H2 CHEMISTRY 9729

Paper 1

Multiple Choice Questions

1	2	3	4	5	6	7	8	9	10
B	A	D	C	A	C	B	A	B	C
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
C	D	D	D	B	A	B	A	D	C
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
B	B	D	D	D	A	A	B	D	C

1 Answer: **B**
At ground state, the electronic configuration of C is $1s^2\ 2s^2\ 2p^2$.

- The occupied orbital of the highest energy is the 2p orbital which is dumb-bell in shape.
- The occupied orbital of the lowest energy is the 1s orbital which is spherical in shape.
- There are 2 electrons in the p orbitals and 4 electrons in the s orbitals (1s and 2s).
- The electrons are present in 3 different energy levels.

2 Answer: **A**
The angle of deflection is proportional to charge/mass of the particle.

The angle of deflection of X^+ is smaller than that of P^+. Since both particles have the same charge, X^+ must have a larger mass than P^+.

3 Answer: **D**
C_2H_4: trigonal planar, 120°
HCHO: trigonal planar, 120°
NH_4^+: tetrahedral, 109.5°
NH_3: trigonal pyramidal, 107°

4 Answer: **C**
C_2H_2: 5 σ bonds
C_2H_5OH: 8 σ bonds
CH_3CHO: 6 σ bonds
CH_3CO_2H: 7 σ bonds

5 Answer: **A**
Since the flasks are identical, the volumes of the 3 gases are the same. The masses of the 3 gases are also the same.

$pV = nRT$ and $n = m/M_r$
$pV = (m/Mr)RT$
Since V, m and R are constant,
$M_r \propto T/P$
$M_r(X) = k(t/p)$; $M_r(Y) = 0.5k(t/p)$; $M_r(Z) = 2k(t/p)$

6 Answer: **C**
Amount of CO_2 at r.t.p. = 500 ÷ 24000
= 0.020833 mol
In 1 molecule of CO_2, there are 3 atoms.
Amount of atoms = 3×0.020833
= 0.0625 mol
Number of atoms = $0.0625 \times 6.02 \times 10^{23}$
= 3.76×10^{22}

7 Answer: **B**

$$H_2S(g) + \tfrac{1}{2}O_2(g) \rightarrow S(s) + H_2O(g)$$

$\Delta H = \Sigma[\Delta H_f(\text{products})] - \Sigma[\Delta H_f(\text{reactants})]$
$\Delta H = [0 + (-243.0)] - [(-20.5) + 0]$
$= -222.5\ \text{kJ mol}^{-1}$

8 Answer: **A**
$\Delta G^\ominus = \Delta H^\ominus - T\Delta S^\ominus$
$= (+61) - 298\ (-30\times10^{-3})$
$= +69.9\ \text{kJ mol}^{-1}$

- $\Delta G^\ominus$ is positive.
- A positive $\Delta G^\ominus$ indicates that dissolution is not spontaneous, hence silver chromate is almost insoluble in water.
- Since ΔS is negative, at a higher temperature, ΔG tends towards a more positive value. Dissolution becomes less spontaneous at higher temperature.

9 Answer: **B**

- At low [substrate], the graph shows a straight line (similar to y = mx graph) shows that the rate is directly proportional to [substrate]. Hence the order of reaction is first order with respect to [substrate].
- At high [substrate], the graph shows a horizontal line (similar to y = k graph) shows that the rate is independent of [substrate]. Hence the order of reaction is zero with respect to [substrate].
- The enzyme-substrate is an intermediate of the reaction and hence should not appear in the rate equation since rate equation is expressed in terms of the concentrations of the reactants.

10 Answer: **C**

$4X \rightarrow 2X \rightarrow X \rightarrow 0.5X$

3 half-lives = 3 × 5 min = 15 mins

$Y \rightarrow 0.5Y$

1 half-life = 15 mins

11 Answer: **C**

- When the pressure is increased, the position of the equilibrium shifts to the side with fewer number of moles of gaseous molecules to decrease the additional pressure. Hence the equilibrium shifts to the right and the colour becomes lighter.
- When the temperature is increased, the position of the equilibrium will shift towards the endothermic reaction to absorb the additional heat. Hence the equilibrium shifts to the left and the colour becomes darker.

12 Answer: **D**

There is no sharp increase in the pH of a weak acid – weak base titration. Hence there is no suitable indicator for such a titration.

13 Answer: **D**

A mixture of benzoic acid and sodium benzoate forms an acidic buffer solution.

$$pH = pK_a + \log \frac{[salt]}{[acid]}$$

$$= -\log(6 \times 10^{-5}) + \log (0.1/0.01) = 5.22$$

14 Answer: **D**

For precipitation to occur, ionic product = K_{sp}

$PbX_2(s) \rightleftharpoons Pb^{2+}(aq) + 2X^-(aq)$

- $PbBr_2$
  $[Pb^{2+}][1 \times 10^{-3}]^2 = 4.0 \times 10^{-5}$
  $[Pb^{2+}] = 40.0$ mol dm^{-3}
- PbF_2
  $[Pb^{2+}][1 \times 10^{-3}]^2 = 2.7 \times 10^{-8}$
  $[Pb^{2+}] = 0.027$ mol dm^{-3}
- PbI_2
  $[Pb^{2+}][1 \times 10^{-3}]^2 = 7.1 \times 10^{-9}$
  $[Pb^{2+}] = 0.00710$ mol dm^{-3}

$PbSO_4(s) \rightleftharpoons Pb^{2+}(aq) + SO_4^{2-}(aq)$

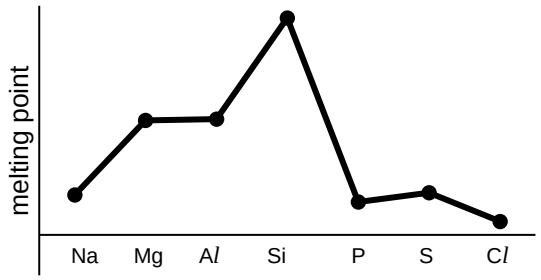
- $PbSO_4$
  $[Pb^{2+}][1 \times 10^{-3}] = 1.6 \times 10^{-8}$
  $[Pb^{2+}] = 0.000016$ mol dm^{-3}

$PbSO_4$ requires the lowest concentration of $Pb^{2+}(aq)$ to be precipitated. Hence, $PbSO_4$ will be the one that precipitate out first.

15 Answer: **B**

Going across period 3,

- Na, Mg and A*l* are metals, Si is metalloid, P_4, S_8 and Cl_2 are non-metals.
- The maximum oxidation states exhibited in the compounds of the elements corresponds to their group number increasing for +1 in Na to +7 in chlorine.
- The melting points of the elements does not decreases consistently across the period.



16 Answer: **A**

Rn (Group 18 of Period 6), Fr (Group 1 of Period 7), Ra (Group 2 of Period 7)

The shielding effect in Rn is the lowest since it has fewer inner shell electrons than Fr and Ra. Hence it will require the most amount of energy to remove the valence electron.

Both Fr and Ra belongs to the same period. The nuclear charge of Fr is lower than that of Ra and they both have approximately the same shielding effect. Hence the effective nuclear charge of Fr is lower than Ra and requires a lower amount of energy to remove the valence electron.

17 Answer: **B**

CCl_4 does not dissolve in water because is non-polar and cannot form hydrogen bonds with water molecule.

It also does not react with water because the C atom does not have any energetically accessible d-orbitals.

18 Answer: **A**

Going down Group 17,

(A) the strength of the instantaneous dipole – induced dipole increases as the electron cloud size gets bigger, hence boiling increases;

(B) the bond length increases as the size of the p-orbitals overlapping increases and thus the effectiveness of the orbital overlapping decreases.

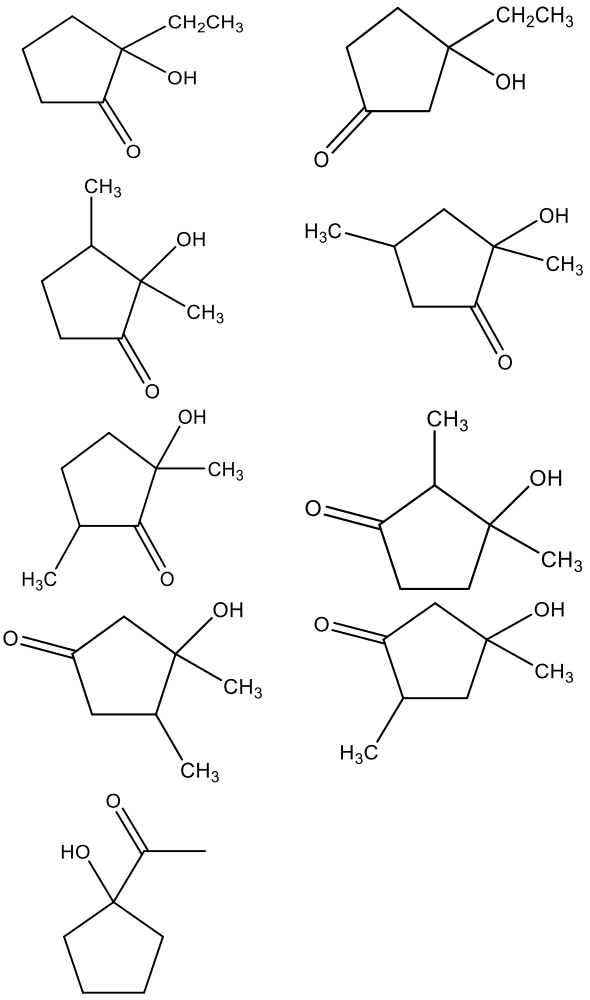
(C) the electronegativity decreases;

(D) the ionic radius increases as the increase in the number of inner electron shell and thus shielding effect outweighs the increase in the nuclear charge;

19 Answer: **D**

- a five-membered ring is a cyclopentane;
- a ketone has 2 R groups bonded to the C=O;
- a tertiary alcohol has 3 R groups bonded to the carbon with the –OH group.

In this case, the type of constitutional isomerism involved in positional and chain isomerism.



20 Answer: **C**

Amount of C = 0.66 ÷ 44.0 = 0.0150 mol

Amount of H = 2 × (0.36 ÷ 18.0) = 0.0400 mol

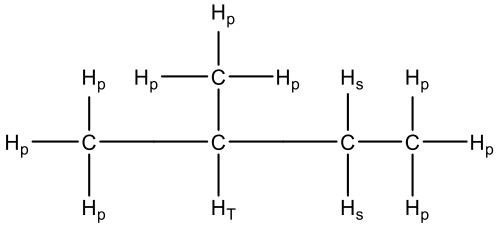
Mole ratio of C : H = 0.0150 : 0.0400 = 3 : 8

Empirical formula of Y is C_3H_8

21 Answer: **B**

Alkanes are unreactive as the C-H bonds are not polar and hence they will not be attacked by electrophiles and nucleophiles.

22 Answer: **B**



type of H atom	number of atoms	expected ratio
primary, H_P	9	$9 \times 1 = 9$
secondary, H_S	2	$2 \times 4 = 8$
tertiary, H_T	1	$1 \times 6 = 6$

23 Answer: **D**

(A) is incorrect as pentaerythritol only reacts with HBr(g) or conc. HBr.

(B) is incorrect as both the empirical and molecular formulae is $C_5H_{12}O_4$.

(C) is incorrect as the central C atom, which is the adjacent C atoms to all the C with –OH group does not contain any H for elimination to occur.

(D) is correct. Since 1 mole of –OH reacts with sodium to form 0.5 mole of hydrogen gas, the presence of 4 –OH groups in pentaerythritol will produce 2 moles of hydrogen gas.

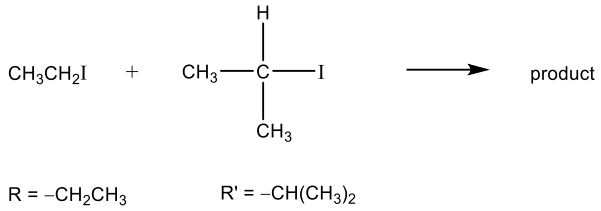
24 Answer: **D**

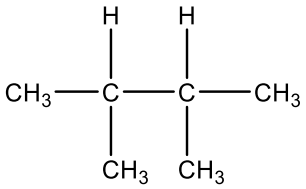
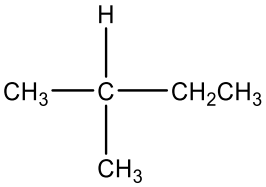
1 $CH_3)_2C{=}CHCH_2CH_2CH{=}CH_2$ will oxidise to form $(CH_3)_2C{=}O$ and $HO_2CCH_2CH_2CO_2H$ and CO_2

2 $CH_3(CH_2)_4CH{=}CHCH_2OH$ will oxidise to form $CH_3(CH_2)_4CO_2H$ and $(CO_2H)_2$. $(CO_2H)_2$ will further oxidise to form CO_2 and H_2O so it forms only one organic compound in the end.

3 $CH_3(CH_2)_2CH{=}CH(CH_2)_2CH_3$ will oxidise to form 2 moles of $CH_3(CH_2)_2CO_2H$

25 Answer: **D**



(A)	 R'–R'
(B)	 R'–R
(C)	CH_3CH_2–CH_2CH_3 R–R
(D)	$CH_3CH_2CH_2CH_2CH_2CH_3$ will not be formed

26 Answer: **A**

(A) The alcohol is involved in the formation of the intermediate species in step 1.

(B) Only step 2 involves the formation of a 5-coordinated transition state via S_N2.

(C) PBr_3 will react with water to form H_3PO_3 and HBr.

(D) The oxygen atom in the alcohol donates a lone pair of electrons to the electron deficient phosphorous atom in PBr_3 to form a dative covalent bond,

27 Answer: **A**

When 1-bromo-2-methylcyclopentane is reacted with aqueous sodium hydroxide, the main reaction that is occurring is nucleophilic reaction. However, elimination reaction also occurs but to a smaller extent.

Option B and C will not be form as carbon with the methyl group is not electron deficient and hence will not attract nucleophiles. Option D will not form with similar reasoning for carbon3.

28 Answer: **B**

val-ser
ser-glu
glu-lys-glu
lys-glu-phe
phe-cys

val-ser-glu-lys-glu-phe-cys

29 Answer: **D**

- $E^{\ominus}(Z^{2+}/Z) = -0.3$ V, $E^{\ominus}(Y^{+}/Y) = -0.9$ V
  Since $E^{\ominus}(Y^{+}/Y)$ is more negative, Y will be oxidised and Z^{2+} will be reduced.
  Incorrect.
- $E^{\ominus}(W^{+}/W) = +1.8$ V (reduction)
  $E^{\ominus}(X^{2+}/X) = +0.3$ V (oxidation)
  $E^{\ominus}_{cell} = +1.8 - (+0.3) = +1.5$V
- The strongest oxidising agent will be the one that is most easily reduced. Since the standard electrode potential of W^{+} is the most positive, it will be the strongest oxidising agent.

30 Answer: **C**

$Mg^{2+} + 2e^{-} \rightarrow Mg$

Amount of Mg = 4.8 ÷ 24.3
= 0.19753 mol
Amount of electron = 0.19753 × 2
= 0.39506 mol

$Cr^{3+} + 3\ e^{-} \rightarrow Cr$
Amount of Cr = 0.39506 ÷ 3
= 0.13168 mol
Mass of Cr = 0.13168 × 52.0
= 6.84 g

~CHEM-IS-TRY~