FIITJEE Internal test

PINNACLE 1ST YEAR (2021-2023)

PHASE-4 (JEEA-12)

Time : 3 hours **Maximum Marks: 240**

INSTRUCTIONS

A. Questions paper format :

i) This question paper consists of 3 sections (Section 1 – Maths, Section 2 – Physics & Section 3 - Chemistry) Each Section has 2 parts: PART – A, PART – B

ii) **PART – A** contains 16 multiple choice questions. Each question has 4 choices a, b, c and d, out of which **10 questions** are **single answer correct** and **6 questions** are **comprehension based.**

iii) **Part – B contain 2 questions** in which statements are given in 2 columns. Statements in the first column are to be matched with statements in the second column. The answers to these questions are to be appropriately bubbled in the ORS.

B. Marking scheme :

i) For each question in **PART- A,** you will be awarded **4 Marks** if you darkened only the bubble corresponding to the correct answer and **zero mark** if no bubble is darkened. In all other cases, **minus one (-1) mark** will be awarded.

ii) For each question in **PART- B** you will be awarded **2 Marks** for each row if you match the statement in column I of the row with all but only statements with which the matching is possible. Thus, each question in this section carries a maximum of 8 marks. There is no negative mark for incorrect answer(s) for this section.

IMPORTANT DATA

Mass of an electron (m) = 9.1×10^{-31} kg Charge of an electron (e) = 1.6×10^{-19} coulombs

Avogadro's Number (N_a) = 6.023×10^{23} Planck's constant (h) = 6.626×10^{-34} Js

1 Faraday = 96500 Coulomb 1 Calorie = 4.2 joule

Atomic Masses: Cr = 52, Mn = 55, Fe = 56, Co = 59, Ni = 58.7, Cu = 63.5, Zn = 65.4, As = 75, Br = 80, Kr = 83.8, Ag = 108, Sn=118.6,I = 127,Xe = 131, Ba = 137,Au= 197, Pb = 207, U=238

Enrollment No. : | | | | | | | | | | | | |

Batch : _____

Name : _____

SECTION – 1

Mathematics

PART - A

SINGLE ANSWER CORRECT:

1. Which of the following function is differentiable at $x=0$?

   a) $|\cos x|$ b) $|\sin x|$ c) $|x^3|$ d) $\sin|x|$

2. If the equation of tangent to the curve $y^2=ax^3+b$ at $(2,3)$ is $y=4x-5$. Then

   a) $a=0$ b) $a=1$ c) $b=1$ d) $b=-7$

3. If $f(x)=\begin{cases}\dfrac{\sin(a+2)x+\sin x}{x}; & x<0\\ b\ ; & x=0\\ \dfrac{\left(x+3x^2\right)^{1/3}-x^{1/3}}{x^{4/3}}, & x>0\end{cases}$ is continuous at $x=0$, then $a+2b$ is equal to

   a) – 2 b) 1 c) 0 d) – 1

4. If a function $f(x)$ defined by $f(x)=\begin{cases}ae^x+be^{-x}, & -1\le x<1\\ cx^2, & 1\le x\le 3\\ ax^2+2cx, & 3<x\le 4\end{cases}$ be continuous for some $a,b,c\in R$ and $f^1(0)+f^1(2)=e$, then the value of a is

   a) $\dfrac{1}{e^2-3e+13}$ b) $\dfrac{e}{e^2-3e-13}$ c) $\dfrac{e}{e^2+3e+13}$ d) $\dfrac{e}{e^2-3e+13}$

5. The equation of tangent to the curve $y=\dfrac{4}{x^2}+x$ which is parallel to the x – axis is

   a) $y=8$ b) $y=0$ c) $y=3$ d) $y=2$

---------- ROUGH WORK ----------

6. Let $f(x)=\frac{x}{\sqrt{a^2+x^2}}-\frac{d-x}{\sqrt{b^2+(d-x)^2}}$, $x\in R$, where a,b and d are non-zero real constants. Then
   a) f is an increasing function of x
   b) f is an decreasing function of x
   c) f is neither increasing nor decreasing function of x
   d) f^1 is not a continuous function of x

7. Let $f:R\to R$ be a differential function such that $f(u+v)=f(u)+2v^2+4uv$ for all $u,v\in R$. If $f(1)=3$, then the equation of the normal to the curve $y=f(x)$ at the point $\left(\frac{1}{2},f\left(\frac{1}{2}\right)\right)$ is
   a) $2x+4y=7$ b) $3x-y=0$ c) $3x+y=3$ d) $2x-4y=-5$

8. If the tangent to the curve $y=\frac{x}{x^2-3}$, $x\in R$, $\left(x\neq\pm\sqrt{3}\right)$, at a point $(\alpha,\beta)\neq(0,0)$ on it is parallel to the line $2x+6y-11=0$, then
   a) $|6\alpha+2\beta|=19$ b) $|2\alpha+6\beta|=11$ c) $|2\alpha+6\beta|=19$ d) $|6\alpha+2\beta|=9$

9. The function $f(x)=e^{x+1}\left(4x^2-16x+11\right)$ is
   a) decreasing in $\left(-\infty,-\frac{5}{2}\right)\cup\left(\frac{1}{2},\infty\right)$ b) decreasing in $\left(-\infty,\frac{1}{2}\right)\cup\left(\frac{5}{2},\infty\right)$
   c) increasing in $(-\infty,-2)\cup(2,\infty)$ d) increasing in $\left(-\infty,-\frac{1}{2}\right)\cup\left(\frac{5}{2},\infty\right)$

10. The number of normals to the curve $x^2=4y$ passing through point $(1,2)$ is
    a) 1 b) 2 c) 3 d) 0

---------- ROUGH WORK ----------

COMPREHENSION

Consider the curve $x=1-3t^2$, $y=t-3t^3$. A tangent at point $\left(1-3t^2, t-3t^3\right)$ is inclined at an angle θ to the positive x-axis and another tangent at point $P(-2,2)$ cuts the curve again at Q.

11. The value of $\tan\theta+\sec\theta$ is equal to
a) 3t b) t c) $t-t^2$ d) t^2-2t

12. The point Q will be
a) $(1,-2)$ b) $\left(-\frac{1}{3},-\frac{2}{3}\right)$ c) $(-2,1)$ d) $\left(\frac{1}{3},\frac{2}{3}\right)$

13. The angle between the tangents at P and Q will be
a) $\frac{\pi}{4}$ b) $\frac{\pi}{6}$ c) $\frac{\pi}{2}$ d) $\frac{\pi}{3}$

COMPREHENSION

$f(x)=x^2+xg'(1)+g''(2)$ and $g(x)=f(1)x^2+x\,f'(x)+f''(x)$

14. The value of $f(3)$ is
a) 1 b) 0 c) – 1 d) – 2

15. The value of $g(0)$ is
a) 0 b) – 3 c) 2 d) – 2

16. The domain of the function $\sqrt{\frac{f(x)}{g(x)}}$ is
a) $(-\infty,1]\cup(2,\ 3]$ b) $(-2,0]\cup(1,\infty)$ c) $(-\infty,0]\cup(2/3,3]$ d) $[2,\ 3]$

---------- ROUGH WORK ----------

PART - B

MATCH THE MATRIX:

1. Match the following

Column – I (Curves)		Column – II (Angle between the curves)	
(1)	$y^2 = 4x \text{ and } x^2 = 4y$	(A)	90^0
(2)	$2y^2 = x^3 \text{ and } y^2 = 32x$	(B)	Any one of $Tan^{-1}\frac{3}{4}$ or $Tan^{-1}\left(16^{1/3}\right)$
(3)	$xy = a^2$ and $x^2 + y^2 = 2a^2$	(C)	0^0
(4)	$y^2 = x$ and $x^3 + y^3 = 3xy$ at other than origin	(D)	$Tan^{-1}\frac{1}{2}$

2. Length of normal, sub-normal, tangents and sub-tangents are to be matched at the given points for the function given

Column – I		Column – II	
(1)	Value of 'k' so that length of sub-normal at any point of $y = 2^{1-k}x^k$ is constant	(A)	$\frac{1}{\log_e^2}$
(2)	Length of sub-tangent, at any point of the curve $y = 2^x$ is	(B)	2
(3)	Length of sub-normal at any point on the curve $y^2 = 4x$ is	(C)	$\frac{\sqrt{17}}{4}$
(4)	Length of tangent on $y = x^3 + 3x^2 + 4x - 1$ at $x = 0$ is	(D)	$\frac{1}{2}$

---------- ROUGH WORK ----------

SECTION – 2

Physics

PART - A

SINGLE ANSWER CORRECT:

1. The radiation power of a black body at temperature 200K is 544 watt. Its surface area is $\left(\sigma = 5.67 \times 10^{8}\, wm^{-2}k^{-4}\right)$

   a) 6 x 10^{-2} m^2 b) 6 m^2 c) 6 x 10^{-6} m^2 d) 6 x 10^{2} m^2

2. The temperature of the sun is about 6000 k and maximum intensity is emitted at $4800A^0$ from it. If the sun cools to 3000k, then the maximum intensity would occur at

   a) $4800A^0$ b) $2400A^0$ c) $9600A^0$ d) $19200A^0$

3. An ideal gas is heated at a constant pressure. The fraction of heat supplied used for external work is (γ - adiabatic exponent)

   a) $\frac{1}{\gamma}$ b) $1-\frac{1}{\gamma}$ c) $\gamma - 1$ d) $1-\frac{1}{\gamma^2}$

4. The pressure (P) of an ideal gas is changing with its volume (V) $P = xV$, where x is a positive constant. The work done by the gas when its volume is changed from $2V_0$ to $4V_0$ is

   a) $\left(2V_0\right)x$ b) $\left(6V_0^2\right)x$ c) zero d) $\left(4V_0^2\right)x$

5. A metal rod having a coefficient of linear expansion of 2 x 10^{-5} $/^0$ C has a length of 100cm at 20^0 C. The temperature at which it is shortened by 10^{-3} m is

   a) -40^0 C b) -30^0 C c) -20^0 C d) -10^0 C

6. Four point masses each equal to m are arranged at the four corners of a square of side l. Force acting on any one mass due to other masses is

   a) $\frac{Gm^2}{l^2}\left(\sqrt{2}+\frac{1}{2}\right)$ b) $\frac{Gm^2}{l^2}\left(\sqrt{2}\right)$ c) $\frac{Gm^2}{l^2}\frac{1}{2}$ d) zero

---------- ROUGH WORK ----------

7. A number of point masses each equal to m are arranged along x-axis at $x = 1\,m$, $x = 2\,m$, $x = 4\,m$ and so on. Another mass M is arranged at the origin. Force experienced by M due to infinite point masses is

a) $GMm\frac{4}{3}$ b) $GMm\frac{3}{4}$ c) $\frac{GMm}{3}$ d) GMm

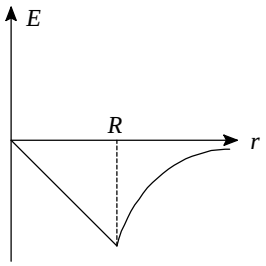
8. Two identical spheres of same radius R and same density ρ are in contact. Force between the spheres is

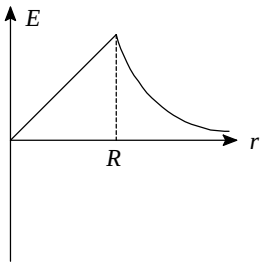
a) $\frac{4}{9}G\pi^2R^4\rho^2$ b) $G\pi^2R^4\rho^2$ c) $\frac{1}{9}G\pi^2R\rho^2$ d) $GR\rho$

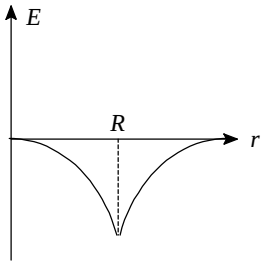
9. Mass M = 1 unit is divided into two parts X and (1 – X). For a given separation the value of X for which the gravitational force between them becomes maximum is

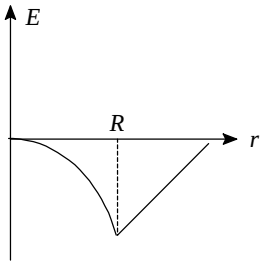
a) $\frac{1}{2}$ b) $\frac{3}{5}$ c) 1 d) 2

10. The magnitude of gravitation field strength due to a solid sphere (mass M, radius R) varies with distance r from centre as :

a) 

b) 

c) 

d) 

---------- ROUGH WORK ----------

COMPREHENSION

Three identical particles each of mass *m*, are placed at the three corners of an equilateral triangle of side '*a*'

11. Magnitude of force exerted by this system on another particle of mass *m* placed at the midpoint of any side of the triangle is

a) $\frac{Gm^2}{a^2}$ b) $\frac{2}{3}\frac{Gm^2}{a^2}$ c) $\frac{3}{4}\frac{Gm^2}{a^2}$ d) $\frac{4}{3}\frac{Gm^2}{a^2}$

12. The force exerted by this system on another particle of mass *m* placed at the centre of the triangle

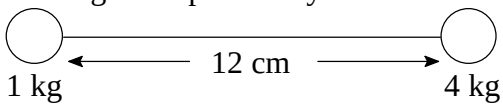
a) zero b) $\sqrt{3}\frac{Gm^2}{a^2}$ c) $\frac{Gm^2}{3a^2}$ d) $\frac{3}{2}\frac{Gm^2}{a^2}$

13. The magnitude of gravitational force on any one of the particles due to other two particles

a) $\frac{3}{2}\frac{Gm^2}{a^2}$ b) $\sqrt{3}\frac{Gm^2}{a^2}$ c) $\frac{\sqrt{3}}{4}\frac{Gm^2}{a^2}$ d) $\frac{2}{3}\frac{Gm^2}{a^2}$

COMPREHENSION

Two particles of mass 1 kg and 4 kg are separated by a distance of 12 cm as shown in figure



14. At what distance from particle 1 kg along the line joining of two particles, the 3rd particle of mass 1 kg should be placed to get resultant gravitational force on the 3rd particle due to remaining 2 particle forces is zero

a) 2 cm b) 4 cm c) 6 cm d) 8 cm

15. At what distance from 4 kg resultant gravitational field due to two masses, along the line joining between the masses is zero

a) 2 cm b) 4 cm c) 6 cm d) 8 cm

16. If mass of the two particles (given 1 kg and 4 kg) reduced to half of them and it's separation is reduced to half of it's original value then force between them becomes

a) zero b) doubled c) Three times d) remains same

---------- ROUGH WORK ----------

PART - B

MATCH THE MATRIX:

1. If M be the mass of the body, R be the Radius of the body, *r* be the distance of the point.

Column – I		Column – II	
1)	Gravitational field of a ring on its axis at a point of distance *r*	A)	Zero
2)	Gravitational field due to a uniform thin spherical shall at a point in side the shell	B)	$\frac{GM}{r^2}\left(r \geq R\right)$
3)	Gravitational field due to a uniform solid sphere at a point outside of the solid sphere	C)	$\frac{GMr}{R^3}\left(r < R\right)$
4)	Gravitational field due to a uniform solid sphere at a point inside of the solid sphere	D)	$\frac{GMr}{\left(R^2 + r^2\right)^{3/2}}\left(r > R\right)$

2. Heat conduction is taking place through the three rods (slabs) each of equal length ' ℓ ' and each area of cross section 'A' having thermal conductivity 'K' to each of the rod. If the system is in steady state then

Column – I		Column – II	
1)	If the three rods are in series the effective co-efficient of thermal conductivity	A)	K
2)	If the three rods are in parallel the effective co-efficient of thermal conductivity	B)	$\frac{K}{2}$
3)	If any two rods are in series the effective co-efficient of thermal conductivity	C)	$\frac{K}{3}$
4)	If any two rods are in parallel and the third rod is in series to that parallel combination, the co-efficient of thermal conductivity	D)	$\frac{2}{3}K$

---------- ROUGH WORK ----------

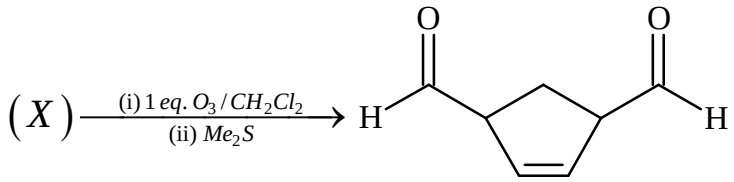
SECTION – 3

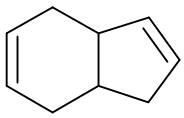
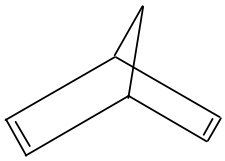
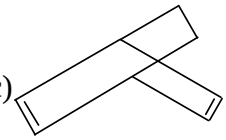
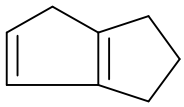
Chemistry

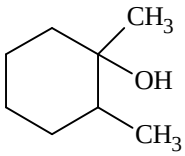
PART - A

SINGLE ANSWER CORRECT:

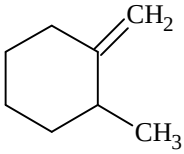
1. Identify the reactant (X) on the given reaction

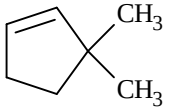


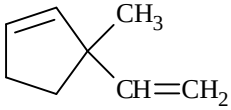
a)  b)  c)  d) 

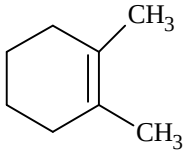
2. Compound (A) $\xrightarrow{dil.\ H_2SO_4}$ 

Compound (A) cannot be

a) 

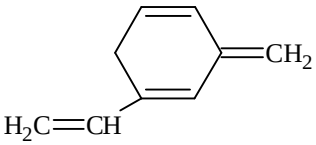
b) 

c) 

d) 

3. Which of the following does not give glyoxal as one of the product on ozonolysis?

a) 

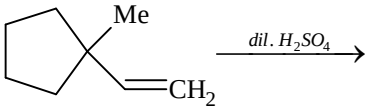
b) 

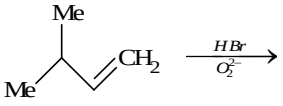
c) $H_2C{=}CH{-}CH{=}CH_2$

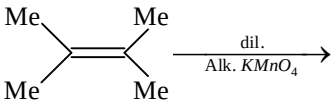
d) Benzene

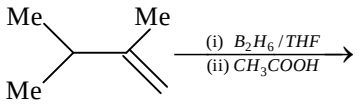
---------- ROUGH WORK ----------

4. In which of the following reaction the rearrangement of carbocation is involved?

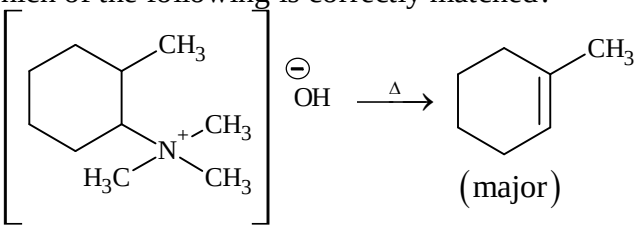
a) 

b) 

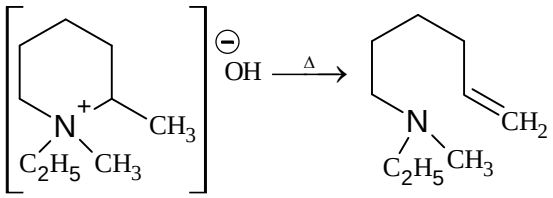
c) 

d) 

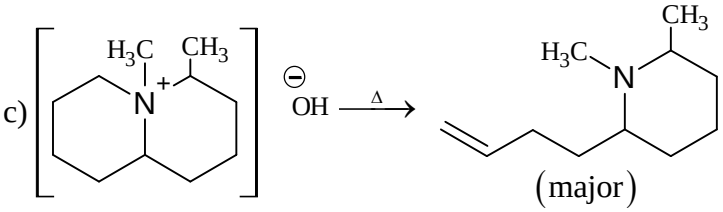
5. Which of the following is correctly matched?

a) 

(major)

b) 

(major)

c) 

(major)

d) All of these

---------- ROUGH WORK ----------

6. Identify end products *A, B* and *C* of the following

$CH_3CH{=}CH_2 \xrightarrow[(ii)\ H_2O]{(i)\ D^{\oplus}} A$

$CH_3CH{=}CH_2 \xrightarrow[(ii)\ D_2O]{(i)\ H^{\oplus}} B$

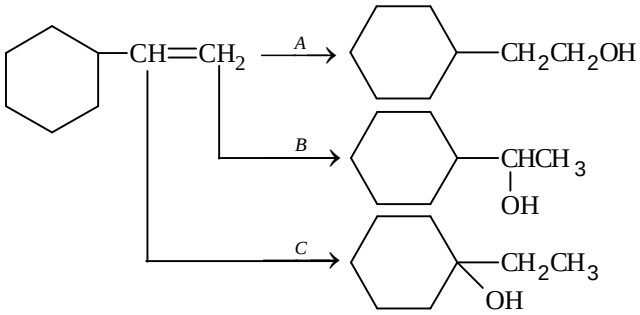
$CH_3CH{=}CH_2 \xrightarrow[(ii)\ D_2O]{(i)\ D^{\oplus}} C$

a) $\underset{\underset{OH}{|}}{CH_3CHCH_3}$ in all cases

b) $CH_3CH(OH)CH_2D,\ CH_3CH(OD)CH_3,\ CH_3CH(OD)CH_2D$

c) $\underset{\underset{OD}{|}}{CH_3CHCH_3}$ in all cases

d) $\underset{\underset{OD}{|}}{CH_3CHCH_2D}$ in all cases

7. 

Schemes *A, B* and *C* are

a) simple acid catalysed hydration

b) Hydroboration-oxidation, mercuration-demercuration, acid –catalysed hydration

c) acid-catalysed hydration, Hydroboration-oxidation, mercuration-demercuration

d) mercuration-demercuration, acid-catalysed hydration, Hydroboration-oxidation

---------- ROUGH WORK ----------

8. Which of the following reactions will not give alkyne?

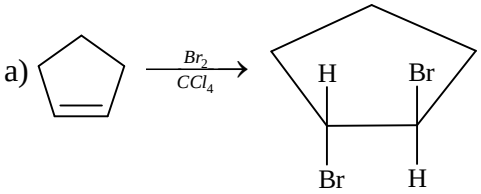
a) $CH_3CH_2CH(Cl)-CH_2(Cl) \xrightarrow[H_2O]{NaNH_2}$

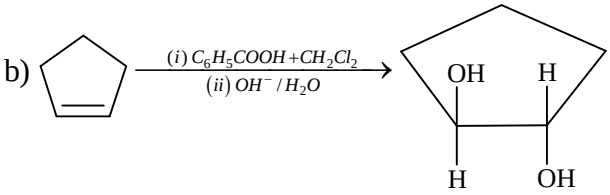
b) $CH_3CH_2CHBr_2 \xrightarrow{alc.\ KOH}$

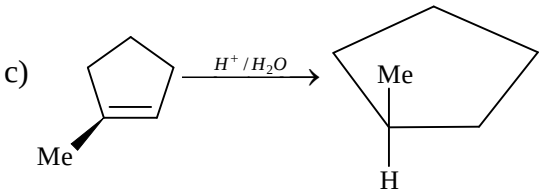
c) $CH_3-C(Br)(Br)-C(Br)(Br)-CH_3 \xrightarrow[\Delta]{Zn\ /\ alcohol}$

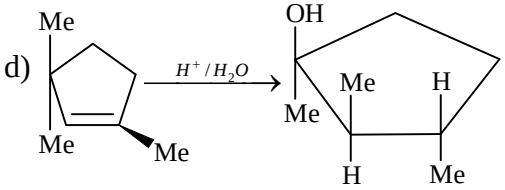
d) Potassium maleate $\xrightarrow{Electrolysis}$

9. Which of the following reactions are correct?

a) 

b) 

c) 

d) 

10. In which of the following Acetylene is produced?

a) $CaC_2 + H_2O \longrightarrow$

b) $Be_2C + H_2O \longrightarrow$

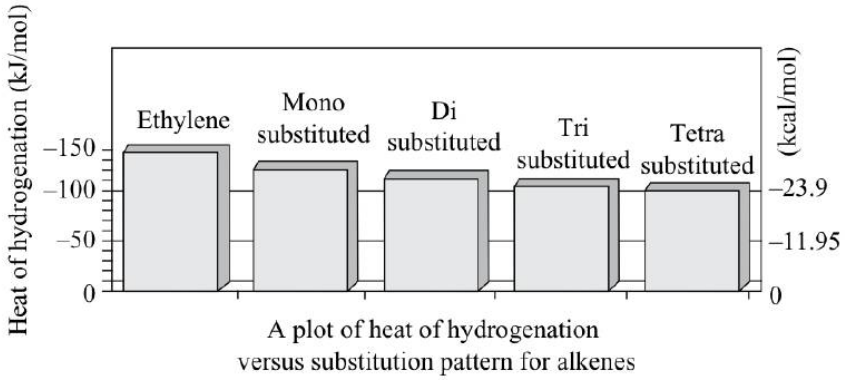
c) $Al_4C_3 + H_2O \longrightarrow$

d) $Mg_2C_3 + H_2O \longrightarrow$

---------- ROUGH WORK ----------

COMPREHENSION

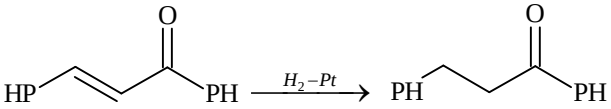
Following figure is given to test analytical ability. Based on it, answer the questions at the end of it.



A plot of heat of hydrogenation versus substitution pattern for alkenes

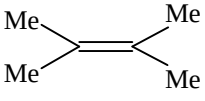
Catalytic hydrogenation is usually a stereospecific reaction called syn addition.

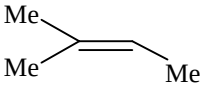
- The $C \equiv C$ bond is reduced more readily than $C \equiv C$ but other unsaturated groups (except nitro and acid chlorides) are reduced less readily. Catalytic hydrogenation can, therefore, be used for the selective reduction of $C \equiv C$ in the presence of aromatic rings and carbonyl groups, whether or not the unsaturated functions are conjugated.

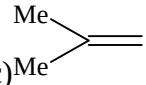


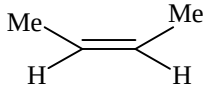
The rate of hydrogenation of olefinic bonds under standard state is $-CH = CH_2 > -CH = CH -$ or a ring double bond.

11. Base on the data of heat of hydrogenation, which has maximum stability ?

a) 

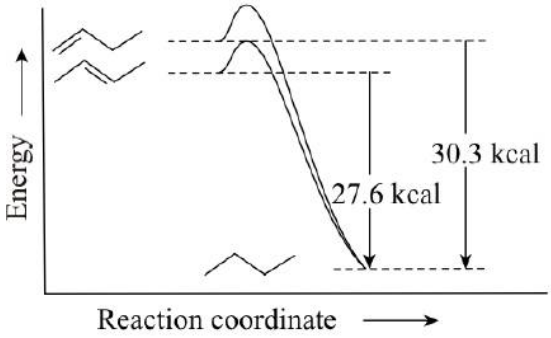
b) 

c) 

d) 

---------- ROUGH WORK ----------

12. Consider following graph



From this, it is clear that

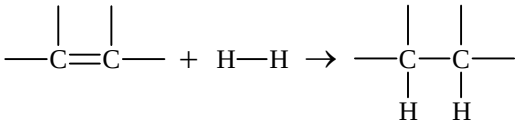
a) cis-2-butene is more stable than 1-butene by 2.7 kcal

b) trans-2-butene is more stable than 1-butene by 2.7 kcal

c) trans-2-butene is more stable than cis-2-butene by 11 kJ

d) trans-2-butene is more stable than 1-butene by 11 kJ

13. Bond energies (in kcal mol^{-1}) of different types of bonds have been given as $C-C$ (π bond $=40$); $H-H=(104)$ and $C-H=(87)$.



Heat of hydrogenation of the above reaction is

a) 57 kcal mol^{-1} b) -57 kcal mol^{-1} c) -30 kcal mol^{-1} d) 30 kcal mol^{-1}

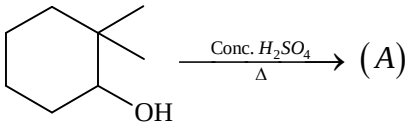
---------- ROUGH WORK ----------

COMPREHENSION

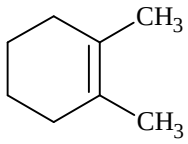
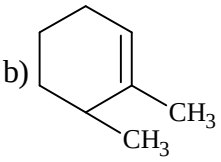
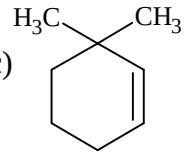
Strictly speaking, then, dehydration is not an $E1$ reaction of the protonated alcohol. In a true $E1$ elimination, the rate of reaction depends only upon heterolysis step, since every carbocation formed goes rapidly on to the product, that is, loss of a proton is much faster than regeneration of substrate. Here that is not the case for carbocations that are formed reversely from the protonated alcohol, and every so often one looses a proton to yield an alkene. Where the structure of alkyl group permits, rearrangement takes place. The initially formed carbocation rearranges to a more stable carbocation. The alkenes obtained are those formed by a loss of proton from this rearranged carbocation as well as from the original one.
When more than one alkene can be formed the preferred product is the more stable one. Another factor comes in here. Since dehydration is reversible, the composition of the product does not necessarily reflect which alkene is formed faster but depending upon hoe nearly reaction approaches equilibrium which alkene is more stable.

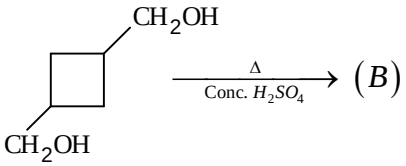
14. When neopentyl alcohol, $(CH_3)_3CCH_2OH$ is heated with an acid, it is slowly converted to a 85:15 mixture of two alkenes of formula C_5H_{10}. The 85 % of these alkene is

a) $H_3C-\underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}}=CH_2$ b) $H_3C-\underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}}-CH=CH_2$ c) $H_3C-\underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}}=CH-CH_3$ d) $H_2C=\underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}}-CH_2\text{-}CH_3$

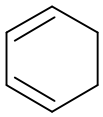
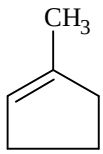
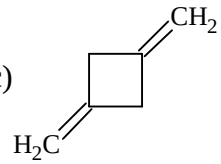
15. 

The product (A) is

a)  b)  c)  d) None

16. 

The product (B) is

a)  b)  c)  d) None

---------- ROUGH WORK ----------

PART - B

MATCH THE MATRIX:

1. Match the following:

COLUMN – I		COLUMN - II	
(1)	$C(H_3C)_3-CH=CH_2 \rightarrow (H_3C)_2C(OH)-CH(CH_3)_2$	(A)	$B_2H_6 + H_2O/OH^-$
(2)	$C(H_3C)_3-CH=CH_2 \rightarrow (H_3C)_3C-CH(OH)-CH_3$	(B)	$O_3 + Zn/H_2O$
(3)	$H_5C_6-CH=CH_2 \rightarrow C_6H_5-CHO$	(C)	$Hg(OAc)_2/H_2O + NaBH_4/OH^-$
(4)	$H_5C_6-CH=CH_2 \rightarrow C_6H_5-CH_2-CH_2OH$	(D)	H_2O/H^+

2. Match the following:

COLUMN – I (Substrate for elimination reaction)		COLUMN – II (Type of elimination)	
(1)	$Me-CH(CH_3)-CH_2-CH_3$ $Me-C(=O)-O$ $\xrightarrow[\text{temp.}]{\text{High}}$	(A)	E1
(2)	$H_3C-C(OH)(CH_3)-CH_2-CH_3 \xrightarrow{H^{\oplus}/\Delta}$	(B)	E2
(3)	$H_3C-CH_2-CH(Br)-CH_3 \xrightarrow[KOH]{\text{Alc.}}$	(C)	Pyrolysis
(4)	$H_3C-CH_2-CH(F)-CH_3 \xrightarrow[KOH]{\text{Alc.}}$	(D)	Saytzeff product is major
		(E)	Hoffmann product is major

ROUGH WORK