Date: 12.01.2022 **CODE: 100479.0** **SET – A**

FIITJEE Internal test

PINNACLE 1ST YEAR (2021-2023)

PHASE – 4 (JEEM–12)

Time : 3 hours **Maximum Marks: 300**

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 – D

ii) **PART – A** contains 20 multiple choice questions. Each question has 4 choices a, b, c and d, out of which are **single answer correct**.

iii) **PART – D** contains 5 numerical type questions. The answer to each of the questions is a decimal answer or numerical. **THE ANSWER SHOULD HAVE ONLY UPTO 2 PLACES AFTER DECIMAL**.

B. Marking scheme :

i) For each question in **PART- A,** you will be awarded **4 Marks** if you have 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- D**, you will be **awarded 4 marks** if you have darkened only the bubble corresponding to the correct answer and **zero mark** if no bubble is darkened. 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. Let $f(x)=\begin{cases}1+x, & x\in[0,2]\\ 3-x, & x\in(2,3]\end{cases}$. Suppose $g(x)=f(f(x))$ then
   a) $g(x)$ is discontinuous only at $x=1$
   b) $g(x)$ is discontinuous only at $x=2$
   c) $g(x)$ is discontinuous at both $x=1$ and $x=2$
   d) $g(x)$ is continuous everywhere

2. Which of the following function is differentiable at $x=0$?
   a) $|x|$ b) $|\sin x|$ c) $\cos|x|$ d) $\sin|x|$

3. Let $f(x)=(\sin\pi x)|x-1||x-2|$. Then
   a) $f(x)$ is Not differentiable at $x=1$ b) $f(x)$ is Not differentiable at $x=2$
   c) $f(x)$ is Not differentiable at $x=0,1,2$ d) $f(x)$ is Differentiable everywhere

4. $f(x)=\begin{cases}x^2+ax+1, & x\text{ is Rational}\\ ax^2+2x+b, & x\text{ is Irrational}\end{cases}$. If $f(x)$ is continuous at $x=1$ and $x=2$. Then a and b equals
   a) $a=\frac{1}{2}, b=0$ b) $a=0, b=\frac{1}{2}$ c) $a=b=\frac{1}{2}$ d) $a=\frac{1}{2}, b\in R$

5. If a function $f(x)$ is differentiable at $x=2$ then which is FALSE ?
   a) $\lim\limits_{h\to0}\frac{f(2+h)-f(2)}{h}$ must exist and is finite
   b) $\lim\limits_{h\to0}\frac{f(2+h)-f(2-h)}{h}$ must exist and is finite
   c) $\lim\limits_{h\to0} f(2+h)-f(2)=0$
   d) $\lim\limits_{h\to0} f(2+h)-f(2)\neq0$

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

6. The number of points of Non-Differentiability of $f(x)=\left|x^2+ex+\pi\right|$ is

a) 4 b) 2 c) 1 d) 0

7. If $f(x)=\begin{cases}\dfrac{x-|x|}{x} & ,\text{when } x<0\\ 5x^2+a & ,\text{when } 0\le x\le 1\\ b\left(\dfrac{x^2-1}{x^2-3x+2}\right) & ,\text{when } 1<x<3\\ -14 & ,\text{when } x\ge 3\end{cases}$ is a continuous function on IR, then $(a,b)=$

a) $\left(2,-\frac{7}{2}\right)$ b) $(2,-14)$ c) $\left(-\frac{7}{2},-14\right)$ d) $(2,7)$

8. Let $f:IR\to IR$ be the function defined by $f(x)=\begin{cases}5 & ,\text{ if } x\le 1\\ a+bx & ,\text{ if } 1<x<3\\ b+5x & ,\text{ if } 3\le x<5\\ 30 & ,\text{ if } x\ge 5\end{cases}$ then f is

a) continuous if $a=5$ and $b=5$ b) continuous if $a=0$, $b=5$

c) continuous if $a=-5, b=10$ d) not continuous for any value of a and b

9. If $f:R\to R$ is defined by $f(x)=\begin{cases}\dfrac{1+3x^2-\cos 2x}{x^2}, & for \quad x\ne 0\\ k, & for \quad x=0\end{cases}$ is continuous at $x=0$, then $k=$

a) 1 b) 5 c) 6 d) 0

10. The value of $f(\pi)$ so that $f(x)=\dfrac{1-\cos 7(x-\pi)}{x-\pi}$ is continuous at the point $x=\pi$ is

a) 0 b) 1 c) π d) $\frac{\pi}{2}$

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

11. If $f:R\to R$ is defined by $f(x)=\begin{cases}\dfrac{\cos 3x-\cos x}{x^2} & \text{for} \quad x\neq 0\\ \lambda & \text{for} \quad x=0\end{cases}$ and if f is continuous at $x=0$, then $\lambda=$

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

12. Consider $f(x)=\dfrac{x^2}{|x|},\ x\neq 0,\ f(x)=0, x=0$

a) $f(x)$ is discontinuous at every $x\in R$ b) $f(x)$ is continuous at every $x\in R$

c) $f'(x)$ exists in $(-1, 1)$ d) $f'(x)$ exists in $(-2, 2)$

13. The function $f(x)=(x^2-1)|x^2-3x+2|+\cos|x|$ is not differentiable at

a) -1 b) 0 c) 1 d) 2

14. Let $f(x)=\min\{x, x^2\}$, for every real x. Then

a) f is continuous for all x b) f is differentiable for all x

c) $f'(x)=0\ \forall\ x>1$ d) f is differentiable at 0, 1

15. If $f(x)=\dfrac{\sin\left(e^{x-2}-1\right)}{\ln(x-1)},\ x\neq 2$ is continuous at $x=2$, then $f(2)=$

a) 0 b) 2 c) 1 d) -2

16. If p and q are number of points of discontinuous and non-differentiable respectively, of the function $f(x)=[2+3\sin x]$, where $x\in(-\pi, 2\pi)$, then the value of $p+q$ is (where $[x]$ is GIF)

a) 34 b) 32 c) 30 d) 28

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

17. If $f(x)=\begin{cases} e^x & \text{for } x<1 \\ a-bx & \text{for } x\geq 1 \end{cases}$ is differentiable for $x\in R$, then

a) $a=1,\ b=e-1$ b) $a=0,\ b=e$ c) $a=0,\ b=-e$ d) $a=e,\ b=1$

18. Which of the following statements are TRUE about a function $f:R\to R$ (where $a\in R$)

a) f is continuous at $x=a \Rightarrow f$ is differentiable at $x=a$

b) f is differentiable at $x=a \Rightarrow f$ is continuous at $x=a$

c) f is not differentiable at $x=a \Rightarrow f$ is not continuous at $x=a$

d) f is not continuous at $x=a \Rightarrow f$ is differentiable at $x=a$

19. The number of non-differentiable points of $f(x)=|\sin 2x|$ where $x\in(0,2\pi)$ is

a) 0 b) 1 c) 3 d) 4

20. $f(x)=x+|x|$. Then f is

a) Differentiable at all $x\in R$

b) Differentiable at all $x\in R$ except at one point

c) Differentiable at all $x\in R$ except at two points

d) Differentiable at all $x\in R$ except at three points

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

PART - D

NUMERICAL ANSWER TYPE:

1. If the function $f:IR\to IR$ defined by $f(x)=\begin{cases} a\left(\dfrac{1-\cos 2x}{x^2}\right) & ,\text{for} \quad x<0 \\ b & ,\text{for} \quad x=0 \\ \dfrac{\sqrt{x}}{\sqrt{4+\sqrt{x}}-2} & ,\text{for} \quad x>0 \end{cases}$ is continuous at $x=0$, then $a+b=k$, then the value of $\dfrac{20k}{9}$ is

2. The number of points in the interval $(0,\ 2)$ at which $f(x)=|x-0.5|+|x-1|+\tan x$ is not differentiable is p then the value of $\dfrac{20p}{8}$ is

3. Define $f(x)=\begin{cases} x^2+bx+c & ,x<1 \\ x & ,x\geq 1 \end{cases}$. If $f(x)$ is differentiable at $x=1$, then $(b-c)=-p$, then the value of p^5 is

4. The number non-differentiable points of the function $f(x)=[\sin x]$ in the interval $(0,4\pi)$ is

5. Number of non-differential points of the function $f(x)=\left\{\dfrac{x}{2}\right\}$ in the interval $(0,100)$ is

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

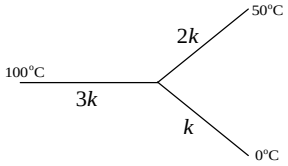
SECTION – 2

Physics

PART - A

SINGLE ANSWER CORRECT:

1. Three rods of identical dimensions have thermal conductivities 3k, 2k and k, their arrangement and temperatures are shown. Temperature at their junction is



a) $\frac{200}{3}\,^{o}C$ b) $\frac{200}{4}\,^{o}C$ c) $\frac{200}{5}\,^{o}C$ d) $\frac{200}{6}\,^{o}C$

2. A semicircular rod is joined at its ends to a rod of same material and same cross-sectional area. Their junctions are maintained at different temperatures. The ratio of heat current through then is
a) $1:\pi$ b) $\pi:1$ c) $2:\pi$ d) $\pi:2$

3. A rod of length 1 m, cross sectional are $4\,cm^2$ and thermal conductivity 42 J/ms ^{o}C is used to melt ice. One end of the rod is placed in boiling water and other in ice. The mass of ice melt in one day is
a) 216 g b) 432 g c) 648 g d) 864 g

4. Two spheres of same material and radius 1 : 4 has surface temperatures in the ratio 2 : 1. The ratio of their power radiation is
a) $\frac{1}{4}$ b) $\frac{1}{2}$ c) 1 d) 4

5. A body cools from $50^{o}C$ to $40^{o}C$ in 5 min in a surrounding of $20^{o}C$. Temperature of the body after another 5 min would be about
a) $\frac{100}{6}$ b) $\frac{100}{3}$ c) 200 d) $\frac{200}{3}$

6. Two stars has maximum spectral emissive power at wavelengths $4000\,A^{o}$ and $5000\,A^{o}$. Ratio of their surface temperatures is
a) 4 : 5 b) 5 : 4 c) 16 : 25 d) 25 : 16

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

7. A metal sphere of radius 10 cm, emissivity 0.1 and temperature $127^{o}C$ is placed in a surrounding of temperature $27^{o}C$. The initial rate of loss of heat by the sphere is
a) 3 W b) 7.5 W c) 12.5 W d) 19 W

8. It takes 5 min cool a liquid from $70^{o}C$ to $60^{o}C$ in a surrounding of $30^{o}C$. The additional time taken to cool it to $50^{o}C$ is
a) 5 min b) 6 min c) 7 min d) 8 min

9. Temperature of a metal sphere is maintained at 500 K, in an evacuated chamber at 300 K, with the help of a power source of 210 W. When the metal sphere is completely blackened then it requires a power of 700 W to maintain same temperature. Emissivity of that metal is
a) 0.3 b) 0.4 c) 0.5 d) 0.6

10. A body takes 30s to cool down from $60^{o}C$ to $55^{o}C$ when weather temperature is $45^{o}C$. Time taken by the body to cool down from $55^{o}C$ to $50^{o}C$ is about
a) 30 s b) 40 s c) 50 s d) 60 s

11. Two cylindrical rods of same material has ratio of length 2 : 1 and ratio of diameters is 1 : 2. If temperature difference along their lengths is same, then the ratio of heat current through them is
a) 1 : 1 b) 1 : 2 c) 1 : 4 d) 1 : 8

12. Two identical rods, when welded in series, carry 20 cal of heat at a particular temperature difference. If they are now welded in parallel, then the time taken to carry same amount of heat at same temperature difference is
a) 1 min b) 2 min c) 4 min d) 8 min

13. A wall of two layers of same thickness has ratio of conductivity 2 : 1. At steady state, temperature difference across the wall is $36^{o}C$, then temperature difference across the layer of higher conductivity is
a) $6^{o}C$ b) $12^{o}C$ c) $18^{o}C$ d) $24^{o}C$

14. A slab consists of two parallel layers of copper and brass of same thickness having ratio of thermal conductivities 4 : 1. If free face of copper and brass are kept at $0^{o}C$ and $100^{o}C$ respectively then temperature of the interface is
a) $20^{o}C$ b) $40^{o}C$ c) $60^{o}C$ d) $80^{o}C$

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

15. It takes 6 h to grow ice from 0 to 1 cm on a lake when atmospheric temperature is $-10^{o}C$. The time taken to grow thickness of ice from 1 cm to 2 cm is
a) 6 h b) 12 h c) 18 h d) 24 h

16. The ratio of lengths of two rods is 1 : 2 and the ratio of coefficient of expansions is 2 : 3. The first rod is heated through $60^{o}C$. Find the temperature through which the second rod is to be heated so that its expansion is twice that of first is
a) $60^{o}C$ b) $40^{o}C$ c) $30^{o}C$ d) $10^{o}C$

17. A wire of length 60 cm is bent into a circle with a gap of 1 cm at its ends. On heating it by $100^{o}C$, the length of the gap increases to 1.02 cm. α of material of wire is
a) $2\times10^{-4}/^{o}C$ b) $4\times10^{-4}/^{o}C$ c) $6\times10^{-4}/^{o}C$ d) $1\times10^{-4}/^{o}C$

18. A metal metre scale gives correct measurement at $0^{o}C$. It is generally used at a temperature of $40^{o}C$. The correction to be made for every metre is ($\alpha=10^{-6}/1^{o}C$)
a) 4×10^{-5}m b) 4×10^{-5}m to be added
c) 4×10^{-5}m must be deducted d) None of the above

19. A metal rod has a length of 1 m at $30^{o}C$. α of metal is $2.5\times10^{-5}/^{o}C$. The temperature at which it will be shortened by 1 mm is
a) $-30^{o}C$ b) $-40^{o}C$ c) $-10^{o}C$ d) $10^{o}C$

20. Density of a substance at $0^{o}C$ is 10.6 gm/c.c. and at $100^{o}C$ is 10 gm/c.c. coefficient of linear expansion of solid is
a) $0.0006/^{o}C$ b) $0.0004/^{o}C$ c) $0.0003/^{o}C$ d) $0.0002/^{o}C$

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

PART - D

NUMERICAL ANSWER TYPE:

1. Three metal rods of same lengths and same area of cross section having conductivities 1, 2, 6 units are connected in series. Then their effective conductivity will be *x* units, the value of *x* is

2. A body takes 8 minutes to cool from $90^{o}C$ to $80^{o}C$ in a surrounding of temperature $25^{o}C$. The time taken by it to cool from $80^{o}C$ to $70^{o}C$ in the same surroundings is in minutes

3. If the co-efficient of cubical expansion is *x* times co-efficient of superficial expansion then the value of *x* is

4. Up on heating, the length of the side of a cube changes by 2%. The volume of cube changes by *x* %, the value of *x* is

5. In steady state condition, the temperatures at the two ends of a metal rod of length 25 cm are $100^{o}C$ and $0^{o}C$. Then temperature at a point 8 cm from the hot end is __ ^{o}C

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

SECTION – 3

Chemistry

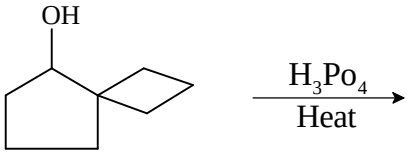
PART - A

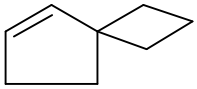
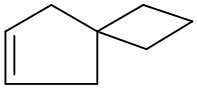
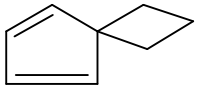
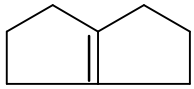
SINGLE ANSWER CORRECT:

1. How many different alkenes are formed when 2 – chlorobutane is treated with ethanolic solution of KOH ?

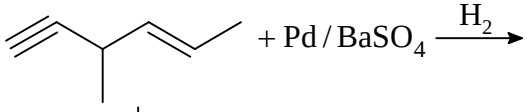
   a) 1 b) 2 c) 3 d) 4

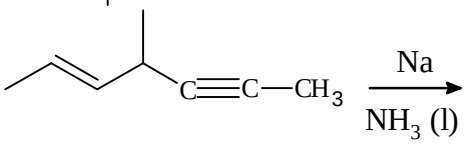
2. What is the major dehydration product for the following reaction :

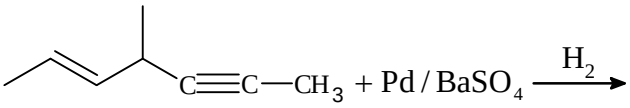


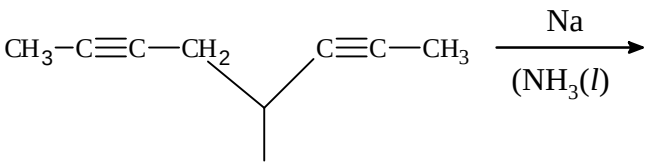
a)  b)  c)  d) 

3. Which of the following compounds will lose optical activity after the reaction.

a) 

b) 

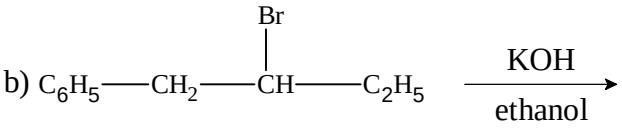
c) 

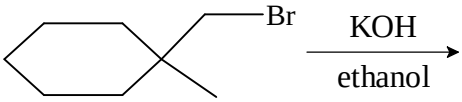
d) 

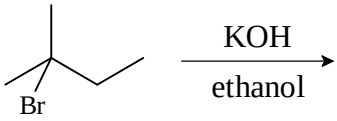
---------- ROUGH WORK ----------

4. In which of the following reactions only single isomer of alkene is formed ?

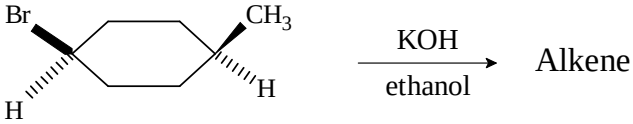
a) $C_6H_5—CH_2—CH_2—CH_2—Br \xrightarrow[\text{ethanol}]{KOH}$

b) 

c) 

d) 

5. Consider the following reaction



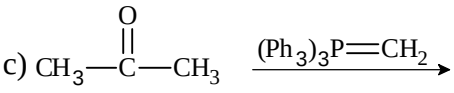
The correct statement concerning product of the above reaction is

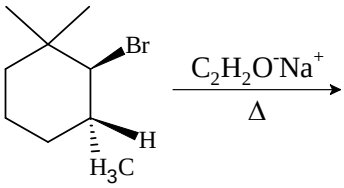
a) only single alkene is formed
b) a pair of geometrical isomers are formed
c) a pair of enantiomers in equal amounts is formed
d) a pair of diastereomers in equal amount is formed

6. Which of the following reactions cannot produce an alkene

a) $CH_3—CH_2—OH \xrightarrow[\Delta]{Conc.\ H_2SO_4}$

b) $CH_3—CH_2—OH \xrightarrow[\Delta]{Al_2O_3}$

c) 

d) 

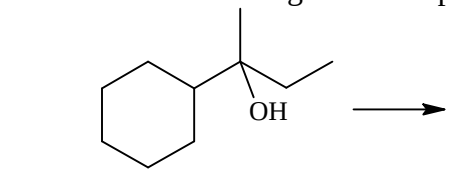
7. What is the major product of the reaction given below : ?

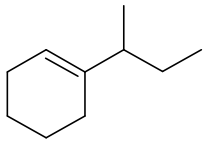
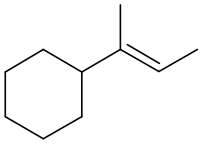
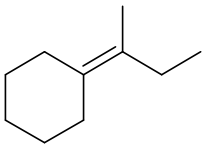
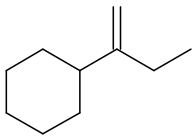
meso – 2, 3 – dichlorobutane $+NaI_{(aq)} \xrightarrow{acetone}$

a) cis – 2 – butene b) 1, 3 – butadiene c) trans – 2 – butene d) 1 – butene

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

8. Which of the following is not the product of dehydration of



a)  b)  c)  d) 

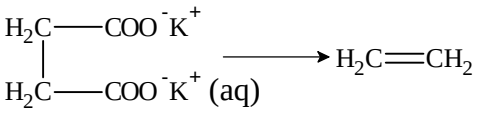
9. In the reaction below X is

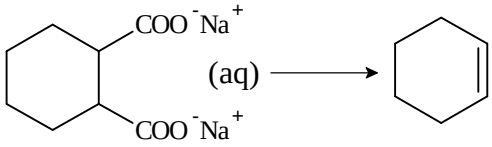
Neopentyl alcohol $\xrightarrow{H_2SO_4}$ X

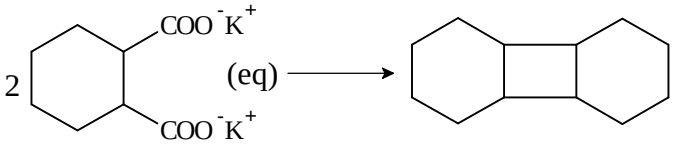
a) 2 – methyl pentane b) 2 – methyl pent – 2 – ene

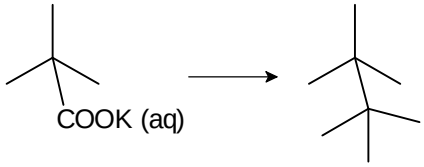
c) 2 – methylbut – 2 – ene d) Neopentane

10. Which of the following reactions is incorrect for Kolbe's electrolysis ?

a) 

b) 

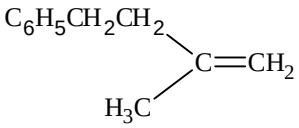
c) 

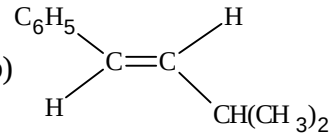
d) 

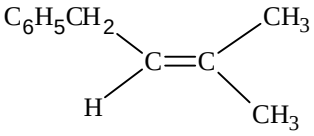
---------- ROUGH WORK ----------

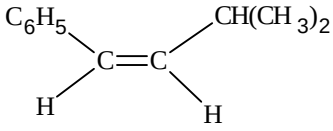
11. The main product of the following reaction is

$$C_6H_5CH_2CH(OH)CH(CH_3)_2 \xrightarrow{\text{Conc. } H_2SO_4}$$

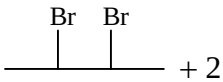
a) 

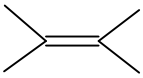
b) 

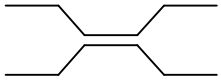
c) 

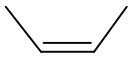
d) 

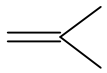
12. Trans 2 – Phenyl – 1 – bromo cyclopentane on reaction with alcoholic KOH produces.
a) 4 – phyenyl cyclopentene b) 2 – phenyl cyclopentene
c) 1 – phenyl cyclopentene d) 3 – phenyl cyclopentene

13.  $+ 2\ NaI \xrightarrow{\text{acetone}} B$ then B is

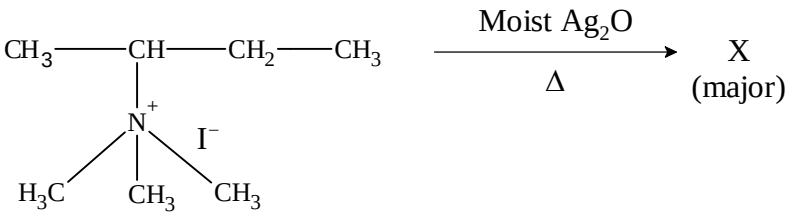
a) 

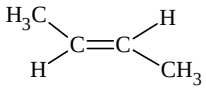
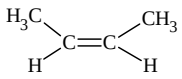
b) 

c) 

d) 

14. Which of the following statements is incorrect ?
a) $3^{o}R-X > 2^{o}R-X > 1^{o}(R-X)$ $[E_1 \text{ (or) } E_2]$
b) rate $\propto [R-X]$ (Unimolecular elimination)
c) rate $\propto [R-X][OH^-]$ (Bimolecular elimination)
d) $I^- < Br^- < Cl^-$ (Leaving ability)

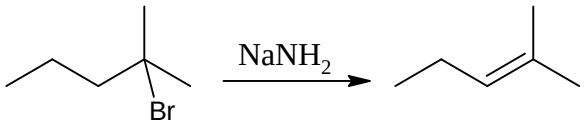
15. 

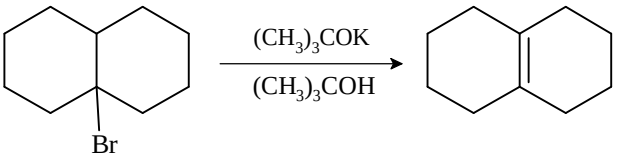
a) $H_2C{=}CH_2$ b)  c)  d) $CH_2=CH-CH_2-CH_3$

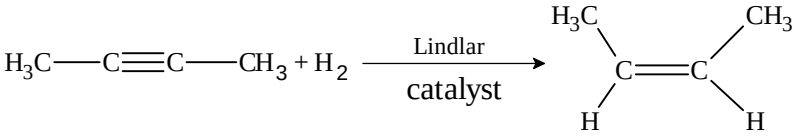
---------- ROUGH WORK ----------

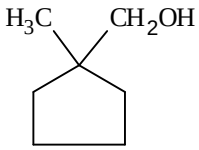
16. Which of the following reaction is incorrect ?

a) $CH_3 - CHBr_2 + 2Zn + Br_2CH - CH_3 \rightarrow CH_3 - CH = CH - CH_3 + 2ZnBr_2$

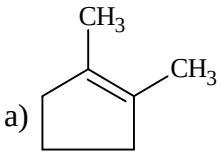
b) 

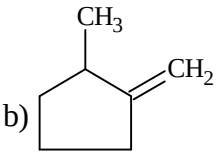
c) 

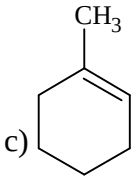
d) 

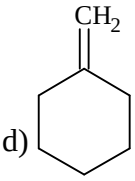
17. The major product obtained in acid catalyzed dehydration 

is

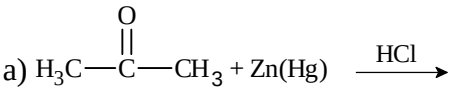
a) 

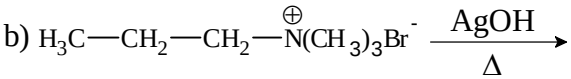
b) 

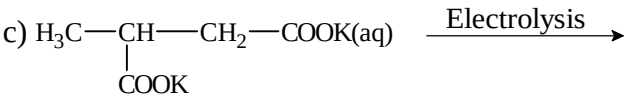
c) 

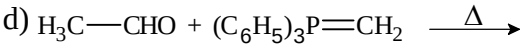
d) 

18. Which of the following reaction cannot produce propene as one of the important organic product ?

a) 

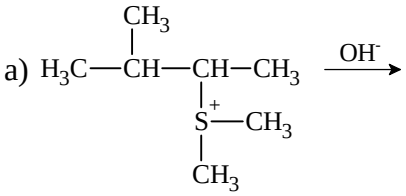
b) 

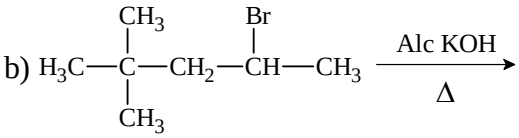
c) 

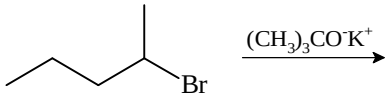
d) 

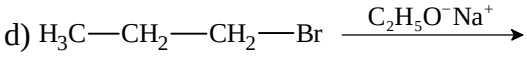
---------- ROUGH WORK ----------

19. Which of the following reaction produce saytzeff product as major ?

a) 

b) 

c) 

d) 

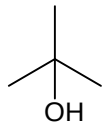
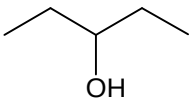
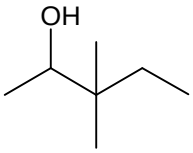
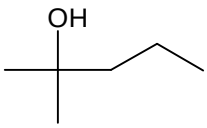
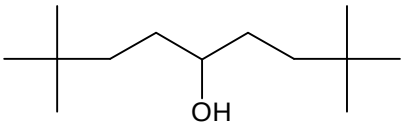
20. Correct statement for E_2 reaction is

a) It is two step process
b) Rearrangement is possible
c) Weak base is favourable
d) It is one step concerted process

PART - D

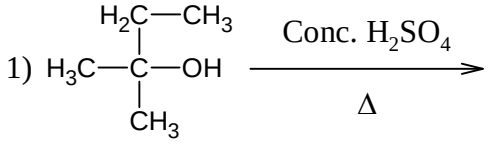
NUMERICAL ANSWER TYPE:

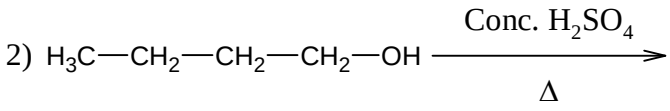
1. How many of the following alcohols can undergo dehydration faster than C_2H_5OH .

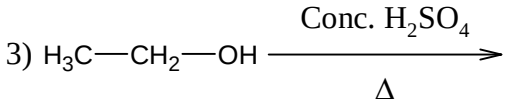
(a) 
(b) 
(c) 
(d) 
(e) 

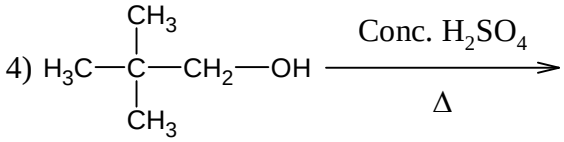
---------- ROUGH WORK ----------

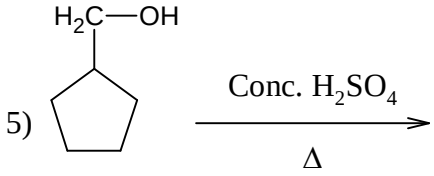
2. How many of the following reactions are produce alkene ?

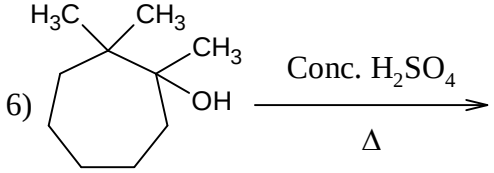
1) 

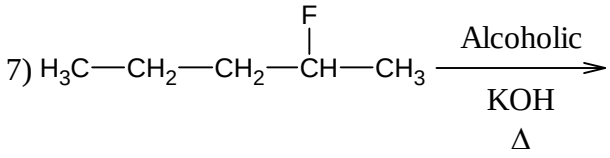
2) 

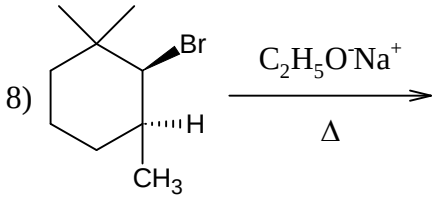
3) 

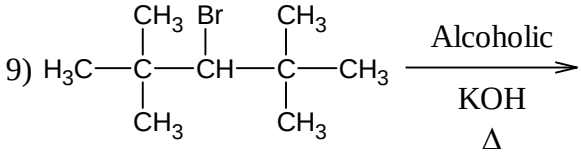
4) 

5) 

6) 

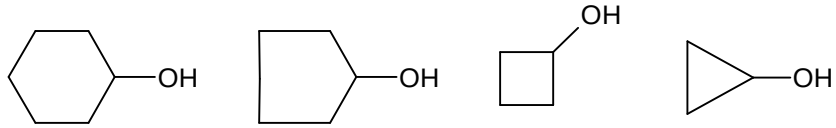
7) 

8) 

9) 

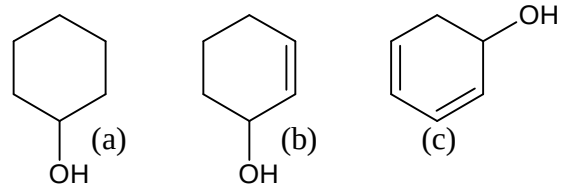
---------- ROUGH WORK ----------

3. How many of the following statements is/are correct ?

a) 

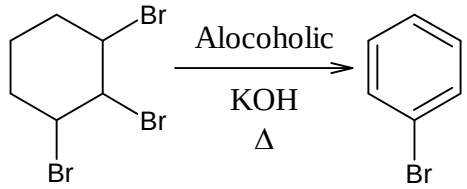
(P) (Q) (R) (S)

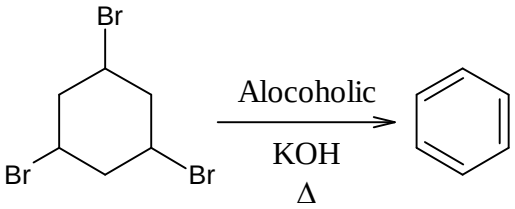
P > Q > R > S [Dehydration rate]

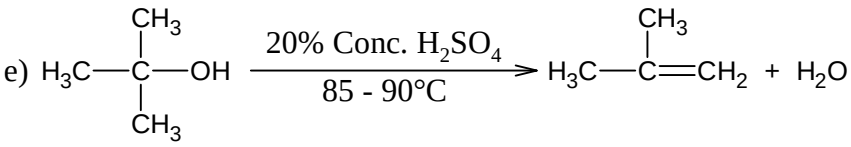
b) 

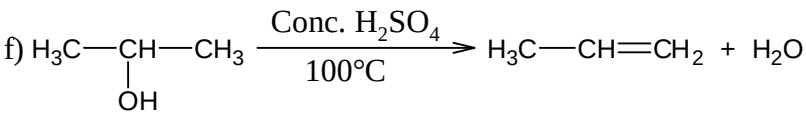
(a) (b) (c)

c < b < a

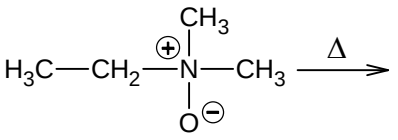
c) 

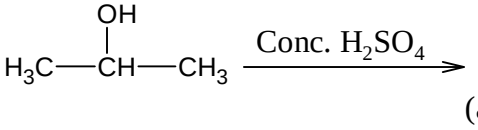
d) 

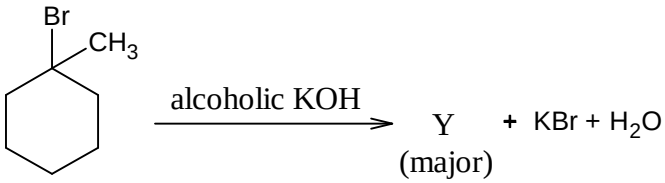
e) 

f) 

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

4.  X is alkene. Find $Y = \frac{M.W\ of\ X}{7} + 11.28$.

5. 
(alkene)


(major)

No. of αH hydrogen in X (major) + No. of α hydrogen in Y (major) + 0.58

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