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JEE (Main)

PAPER-1 (B.E./B. TECH.)

2023

COMPUTER BASED TEST (CBT)

Questions & Solutions

Date: 15 April, 2023 (SHIFT-1) | TIME : (9.00 a.m. to 12.00 p.m)

Duration: 3 Hours | Max. Marks: 300

SUBJECT: CHEMISTRY

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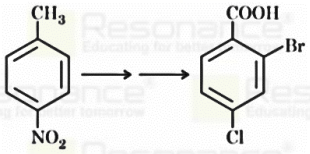
PART : CHEMISTRY

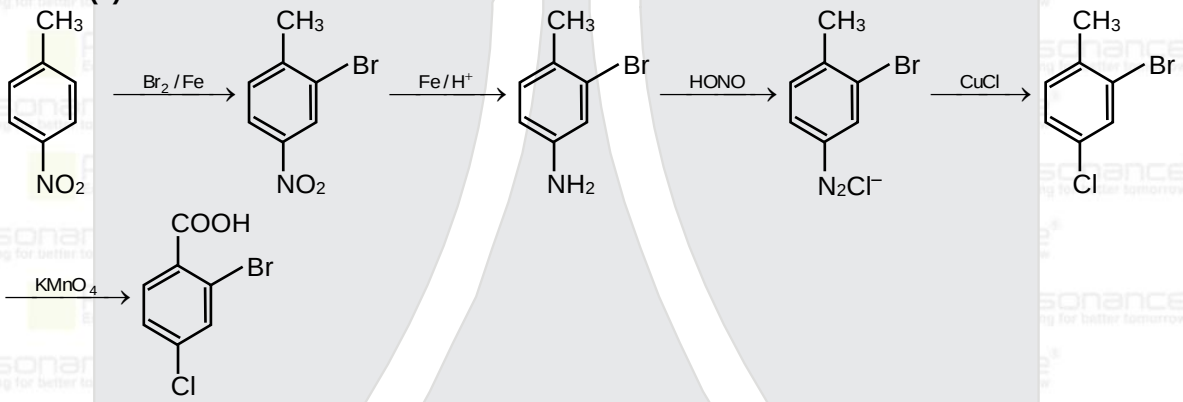
61.



In the above conversion the correct sequence of reagents to be added is
(1) (i) Br_2/Fe, (ii) Fe/H^+, (iii) $KMnO_4$, (iv) Cl_2
(2) (i) $KMnO_4$, (ii) Br_2/Fe, (iii) Fe/H^+, (iv) Cl_2
(3) (i) Fe/H^+, (ii) HONO, (iii) CuCl, (iv) $KMnO_4$, (v) Br_2
(4) (i) Br_2/Fe, (ii) Fe/H^+, (iii) HONO, (iv) CuCl, (v) $KMnO_4$,

Ans. **NTA : (4)**
Reso : (4)

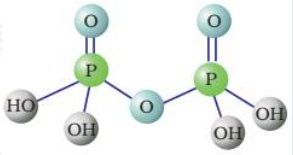
Sol.



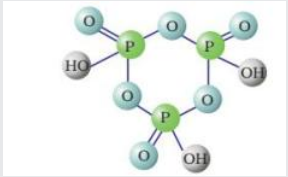
62. The number of P – O – bonds in $H_4P_2O_7$, $(HPO_3)_3$ and P_4O_{10} are respectively
(1) 1, 3, 6 (2) 0, 3, 4 (3) 0, 3, 6 (4) 1, 2, 4

Ans. **NTA : (1)**
Reso : (1)

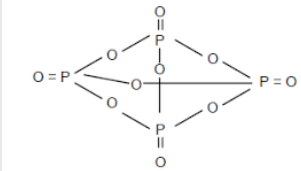
Sol.



$H_4P_2O_7$: Pyrophosphoric acid



$(HPO_3)_3$: Cyclotrimetaphosphoric acid



P_4O_{10} : Dimer of phosphorus pentaoxide

Number of P-O-P bond	
Pyrophosphoric acid	1
Cyclotrimetaphosphoric acid	3
Dimer of phosphorus pentaoxide	6

63. Which of the following statement is correct for paper chromatography?
(1) Water present in the pores of the paper forms the stationary phase.
(2) Paper and water present in its pores together form the stationary phase.
(3) Water present in the mobile phase gets absorbed by the paper which then forms the stationary phase.
(4) Paper sheet forms the stationary phase.

Ans. **NTA : (1)**
Reso : (1)

Sol. Based on fact

64. Which one of the following is not an example of calcination?

(1) $CaCo_3 . MgCO3 \xrightarrow{\Delta} CaO+MgO+2CO_2$

(2) $CaCo_3 \xrightarrow{\Delta} CaO+CO_2$

(3) $Fe_2O_3 . xH_2O \xrightarrow{\Delta} Fe_2O_3+xH_2O$

(4) $2PbS+3O_2 \xrightarrow{\Delta} 2PbO+2SO_2$

Ans. **NTA : (4)**

Reso : (4)

Sol. $PbS + O_2 \longrightarrow PbO + SO_2$ is a roasting reaction.

65. Match **List I** with **d**:

	List I-(Monomer)		**List II - (Polymer)**
(A)	Tetrafluoroethene	(1)	Orlon
(B)	Acrylonitrile	(II)	Natural rubber
(C)	Caprolactam	(III)	Teflon
(D)	Isoprene	(IV)	Nylon-6

Choose the correct answer from the options given below:

(1) (A)-(II), (B)-(III), (C)-(IV), (D)-(I) (2) (A)-(III), (B)-(I), (C)-(IV), (D)-(II)

(3) (A)-(IV), (B)-(I), (C)-(II), (D)-(III) (4) (A)-(III), (B)-(IV), (C)-(II), (D)-(I)

Ans. **NTA : (2)**

Reso : (2)

Sol. The correct match is.

	LIST-I (Monomer)		**LIST-II (Polymer)**
(A)	Tetrafluoroethene	(I)	Orlon
(B)	Caprolactum	(II)	Natural rubber
(C)	Acrylonitrile	(III)	Nylon-6
(D)	Isoprene	(IV)	Teflon

(1) (A) – (IV) ; (B) – (III) ; (C) – (II) ; (D) – (I) (2) (A) – (IV) ; (B) – (II) ; (C) – (III) ; (D) – (I)

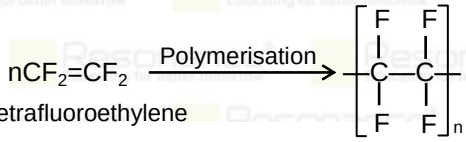
(3) (A) – (IV) ; (B) – (III) ; (C) – (I) ; (D) – (II) (4) (A) – (III) ; (B) – (II) ; (C) – (IV) ; (D) – (I)

Ans. **NTA : (3)**

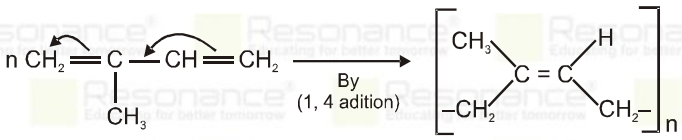
Reso : (3)

Sol.

Acrylonitrile — Polyacrylonitrile(Orlon)

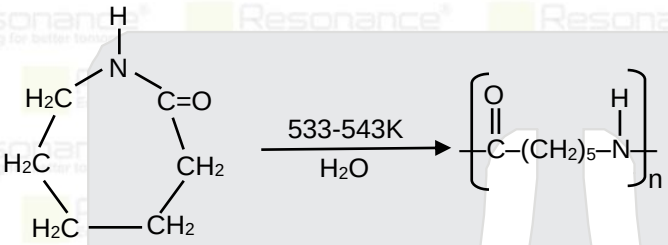


Tetrafluoroethylene — Teflon



(Isoprene)

cis-polyisoprene
or
Natural rubber



66. The complex with highest magnitude of crystal field splitting energy (Δ_0) is

(1) $[Mn(OH_2)_6]^{3+}$ (2) $[Fe(OH_2)_6]^{3+}$

(3) $[Cr(OH_2)_6]^{3+}$ (4) $[Ti(OH_2)_6]^{3+}$

Ans. **NTA : (3)**
Reso : (3)

Sol. In 3d series as M^{3+} ion size decreases, change density increase, so attraction b/w M^{3+} and ligand increase so Δ_0 increase. Ti^{+3} = 67 pm , Cr^{+3} = 62 pm, Mn^{+3} = 65 pm, Fe^{+3} = 65 pm.
So Cr^{+3} = 62 pm has highest tendency to attract ligand. Hence Δ_0 is more for Cr^{+3} complex.

67. The possibility of photochemical smog formation will be minimum at

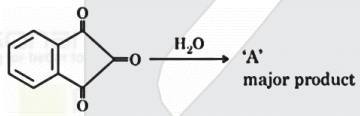
(1) Kolkata in October (2) New-Delhi in August (Summer)

(3) Srinagar, Jammu and Kashmir in January (4) Mumbai in May

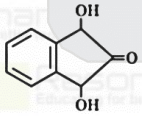
Ans. **NTA : (3)**
Reso : (3)

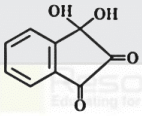
Sol. Photo chemical Smog is created by automobile pollution of big cities Srinagar, Jammu and Kashmir in January is frozen with least traffic and pollution.

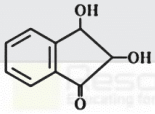
68.

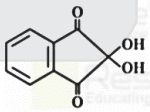


'A' formed in the above reaction is

(1) 

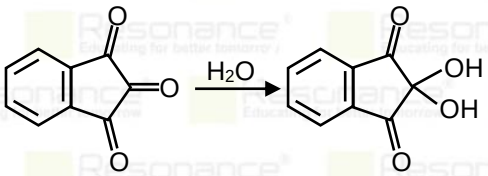
(2) 

(3) 

(4) 

Ans. **NTA : (4)**
Reso : (4)

Sol.

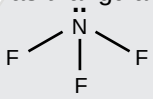


Ninhydrin Ninhydrin-hydrate

69. Consider the following statements:
(A) NFS molecule has a trigonal planar structure.
(B) Bond length of N2 is shorter than O2.
(C) Isoelectronic molecules or ions have identical bond order.
(D) Dipole moment of H2S is higher than that of water molecule.
Choose the correct answer from the options given below:
(1) (C) and (D) are correct (2) (B) and (C) are correct
(3) (A) and (B) are correct (4) (A) and (D) are correct

Ans. **NTA : (2)**
Reso : (2)

Sol. (A) NF_3 has triangular pyramidal structure



(B) **Molecule :** N_2 O_2
B.O. 3 2
B. L N_2 < O_2
(C) Isoelectronic molecules or ions have identical bond order.
(D) Dipole moment H_2S < H_2O due to less EN difference b/w H and S as compare to H and O.

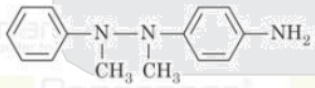
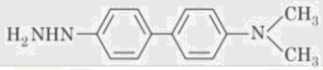
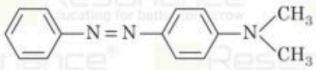
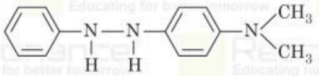
70. Given below are two statements: One is labelled as **Assertion A** and the other is labelled as **Reason R**:
Assertion (A) : $BeCl_2$ and $MgCl_2$ produce characteristic flame
Reason (R) : The excitation energy is high in $BeCl_2$ and $MgCl_2$
In the light of the above statements, choose the correct answer from the options given below:
(1) **(A)** is false but **(R)** is true
(2) Both **(A)** and **(R)** are true but **(R)** is NOT the correct explanation of **(A)**
(3) **(A)** is true but **(R)** is false
(4) Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**

Ans. **NTA : (1)**
Reso : (1)

Sol. Due small size and high EN of Be and Mg.

71. Consider the following sequence of reactions:

The product 'B' is

(1) 
(2) 
(3) 
(4) 

Ans. **NTA : (3)**
Reso : (3)

Sol. 

72. The product formed in the following multistep reaction is:

$$CH_3-CH=CH_2 \xrightarrow[\text{iii) PCC}]{\text{i) } B_2H_6 \text{ ii) } H_2O_2, NaOH \text{ iv) } CH_3MgBr}$$

(1) $CH_3-CH_2-\overset{\overset{O}{\|}}{C}-OCH_3$

(2) $CH_3-CH_2-CH_2-CH_2-OH$

(3) $CH_3-\overset{\overset{OH}{|}}{\underset{\underset{CH_3}{|}}{C}}-CH_3$

(4) $CH_3-CH_2-\overset{\overset{OH}{|}}{CH}-CH_3$

Ans. **NTA : (4)**
Reso : (4)

Sol.

$$CH_3-CH=CH_2 \xrightarrow[H_2O_2/OH^{\ominus}]{B_2H_6} CH_3-CH_2-\underset{\underset{OH}{|}}{CH_2} \xrightarrow{PCC} CH_3-\underset{\underset{O}{\|}}{CH_2}-CH \xrightarrow{CH_3MgX} CH_3-CH_2-\underset{\underset{OH}{|}}{CH}-CH_3$$

73. Which of the following statement(s) is/are correct?
(A) The pH of 1×10^{-8} M HCl solution is 8.
(B) The conjugate base of H_2, PO_4^- is HPO_4^{2-}.
(C) K_w increases with increase in temperature.
(D) When a solution of a weak monoprotic acid is titrated against a strong base at half neutralisation point, pH = $\frac{1}{2}pK_a$.
Choose the correct answer from the options given below:
(1) (A), (B), (C) (2) (B), (C) (3) (A), (D) (4) (B), (C), (D)

Ans. **NTA : (2)**
Reso : (2)

Sol. (A)

$$H_2O \rightleftharpoons H^+ + OH^-$$

$10^{-8} + x$ $\quad$ x

$K_w = [H^+]\,[OH^-]$

$10^{-14} = x(x \times 10^{-8})$

$\Rightarrow x^2 + x \times 10^{-8} - 10^{-14} = 0$

$$x = \frac{-10^{-8} \pm \sqrt{10^{-16} + 4 \times 10^{-14}}}{2}$$

$$= \frac{-10^{-8} + 10^{-7}\sqrt{4 + \frac{1}{100}}}{2}$$

$$= \frac{(\sqrt{401} - 1)10^{-8}}{2} = 0.95 \times 10^{-7}$$

$[pH] = 10.5 \times 10^{-8} = 1.05 \times 10^{-7}$

$[pH] = 7 - \log 1.05 \approx 6.98$

(B) The conjugate base of H_2, PO_4^- is HPO_4^{2-}.

(C) K_w increases with increase in temperature. As the temperature increases, the dissociation of water increases.

(D) At half neutralisation point, half of the acid is present in the form of salt. So it forms acidic buffer solution.

$$pH = p^{ka} + \log\frac{[salt]}{[acid]}$$

$$pH = p^{ka} + \log\frac{1}{1}$$

$pH = p^{ka}$.

74. During water-gas shift reaction

(1) carbon is oxidized to carbon monoxide. (2) water is evaporated in presence of catalyst.

(3) carbon dioxide is reduced to carbon monoxide. (4) carbon monoxide is oxidized to carbon dioxide.

Ans. **NTA : (4)**

Reso : (4)

Sol. The production of dihydrogen can be increased by reacting CO of Syn gas mixture with steam in the presence of iron chromate as catalyst. In this reaction carbon monoxide is oxidized to carbon dioxide.

$$CO(g) + H_2O(g) \xrightarrow[\text{Catalyst}]{673K} CO_2(g) + H_2(g)$$

Water gas shift Reaction.

75. Which is not true for arginine?

(1) It is a crystalline solid.

(2) It has a fairly high melting point.

(3) It is associated with more than one pKa values.

(40 It has high solubility in benzene.

Ans. **NTA : (4)**

Reso : (4)

Sol. Arginine exist as Swatter ion, and such ionic compounds are insoluble in non polar solvent "benzene".

76. Given below are two statements:

Statement I : According to Bohr's model of hydrogen atom, the angular momentum of an electron in a given stationary state is quantised.

Statement II : The concept of electron in Bohr's orbit, violates the Heisenberg uncertainty principle.

In the light of the above statements, choose the most appropriate answer from the options given below:

(1) **Statement I** is incorrect but **Statement II** is correct

(2) Both **Statement I** and **Statement II** are incorrect

(3) **Statement I** is correct but **Statement II** is incorrect

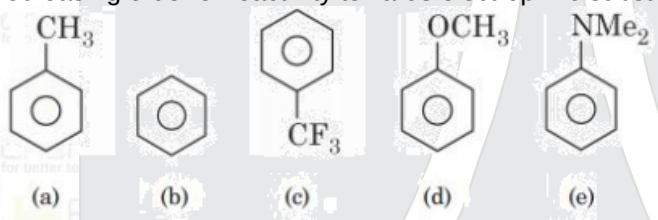
(4) Both **Statement I** and **Statement II** are correct

Ans. **NTA : (4)**

Reso : (4)

Sol. According to Bohr's modal orbit angular momentum of stationary orbit is quantaized it is equal to $\frac{nh}{2\pi}$ (on = No. of orbit) Heisenberg's uncertainty principle explain orbital concept, which is depends on finding probability of electron.

77. Decreasing order of reactivity towards electrophilic substitution for the following compounds is:



(1) d > a > e > c > b

(2) c > b > a > d > e

(3) a > d > e > b > c

(4) e > d > a > b > c

Ans. **NTA : (4)**

Reso : (4)

Sol. Rate of electrophilic substitution reaction $\propto$ Electron density in benzene ring.

78. Which of the following expressions is correct in case of a CsCl unit cell (edge length 'a')?

(1) $r_{Cs^+} + r_{Cl} = \frac{a}{\sqrt{2}}$

(2) $r_{Cs^+} + r_{Cl^-} = \frac{\sqrt{3}}{2}a$

(3) $r_{Cs^+} + r_{Cl^-} = \frac{a}{2}$

(4) $r_{Cs^+} + r_{Cl^-} = a$

Ans. **NTA : (2)**

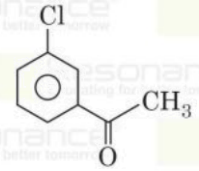
Reso : (2)

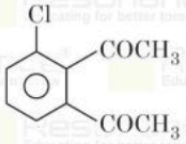
Sol. CsCl has body centred unit cell (BCC)

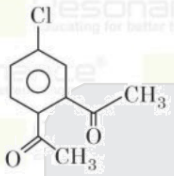
So body diagonal $\sqrt{3}a = 2(r^+ + r^-)$

$(r^+ + r^-) = \left(\frac{\sqrt{3}a}{2}\right)$

79. The major product formed in the Friedel-Craft acylation of chlorobenzene is

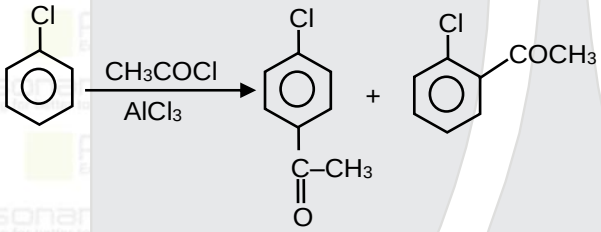
(1) 

(2) 

(3) 

(4) 

Ans. **NTA : (4)**
Reso : (4)

Sol. 

80. For a good quality cement, the ratio of silica to alumina is found to be
(1) 1.5
(2) 2
(3) 3
(4) 4.5

Ans. **NTA : (3)**
Reso : (3)

Sol. For gas good quality of cement the ratio of silica (SiO_2) to Alumina (Al_2O_3) should be between 2.5 and 4.

81. The number of correct statements from the following is_____
(A) Conductivity always decreases with decrease in concentration for both strong and weak electrolytes.
(B) The number of ions per unit volume that carry current in a solution increases on dilution.
(C) Molar conductivity increases with decrease in concentration.
(D) The variation in molar conductivity is different for strong and weak electrolytes.
(E) For weak electrolytes, the change in molar conductivity with dilution is due to decrease in degree of dissociation.

Ans. **NTA : (3)**
Reso : (3)

Sol. (A) Conductivity always decreases with decrease in concentration for both strong and weak electrolytes.
(B) The number of ions per unit volume that carry current in a solution decreases on dilution.
(C) Molar conductivity increases with decrease in concentration.
(D) The variation in molar conductivity is different for strong and weak electrolytes.
(E) For weak electrolytes, the change in molar conductivity with dilution is due to increase in degree of dissociation.
The correct statements are (A), (C) and (D).

82. The total number of isoelectronic species from the given set is_____.
O^{2-}, F^-, Al, Mg^{2+}, Na^+, O^+, Mg, Al^{3+}, F

Ans. **NTA : (5)**
Reso : (5)

Sol.

Species :	O^{2-}	F^-	Al	Mg^{2+}	Na^+	O^+	Mg	Al^{3+}	F
No. of e^- :	10	10	13	10	10	7	12	10	9

83. The total change in the oxidation state of manganese involved in the reaction of KMnO4 and potassium iodide in the acidic medium is_____.

Ans. **NTA : (5)**
Reso : (5)

Sol. $10KI + \underset{(+7)}{2KMnO_4} - 8H_2SO_4 \longrightarrow \underset{(+2)}{2MnSO_4} + 8H_2O + 5I_2 + 6K_2SO_4$
change on Oxidation number of Mn = ((+7) – (+2)) = 5

84. The volume (in mL) of 0.1 M $AgNO_3$ required for complete precipitation of chloride ions present in 20 mL of 0.01 M solution of $[Cr(H_2O)_5, Cl]Cl_2$, as silver chloride is_____.

Ans. **NTA (4)**
Reso (4)

Sol. $[Cr(H_2O)_5\ Cl]Cl_2 + 2AgNO_3 \longrightarrow [Cr(H_2O)_5\ Cl](NO_3)_2 + 2AgCl\downarrow$
0.01 M × 20 ml 0.1 M × V = 0.2 mili mole
0.2 milimole $[Cr(H_2O)_5\ Cl]Cl_2$ requires 0.4 milimole $AgNO_3$
0.1 × V = 0.4

$V = \frac{0.4}{0.1}$ = 4 ml

85. In Chromyl chloride, the oxidation state of chromium is (+)_____.

Ans. **NTA : (6)**
Reso : (6)

Sol. Chromyl chloride : CrO_2Cl_2
Oxidation number of Cr = +6
CrO_2Cl_2
x + 2(-2) + 2(-1) = 0
x = +6

86. The homoleptic and octahedral complex of Co^{2+} and H_2O has_____ unpaired electron(s) in the t_{2g} set of orbitals.

Ans. **NTA : (1)**
Reso : (1)

Sol. $[Co(H_2O)_6]^{2+}$; $Co^{2+} = d^7$ configuration
$t_{2g}^{22''}\ eg^{11}$
No. of unpaired electron = 1 in t_{2g}

87. 20 mL of 0.5 M NaCl is required to coagulate 200 mL of As_2,S_3 solution in 2 hours. The coagulating value of NaCl is_____.

Ans. **NTA : (50)**
Reso : (50)

Sol. The minimum concentration of electrolyte in millimoles required to cause coagulation of one litre of colloidal solution is called coagulation value. It is express in terms of millimoles/litre.

$$\textit{Coagulation value} = \frac{\text{millimoles of electrolyte}}{\text{volume of sol in litre}}$$

$$\text{Coagulating value} = \frac{20\times 0.5}{200}\times 1000 = 50$$

88. 30.4 kJ of heat is required to melt one mole of sodium chloride and the entropy change at the melting point is 28.4 J K^{-1} mol^{-1} at 1 atm. The melting point of sodium chloride is_____ K (Nearest Integer)

Ans. **NTA : (1070)**
Reso : (1070)

Sol. $\Delta S = \frac{\Delta H_{fus}}{T_{mp}}$

$28.4 = \frac{30.4 \times 1000}{T_{mp}}$

T_{mp} = 1070.422 K

89. The vapour pressure of 30% (w/v) aqueous solution of glucose is_____ mm Hg at 25°C.
[Given: The density of 30% (w/v), aqueous solution of glucose is 1.2 g cm^{-3} and vapour pressure of pure water is 24 mm Hg.]
(Molar mass of glucose is 180 g mol^{-1}.)

Ans. **NTA : (23)**
Reso : (23)

Sol. $\frac{P^o - Ps}{Ps} = \frac{n}{N}$

density of solution = $\frac{Mass}{volume}$

density of solution = 100 ml

Mass = 120g

weight of glucose = $120x\frac{30}{100}$ = 36g

weight of H_2O = 120 – 36 = 84g

mole of glucose = 36/180 = 0.2 mole

mole of H_2O = $\frac{84}{18}$ = 4.6 mole

$\frac{24 - Ps}{Ps} = \frac{0.2}{4.67}$

24 – Ps = 0.0428 Ps

Ps = $\frac{24}{1.0428}$ = 23.015 mm of Hg = 23 mm of Hg

90. For a reversible reaction $A \rightleftharpoons B$, the $\Delta H_{forward\ reaction}$ = 20 kJ mol^{-1}. The activation energy of the uncatalysed forward reaction is 300 kJ mol^{-1}. When the reaction is catalysed keeping the reactant concentration same, the rate of the catalysed forward reaction at 27°C is found to be same as that of the uncatalysed reaction at 327°C. The activation energy of the catalysed backward reaction is kJ mol^{w}.

Ans. **NTA : (130)**
Reso : (130)

Sol. E_a = 300 kJ/mol

$\left(\frac{E_a}{T}\right) = \left(\frac{E_a^1}{T^1}\right)_{Cat}$

$\frac{300}{600} = \frac{(E_a^1)_f}{300}$

$(E_a^1)_f$ = 150

$\Delta H = (E_a^1)_f - (E_a^1)_b$

20 = 150 – $(E_a^1)_b$ $\qquad$ $(E_a^1)_b$ = 130 kJ/mol