^3 of 2 M NaOH reacted with 50 cm^3 of 1 M H_2SO_4.

i.) Write the balanced chemical equation for this reaction including all physical states.

.....

ii.) Write the net ionic equation for this reaction?

.....

iii.) Calculate the number of moles of *each* reagent used at the start of this reaction.

iv.) Which reagent is the limiting reagent?

.....

v.) If 40 cm^3 of water is added to 40 cm^3 of 2 M NaOH, what is the new molarity of the solution?

3 Some manganese(IV) oxide (a catalyst) was added to a solution of hydrogen peroxide in the apparatus shown in Figure 1.

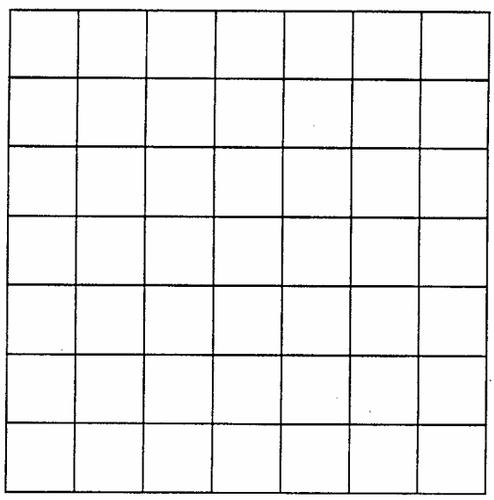
Oxygen gas was liberated in the reaction

$$2\,H_2O_2(aq) \longrightarrow O_2(g) + 2\,H_2O(l)$$

The table shows readings of the volume of oxygen, measured at S.T.P., collected at various times after the start of the reaction.

Volume of oxygen/cm^3	Time/min
37	1
67	2
87	3
107	4
114	5
120	6
120	7
120	8

(a) Plot, on the grid below, a graph of the volume of oxygen in cm^3 against the time in minutes after the start of the experiment. Be sure to label the axis and choose an appropriate scale for your graph.



(b) What is the total number of moles of oxygen formed in this reaction?

.....

(c) Determine the *average rate* of production of oxygen in cm^3s^{-1} during the first and second minutes of this reaction?

.....

(d) On your graph, sketch the curve that you would predict if the reaction were carried out at 30 °C.

4 In each of the situations below, write balanced half reactions to show firstly the process occuring at the anode and secondly the process occurring at the cathode. Indicate states where appropriate.

(a) The electrolysis of molten sodium chloride.

i.) AT ANODE : .....

ii.) AT CATHODE: .....

(b) The electrolysis of dilute aqueous sodium chloride solution.

i.) AT ANODE : .....

ii.) AT CATHODE: .....

(c) The electroylsis of aqueous copper(II) sulphate solution using copper electrodes.

i.) AT ANODE : .....

ii.) AT CATHODE: .....

5 (a) Predict the products of the following reactions and write a balanced equation, including states symbols. in each case. If there is no chemical change, write "no reaction".

i.) $Mg(s) + HCl(aq) \longrightarrow$ .....

ii.) $Cu(s) + HCl(aq) \longrightarrow$ .....

iii.) $Cs(s) + H_2O(l) \longrightarrow$ .....

iv.) $KNO_3(s) + \text{heat} \longrightarrow$ .....

(b) Copper metal reacts with aqueous silver nitrate solution according to the following equation.

$Cu(s) + 2\,AgNO_3(aq) \longrightarrow 2\,Ag(s) + Cu(NO_3)_2(aq)$

i.) Write the net ionic equation for this reaction including states symbols.

.....

ii.) Write the two half-reactions associated with this equation and identify the oxidation and the reduction.

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