Solution to MCQ

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

1	0.005mg = $\frac{0.005}{1000}$g No. of moles = $\frac{0.005}{1000} \times \frac{1}{27}$ No of molecules = $\frac{0.005}{1000} \times \frac{1}{27} \times 6 \times 10^{-23}$
	C

2	Compound E: Biggest jump in IE from 3rd to 4th IE => Group III Compound G: Biggest jump in IE from 6th to 7th IE => Group VI
	B

3	The greater the no of protons, the higher the nuclear charge, the greater the nuclear attraction for the same no. of valence electrons, thus the smaller the size. Ca^{2+} has the largest proton number, followed by S^{2-} and P^{3-}
	A

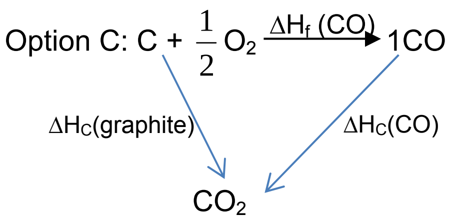
4	Al: [Ne] $3s^2 3p^1$	No. of unpaired valence eln=1
	Ti^{3+}:[Ar]$3d^1$	No. of unpaired valence eln=1
	Zn^{2+}: [Ar]$3d^{10}$	No. of unpaired valence eln=0
	Cr^{3+}: [Ar]$3d^3$	No. of unpaired valence eln=3
	D	

5	3 lone pair on each Chlorine (2 × 3) 2 lone pair on each oxygen (2 × 2) 1 lone pair on each nitrogen (1× 1) Total: 6+4+1=11
	C

6	A: False (negligible electronegativity difference between C and H) B: False (C_2H_4: Trigonal planar; C_2H_2: Linear) C: True (C_2H_4 has 5 sigma and 1 pi bond, C_2H_2 has 3 sigma and 2 pi bond.) D: False (C_2H_4: 120º bond angle; C_2H_2: 180º)
	C

7	For a compound to exhibit greatest covalent character, the cation must have the highest charge/size ratio. Francium has the highest charge and the smallest size among the 4 elements
	D

8	A: Enthalpy change of hydration => exothermic B: Enthalpy change of atomization => endothermic C: Lattice energy => exothermic D: Enthalpy change of neutralization => exothermic
	B

9	ΔH_f (CO): C + $\frac{1}{2}O_2 \rightarrow$ 1CO  ΔH_f (CO)= ΔH_C(graphite) – ΔH_C(CO)
	C

10	Amount of Fe^{2+}: $\frac{40}{1000} \times 0.15 = 0.006$ mol $Fe^{2+} \longrightarrow Fe^{3+} + e$ Amount of eln transfer: 0.006mol Amount of YO_4^{2-} = $\frac{10}{1000} \times 0.30 = 0.003$ Amount of eln: amount of YO_4^{2-} = 2:1 Final oxidation state of Y = +6−2 = +4
	C

11	Concepts: Le Chatelier's Principle A: Adding NaCl to bleach cause an increase in [Cl^-], therefore, based on LCP, equilibrium shift LHS to partially offset increase in [Cl^-], increased in liberation of Cl_2 gas.
	A

12	pH =2 => [H^+]=10^{-2} mol dm^{-3} pH =4 => [H^+]=10^{-4} mol dm^{-3} Mixing equal volume of both solution, concentration of H+ in both solution drop by 2 times.

	$[H^+]_{total}$ = ½ (10^{-2}) + ½ (10^{-4}) = 0.00505 pH = −log $[H^+]$ = 2.3
	B

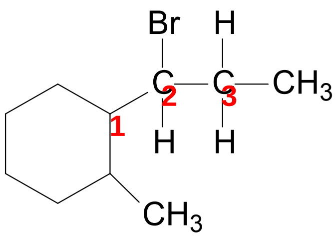
13	False statement: It always has a lower pH than a weak acid. A very concentrated solution of weak acid can have a lower pH than a very diluted solution of a strong acid since pH is negative logarithm of $[H^+]$.
	A

14	The rate of reaction is first order with respect to hydrogen and second order with respect to nitrogen monoxide. 0.100 mol dm^{-3} of H_2 and 5.00 mol dm^{-3} of NO were put into a sealed flask of fixed volume. It was found that there was 0.0250 mol dm^{-3} of H_2 left 40 minutes later Since NO is present in huge excess, and only $\frac{0.025}{0.100} = \frac{1}{4}$ is left after 40minutes, Half-life of the reaction is 20minutes.
	B

15	When catalyst is added, the Boltzmann graph does not shift but the activation energy is lowered.
	B

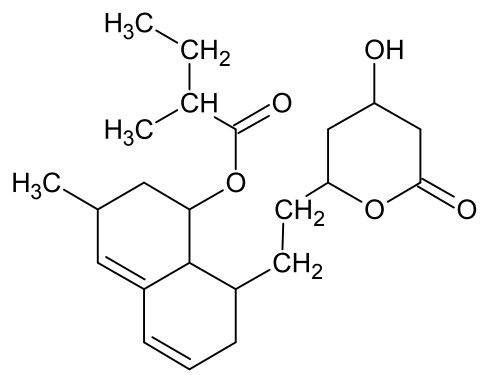
16	Burn to produce an orange flame => sodium Oxide is alkaline since it gives a blue colour with universal indicator => only possibility is sodium or magnesium.
	A

17	A: False (CCl_4 is a simple covalent molecule) B: True ($SiCl_4$ Or PCl_3 or PCl_5 hydrolyse due to presence of empty d-orbitals that can accept lone pair from water) C: False (hydrolysis and dissolution is two different concepts) D: False (charge/size considered only for Na^+, Mg^{2+} and Al^{3+} in discussing hydrolysis)
	B

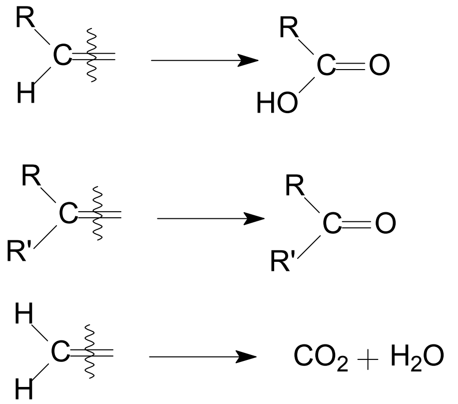
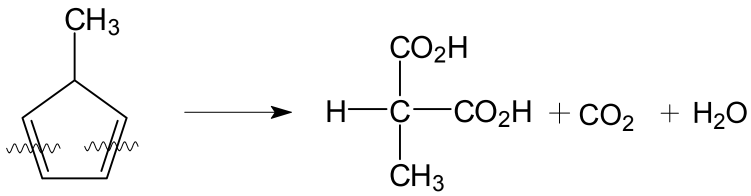
18	 undergo elimination with hot ethanolic NaOH. HX can be eliminated so long there is a hydrogen on an adjacent carbon to X. Br on carbon 2 can be eliminated with H on carbon 1 to give a pair of geometric isomers.

	Br on carbon 2 can be eliminated with H on carbon 3 to give a pair of geometric isomers Total: 4 geometric isomers
	C

19	A: Hexane and benzene: Both will not react with Br_2 in CCl_4 in the dark; thus same observation. B: Hexane and hexene: Hexene decolourise Br_2 in CCl_4; hexane does not decolourise Br_2 in CCl_4 C:Hexene and benzene: Hexene decolourise Br_2 in CCl_4; benzene does not decolourise Br_2 in CCl_4 D:Hexene and methylbenzene: Hexene decolourise Br_2 in CCl_4; methylbenzene does not decolourise Br_2 in CCl_4
	A

20	 A: True; only carboxylic acid or alcohol reacts with PCl_5 ; there is only 1 alcohol present in lovastatin. B: The two C=C double bond will react with bromine dissolved in CCl_4 . C: The two ester bond will undergo hydrolyse with hot aqueous sodium hydroxide. D: No carbonyl compound in lovastatin, thus no reaction with 2,4 DNPH.
	D

21	C_6H_8 undergo refluxing with acidified potassium manganate (VII) => C=C undergo vigorous oxidation. Recall product of vigorous oxidation:

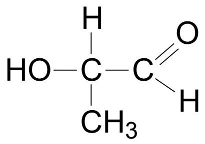
	 Option C:  Remarks: $(COOH)_2$ oxidise to CO_2 and H_2O.
	C

22	**V** must be a carboxylic acid; since it reacts with alcohol to give an ester => **U** must be a primary alcohol (recall secondary alcohol oxidise to give a ketone) **W** is an ester which is formed from a 6-carbon long carboxylic acid and ethanol.
	D

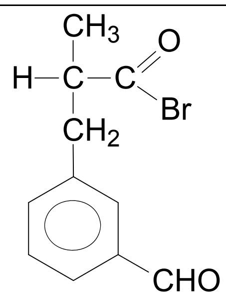
23	CH_2=$CHCH_2CN$ contains 3 pi bond. So the C=C require 1 mol of H_2 and the CN require 2 mol of H_2 => total require 3 mol of H_2. 3 x 22.4 = 67.2 dm^3
	D

24	$(CH_3)_2CHCH_2COCH_3$ MIBK A: Does not react with Fehling solution since it does not contain any aliphatic aldehyde. B: Ketone does not undergo further oxidation C:contains the structural feature CH3=CO that allows it to undergo positive triiodomethane test. D: Ketone does not undergo condensation reaction with carboxylic acid.
	C

25



R



S

Na: can react with OH on R, does not react with S.
$KmnO_4$: Both undergo oxidation, but S undergo side chain oxidation to give effervescence of CO_2.
Alkaline Cu(II) tartate: can react with aliphatic aldehyde on R, not with aromatic aldehyde on S.
Silver diammine: Both contains aldehyde that will undergo reaction with silver diammine to give silver mirror.

D

26

28g of N_2 = 28/28= 1 mol of N_2 molecule.

Option 1: T: 8/32= 0.25 mol of O_2 molecule=> 0.5 mol of O atom.

Option 2: 10/20 = 0.5 mol of Ne atom. 1 mol of N_2 molecule contains 2 mol of N atoms, so it is 4 times that of Ne atom. False.

Option 3: 12/12= 1 mol of C atom. 2 mol of N atoms is more than 1 mol of C atom. False

D

27

Which bond is present in $H\underset{1}{C}\equiv \underset{2}{C}\underset{3}{C}H_2\underset{4}{C}H=\underset{5}{C}H_2$?

C1: 2 eln domain = sp
C2: 2 eln domain = sp
C3: 4 eln domain = sp^3
C4: 3 eln domain = sp^2
C5: 3 eln domain = sp^2

1: a σ bond formed by sp^2–sp^2 overlap (between C4 and C5)
2: a σ bond formed by sp–sp^3 overlap (between C2 and C3)
3: a π bond formed by sp–sp overlap (π bond is formed from p orbital overlap)

B

28	The position of equilibrium lies to the right in each of these reactions. **Reaction 1**: $N_2H_4 + HBr \rightleftharpoons N_2H_5^+ + Br^-$ **Reaction 2**: $N_2H_5^+ + NH_3 \rightleftharpoons NH_4^+ + N_2H_4$ Based on this information, which of the following statements are **correct**? 1: Br^- is the conjugate base of HBr. (T: differ by a H+) 2: $N_2H_5^+$ is the acid in reaction 2. (T: it donates a proton to form N_2H_4) 3: The order of acid strength is HBr > $N_2H_5^+$ > NH_4^+. (T: HBr is the acid when it reacts with N_2H_4 while N_2H_5 is the conjugate acid of N_2H_4, so HBr is strong acid than $N_2H_5^+$) $N_2H_5^+$ is the acid when it reacts with NH_3, while NH_4^+ is the conjugate acid of NH_3, so $N_2H_5^+$ is a stronger acid than NH_4^+)
	A

29	1: T (Butanal and butanone are both carbonyl compound, so both reacts with 2,4 DNPH) 2: T ($CH_3CH_2CH_2CHO$ and $CH_3COCH_2CH_3$ both have molecular formula C_4H_8O) 3: F (Butanal can undergo oxidation but butanone cannot undergo oxidation.)
	B

30

	Products from T	**Products from V**
1	$HOCH_2CH_2CH_2OH$ (substitution of X)	$HOCH_2CH_2CH_2OH$ (reduction of carboxylic acid and aldehyde)
2	$C_6H_5CH(OH)CH_3$ (substitution of X)	$C_6H_5CH(OH)CH_3$ (reduction of ketone)
3	$CH_3CH_2CH_2OH$ (substitution of X)	$(CH_3)_2CHOH$ (reduction of ketone)

B