2017 H2 Chemistry Promo Exam Paper 2 Answers

Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	C	2	C	3	D	4	D
5	B	6	A	7	D	8	B
9	A	10	B	11	A	12	B
13	A	14	A	15	D	16	B
17	A	18	D	19	D	20	C
21	B	22	C	23	A	24	D
25	A						

C

The molar mass of CaO = 40.1 + 16.0 = 56.1 g mol^{-1}
Amount of CaO = 14.0 ÷ 56.1 = 0.2496 mol = Amount of Ca
Mass of Ca in 14.0 g of CaO = 0.2496 × 40.1 = 10.0 g
Percentage by mass of calcium in the bone
= (10÷50) × 100% = 20.0%

C

Amount of MnO_4^- used = $\frac{60}{1000} \times 0.10 = 6 \times 10^{-3}$ mol
Let the initial oxidation state (O.S.) of Y be w.

Amt of electrons released during [O] = Amt of electrons gained during [R]
⇒ Amt of Y × Change in O.S. of Y
= Amt of MnO_4^- × Change in O.S. of Mn
⇒ $2 \times 0.0050 \times (6 - w) = 6 \times 10^{-3} \times (7 - 2)$
⇒ w = 3

Hence, to calculate the value of x in Y_2O_x:
$2(3) + x(-2) = 0$
$\Rightarrow x = 3$

3 D

$C_6H_y(g) + (6+\frac{y}{4})\,O_2(g) \rightarrow 6CO_2(g) + \frac{y}{2}\,H_2O(g)$
Initial total volume of $C_6H_y + O_2$ = 1050 cm^3
Final total volume of $CO_2 + H_2O$ = 1300
Initial total volume : Final total volume = $(1 + 6+\frac{y}{4}) : (6 + \frac{y}{2})$
= 1050 : 1300

$\Rightarrow (7 + \frac{y}{4}) : (6 + \frac{y}{2}) = 21 : 26$
$\Rightarrow (28 + y) : (24 + 2y) = 84 : 104$
$\Rightarrow y = 14$

4 D

Option A is incorrect because:
The electronic configuration of Ni atom is $1s^2 2s^2 2p^6 3s^2 3p^6 3d^8 4s^2$, thus, Ni^{2+} should be $1s^2 2s^2 2p^6 3s^2 3p^6 3d^8$.

Option B is incorrect because isotopes of the same element have same number of protons (known as atomic number). The nucleus is still intact during the removal of electrons (ionization).

Option C is incorrect as $^{60}Ni^{2+}$ is heavier than $^{58}Ni^{2+}$, since both ions have the same charge, $^{58}Ni^{2+}$ will deflect more than $^{60}Ni^{2+}$ (angle of deflection $\alpha \frac{\text{charge}}{\text{mass}}$).

Option D is correct because isotopes have different number of neutrons but same number of protons. Since both $^{58}Ni^{2+}$ and $^{60}Ni^{2+}$ have the same charge, they must have the same number of electrons.

5 B

If Y contains $(n-1)$ protons as X, this would mean that Y originally (before forming the cation) will have one electron less than X. In addition, Y has the same number of electrons as X, implies that Y has a charge of +1. Hence, option B is the answer.

6 A

The melting point of an ionic compound is proportional to the strength of the ionic bond. The strength of the ionic bond is directly proportional to $\frac{q_+ \times q_-}{r_+ + r_-}$.
Based on the above formula, straight away we can eliminate options B and D as the anions in these two options have greater charge.
Option A is the correct answer because the cation is bigger in size due to the longer alkyl chains.

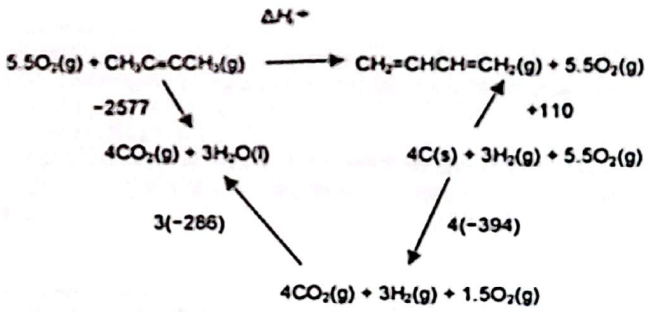
7 D

Option	Molecule	No. of lone pair	No. of bond pair	Bond angle
A	OF_2	2	2	105°
B	BF_3	0	3	120°
C	CO_2	0	2	180°
D	NO_2	1	2	134°

The lone pair in NO_2 has only one electron. Hence, there weaker repulsion than an electron pair (two electrons), leading to a bond angle between 120° and 180°

8 B

Construct the energy cycle:



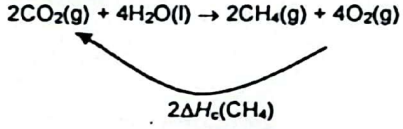
By Hess' Law,

$\Delta H_r^\ominus = -2577 - (3 \times -286) - (4 \times -394) + 110 = -33$ kJ mol^{-1}

9 A

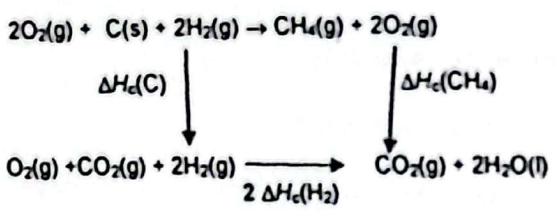
Given $C(s) + O_2(g) \rightarrow CO_2(g)$ {enthalpy change of combustion of carbon, $\Delta H_c(C)$ }
$H_2(g) + 1/2O_2(g) \rightarrow H_2O(l)$ {enthalpy change of combustion of hydrogen, $\Delta H_c(H_2)$ OR enthalpy change of formation of $H_2O(l)$, $\Delta H_f(H_2O(l))$ }
$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$ {enthalpy change of combustion of methane, $\Delta H_c(CH_4)$ }

Option 1: Correct



Therefore, enthalpy change for forward reaction = $-2\Delta H_c(CH_4)$
Option 2: Correct. The enthalpy change of formation of water is equationally same as the enthalpy change of combustion of hydrogen.

Option 3: Correct.



10 B

$\Delta S < 0$ because the number of gas particles decreased from left to right. Hence, the level of disorderliness decreases as gas particles are more disordered. So, with this we can eliminate options C and D.

Now, if the reaction is thermodynamically feasible at low temperature, this would mean that $\Delta G = \Delta H - T\Delta S < 0$ at low temperature. But since $\Delta S < 0$, $-T\Delta S > 0$. Thus, $\Delta H < 0$ in order for $\Delta G < 0$. Hence, answer is option B.

11 A

$PV = nRT$

$= \frac{m}{M} RT$ where M is the molar mass

$P = \frac{\rho RT}{M}$ where density $\rho = m/V$

Since P and T are constant, $\rho \alpha M$

Since the density of the gaseous mixture is greater than that of pure Ar, the other gas in the mixture must have a molar mass that is greater than that of Ar (M_{Ar} = 39.9 g mol^{-1}). Only CO_2 has a molar mass that is greater than that of Ar (M_{CO2} = 44.0 g mol^{-1}). M_{F2} = 38.0 g mol^{-1} , M_{Ne} = 20.2 g mol^{-1} and M_{O2} = 32.0 g mol^{-1}

12 B

Option 1: Correct

By Le Chatelier's Principle, an increase in temperature favours the endothermic reaction by absorbing the excess heat to lower the temperature. Since there is an increase in the amount of U, the formation of U must be an endothermic process. Since U is a reactant, the forward reaction must be exothermic.

Option 2: Correct

By Le Chatelier's Principle, an increase in pressure favours the reaction that forms less moles of gaseous particles to lower the pressure. Since there is an increase in the amount of U, the formation of U must be associated with a reduction in the number of moles of gaseous particles e.g. $U(g) \rightleftharpoons V(g) + W(g)$.

Option 3: Incorrect

K_p is only affected by temperature.

13 A

Let benzoic acid be HX.

$HX \rightleftharpoons H^+ + X^-$

$6 \times 10^{-5} = \frac{[H^+]^2}{0.100}$

$[H^+] = 2.45 \times 10^{-3}$ mol dm^{-3}

$pH = -\lg(2.45 \times 10^{-3})$

$= 2.61$

14 A

Option A: Incorrect

When a small amount of acid is added into the buffer solutions, the pH of the solution will decrease slightly.

Option B: Correct

As the ratio of [salt] [acid] (or [salt] [base]) is constant upon the addition of water, the pH of the buffer solution is constant.

Option C: Correct

An acidic buffer can be prepared by mixing a weak acid and its salt.

Option D: Correct

Blood pH can be maintained by the following buffer: H_2CO_3 / HCO_3^-

When a small amount of base is added,

$H_2CO_3 + OH^- \rightarrow HCO_3^- + H_2O$

When a small amount of acid is added,

$HCO_3^- + H^+ \rightarrow H_2CO_3$

15 D

This is a neutralisation reaction between a weak acid and a weak base. There is no sharp change in pH near the end point. Thus there is no satisfactory indicator.

16 B

Option A: Incorrect

With a larger total volume due to the addition of water, the maximum amount of the solute, $Ca(CH_3CO_2)_2$ that can be dissolved increases proportionately. Hence the solubility of $Ca(CH_3CO_2)_2$ remains constant.

Option B: Correct

Dil. HNO_3 supplies H^+ ions which react with $CH_3CO_2^-$ ions as shown below.

$CH_3CO_2^-(aq) + H^+(aq) \rightleftharpoons CH_3CO_2H(aq)$ – (1)

This results in a decrease in $[CH_3CO_2^-]$ and by Le Chatelier's Principle, the position of equilibrium in (2) will shift to the right, increasing the solubility of $Ca(CH_3CO_2)_2$.

$Ca(CH_3CO_2)_2(s) \rightleftharpoons Ca^{2+}(aq) + CH_3CO_2^-(aq)$ – (2)

Option C: Incorrect

Addition of CH_3CO_2Na results in an increase in the concentration of the common ion, $CH_3CO_2^-$. By Le Chatelier's Principle, the position of equilibrium in (2) will shift to the left, decreasing the solubility of $Ca(CH_3CO_2)_2$.

Option D: Incorrect

Addition of $CaCl_2$ results in an increase in the concentration of the common ion, Ca^{2+}. By Le Chatelier's Principle, the position of equilibrium in (2) will shift to the left, decreasing the solubility of $Ca(CH_3CO_2)_2$.

17 A

Let solubility of salt be y mol dm^{-3}.

For AgBr, $y^2 = 5 \times 10^{-13} \Rightarrow y = 7.07 \times 10^{-7}$

(between 10^{-7} and 10^{-6})

$[Ag^+]$ in a saturated solution of AgBr=7.07×10^{-7} mol dm^{-3}

For AgCl, $y^2 = 2 \times 10^{-10} \Rightarrow y = 1.41 \times 10^{-5}$

$[Ag^+]$ in a saturated solution of AgCl=1.41×10^{-5}mol dm^{-3}

For $AgIO_3$, $y^2 = 2 \times 10^{-8} \Rightarrow y = 1.41 \times 10^{-4}$

$[Ag^+]$ in a saturated solution of $AgIO_3$

$=1.41 \times 10^{-4}$moldm^{-3}

For Ag_2CO_3, $4y^3 = 5 \times 10^{-12} \Rightarrow y = 1.08 \times 10^{-4}$

$[Ag^+]$ in a saturated solution of $Ag_2CO_3 = 2 \times 1.08 \times 10^{-4}$

$= 2.15 \times 10^{-4}$ mol dm^{-3}

18 D

Mechanism is a nucleophilic substitution in which CH_3O^-, a nucleophile (electron–pair donor with lone pair on O) reacts with the halogenoalkane and substitutes for the Br atom.

19 D

Option A: Incorrect

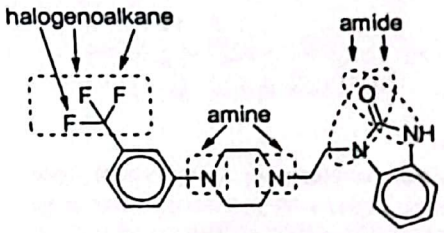
To be chiral, the carbon atom must be bonded to 4 different groups. There are no chiral carbon centres in Flibanserin.

Option B: Incorrect

To be a planar molecule, all the atoms must be on the same plane. However, in flibanserin, there are some atoms that are not on the same plane, e.g. F in $-CF_3$ and H in $-CH_2$ groups where the shape with respect to the C atom is tetrahedral.

Option C: Incorrect

Flibanserin does not have a carbonyl functional group.



Flibanserin

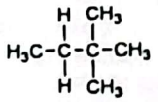
Option D: Correct.

There are two benzene rings, thus it has 6 sp^2 carbon each.

The carbon atom at C=O is also a sp^2 hybridised.

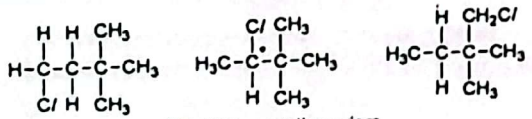
Hence, there are 13 sp^2 carbon atoms in total.

20 C

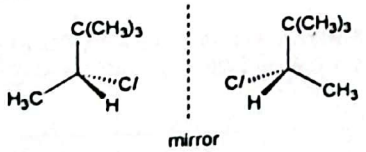


2,2-dimethylbutane

3 structural isomers of mono-substituted product:



*Exhibits enantiomerism to give 2 stereoisomers



mirror

Total number of mono-substituted product (including stereoisomers) = 4

21 B

From the data booklet,

BE (C – H) = 410 kJ mol^{-1}

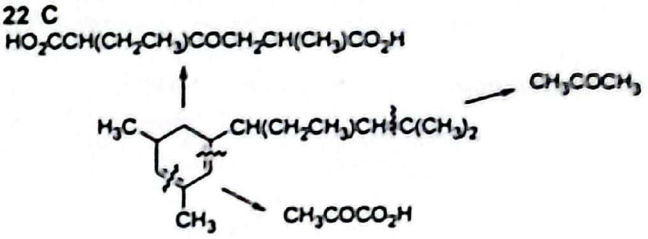
BE (Cl – Cl) = 244 kJ mol^{-1}

BE (H – Br) = 366 kJ mol^{-1}

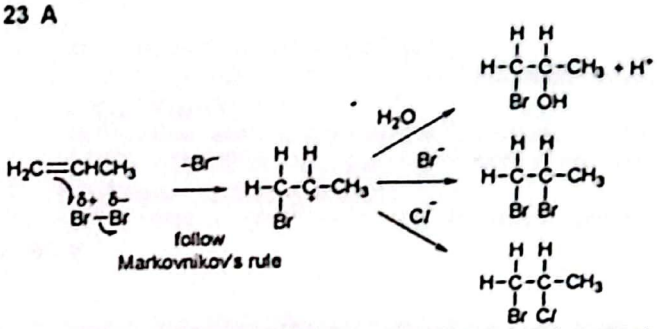
BE (H – H) = 436 kJ mol^{-1}

The weakest bond as indicated by the smallest bond energy will be the easiest bond to break in the initiating step of a free radical process.

22 C



23 A



Option B and D: Both chloride ion and water molecule cannot be the electrophile as both are electron–rich.

Option C: Free radical substitution cannot take place in the dark with bromine.

24 D

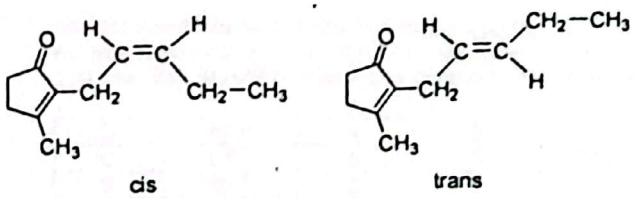
1 Correct. Electrophilic addition of alkenes gives the intended product with a good yield, as there is no other side product.

2 Incorrect. No such reaction.

3 Incorrect. This reaction is a free radical substitution with many different possible di–substituted products thus the yield is low.

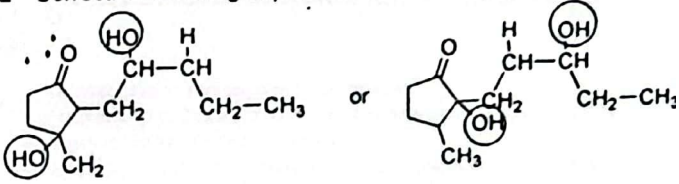
25 A

1 Correct



cis trans

2 Correct. Two –OH groups are formed in the product.



3 Correct. There are 4 chiral centres as shown below.
Hence total number of stereoisomers = 2^4 = 16