

PHYSICS, CHEMISTRY & MATHEMATICS

Pattern - 1

QP Code:

TEST - 1

Time Allotted: 3 Hours

Maximum Marks: 198

- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.
- You are not allowed to leave the Examination Hall before the end of the test.

INSTRUCTIONS

Caution: Question Paper CODE as given above MUST be correctly marked in the answer OMR sheet before attempting the paper. Wrong CODE or no CODE will give wrong results.

A. General Instructions

1. Attempt ALL the questions. Answers have to be marked on the OMR sheets.
2. This question paper contains **Three Sections**.
3. **Section-I** is Physics, **Section-II** is Chemistry and **Section-III** is Mathematics.
4. Each **Section** is further divided into **Two Parts: Part-A & B** in the OMR.
5. Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
6. Blank Papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices, in any form, are not allowed.

B. Filling of OMR Sheet

1. Ensure matching of OMR sheet with the Question paper before you start marking your answers on OMR sheet.
2. On the OMR sheet, darken the appropriate bubble with HB pencil for each character of your Enrolment No. and write in ink your Name, Test Centre and other details at the designated places.
3. OMR sheet contains alphabets, numerals & special characters for marking answers.

C. Marking Scheme For All Two Parts.

- (i) **Part-A (01-06)** – Contains six (06) multiple choice questions which have **ONLY ONE CORRECT** answer. Each question carries **+3 marks** for correct answer and **-1 marks** for wrong answer.
- (ii) **Part-A (07-12)** – Contains seven (06) multiple choice questions which have **One or More** correct answer.
Full Marks: +4 If only the bubble(s) corresponding to all the correct option(s) is (are) darkened.
Partial Marks: +1 For darkening a bubble corresponding to **each correct option**, provided **NO** incorrect option is darkened.
Zero Marks: 0 If none of the bubbles is darkened.
Negative Marks: -1 In all other cases.
For example, if **(A), (C) and (D)** are all the correct options for a question, darkening all these three will result in **+4 marks**; darkening only **(A) and (D)** will result in **+2 marks**; and darkening **(A) and (B)** will result in **-1 marks**, as a wrong option is also darkened.
- (ii) **Part-B (01-06)** contains Six (06) Numerical based questions, the answer of which maybe positive or negative numbers or decimals (e.g. 6.25, 7.00, -0.33, -30, 30.27, -127.30) and each question carries **+4 marks** for correct answer and **there will be no negative marking**.

Name of the Candidate : _____

Batch : _____ Date of Examination : _____

Enrolment Number : _____

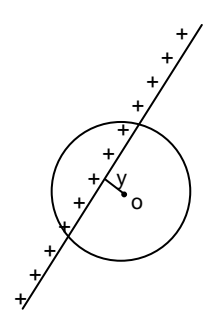
BATCHES – 2022 Batches (B – lot)

SECTION-1 : PHYSICS

PART – A

(Single Correct Choice Type)

This section contains **6 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

1. A dipole of moment $\vec{p} = 10^{-7} (5\hat{i} + \hat{j} - 2\hat{k})$ cm is placed in an electric field $\vec{E} = 10^{-7} (5\hat{i} + \hat{j} - 2\hat{k})$ V m⁻¹. Find the torque experienced ?
 (A) 8.6 N – m (B) 5.6 N – m (C) 0 N – m (D) 6.8 N – m
1. C
2. A charge q is placed at the centre of the line joining two equal charges Q. The system of the three charges will be in equilibrium if q is equal to:
 (A) $-\frac{Q}{2}$ (B) $-\frac{Q}{4}$ (C) $+\frac{Q}{4}$ (D) $+\frac{Q}{2}$
2. B
3. A cylinder of radius r and length ℓ is placed in an uniform electric field E parallel to the axis of cylinder. Total electric flux through surface of cylinder is
 (A) $2\pi r\ell E$ (B) $\pi r^2 E$
 (C) $(2\pi r\ell + \pi r^2)E$ (D) Zero
3. D
4. The potential on the surface of a spherical conductor of radius 3 m is 6V. The potential at centre is
 (A) Zero (B) 2 V
 (C) 6 V (D) 18 V
4. C
5. A uniformly charged and infinitely long line having a linear charge density ' λ ' is placed at a normal distance y from a point O. Consider a sphere of radius R with O as centre and $R > y$. Electric flux through the surface of the sphere is
 (A) zero (B) $\frac{2\lambda R}{\epsilon_0}$
 (C) $\frac{2\lambda\sqrt{R^2 - y^2}}{\epsilon_0}$ (D) $\frac{\lambda\sqrt{R^2 + y^2}}{\epsilon_0}$

5. **C**
6. A point body of mass of 2g and 2μC charge, on being released from rest, move through a potential difference 1000V. What will be the velocity acquired by the body is
 (A) 2m/s (B) $\sqrt{2}$ m/s
 (C) 1/2 m/s (D) $\frac{1}{\sqrt{2}}$ m/s
6. B

(Multi Correct Choice Type)

This section contains 6 **multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

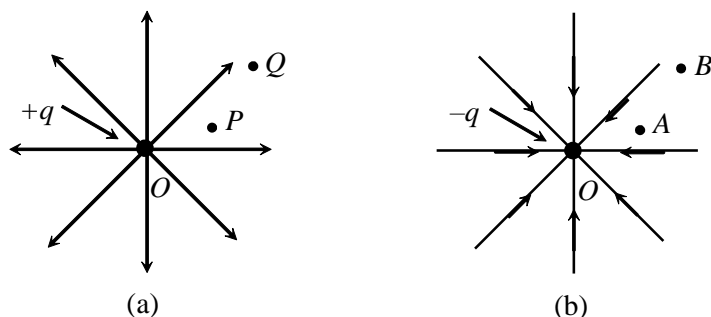
7. Two capacitors of capacitance $3 \mu\text{F}$ and $6 \mu\text{F}$ are charged to a potential of 12 V each. They are now connected to each other, with the positive plate of one to the negative plate of the other. Then
- (A) the potential difference across $3 \mu\text{F}$ is zero
 (B) the potential difference across $3 \mu\text{F}$ is 4 V
 (C) the charge on $3 \mu\text{F}$ is zero
 (D) the charge on $3 \mu\text{F}$ is $12 \mu\text{C}$

7. **BD**

8. A non-conducting solid sphere of radius R is uniformly charged. The magnitude of the electric field due to the sphere at a distance r from its centre
- (A) Increases as r increases for $r < R$
 (B) decreases as r increases for $0 < r < \infty$
 (C) decreases as r increase for $R < r < \infty$
 (D) is discontinuous at $r = R$

8. **AC**

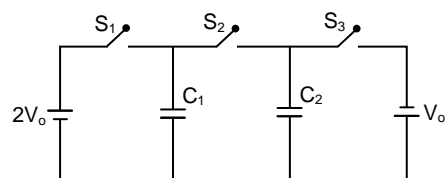
9. Figures shows the lines of force of the electric field of a positive charge ($+q$) and a negative charge ($-q$) respectively. Which of the following statements are correct?



- (A) potential at P is greater than that at Q.
 (B) potential at A is greater than that at B.
 (C) potential at P is less than that at Q.
 (D) potential at B is greater than that at A.

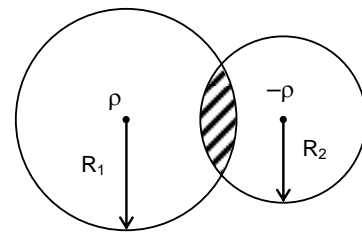
9. **AD**

10. In the circuit shown in the figure, there are two parallel plate capacitors each of capacitance C . The switch S_1 is pressed first to fully charge the capacitor C_1 and then released. The switch S_2 is then pressed to charge the capacitor C_2 . After some time, S_2 is released and then S_3 is then pressed. After some time
- (A) the charge on the upper plate of C_1 is $2CV_0$.
 (B) the charge on the upper plate of C_1 is CV_0 .
 (C) the charge on the upper plate of C_2 is 0 .
 (D) the charge on the upper plate of C_2 is $-CV_0$.



10. **BD**

11. Two non-conducting spheres of radii R_1 and R_2 and carrying uniform volume charge densities $+\rho$ and $-\rho$, respectively, are placed such that they partially overlap, as shown in the figure. At all points in the overlapping region,
- (A) the electrostatic field is zero.
 (B) the electrostatic potential is constant.
 (C) the electrostatic field is constant in magnitude.
 (D) the electrostatic field has same direction.



11. **CD**

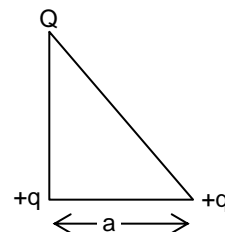
12. Three charges Q , $+q$ and $+q$ are placed at the vertices of a right angle triangle (isosceles triangle) as shown. The net electrostatic energy of the configuration is zero, if Q is equal to

(A) $\frac{-q}{1+\sqrt{2}}$

(B) $\frac{-2q}{2+\sqrt{2}}$

(C) $-2q$

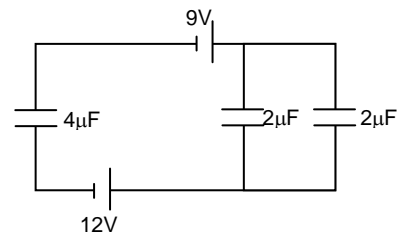
(D) $+q$



12. **B**

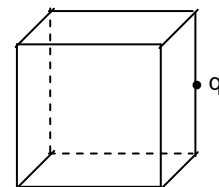
PART – B (Numerical based)

1. In the circuit shown, in steady state, Charge across $4\ \mu\text{F}$ capacitor is (in μF)



1. **6**

2. If the total flux of electric lines of forces of a charge q placed at the mid point of the edge of a side of rectangular box, as shown in figure is $\frac{q}{n\epsilon_0}$, then $n =$



2. **4**

3. A $100\ \text{pF}$ capacitor is charged to a potential difference of $24\ \text{V}$. It is connected to an uncharged capacitor of $20\ \text{pF}$. The new potential difference across the $100\ \text{pF}$ capacitor is $10\ \text{K}$ volt. Find the value of K .

3. **2**

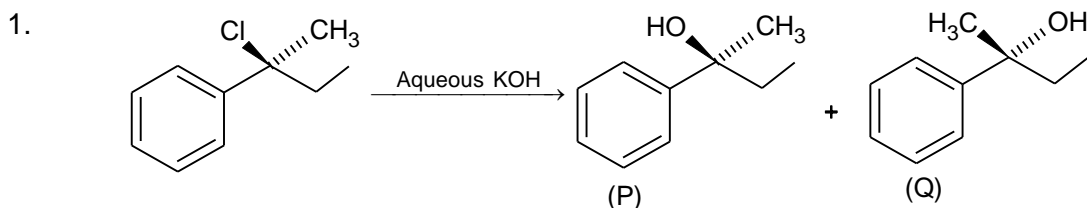
4. A solid sphere of radius R has a charge Q distributed in its volume with a charge density $\rho = kr^a$, where k and a are constants and r is the distance from its centre. If the electric field at $r = \frac{R}{2}$ is $\frac{1}{8}$ times that at $r = R$, find the value of 'a'.

4. **2**

-
5. A capacitor of capacity $C_1 = 1.0 \mu\text{F}$ withstands the maximum voltage $V_1 = 6\text{kV}$ while another capacitor of capacitance $C_2 = 2 \mu\text{F}$ withstands the maximum voltage $V_2 = 4 \text{ kV}$. What maximum voltage (In kV) will the system of these two capacitors withstand if they are connected in series?
5. **9**
6. Three identical charges are placed at corners of an equilateral triangle of side 5 m. If force between any two charges is 5 N, the work required to double the dimensions of triangle is:
6. **37.50**

SECTION-2 : CHEMISTRY**PART – A****(Single Correct Choice Type)**

This section contains **6 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

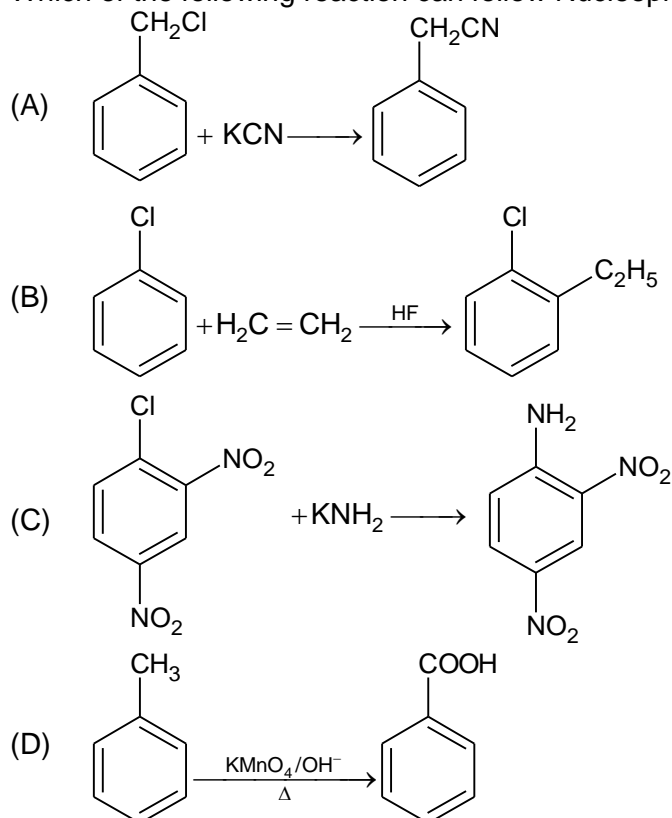


In above reaction (P) and (Q) are formed in equal quantities. Addition of which compound increases the product yield?

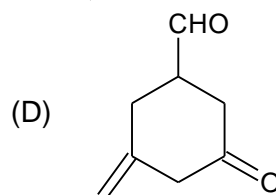
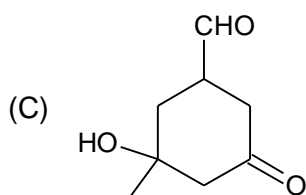
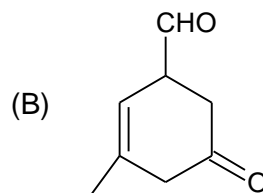
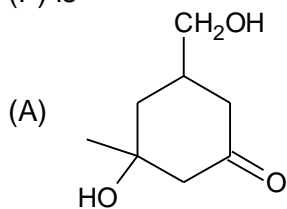
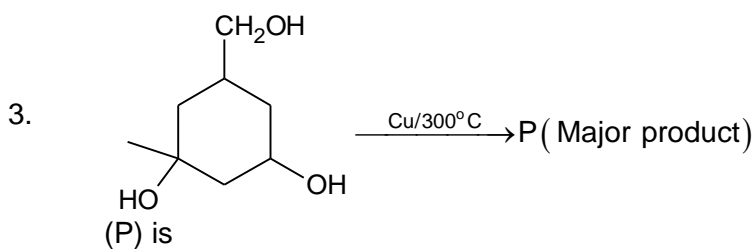
- (A) Pyridine (B) AgNO₃
(C) HCl (D) C₂H₅OH

1. B

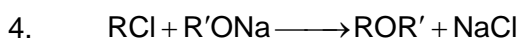
2. Which of the following reaction can follow Nucleophilic aromatic substitution mechanism?



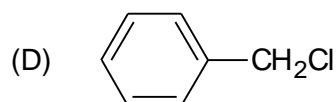
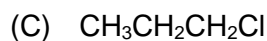
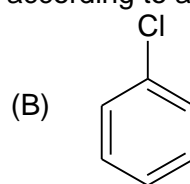
2. C



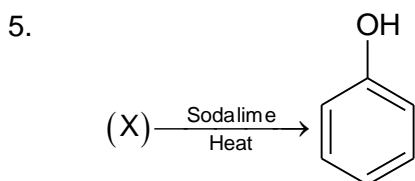
3. B



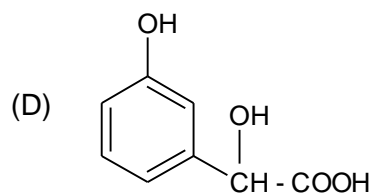
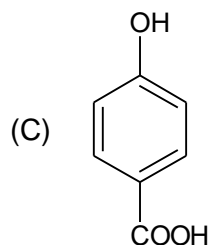
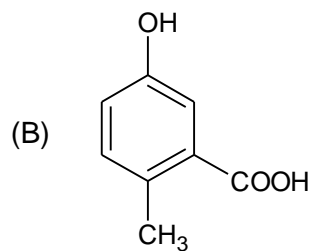
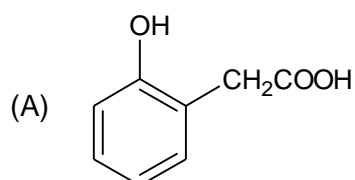
Which reactant is not used to prepare ether according to above reaction?



4. B



In above reaction, (X) is

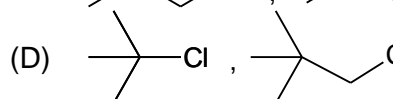
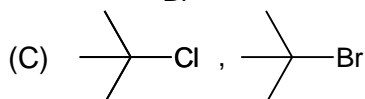
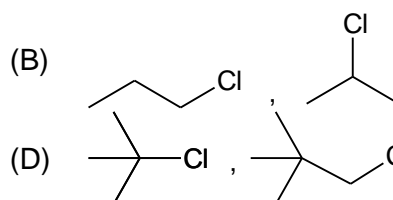
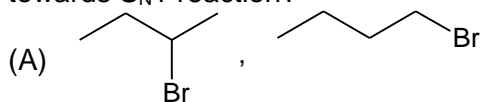


5. C
6. The incorrect statement regarding the following reaction is:
 $\text{CH}_3\text{I} + \text{KSH} \longrightarrow \text{CH}_3\text{SH} + \text{KI}$
 (A) The rate of reaction depends on the concentration of CH_3I and KSH
 (B) A reaction intermediate is formed
 (C) Carbon shows penta valency in the transition state
 (D) Reactivity order of methyl halides is
 $\text{CH}_3\text{I} > \text{CH}_3\text{Br} > \text{CH}_3\text{Cl} > \text{CH}_3\text{F}$
6. B

(Multi Correct Choice Type)

This section contains 6 **multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

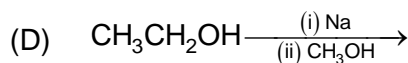
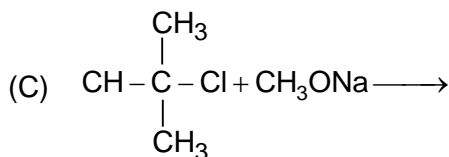
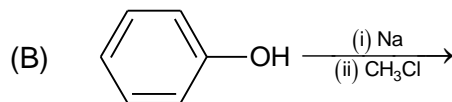
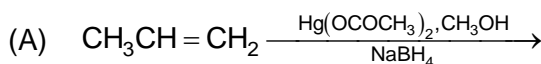
7. In which option(s), the left side compound is more reactive than the right side compound towards $\text{S}_{\text{N}}1$ reaction?



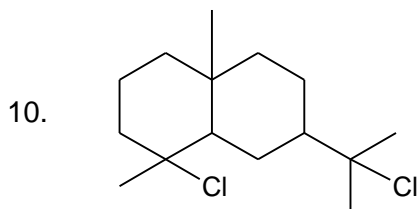
7. AD
8. Reaction of $\text{CH}_3\text{CH}_2\text{OH}$ with which of the following reagent(s) involve cleavage of O – H bond?
 (A) Na (B) CH_3MgBr
 (C) CH_3COOH (D) SOCl_2

8. ABCD

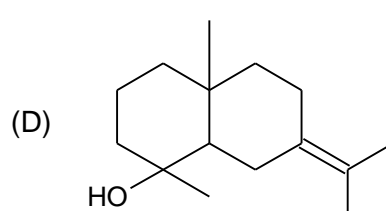
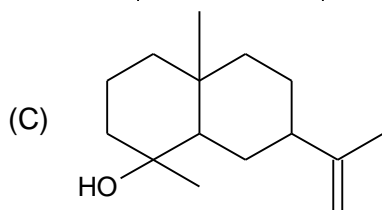
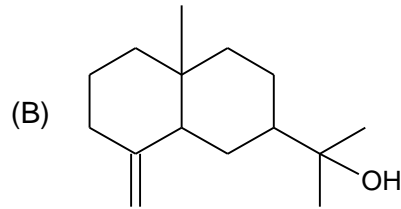
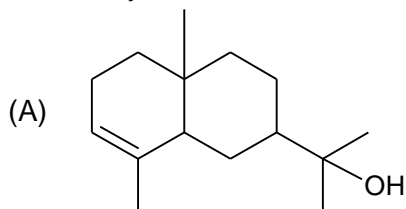
9. Which of the following reaction(s) do/does produce ether(s)?



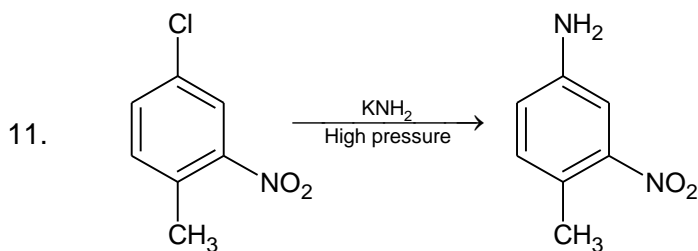
9. AB



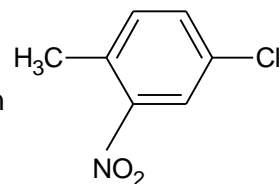
Which of the following compound(s) form(s) the above substance as the major product when they react with HCl?



10. ABCD

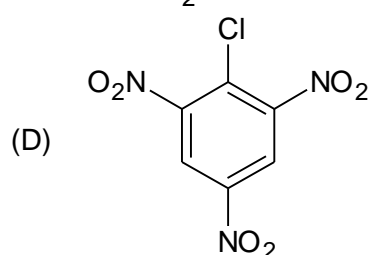
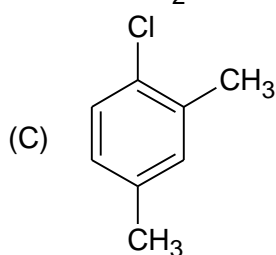
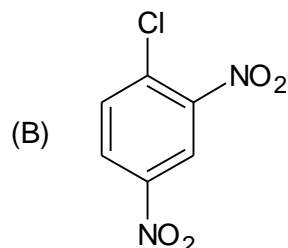
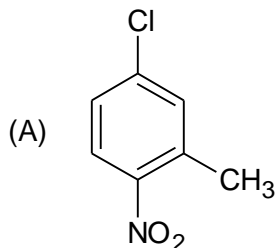


Which of the following compound(s) is/are more reactive than



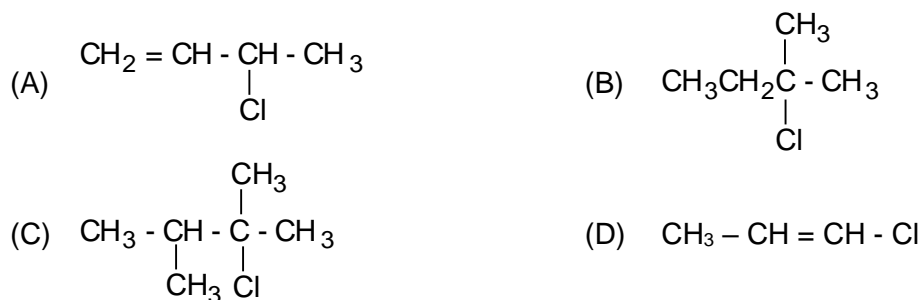
towards

above reaction?



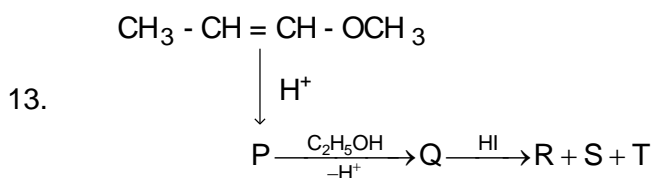
11. ABD

12. Which of the following alkyl halide(s) is/are more reactive than $\text{CH}_3\text{CH}_2\underset{\text{Cl}}{\text{CH}}\text{CH}_3$ towards 1, 2-elimination reaction in presence of alcoholic KOH?



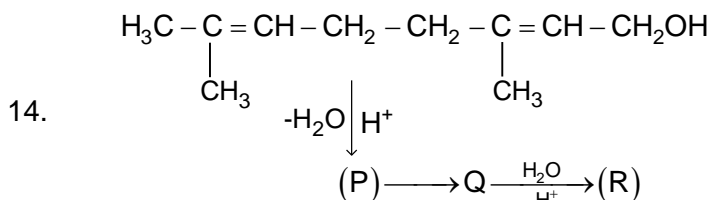
12. ABC

PART – B
(Numerical based)



P is an oxonium ion and S and T are CH_3I and $\text{C}_2\text{H}_5\text{I}$. What is the molar mass of R in g mol^{-1} unit?

13. 58

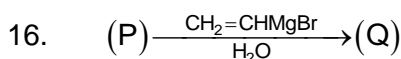


In above reaction (P) is an acyclic primary carbocation which changes to a substituted cyclohexyl tertiary carbocation(Q). The sum of the number of primary(1°) and secondary(2°) hydrogen atoms present in (R) is

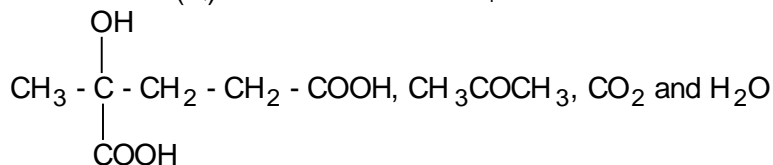
14. 15

15. An organic compound $\text{P}(\text{C}_8\text{H}_8\text{O})$ responds to FeCl_3 test and produce H_2 gas when reacts with sodium metal. Zinc dust distillation of (P) produces $\text{Q}(\text{C}_8\text{H}_8)$ which is an aromatic compound. Ozonolysis of (Q) produces benzaldehyde and another aldehyde(R)? What is the degree of unsaturation of (P)?

15. 5

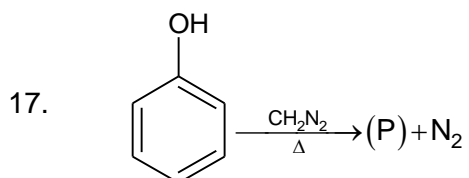


Oxidation of (Q) with acidified KMnO_4 solution forms the following compounds.



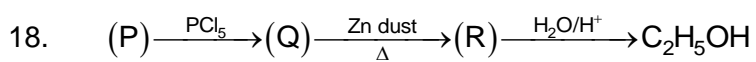
How many hydrogen atom(s) is/are present in one molecule of (P)?

16. 14



Molar mass of (P) in g mol^{-1} unit is

17. 108



What is the molar mass in g mol^{-1} unit of (P) if it contains two carbon atoms?

18. 62

SECTION-3 : MATHEMATICS

PART – A

(Single Correct Choice Type)

This section contains **6 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

1. If x is real, then value of expression $\frac{x^2 + 14x + 9}{x^2 + 2x + 3}$ lies between
 (A) 5 and 4 (B) 5 and -4
 (C) -5 and 4 (D) none of these
1. **C**
2. Let $f(x) = \sin^2 \frac{x}{2} + \cos^2 \frac{x}{2}$ and $g(x) = \sec^2 x - \tan^2 x$. The two functions are equal over the set
 (A) ϕ (B) \mathbb{R}
 (C) $\mathbb{R} - \left\{ x : x = (2n+1)\frac{\pi}{2}, n \in \mathbb{I} \right\}$ (D) none of these
2. **C**
3. Domain of definition of the function $f(x) = \frac{3}{4-x^2} + \log_{10}(x^3 - x)$, is
 (A) (1, 2) (B) $(-1, 0) \cup (1, 2)$
 (C) $(1, 2) \cup (2, \infty)$ (D) $(-1, 0) \cup (1, 2) \cup (2, \infty)$
3. **D**
4. $\lim_{x \rightarrow 0} \left(\frac{e^x + e^{-x} - 2}{x^2} \right)^{1/x^2}$ is equal to
 (A) $e^{1/2}$ (B) $e^{1/4}$
 (C) $e^{1/8}$ (D) $e^{1/12}$
4. **D**
5. If $\lim_{x \rightarrow 0} \frac{[(a-n)x - \tan x] \sin nx}{x^2} = 0$, where n is non-zero real number, then a is equal to
 (A) 0 (B) $\frac{n+1}{n}$
 (C) n (D) $n + \frac{1}{n}$
5. **D**

6. $\lim_{n \rightarrow \infty} \left\{ \frac{1}{1-n^2} + \frac{2}{1-n^2} + \dots + \frac{n}{1-n^2} \right\}$ is equal to

- (A) 0 (B) $\frac{-1}{2}$
 (C) $\frac{1}{2}$ (D) 1

6. **B**

(Multi Correct Choice Type)

This section contains 6 **multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

7. Function (s), whose graph is symmetrical about the origin, is (are)

- (A) $f(x) = x^3$ (B) $f(x) = e^x + e^{-x}$
 (C) $f(x) = \sin x$ (D) $f(x) = e^x - e^{-x}$

7. **ACD**

8. The function $f : \mathbb{R} \rightarrow (-1, 1)$ defined by $f(x) = \frac{e^x - e^{-x}}{e^x + e^{-x}}$, then

- (A) $f(x)$ is a non bijective function (B) $f(x)$ is a bijective function
 (C) $f^{-1}(x) = \frac{1}{2} \log \left(\frac{1+x}{1-x} \right)$ (D) $f(x)$ is many – one – onto function

8. **BC**

9. Let $f(x) = \cos(\sqrt{p})x$, where $p = [a]$, ($[.]$ denotes the greatest integer function), is a periodic function with period π , then

- (A) $a = \frac{9}{2}$ (B) $a = 4$
 (C) $a = 2$ (D) $a = \frac{5}{2}$

9. **AB**

10. Let $f(x) = \left(\frac{x}{(x+3)} \right)^{3x}$. Then

- (A) $\lim_{x \rightarrow \infty} f(x) = e^{-9}$ (B) $\lim_{x \rightarrow 1} f(x) = \frac{1}{64}$
 (C) $\lim_{x \rightarrow 2} f(x) = \frac{64}{625}$ (D) $\lim_{x \rightarrow 2} f(x) = \frac{3}{4}$

10. **AB**

11. $\lim_{x \rightarrow 0} \frac{\sin(\pi \cos^2 x)}{x^2}$ equals

- (A) $-\pi$ (B) π
 (C) $\frac{\pi}{2}$ (D) $\lim_{x \rightarrow 0} \frac{\sin \pi x}{x}$

11. **BD**

12.
$$\lim_{x \rightarrow 1} \frac{\sqrt{1 - \cos 2(x-1)}}{x-1}$$

(A) Right hand limit exists and it equals $\sqrt{2}$ (B) Left hand limit exists and it equals $-\sqrt{2}$ (C) does not exist because $x-1 \rightarrow 0$

(D) does not exist because left hand limit is not equal to right hand limit

12. **ABD****PART – B**
(Numerical based)1. If $f(x) = \cos(\log x)$, then the value of $f(x) \cdot f(4) - \frac{1}{2} \left[f\left(\frac{x}{4}\right) + f(4x) \right]$ is equal to k, then value of $100k + 15$ is equal to1. **15**2. If $f(x) = \begin{cases} 2 + |x|, & x < -2 \\ [x], & x \geq -2 \end{cases}$; where $[.]$ is the greatest integer function, then $f(f(-3.4))$ is equal to2. **5**3. Let $f(x) = \frac{4^x}{4^x + 2}$. Then the value of $f\left(\frac{1}{1997}\right) + f\left(\frac{2}{1997}\right) + \dots + f\left(\frac{1996}{1997}\right)$ is3. **998**4. If $\lim_{x \rightarrow 0} \frac{x(1 + a \cos x) + b \sin x}{x} = 1$ then value of $a + b + 25$ equals to4. **25**5. $\lim_{x \rightarrow \infty} \frac{\log x^n - [x]}{[x]}$, $n \in \mathbb{N}$, (where $[.]$ denotes greatest integer less than or equal to x) equals to p where $p + 105$ equals to5. **104**6. $\lim_{n \rightarrow \infty} (6^n + 5^n)^{1/n}$ is equal to6. **5**

ANSWERS

SECTION-1 : PHYSICS

PART – A

PART – B

SECTION – 2 : CHEMISTRY

PART – A

PART – B

SECTION – 3 : MATHEMATICS

PART – A

PART – B