ADVANCED PATTERN PART TEST-4(APT-4)

TARGET : JEE (MAIN+ADVANCED) 2017

REVISION PLAN-2   **COURSE : VIJETA (ADP), VIJAY (ADR)**

Date : 03-05-2017   **Time: 3 Hours**   **Maximum Marks : 180**

Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.

GENERAL :
1. The sealed booklet is your Question Paper. Do not break the seal till you are instructed to do so.
2. The question paper CODE is printed on the right hand top corner of this sheet.
3. Use the Optical Response Sheet (ORS) provided separately for answering the question.
4. Blank spaces are provided within this booklet for rough work.
5. Write your Name and Roll Number in the space provided on the below cover.
6. After the open booklet, verify that the booklet contains all the **60** questions along with the options are legible.

QUESTION PAPER FORMAT AND MARKING SCHEME :
7. The question paper has three parts: **Mathematics, Physics and Chemistry. Each part has Four sections.**
8. Each section as detailed in the following table :

Section	Question Type	Number of Questions	Category-wise Marks for Each Question				Maximum Marks of the Section
			Full Marks	**Partial Marks**	**Zero Marks**	**Negative Marks**	
1	Single Correct Option	4	+3 If only the bubble corresponding to the correct option is darkened	–	0 If none of the bubbles is darkened	–1 In all other cases	12
2	One or More Correct Option(s)	10	+3 If only the bubble(s) corresponding to all the correct option(s) is(are) darkened	+1 For darkening a bubble corresponding to each correct option, provided NO incorrect option is darkened	0 If none of the bubbles is darkened	–1 In all other cases	30
3	Matrix Match List	2	+3 If only the bubble corresponding to the correct option is darkened	–	0 if not attempted	–1 In all other cases	6
4	Double digit Integer (00-99)	4	+3 If only the bubble(s) corresponding to all the correct option(s) is(are) darkened	–	0 if not attempted	–1 In all other cases	12

OPTICAL RESPONSE SHEET :
9. Darken the appropriate bubbles on the original by applying sufficient pressure.
10. The original is machine-gradable and will be collected by the invigilator at the end of the examination.
11. Don not tamper with or mutilate the ORS.
12. Write your name, roll number and the name of the examination centre and sign with pen in the space provided for this purpose on the original. **Do not write any of these details anywhere else**. Darken the appropriate bubble under each digit of your roll number.

DARKENING THE BUBBLES ON THE ORS :
13. Use a **BLACK BALL POINT** to darken the bubbles in the upper sheet.
14. Darken the bubble **COMPLETELY.**
15. Darken the bubble **ONLY** if you are sure of the answer.
16. The correct way of darkening a bubble is as shown here : ●
17. There is **NO** way to erase or "un-darkened bubble.
18. The marking scheme given at the beginning of each section gives details of how darkened and **not darkened** bubbles are evaluated.

NAME OF THE CANDIDATE : ……………………………………………………………..…………………………

ROLL NO. : ……………………….…..………………………

I have read all the instructions   I have verified the identity, name and roll number
and shall abide by them   of the candidate.

-        -
Signature of the Candidate   Signature of the Invigilator

DO NOT BREAK THE SEAL WITHOUT BEING INSTRUCTED TO DO SO BY THE INVIGILATOR

PART : I MATHEMATICS

SECTION – 1 : (Maximum Marks : 12)

Ñ   This section contains **FOUR** questions
Ñ   Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four option is correct
Ñ   For each question, darken the bubble corresponding to the correct option in the ORS
Ñ   Marking scheme :
  +3 If only the bubble corresponding to the correct option is darkened
   0 If none of the bubble is darkened
  −1 In all other cases

1. α, β are real roots of $x^2 - \dfrac{x}{a} + \dfrac{1}{b} = 0$ where $\dfrac{1}{a}, \dfrac{1}{b} \in I$ and $\dfrac{1}{a} > 2$ and $\left[\dfrac{\alpha}{a}\right] + \left[\dfrac{\beta}{a}\right]$ = (integer)^2 if

   and only if (where [.] denotes the greatest integers function)
   (A) $\alpha \in I$ & β may not be integer
   (B) $\alpha, \beta, \in I$
   (C) $\beta \in I$ and α may not be integer
   (D) both α, β may not be integer

2. The interval in which x (> 0) must lie so that the greatest term in the expansion of $(1 + x)^{2n}$, $(n \in N)$ has the greatest coefficient is

   (A) $\left(\dfrac{n-1}{n}, \dfrac{n}{n-1}\right)$
   (B) $\left(\dfrac{n}{n+1}, \dfrac{n+1}{n}\right)$
   (C) $\left(\dfrac{n}{n+2}, \dfrac{n+2}{n}\right)$
   (D) $\left(\dfrac{n-1}{n}, \dfrac{n}{n+1}\right)$

3. If the number of terms in $(1 + x^{-1} + x^{-2})^n$ is 53, then the largest prime p so that n! is divisible by 5^{p-1} is ,
   (A) 2
   (B) 3
   (C) 5
   (D) 7

4. If largest constant such that $\dfrac{Kabc}{a+b+c} \le (a + b)^2 + (a + b + 4c)^2 \ \forall \ a,b,c > 0$ is K then $\dfrac{K}{25}$ is equal to
   (A) 4
   (B) 5
   (C) 6
   (D) 7

Space for Rough Work

SECTION – 2 : (Maximum Marks : 30)

Ñ This section contains **TEN** questions

Ñ Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct

Ñ For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS

Ñ For each question, marks will be awarded in <u>one of the following categories :</u>

Full Marks : +3 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.

Ñ 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.

5. Consider the quadratic equation $(a + c - b) x^2 + 2cx + (b + c - a) = 0$ where a,b,c are distinct real number and $a + c - b \neq 0$ and coefficient are in simplest form. If both the roots of the equation are rational then the numbers which must be rational are

(A) a,b,c
(B) $\dfrac{c}{a-b}$
(C) $\dfrac{b+c-a}{a+c-b}$
(D) $\dfrac{b^2}{c-a}$

6. If α and β^2 are the roots of $8x^2 - 10x + 3 = 0$ then the equation whose roots are $(\alpha + i\beta)^{100}$ and $(\alpha - i\beta)^{100}$ can be

(A) $x^2 + x + 1 = 0$
(B) $x^2 - x + 1 = 0$
(C) $x^3 - 1 = 0$
(D) $2x^2 + x + 1 = 0$

Space for Rough Work

7. b and c are arithmetic mean between a and d (a > d > 0) and h and k are the geometric mean between a and d then

(A) bc is always greater than hk

(B) bc is always less than hk

(C) bc may be equal to hk

(D) none of these

8. If 6, 8 and 12 are p^{th}, q^{th} and r^{th} terms respectively of an A.P. and $f(x) = rx^2 + 2px - 2q$, then $f(x) = 0$ has

(A) a root between 0 and 1

(B) both roots positive

(C) both roots negative

(D) both roots are of opposite sign

9. An A.P., a G.P., a H.P. have a and b(a≠b) as their first two terms, if their $(n + 2)^{th}$ terms respectively will be in G.P. then $\dfrac{b^{2n+2} - a^{2n+2}}{ba(b^{2n} - a^{2n})}$ equals

(A) $\dfrac{n+1}{n}$

(B) $\dfrac{n-1}{n}$

(C) $\dfrac{{}^{n+1}C_n}{{}^{n}C_{n-1}}$

(D) $\dfrac{{}^{n-1}C_{n-2}}{{}^{n}C_{n-1}}$

Space for Rough Work

10. If $f(k) = \sum_{r=1}^{k} \frac{1}{r}$ and $\sum_{r=1}^{2013} f(r) = a\, f(b) + c$, then

(A) b = c   (B) a − b = 1   (C) b + c = 0   (D) a + c = 1

11. If p,q,r are three positive number such that $27\,pqr \ge (p+q+r)^3$, 3p + 4q + 5r = 12, x = $p^3 + q^4 + r^5$

then which of the following is/are correct ?

(A) x is an integer

(B) x is a prime number

(C) p + q + r = 27

(D) the value of x is number of solution of equation |$x^2 - x - 6$| = x + 2; x ∈ R

12. If the fraction $\dfrac{x^3 + (a-10)x^2 - x + a - 6}{x^3 + (a-6)x^2 - x + a - 10}$ reduces to a quotient of two linear functions then which of

the following is/are correct

(A) both polynomial have 2 common roots

(B) The value of a is prime number

(C) The value of a is perfect cube of natural number

(D) common roots are 1 and −1

Space for Rough Work

13. Let $(1 + x^2)^2 (1 + x)^n = A_0 + A_1x + A_2x^2 + ...$If A_0 , A_1 , A_2 are in A.P. then the value of n is

(A) 2   (B) 3   (C) 5   (D) 7

14. If $f(x) = ax^2 + bx + c$ has real roots and its coefficients are odd positive integers then

(A) $f(x) = 0$ always has irrational roots

(B) discriminant is a perfect square

(C) if $ac = 1$, then equation must have exactly one root α such that $[\alpha] = -1$ (where [.] G.I.F)

(D) equation $f(x) = 0$ has rational roots

Space for Rough Work

SECTION – 3 : (Maximum Marks : 6)

Ñ   This section contains **TWO** questions

Ñ   Each questions has matching lists. The codes for the lists have choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

Ñ   For each question, darken the bubble corresponding to the correct option in the ORS

Ñ   Marking scheme :

+3 If only the bubble corresponding to the correct option is darkened

 0   If none of the bubble is darkened

−1 In all other cases

15.   Match List I with List II and select the correct answer using the code given below the lists :

List - I		**List - II**	
(P)	Let P and Q be polynomials such that $P(x)$ and $Q\big(P(Q(x))\big)$ have the same number of roots. If the degree of P is 7, then the degree of Q, is	1.	1
(Q)	The digit in units place of number $\dfrac{10^{2013}-1}{10^{33}-1}$ is	2.	70
(R)	If $m \geq -1$ such that $x^2 + 2(m-2)x + m^2 - 3m + 3 = 0$ has two real and distinct roots α, β then maximum value of $2\alpha\beta - 4$ is	3.	5
(S)	The sum of series $^{84}C_4 + 6.\,^{84}C_5 + 15.\,^{84}C_6 + 20.\,^{84}C_7 + 15.\,^{84}C_8 + 6.\,^{84}C_9 + ^{84}C_{10} = {}^{90}C_r$, the value of 'r' is	4.	10

Codes:

	P	**Q**	**R**	**S**
(A)	1	1	4	4
(B)	1	1	4	2
(C)	1	2	4	3
(D)	3	1	2	4

Space for Rough Work

16. Match List I with List II and select the correct answer using the code given below the lists :

List – I		List - II	
(P)	The number of real solutions of the equation $2^{\frac{x}{2}} + (\sqrt{2}+1)^x = (5+2\sqrt{2})^{\frac{x}{2}}$ are	1.	4
(Q)	Let [.] denotes greatest integer function. Then in [0, 3] the number of solutions of the equation $x^2 - 3x + [x] = 0$ are	2.	2
(R)	The number of solutions of $3^x + 3^{-x} = 2\cos^2\left(\dfrac{x^2+x}{4}\right)$ are	3.	5
(S)	If $x^2 - ax - 21 = 0$ and $x^2 - 3ax + 35 = 0$ have one common root then value of a such that a > 0 is equal to	4.	1

Codes:

	P	Q	R	S
(A)	2	4	1	3
(B)	4	2	4	1
(C)	1	2	3	4
(D)	3	4	1	2

Space for Rough Work

SECTION – 4 : (Maximum Marks : 12)

Ñ   This section contains **FOUR** questions
Ñ   The answer to each question is a **DOUBLE DIGIT INTEGER** ranging from 00 to 99, both inclusive
Ñ   For each question, darken the bubble corresponding to the correct integer in the ORS
Ñ   Marking scheme :
    +3 If the bubble corresponding to the answer is darkened
   0 If none of the bubbles is darkened
    −1 In all other cases

17. If $(1+3+5+...p)+(1+3+5+...+q)=(1+3+5+....r)$, where each paranthese contains sum of consecutive odd integers beginning with 1, then the smallest possible value of p + q + r (where p > 6) is

18. If x, y, z are three number such that x + y + z = 5, x > 3, y > 0, z > 0 and the maximum value of $(x-3)(2y+1)(3z+5)$ is $6\left(\dfrac{m}{n}\right)^3$, here m, n are coprime number then find the value of $18\left(\dfrac{m}{n}\right)$

19. If S is the sum of all 2 digit even natural numbers which do not end in 0, then $\dfrac{S}{99}$ is equal to

20. Number of terms (dissimilar) in the expansion of $\left(\dfrac{x^3+1+x^6}{x^3}\right)^{\Sigma n}$ where $n \in N$ is n^2+Kn+1, then 21K is equal to

Space for Rough Work

PART-II : PHYSICS

SECTION – 1 : (Maximum Marks : 12)

Ñ   This section contains **FOUR** questions
Ñ   Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four option is correct
Ñ   For each question, darken the bubble corresponding to the correct option in the ORS
Ñ   Marking scheme :
   +3 If only the bubble corresponding to the correct option is darkened
    0 If none of the bubble is darkened
   −1 In all other cases

21.   A non–viscous fluid of density ρ is flowing in a tube as shown in figure. Area of section–(1) is double that of section–(2). Centre of mass of section–(2) is h height above the Centre of mass of section–(1) and level of water in tube–1 is 'h' height above that in tube–2. Then :
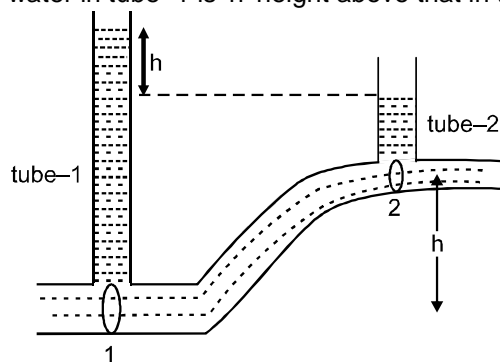
(A) Velocity of fluid of section–(1) is $\sqrt{\dfrac{gh}{3}}$

(B) Velocity of fluid at section–(1) is $\sqrt{\dfrac{2gh}{3}}$

(C) Work done by gravitational force per unit volume from section–(1) to section–(2) is ρgh

(D) Work done by elastic forces (pressure) per unit volume from section–(1) to section–(2) is $3\rho gh$

Space for Rough Work

22. A uniform solid sphere of radius R is in equilibrium inside a liquid whose density varies with depth from free surface as $\rho = \rho_0\left(1+\dfrac{h}{h_0}\right)$, where h is depth from free surface. Density of sphere σ will be:
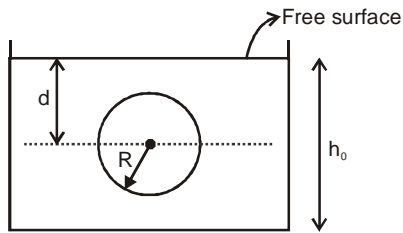
(A) $\sigma = \rho_0\left(1+\dfrac{d}{2h_0}\right)$ (B) $\sigma = \rho_0\left(1-\dfrac{d}{2h_0}\right)$ (C) $\sigma = \rho_0\left(1+\dfrac{2d}{h_0}\right)$ (D) $\sigma = \rho_0\left(1+\dfrac{d}{h_0}\right)$

23. A large open tank is filled with water upto a height H. A small hole is made at the base of the tank. It takes T_1 time to decrease the height of water to $\dfrac{H}{n}$ (n > 1) and it takes T_2 time to take out the remaining water. If $T_1 = T_2$, then the value of n is :

(A) 2   (B) 3   (C) 4   (D) $2\sqrt{2}$

24. In the given figure, two elastic rods A & B are rigidly joined to end supports. A small block of mass 'm' is moving with velocity v between the rods. All collisions are assumed to be elastic & the surface is given to be smooth. The time period of oscillations of small mass 'm' will be:
(A = area of cross section, Y = young's modulus, L = length of each rod)
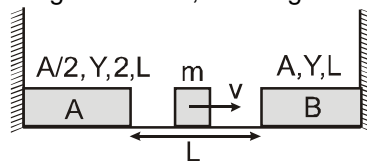
(A) $\dfrac{2L}{v} + 3\pi\sqrt{\dfrac{mL}{AY}}$ (B) $\dfrac{2L}{v} + 2\pi\sqrt{\dfrac{mL}{AY}}$ (C) $\dfrac{2L}{v} + \pi\sqrt{\dfrac{mL}{AY}}$ (D) $\dfrac{2L}{v}$

Space for Rough Work

SECTION – 2 : (Maximum Marks : 30)

Ñ   This section contains **TEN** questions

Ñ   Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct

Ñ   For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS

Ñ   For each question, marks will be awarded in <u>one of the following categories</u> :

Full Marks   :   +3 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.

Ñ   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.

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25. A container of large uniform cross sectional area A resting on a horizontal surface holds two immiscible non-viscous and incompressible liquids of density d and 3d each of height H/2. The lower density liquid is open to the atmosphere having pressure P_o. A tiny hole of area a (a << A) is punched on the vertical side of the container at a height of h from the bottom of container (0 < h < H/2) for which range is maximum.

(A) h = H/3

(B) Range R = $\dfrac{2H}{3}$

(C) Range R = $\dfrac{3H}{2}$

(D) Velocity of efflux v = $\sqrt{\dfrac{2}{3}gH}$

26. A block of density 2000 kg/m³ and mass 10 kg is suspended by a spring of stiffness 100 N/m. The other end of the spring is attached to a fixed support. The block is completely submerged in a liquid of density 1000 kg/m³ . If the block is in equilibrium position (g = 10m/s²).

(A) the elongation of the spring is 1 cm.

(B) the magnitude of buoyant force acting on the block is 50 N.

(C) the spring potential energy is 12.5 J.

(D) magnitude of spring force on the block is greater than the weight of the block.

Space for Rough Work

27. A uniform ring having mass m, radius R, cross section area of the wire A and young's modulus Y is rotating with an angular speed ω (ω is small) on a smooth horizontal surface. Which of the following options is correct :

(A) Tension in the wire is $\dfrac{mR\omega^2}{2\pi}$

(B) Change in length of the wire is $\dfrac{mR^2\omega^2}{2A.Y}$

(C) Change in radius of the ring is $\dfrac{mR^2\omega^2}{2\pi A.Y}$

(D) elastic potential energy stored is $\dfrac{1}{4\pi}\left(\dfrac{m^2\omega^4 R^3}{A.Y}\right)$

28. If ρ is the density of the material of a uniform rod and σ is the breaking stress, and the length of the rod is such that the rod is just about to break due to its own weight when suspended vertically from a fixed support, then

(A) length of the rod is $\dfrac{\sigma}{\rho g}$

(B) stress at a cross section perpendicular to the rod, at one fourth the length of the rod above its lowest point is $\dfrac{\sigma}{4}$

(C) stress at all horizontal sections of the rod is same

(D) the rod is about to break from its mid point

Space for Rough Work

29. Lower end of a capillary tube of radius 10^{-3} m is dipped vertically into a liquid. Surface tension of liquid is 0.5 N/m and specific gravity of liquid is 5. Contact angle between liquid and material of capillary tube is 120°. Choose the correct options (use g = 10m/s^2)

(A) Maximum possible depression of liquid column in the capillary tube is 1 cm.

(B) Maximum possible depression of liquid column in the capillary tube is 2 cm.

(C) If the length of the capillary tube dipped inside liquid is half of the maximum possible depression of liquid column in the capilary tube, angle made by the liquid surface at the end of the capillary tube with the vertical, is $\cos^{-1}\left(-\dfrac{1}{4}\right)$.

(D) If the length of the capillary tube dipped inside liquid is one third of the maximum possible depression of liquid column in the capilary tube, angle made by the liquid surface at the end of the capillary tube with the vertical, is $\cos^{-1}\left(-\dfrac{1}{6}\right)$.

30. An external force 6N is applied on a sphere of radius R = 10 cm of mass 1 kg and the sphere moves in a liquid with a constant velocity 5 m/s making 53° with the horizontal. The coefficient of viscosity of the liquid is 20/(6π), in S.I. units. (Take g = 10 m/s^2)
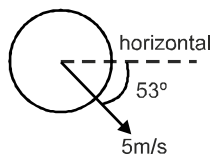
(A) The viscous force on the body is 10N.

(B) The effective weight (weight – upthrust) of the body is 8 N

(C) The direction of the external applied force must be horizontal.

(D) If the external force is suddenly removed the acceleration of the body just after the removal of the force will be 6 m/s^2.

Space for Rough Work

31. In a certain gravity free space, the piston of an injection is being pushed so that the water jet comes out with a constant speed v. The area of the piston is much greater than the orifice of the injection.
(A) The force required to be applied on the piston is proportional to v^2.
(B) The power developed by the force pushing the piston is proportional to v^3.
(C) The time for emptying the injection is proportional to v^{-1}.
(D) The total work done in emptying the injection is proportional to v^2.

32. A light wire of length ℓ and radius r is welded to another light wire of length 2ℓ and radius 2r. The free end of 1st wire is fixed and the free end of 2nd wire supports a mass m as shown. The Young's modulus of each wire is Y.

(A) Extension in upper half of upper wire is $\dfrac{mg\ell}{\pi r^2 Y}$

(B) Total elongation in the composite wire is $\dfrac{3}{2}\dfrac{mg\ell}{\pi r^2 Y}$

(C) Total elongation in the composite wire is $\dfrac{5}{2}\dfrac{mg\ell}{\pi r^2 Y}$

(D) Ratio of energy stored per unit volume in upper and lower wire is 16 : 1

33. A copper wire of negligible mass, 1m length and cross-sectional area 10^{-6} m^2 is kept on smooth horizontal table with one end fixed. A ball of mass 1 kg is attached to the other end. The wire and the ball are rotating with an angular velocity 20 rad/sec, and the elongation in the wire is 10^{-3} m. The wire break down when angular velocity is 100 rad/sec. Which of the following is/are correct ?
(A) the breaking stress is 10^{10} N/m^2 (B) the young's modulus is 4×10^{11} N/m^2
(C) the breaking stress is 2×10^{10}N/m^2 (D) the young's modulus is 8×10^{11} N/m^2

34. When a capillary tube is immersed into a liquid, the liquid neither rises nor falls in the capillary ?
(A) The angle of contact must be 90^0 (B) The angle of contact may be 90^0
(C) The surface tension of liquid must be zero   (D) The surface tension of liquid may be zero

Space for Rough Work

SECTION – 3 : (Maximum Marks : 6)

Ñ   This section contains **TWO** questions
Ñ   Each questions has matching lists. The codes for the lists have choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.
Ñ   For each question, darken the bubble corresponding to the correct option in the ORS
Ñ   Marking scheme :
  +3 If only the bubble corresponding to the correct option is darkened
   0 If none of the bubble is darkened
  −1 In all other cases

35.   A rod is formed by joining two cylinders each having a length ℓ and cross sectional area S. The densities of cylinder are ρ and 2ρ respectively. The rod is now horizontally suspended in a liquid of density 4ρ with help of two string as shown in the figure. The entire setup is kept inside a lift. For the quantities given in List-I select the correct value from those mentioned in List-II.
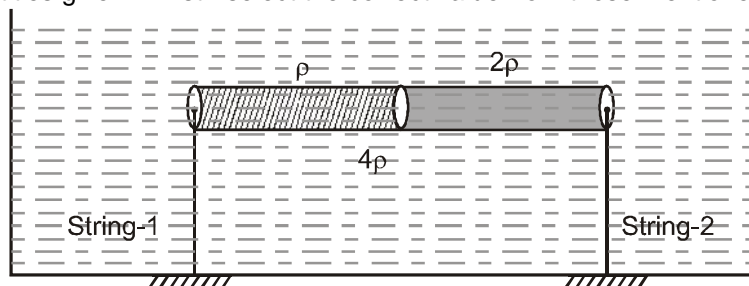
List-I	**List-II**
(P) Tension in string 1 if the lift is moving upwards with constant velocity.	(1) $\dfrac{11}{8}\rho S\ell g$
(Q) Tension in string 2 if the lift is moving upwards with constant velocity	(2) $\dfrac{9}{8}\rho S\ell g$
(R) Tension is string 1 if lift is moving downwards with an acceleration of g/2	(3) $\dfrac{11}{4}\rho S\ell g$
(S) Tension in string 2 if the lift is moving downwards with an acceleration of g/2	(4) $\dfrac{9}{4}\rho S\ell g$

Choose the correct option :
Codes :

	P	Q	R	S
(A)	3	4	1	2
(B)	1	2	3	4
(C)	4	3	2	1
(D)	2	1	4	3

Space for Rough Work

36. A cubical block of mass m and surface area 6A is placed on a thick layer of viscous liquid, of thickness d as shown.
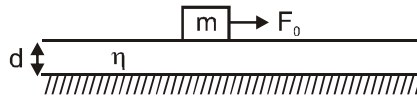
Initially the block is at rest. A constant horizontal force F_0 starts acting on the block at t = 0.

In List-I a physical quantity regarding the motion of the block is given and in List-II corresponding variation with time is given. Match the proper entries from List-II to List-I using the codes given below the lists.

List-I	**List-II**
(P) X (distance travel by the block as function of time.)	(1) $\alpha\, e^{-\beta t}$ $(\alpha, \beta \neq 0)$
(Q) V (velocity of block as as function of time.)	(2) $\alpha + \beta t + \gamma\, e^{-\delta t}$ $(\alpha,\beta,\gamma,\delta \neq 0)$
(R) A (acceleration of block as as function of time.)	(3) $\alpha\, e^{-\beta t} - \gamma\, e^{-\delta t}$ $(\alpha,\beta,\gamma,\delta \neq 0)$
(S) dK/ dt (rate of change in kinetic energy of block as as function of time.)	(4) $\alpha + \beta e^{-\gamma t}$ $(\alpha,\beta,\gamma \neq 0)$

(here $\alpha, \beta, \gamma, \delta$ may have different values in each of options)

Codes :

	P	Q	R	S
(A)	2	1	3	4
(B)	2	4	1	3
(C)	2	4	3	1
(D)	1	2	4	3

Space for Rough Work

SECTION – 4 : (Maximum Marks : 12)

Ñ This section contains **FOUR** questions
Ñ The answer to each question is a **DOUBLE DIGIT INTEGER** ranging from 00 to 99, both inclusive
Ñ For each question, darken the bubble corresponding to the correct integer in the ORS
Ñ Marking scheme :
   +3 If the bubble corresponding to the answer is darkened
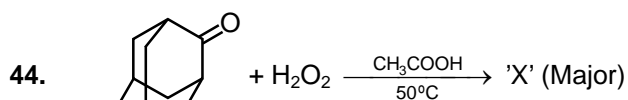   0 If none of the bubbles is darkened
   –1 In all other cases

---

37. In the middle of the mercury barometer tube there is a little column of air of length ℓ_0 and there is vacuum at the top as shown. Under the normal atmospheric pressure and temperature of 300 K, ℓ_0 = 10 cm. What will be the length (in cm) of the air column if the temperature rises to 330 K ? (Neglect expansion of the tube. Vacuum is always present at the top)
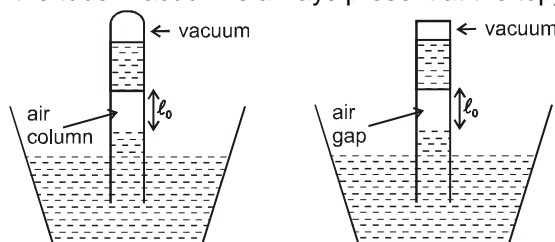
38. A light rod of length 2m is suspended from the ceiling horizontally by means of two vertical wires of equal length tied to its end. One of the wires is made of steel and is of cross-section 0.1 cm^2. The other wire is of brass of cross-section 0.2 cm^2. A weight is suspended from a certain point of the rod such that equal stresses are produced in both the wires. The rod remains horizontal in this case also. If the position of the load from the steel wire is $\dfrac{40}{n}$ m. Find the value of n

---

Space for Rough Work

39. A thin rod of negligible mass and area of cross-section 2×10^{-6} m^2, suspended vertically from one end, has a length of 0.5 m at 200^{0}C. The rod is cooled to 0^{0}C, but prevented from contracting by attaching a mass at the lower end. The value of this mass is : (Young's modulus = 10^{11} N/m^2, Coefficient of linear expansion 10^{-5} K^{-1} and g = 10 m/s^2) :

40. A tube with both ends open floats vertically in water. Oil with a density 800 kg/m^3 is poured into the tube. The tube is filled with oil upto the top end while in equilibrium. The portion out of the water is of length 10 cm. The length of oil in the tube is α cm. Find α (assume effect of surface tension is neglible):
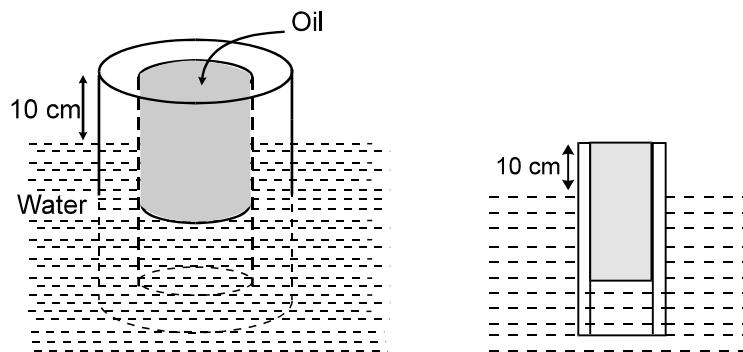
Space for Rough Work

PART : III CHEMISTRY

Atomic masses : [H = 1, D = 2, Li = 7, C = 12, N = 14, O = 16, F = 19, Na = 23, Mg = 24, Al = 27, Si = 28, P = 31, S = 32, Cl = 35.5, K = 39, Ca = 40, Cr = 52, Mn = 55, Fe = 56, Cu = 63.5, Zn = 65, As = 75, Br = 80, Ag = 108, I = 127, Ba = 137, Hg = 200, Pb = 207]

SECTION – 1 : (Maximum Marks : 12)

Ñ   This section contains **FOUR** questions

Ñ   Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four option is correct

Ñ   For each question, darken the bubble corresponding to the correct option in the ORS

Ñ   Marking scheme :

+3 If only the bubble corresponding to the correct option is darkened

  0 If none of the bubble is darkened

−1 In all other cases

41.

'X' will be

(A) racemic

(B)

(C)

(D)
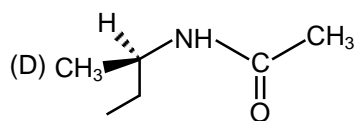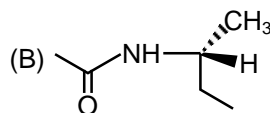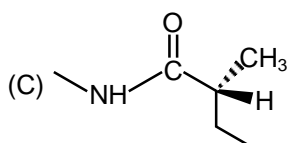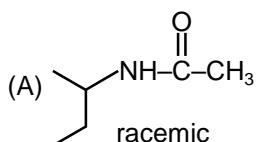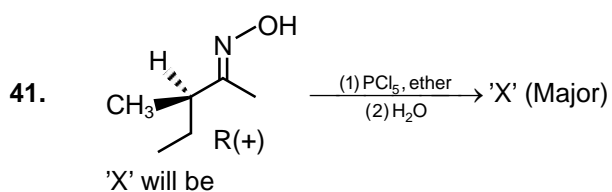
Space for Rough Work

42. The major product of the following reaction sequence is

i) HCHO (excess)/NaOH, heat

ii) HCHO/H$^+$ (catalytic amount)

(A)

(B)

(C)

(D)

Space for Rough Work

43. The structures of J and K in the following reaction are respectively.
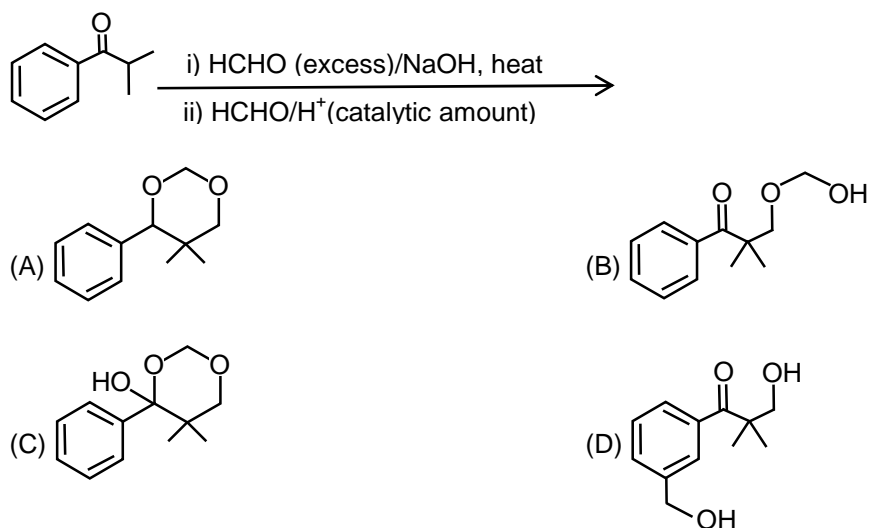
$$\text{(structure)} \xrightarrow[\text{(2) (CH}_2\text{OH)}_2\text{ /H}^\oplus]{\text{(1) PhSH}} \text{J} \xrightarrow[\text{(3) TsCl Pyridine}]{\begin{array}{l}\text{(1) B}_2\text{H}_6\text{ / THF}\\\text{(2) H}_2\text{O}_2\text{, NaOH}\end{array}} \text{K}$$

(A)

(B)

(C)

(D)

44. $+ \text{H}_2\text{O}_2 \xrightarrow[50^\circ\text{C}]{\text{CH}_3\text{COOH}}$ 'X' (Major)

X will be -

(A)   (B)   (C)   (D)

Space for Rough Work

SECTION – 2 : (Maximum Marks : 30)

Ñ   This section contains **TEN** questions

Ñ   Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct

Ñ   For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS

Ñ   For each question, marks will be awarded in <u>one of the following categories :</u>

Full Marks   :   +3   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.

Ñ   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.

45.

Space for Rough Work

46. Which of the following statement/s is/are correct regarding Azulene
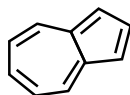
(A) Azulune is an isomer of naphthalene and is blue in colour.

(B) Azulene has very high dipole moment while naphthalene has dipole moment zero.

(C) Seven membered ring of azulene is electrophilic and five membered ring is nucleophilic.

(D) Seven membered ring of azulene is nucleophilic and five membered ring is electrophilic.

47.

$\xrightarrow[\Delta]{CH_3ONa}$ 'x' $\xrightarrow[\Delta]{H_2O/H^{\oplus}}$ 'y'

(2 moles)

x and y will be respectively.

(A)

(B)

(C)

(D)

Space for Rough Work

48.
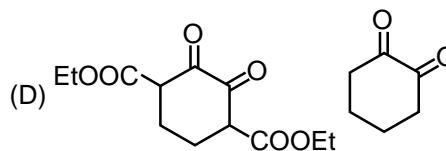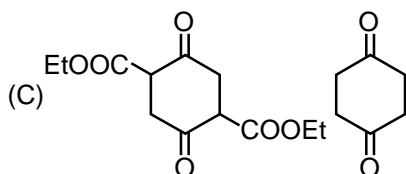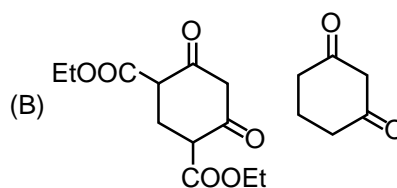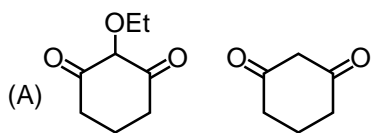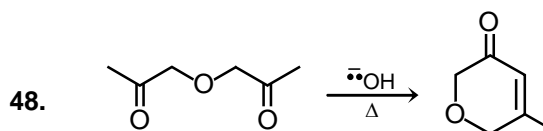
Which of the following step, mechanism/s are involved in above conversion.

(A) Acid base

(B) Nucleophilic addition

(C) E1cB

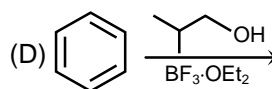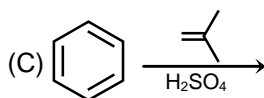(D) Dehydration
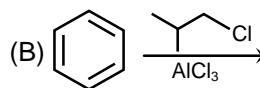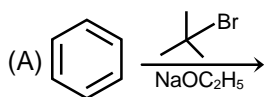
49.

Product 'Z' will be

(A)

(B)

(C)

(D)
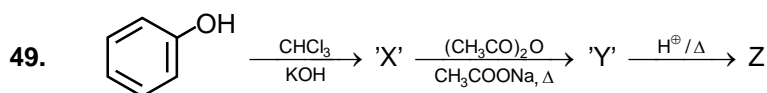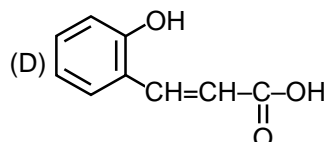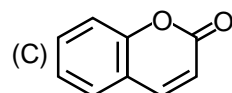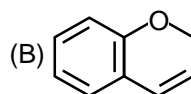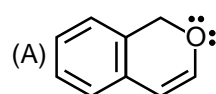
Space for Rough Work

50. The reactivity of compound **Z** with different halogens under appropriate conditions is given below :

→ mono halo substituted derivative when $X_2 = I_2$

→ di halo substituted derivative when $X_2 = Br_2$

→ tri halo substituted derivative when $X_2 = Cl_2$
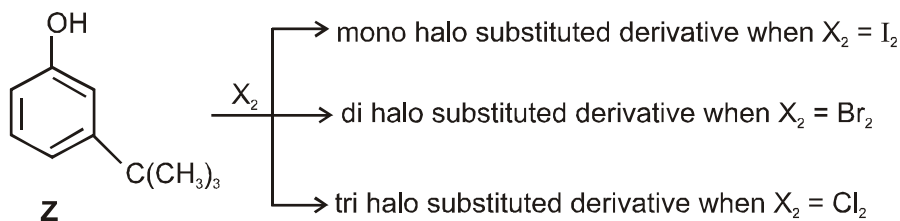
The observed pattern of electrophilic substitution can not be explained by

(A) the steric effect of the halogen

(B) the steric effect of the *tert-butyl* group

(C) the electronic effect of the phenolic group

(D) the electronic effect of the *tert-butyl* group

51. Among the following, reaction(s) which gives(give) *tert*-butyl benzene as the major product is(are)

(A) $\xrightarrow{\text{NaOC}_2\text{H}_5}$

(B) $\xrightarrow{\text{AlCl}_3}$

(C) $\xrightarrow{\text{H}_2\text{SO}_4}$

(D) $\xrightarrow{\text{BF}_3 \cdot \text{OEt}_2}$

Space for Rough Work

52. 2-Phenylbutan-2-ol can be prepared by :

(A) PhMgBr + [ketone structure] $\xrightarrow{\text{ether}}$ $\xrightarrow{H^{\oplus}}$

(B) CH_3MgBr + $Ph{-}\overset{\overset{\displaystyle O}{\|}}{C}{-}C_2H_5$ $\xrightarrow{\text{ether}}$ $\xrightarrow{H^{\oplus}}$

(C) C_2H_5MgBr + $Ph{-}\overset{\overset{\displaystyle O}{\|}}{C}{-}CH_3$ $\xrightarrow{\text{ether}}$ $\xrightarrow{H^{\oplus}}$

(D) $CH_3CH_2CH_2MgBr$ + PhCHO $\xrightarrow{\text{ether}}$ $\xrightarrow{H^{\oplus}}$

53. Treatment of compound **O** with $KMnO_4/H^+$ gave **P**, which on heating with ammonia gave **Q**. The compound **Q** on treatment with $Br_2/NaOH$ produced **R**. On strong heating, **Q** gave **S**.
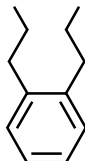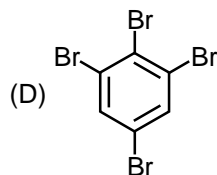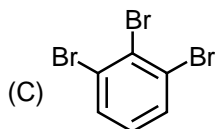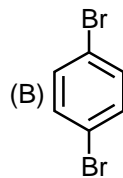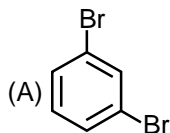
(O)

Which of the following statement(s) is/are correct ?

(A) Compound **R** is [structure: benzene with two NH_2 groups ortho]

(B) Compound **P** is [structure: benzene with two COOH groups ortho]

(C) Compound **R** is [structure: benzene with two C(=O)NHBr groups ortho]

(D) Compound **S** is [structure: phthalimide]

Space for Rough Work

54. The product(s) of the following reaction sequence is(are)
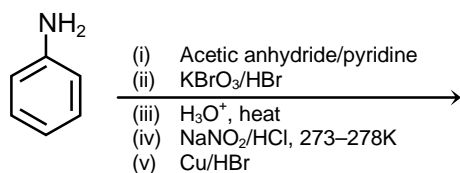
(i)   Acetic anhydride/pyridine
(ii) KBrO$_3$/HBr
(iii) H$_3$O$^+$, heat
(iv) NaNO$_2$/HCl, 273–278K
(v)   Cu/HBr

(A)

(B)

(C)

(D)

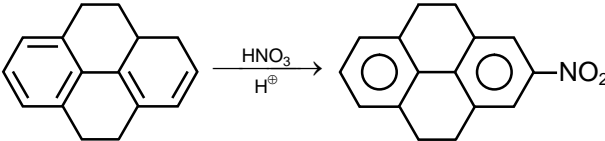**Space for Rough Work**

SECTION – 3 : (Maximum Marks : 6)

Ñ   This section contains **TWO** questions

Ñ   Each questions has matching lists. The codes for the lists have choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

Ñ   For each question, darken the bubble corresponding to the correct option in the ORS

Ñ   Marking scheme :

     +3   If only the bubble corresponding to the correct option is darkened

      0   If none of the bubble is darkened

     –1   In all other cases

---

55.   Match the following with the mechanism involved in conversions :

List-I   **List-II**

(P) $Ph - CH = CH_2 \xrightarrow[\Delta]{H^\oplus}$ (indane ring with CH_3 and Ph)   (1)   Electrophilic addition
       (2eq)

(Q)   (pyrene derivative) $\xrightarrow[H^\oplus]{HNO_3}$ (nitro product $-NO_2$)   (2)   Electrophilic substitution

(R) $CH_3-\overset{\overset{\textstyle O}{\|}}{C}-CH_2-CH_2-OH \xrightarrow[\Delta]{\overset{..}{O}H} CH_3-\overset{\overset{\textstyle O}{\|}}{C}-CH=CH_2$ (3)   E1cB

(S) $Ph-NH_2 \xrightarrow{CH_3-I} Ph-NH-CH_3$ (4)   Nucleophilic substitution

Code :

	P	Q	R	S			P	Q	R	S
(A)	1, 2	3	4	2		(B)	1	2	4	3
(C)	1, 2	2	3	4		(D)	2	1	4	3

Space for Rough Work

56.

List -I	List -II
(Reagents reacting with PhCH$_2$COOH)	**(Product formed)**
(P) CH$_3$–MgBr	(1) PhCH$_2$COCl
(Q) PCl$_5$	(2) PhCH$_2$COOCH$_3$
(R) NH$_3$, followed by heating	(3) CH$_4$
(S) CH$_3$OH in the presence of conc. H$_2$SO$_4$.	(4) PhCH$_2$CONH$_2$

Code :

	(P)	(Q)	(R)	(S)
(A)	1	2	3	4
(B)	3	1	4	2
(C)	4	1	3	2
(D)	3	1	2	4

Space for Rough Work

## SECTION – 4 : (Maximum Marks : 12)

Ñ   This section contains **FOUR** questions

Ñ   The answer to each question is a **DOUBLE DIGIT INTEGER** ranging from 00 to 99, both inclusive

Ñ   For each question, darken the bubble corresponding to the correct integer in the ORS

Ñ   Marking scheme :

    +3 If the bubble corresponding to the answer is darkened

     0 If none of the bubbles is darkened

    −1 In all other cases

57.

Where electrophile will attack at pyrrole and pyridine. (for major product)

If x is the position where electrophile attack on pyrrole and y is the position in case of pyridine.
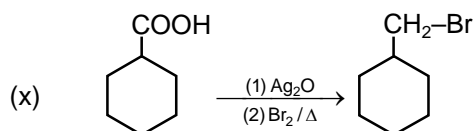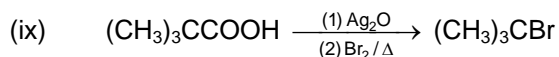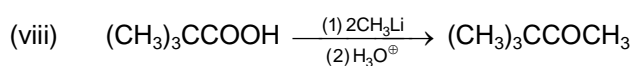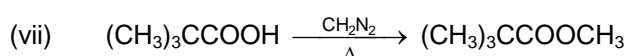
Report your answer as (10x + y).

58.

+ HCHO (Excess) $\xrightarrow{\ddot{O}H}$
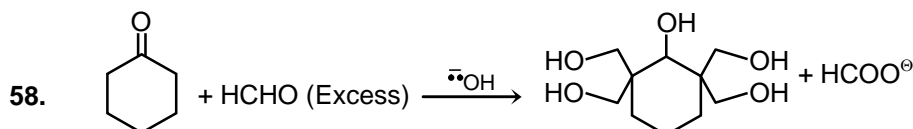
Total number of times aldol (x) and cannizzaro (y) have been taken place for the above conversion. Report your answer (10x + y).

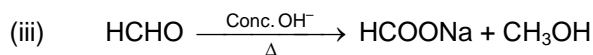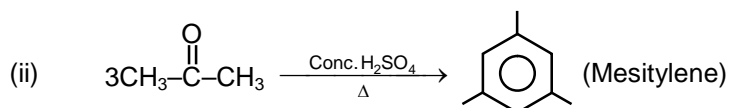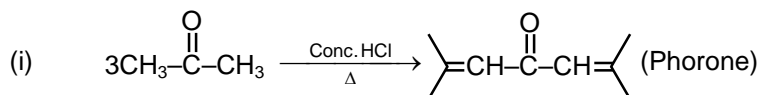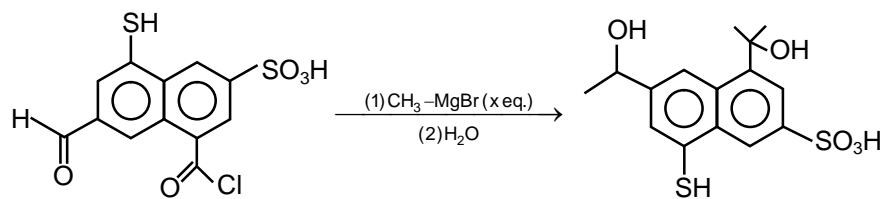**Space for Rough Work**

59. How many of the following reaction have been written with correct products (x) and number of reaction with incorrect product (y). Report your answer (10x + y).

(i) $3CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-CH_3 \xrightarrow[\Delta]{Conc.\,HCl} \rangle\!=\!CH-\overset{\overset{\displaystyle O}{\|}}{C}-CH\!=\!\langle$ (Phorone)

(ii) $3CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-CH_3 \xrightarrow[\Delta]{Conc.\,H_2SO_4}$ (Mesitylene)

(iii) $HCHO \xrightarrow[\Delta]{Conc.\,OH^-} HCOONa + CH_3OH$

(iv) $HCHO \xrightarrow[\Delta]{Conc.\,OD^-} HCOONa + CH_3OD$

(v) $DCDO \xrightarrow[\Delta]{Conc.\,OH^-} DCOONa + CH_3OD$

(vi) $DCDO \xrightarrow[\Delta]{Conc.\,OD^-} DCOONa + CH_3OD$

(vii) $(CH_3)_3CCOOH \xrightarrow[\Delta]{CH_2N_2} (CH_3)_3CCOOCH_3$

(viii) $(CH_3)_3CCOOH \xrightarrow[(2)\,H_3O^{\oplus}]{(1)\,2CH_3Li} (CH_3)_3CCOCH_3$

(ix) $(CH_3)_3CCOOH \xrightarrow[(2)\,Br_2\,/\,\Delta]{(1)\,Ag_2O} (CH_3)_3CBr$

(x) [Cyclohexane with COOH group] $\xrightarrow[(2)\,Br_2\,/\,\Delta]{(1)\,Ag_2O}$ [Cyclohexane with CH₂–Br group]
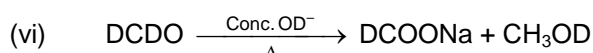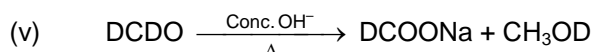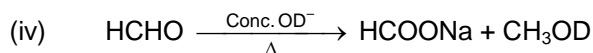
Space for Rough Work

60. How many equivalent (x) of grignard reagent is consumed in the given conversion:

Report your answer (10 + x).

Space for Rough Work