ADVANCED PATTERN CUMULATIVE TEST-3 (ACT-3)

TARGET : JEE (MAIN+ADVANCED) 2018

PAPER-2

COURSE : VIJAY (01JR)

Date : 31-12-2017	Time: 3 Hours	Maximum Marks : 222

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 **three** 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	Double digit Integer (00-99)	6	+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	18
2	One or More Correct Option(s)	10	+4 If only the bubble(s) corresponding to all the correct option(s) is(are) darkened	–	0 If none of the bubbles is darkened	–2 In all other cases	40
3	Comprehension (One or More Correct Option(s))	4	+4 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	–2 In all other cases	16

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. Do 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
and shall abide by them

I have verified the identity, name and roll number
of the candidate.

- -
Signature of the Candidate

- -
Signature of the Invigilator

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

PART : I MATHEMATICS

SECTION – 1 : (Maximum Marks : 18)

Ñ   This section contains **SIX** 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

1.   If a, b are constants, c is equal to number of three digit numbers having exactly three factors and

   $\underset{x \to 0}{Lt} \dfrac{e^{ax} - \sin bx - 1 - cx^2}{x^3}$ exists then the value of limit is $\dfrac{(n)^{3/2}}{3}$. What is value of n ?

2.   Let A = {−3, − 2, −1, 0, 1, 2, 3}, f(x) = $\begin{cases} x[x] : \ -4 < x < -1 \\ 1 - x \ : \ -1 \le x < 1 \\ x^2 - 3x + 2 : 1 \le x < 2 \\ (x-2)[x] : 2 \le x < 4 \end{cases}$ where [x] is G.I.F A point is selected

   from set A. If the probability that f(x) is differentiable given that f(x) is continuous at that point is $\dfrac{p}{q}$,

   where q is prime then value of 5p + 4q is.

Space for Rough Work

3. Assume $e^{\frac{-4}{5}} = \frac{2}{5}$. If x, y satisfy $y = e^x$ then the minimum value of $x^2 + y^2$ is $\frac{m}{n}$, m, n where all relatively prime. What is value of n – m ?

4. Let a + b = 2c. If ax + by + c = 0 passes through A, 2bx – 2ay + c = 0 passes through B and C is point of intersection of lines then locus of point C is $px^2 + qy^2 + rx + y = 0$. Find the value of $p^2 + q^2 + r^2$ $(p, q, r \in I)$

5. Let C be arbitrary constant $\int \frac{(2 + \sec x)\sec x}{(1 + 2\sec x)^2} \, dx = \frac{1}{p\,\mathrm{cosec}\,x + q\cot x} + C$. Find the value of $q^6 + p^6$.

6. A bag contains 5 balls of unknown colours. A ball is drawn and replaced. This is done twice in each occasion it is found to be red. Again two balls are drawn at a time. If the probability of both the balls being red is $\frac{m}{550}$ then sum of proper divisors of m is

Space for Rough Work

SECTION – 2 : (Maximum Marks : 40)

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   Marking scheme :

+4 If the bubbles corresponding to the answers are darkened

  0 If none of the bubbles is darkened

–2 In all other cases

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7.   Let $I = \int_{\frac{\pi}{6}}^{\frac{\pi}{3}} \sin x \, dx$, $S = \sin\left(\frac{53}{100}\right) + \sin\left(\frac{27}{50}\right) + \sin\left(\frac{11}{20}\right) + \ldots + \sin\left(\frac{51}{50}\right) + \sin\left(\frac{103}{100}\right)$. Which of the

following are correct ?

(A) $S = \dfrac{\sin\left(\frac{39}{25}\right)\sin\left(\frac{51}{200}\right)}{\sin\left(\frac{1}{200}\right)}$

(B) $S > 100 \, I$

(C) $S < 100 \, I$

(D) $S = \dfrac{\sin\left(\frac{39}{50}\right)\sin\left(\frac{51}{200}\right)}{\sin\left(\frac{1}{200}\right)}$

Space for Rough Work

8. Let $f(x) = \dfrac{2x+5}{x-2}$ be a function defined from R – {2} to R– {2}. Which of the following are correct ?

(A) $f(x) = f^{-1}(x)$

(B) If $f(x) = f^{-1}(x)$ then $f^{-1}(x) = x$

(C) The number of real solutions of $f^{-1}(x) = x$ is equal to the number of solutions of $f(x) = x$

(D) α is a solution of $f^{-1}(x) = x$ if and only if α is a solution of $f(x) = x$

9. Let A be a non-singular matrix such that $3ABA^{-1} + A = 2A^{-1}BA$. Which of the following are correct ?

(A) A, B are identity matrices

(B) $|A + B| = 0$

(C) $|ABA^{-1} - A^{-1}BA| = 0$

(D) A + B is not a singular matrix

10. Consider the straight line $L \equiv 2x - y - 1 = 0$, Which of the following are true ?

(A) if (a_1, b_1), (a_2, b_2) are two points on the line L = 0 which are at a distance of $\sqrt{5}$ units from (2, 3) then $a_1a_2 - b_1b_2 + 2 = 0$

(B) The distance from a point (4, –3) to the line L = 0 measured along a line making an angle $\tan^{-1}$ 3 with the x-axis is $10\sqrt{10}$.

(C) Area of triangle formed by a line passing through (1, –2)and perpendicular to L = 0 with coordinate axes is $\dfrac{9}{2}$

(D) If P, Q are reflections of the points (4, – 1), (6,–3) respectively with respect to line L = 0 then $PQ = 3\sqrt{2}$

Space for Rough Work

11. Let common root condition of equations $2ax^3 + bx^2 + cx + d = 0$ and $2ax^2 + 3bx + 4c = 0$ be

$(\lambda bc + ad)^2 = \dfrac{9}{2}(\mu bd + 4c^2)(mb^2 - nac)$, $\lambda, \mu, m, n \in N$. If the equation $\left(\dfrac{mx}{1+x^2}\right)^2 + k\left(\dfrac{nx}{1+x^2}\right) + \lambda - \mu = 0$

has exactly two real roots which are distinct, then the set of possible real values of k is

(A) $\left(\dfrac{-13}{2}, 0\right)$

(B) $\left(-\infty, \dfrac{-13}{2}\right)$

(C) $\left(\dfrac{-13}{2}, \dfrac{13}{2}\right)$

(D) $\left(\dfrac{13}{2}, \infty\right)$

12. If $\displaystyle\sum_{n=1}^{\infty} \tan^{-1}\left(\dfrac{\sin^{-1}\left(\dfrac{\sqrt{n} - \sqrt{n-1}}{\sqrt{n(n+1)}}\right)}{1 + \tan^{-1}\sqrt{n}\,\tan^{-1}\sqrt{n-1}}\right) = \tan^{-1}\left(\dfrac{\pi}{m}\right)$ and $f(x) = \sin^{-1}x + m\tan^{-1}x + x^2 + 2mx + 1$ then

(A) m = 2

(B) Range of f(x) is $[-\pi-2, \pi+6]$

(C) m = 4

(D) Range of f(x) is $[-2, \pi]$

13. Let a function f defined on the set of all integers satisfy f(0)   0, f(1) = 3 and
f(x). f(y) = f(x + y) + f(x – y) for all integers x and y. Then
(A) f(2) = 7

(B) f(3) = 21

(C) f(4) = 47

(D) f(7) = 843

Space for Rough Work

14. A culture initially has 1 million number of bacteria. After 2 hours it is observed to be doubled. If the rate of growth is proportional to the number of bacteria present at time 't', then the number of bacteria immediately after 7 hours is $10^6 (n)^{\frac{7}{n}}$, $n \in N$. Which of the following are correct?

(A) n = 2

(B) n is equal to number of solution of $|cosx| = |sin^{-1}(sinx)|$, $x \in [0, \pi]$

(C) If $f(x) = (2x - 3\pi)^3 + 3x - cosx$, then $\dfrac{d}{dx}(f^{-1}(x))$ at $x = \dfrac{3\pi}{2}$ is $\dfrac{1}{n}$

(D) n = 3

15. Consider the set A = {1, 2, 3, ...,n}. Let s be set of all one-one functions f from A to A such that $|f(1) - 1| = |f(2) - 2| = |f(3) - 3| = ... = |f(n) - n|$. Then

(A) if n = 9 the number of elements in S is 1   (B) if n = 9 the number of elements in S is 0

(C) if n = 4 the number of elements in S is 3   (D) if n = 9 the number of elements in S is 2

16. Let f(x) be a differentiable function and $f(\alpha) = f(\beta) = 0$ ($\alpha < \beta$), then in the interval (α, β), which option is **CORRECT** ?

(A) 3f(x) + f '(x) = 0 has at least one real root   (B) 2f(x) – f '(x) = 0 has at least one real root

(C) f(x) . f '(x) = 0 has at least one real root   (D) f(x) + x f '(x) = 0 has at least one real root

Space for Rough Work

SECTION – 3 : (Maximum Marks : 16)

Ñ   This section contains **TWO** paragraphs
Ñ   Based on each paragraph, there will be **TWO** questions.
Ñ1 Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct 1
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   :   +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 :   –2 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 –2 marks, as a wrong option is also darkened.

Paragraph for Question Nos. 17 to 18

Consider $\triangle ABC$ whose vertices are $A \equiv (m, n)$, $B \equiv (1, 2)$, $C \equiv (2, 3)$ and vertex A lies on the line $2x - y + 3 = 0$ where $m, n \in N$ and $m > 2$ let area of $\triangle ABC$ be S such that $[S] = 2$ (where $[x]$ denotes greatest integer less than or equal to x)

17. If the equation of side AC of $\triangle ABC$ is $ax + by = 9$, then

(A) $a - b = 7$
(B) $a + b = 5$
(C) minimum value of the quadratic expression whose zero's are a and b and leading coefficient is 4 is -49
(D) minimum value of the quadratic expression whose zero's are a and b and leading coefficient is -1 is $\dfrac{49}{4}$

18. If the point $R(\alpha,\beta)$ lies inside the $\triangle ABC$ is such that the $\triangle ABR$, $\triangle BCR$ and $\triangle CAR$ are of equal area, then

(A) $\dfrac{\alpha}{\beta} = \dfrac{3}{7}$ (B) $2\alpha + 3\beta = 18$ (C) $3\alpha\beta = 14$ (D) $\alpha + 6\beta = 30$

Space for Rough Work

Paragraph for Question Nos. 19 to 20

Let $A = \begin{bmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ and U_1, U_2, U_3 be columns matrices satisfying $AU_1 = \begin{bmatrix} 2 \\ 0 \\ 0 \end{bmatrix}$, $AU_2 = \begin{bmatrix} 1 \\ 2 \\ 0 \end{bmatrix}$,

$AU_3 = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$. Further U be a 3×3 matrix whose columns are U_1, U_2, U_3 in order.

19. The value of determinant $|U|$ is divisible by

(A) 2   (B) 3

(C) 4   (D) 6

20. The sum of the elements of U^{-1} is α and trace of U is β. then which of the following is/are correct

(A) $\alpha + \beta = \dfrac{25}{4}$ (B) $\alpha + \beta = \dfrac{5}{4}$

(C) $\alpha\beta = \dfrac{25}{4}$ (D) $\alpha\beta = \dfrac{5}{4}$

Space for Rough Work

PART : II PHYSICS

SECTION – 1 : (Maximum Marks : 18)

Ñ   This section contains **SIX** 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

21.   Consider a nonconducting disc of radius r and mass m which has a charge q distributed uniformly over it. The disk is rotated about its axis with an angular speed ω. Magnetic moment of the disc is $\dfrac{1}{N}q\omega r^2$. Then find value of 4N.

22.   Given system is in equilibrium. All surfaces are smooth. Spring is ideal and blocks are sticked at the ends of spring. Now F_0 is removed. Average normal contact force between wall and mass m_1 upto the time spring attains its natural length for the first time in Newton is : (Given that $F_0 = 8\pi$ Newton)
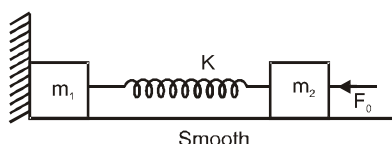
Space for Rough Work

23. Figure shows a string of linear mass density 1.0 g/cm on which a wave pulse is travelling. Find the time taken (in milli second) by the pulse in travelling through a distance of 60 cm on the string. (Take g = 10 m/s^2.)

24. A string of mass 0.8 kg/m is stretched to a tension 500N. Mean power required to maintain a traveling wave of amplitude of 10mm and wavelength 0.5m is X watt. Find integer next to x.

25. Two blocks of masses 10kg and 4kg are connected by a spring of negligible mass and are placed on a frictionless horizontal surface. An impulse gives a speed of 14 ms^{-1} to the heavier block in the direction of the lighter block. Then, find velocity of the centre of mass ?

26. A square metallic loop of side ℓ is placed near a fixed long wire carrying a current i (figure). The loop is moved towards right perpendicular to the wire with a speed v in the plane containing the wire and the loop. The emf induced in the loop when the rear end of the loop is at a distance a = 2ℓ from the wire is $\dfrac{\mu_0 iv}{x\pi}$. Find out value of x.
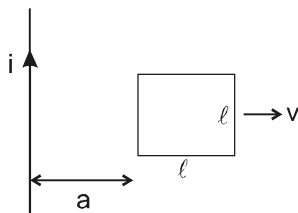
Space for Rough Work

SECTION – 2 : (Maximum Marks : 40)

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   Marking scheme :
   +4 If the bubbles corresponding to the answers are darkened
    0 If none of the bubbles is darkened
   –2 In all other cases

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27.   A light ray passes through a prism with an apex angle 30° as shown in figure. Incident medium is air. Critical angle for air prism interface is 42º. As angle 'i' increases from zero to 90º in anti clock wise sense, angle of emergence changes. Which of following options is/are correct, when i = 90º. [Given sin 42º ≅ 0.670 ; sin 12º ≅ 0.21 ; sin 18º ≅ 0.313]
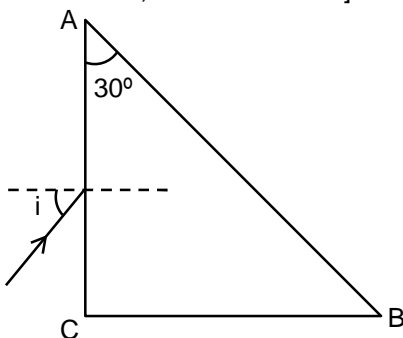
(A) Emergent ray will bent towards base of prism.
(B) Emergent ray will bent away from base of prism.
(C) Deviation produced by prism is 42º in clockwise sense
(D) Angle of emergence will be 18º

Space for Rough Work

28. A cart is moved horizontally with a constant velocity of 4m/sec. A ball is thrown form it with a velocity of 4m/sec. and at an angle θ with the horizontal with respect to the cart. Assume the height of the cart is very small, so that the motion of the ball is assume to be a ground to ground projectile. Horizontal range of the ball with respect to the ground is R_1 and that with respect to the cart is R_2 then:
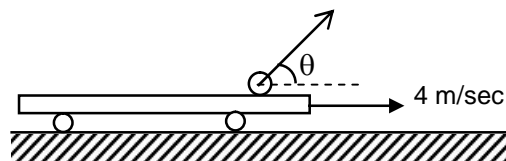
(A) R_1 will be maximum for $\theta = 90°$ (B) R_1 will be maximum for $\theta = 60°$

(C) R_2 will be maximum for $\theta = 60°$ (D) R_2 will be maximum for $\theta = 45°$

29. A bob of mass m connected to the end of an inextensible string of length ℓ, is released from position shown in figure. If impacts of bob with smooth floor is perfectly inelastic. Choose the correct option(s).

Floor
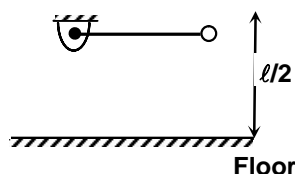
(A) The maximum height reached by the bob during subsequent motion is $\dfrac{\ell}{32}$.

(B) Maximum height reached by the bob during subsequent motion is zero.

(C) Energy loss from the time duration bob is released to the time it reaches at its maximum height during subsequent motion is $\dfrac{3mg\ell}{8}$.

(D) Energy loss from the time duration bob is released to the time it reaches at its maximum height during subsequent motion is $\dfrac{15mg\ell}{32}$.

Space for Rough Work

30. In the figure, the bigger block A has a mass of 40 kg and the upper block B is of 10 kg. The coefficient of friction between all surfaces of contact is 0.1. Choose the correct options. (Segments of string are perfectly parallel and perpendicular to the incline plane) (Use g = 10m/s^2)
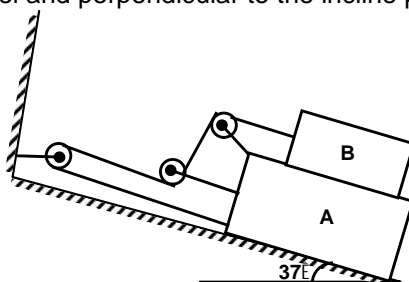
(A) magnitude of acceleration of B is twice of magnitude of acceleration of A.

(B) acceleration of A is $\frac{62}{25}$ m/s^2

(C) Tension in the string is 92.8 N

(D) acceleration of B is $\frac{124}{25}$ m/s^2

31. Let $\vec{R}$ be the position vector of a particle performing curviliinear motion with respect to some reference point and R be its magnitude. Similarly $\vec{v}$ be its velocity vector with respect to the same reference point and v is its magnitude, then choose the correct options :

(A) $v \neq \dfrac{dR}{dt}$ (B) $v = \dfrac{dR}{dt}$ (C) $v = \left|\dfrac{d\vec{R}}{dt}\right|$ (D) $\left|d\vec{R}\right| \neq dR$

Space for Rough Work

32. A circular ring of mass M and radius R lies on a smooth horizontal surface. An insect of mass m starts moving round the ring with uniform velocity v relative to the ring. Choose the correct option(s): (Use M = m)
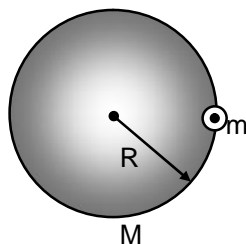
(A) Angular velocity of ring with respect to the ground is $\dfrac{v}{3R}$

(B) Angular velocity of ring with respect to the ground is $\dfrac{v}{2R}$

(C) Speed of insect with respect to the ground is $\dfrac{v}{3}$

(D) Speed of insect with respect to the ground is $\dfrac{v}{2}$

33. The equivalent resistance of a group of resistances is R. If another resistance is connected in parallel to the group, its new equivalent becomes R_1 & if it is connected in series to the group , its new equivalent becomes R_2 we have :

(A) $R_1 > R$ (B) $R_1 < R$ (C) $R_2 > R$ (D) $R_2 < R$

Space for Rough Work

34. A small sphere of mass m is connected by a string to a nail at O and moves in a circle of radius r on the smooth plane inclined at an angle θ with the horizontal. If the sphere has a velocity u at the top position A. Mark the correct options.
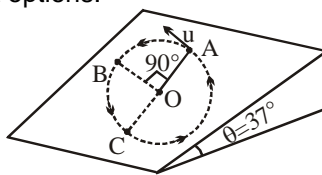
(A) Minimum velocity at A to complete circular motion is $\sqrt{\dfrac{3}{5}gr}$.

(B) Tension at B if sphere has required velocity in option A is $\dfrac{11}{5}$ mg.

(C) Tension at C if sphere has required velocity in option A is $\dfrac{23}{5}$ mg

(D) None of these

35. An infinitely long cylindrical wire of radius R carries a current whose density varies as $j = br^2$, where b is a constant and r is the distance from axis of the wire. Choose the correct option regarding magnetic field of induction as function of radial distance from axis of cylinder
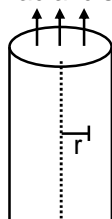
(A) if r is less than R, $B = \dfrac{\mu_0 br^3}{4}$

(B) if r is less than R, $B = \dfrac{\mu_0 br^3}{2}$

(C) if r is greater than R, $B = \dfrac{\mu_0 bR^4}{2r}$

(D) if r is greater than R, $B = \dfrac{\mu_0 bR^4}{4r}$

Space for Rough Work

36. The figures represent two snaps of a travelling wave on a string of mass per unit length,

m = 0.252 kg/m. The two snaps are taken at time t = 0 and t = $\frac{1}{24}$ s . Then
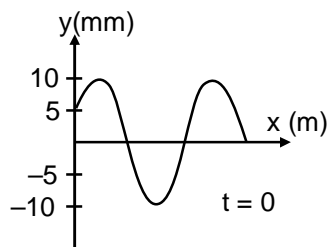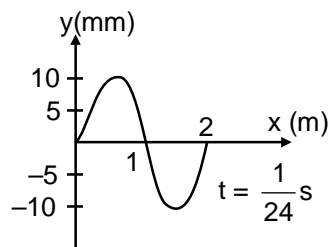
Figure I **Figure** II

(A) speed of wave is 4m/s

(B) the tension in the string is 4N

(C) the equation of the wave is y = 10 sin (πx − 4πt + $\frac{\pi}{6}$)

(D) the maximum velocity of the particle = $\frac{\pi}{25}$ m/s

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Space for Rough Work

SECTION – 3 : (Maximum Marks : 16)

Ñ   This section contains **TWO** paragraphs
Ñ   Based on each paragraph, there will be **TWO** questions.
Ñ1   Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct 1
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 one of the following categories :

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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 :   –2 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 –2 marks, as a wrong option is also darkened.

Paragraph for Question Nos. 37 to 38

A string fixed at both the ends of length 2 m, vibrating in its 7th overtone. Equation of the standing wave is given by $y = A \sin kx \cos(\omega t + \pi/3)$, All the symbols have their usual meaning. Mass per unit length of the string is 0.5 gm/cm. Given that A = 1 cm and $\omega = 100\,\pi$ rad/sec. Answer the following 2 questions based on information given (Use $\pi^2 = 10$)

37.   Starting from t = 0, energy of vibration is completely potential at time t, where t is :

(A) $\dfrac{1}{150}$ sec.   (B) $\dfrac{1}{60}$ sec.   (C) $\dfrac{3}{100}$ sec   (D) $\dfrac{11}{300}$ sec.

38.   Starting from t = 0, energy of vibration is completely kinetic at time t, where t is :

(A) $\dfrac{1}{600}$ sec.   (B) $\dfrac{5}{600}$ (C) $\dfrac{19}{600}$ (D) $\dfrac{25}{600}$ sec.

Space for Rough Work

Paragraph for Questions 39 and 40

A block A of mass m is given a velocity v_0 towards another block B of same mass. B is attached to an ideal spring of spring constant K. A makes a head on perfectly inelastic collision with B.

Smooth
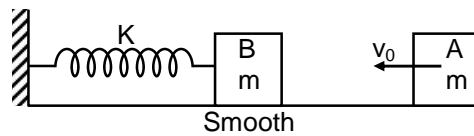
Answer the following two questions:

39. Let the collision takes place at time t = 0, choose the time instant(s), when the spring is in its natural length:

(A) $\pi\sqrt{\dfrac{2m}{K}}$

(B) $2\pi\sqrt{\dfrac{2m}{K}}$

(C) $\pi\sqrt{\dfrac{m}{K}}\ (\sqrt{2}+1)$.

(D) $2\pi\sqrt{\dfrac{m}{K}}$

40. Choose the correct option(s)

(A) Maximum elongation in the spring during subsequent motion is $\dfrac{1}{2}\sqrt{\dfrac{mv_0^2}{K}}$.

(B) Maximum elongation in the spring during subsequent motion is $\sqrt{\dfrac{mv_0^2}{2K}}$.

(C) Final velocity of block A is $\dfrac{v_0}{2}$

(D) Final velocity of block A is $\dfrac{v_0}{4}$

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 : 18)

Ñ   This section contains **SIX** 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

41.   The solubility product of CuCl is 2×10^{-7}. The equilibrium constant for the reaction :

   $$Cu + Cu^{2+}(aq) \longrightarrow 2Cu^{+}(aq)$$
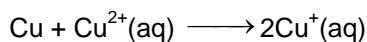
   is 9.6×10^{-7}. Find $|E^{o}_{Cell}| \times 40$ for the reaction $Cu(s) + Cu^{2+}(aq) + 2Cl^{-} \longrightarrow 2CuCl(s)$.

   (Round off your answer to nearest whole number) (log 3 = 0.48, log 2 = 0.3, $\dfrac{2.303RT}{F} = 0.06$)

Space for Rough Work

42. 8×10^{-x} moles of gas A is dissolved in 36 mL of water when pressure of gaseous mixture above water is 4 atm. Mole percentage of gas A in mixture is 25. Henry law constant for gas A in water is 2.5×10^3 atm. Find "10 x".

43. The half reactions that occur in a lead-acid battery are :

$$PbSO_4(s) + 2e^- \rightarrow Pb(s) + SO_4^{2-}(aq) \qquad E^0 = -0.36 \text{ V}$$
$$PbO_2(s) + 4H^+(aq) + SO_4^{2-}(aq) + 2e^- \rightarrow PbSO_4(s) + 2H_2O(l) \quad E^0 = +1.69 \text{ V}$$
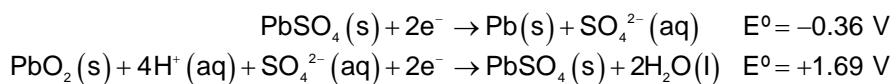
Calculate the overall potential for the cell in discharging reaction, E^0_{cell}. Give your answer in nearest double digit integer after multiplying by 10.

44. $K_4Fe(CN)_6 + H_2SO_4$ (concentrated) $+ H_2O \xrightarrow{\Delta}$

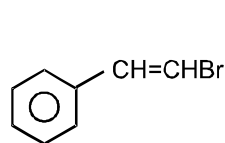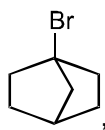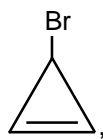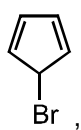In the balanced reaction (with lowest possible integers) determine the value of sum of stoichiometric coefficients all products.

Space for Rough Work

45. How many alkene/s react faster than propene with dil.H_2SO_4?

(a)

(b) Ph

(c)

(d) CH_3O

(e)

(f)

(g)

(h)
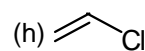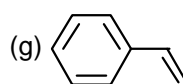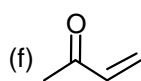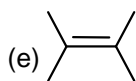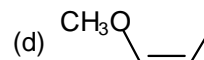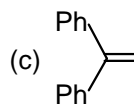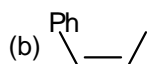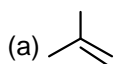
46. How many of these compounds are inert towards nucleophilic substitution by H_2O in aqueous solution ?
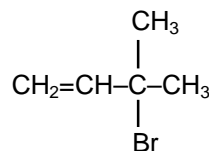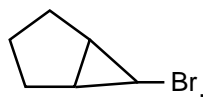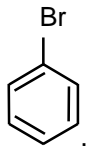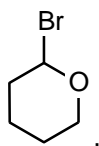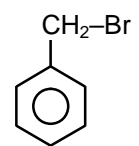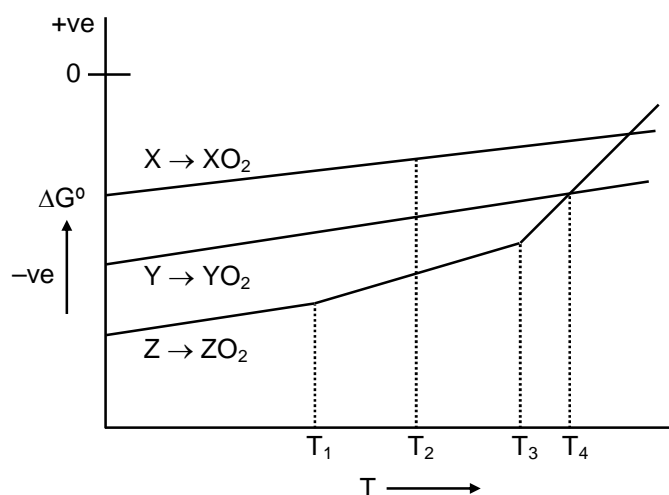

Space for Rough Work

SECTION – 2 : (Maximum Marks : 40)

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   Marking scheme :

   +4   If the bubbles corresponding to the answers are darkened

    0   If none of the bubbles is darkened

   −2   In all other cases

47.   The incorrect statement is :

   (A) Vapour pressure of a liquid always increases by increasing temperature.

   (B) Vapour pressure only depends on temperature and not on the nature of substance.

   (C) Vapour pressure does not depend on the quantity of the liquid taken and the surface area of the liquid.

   (D) Vapour pressure depends on nature of sustance.

48.   Correct statement(s) for orthoboric acid is/are :

   (A) It behaves as a weak acid in water due to self ionization.

   (B) Acidity of its aqueous solution increases upon addition of ethylene glycol.

   (C) It has a three dimensional structure due to hydrogen bonding.

   (D) It is a weak electrolyte in water.

Space for Rough Work

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P201JRACT3311217C0-22

49.

Select the correct option(s) for the above graphs :

(A) Temperature T_1 & T_3 represents melting point and boiling point of Z

(B) Temperature T_1 & T_3 represents melting point and boiling point of ZO_2

(C) At T_2 following reaction is spontaneous $Z + XO_2 \rightarrow X + ZO_2$

(D) At T_2 following reaction is spontaneous $X + ZO_2 \rightarrow Z + XO_2$

50. Which of the following metals are extracted by hydrometallurgy from suitable ore?

(A) Cu   (B) Ag   (C) Au   (D) Pb

Space for Rough Work

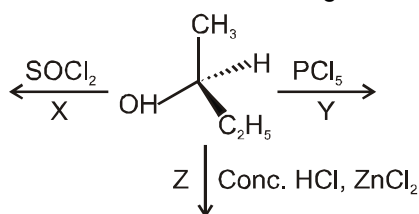**51.** $B_2H_6 + NH_3 \xrightarrow[\text{Heating}]{\text{Slowly}} X \xrightarrow{\Delta} Y$
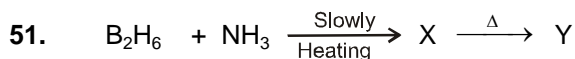
Which of the following statement is correct ?

(A) X is ionic in nature, Hybridisation state of B in both cationic and anionic part is same.

(B) X is ionic in nature, hybridisation state of B in cationic and anionic part are differernt.

(C) Y is covalent and hybridisation state of all B is same.

(D) Y is ionic and hybridisation state of all B are same.

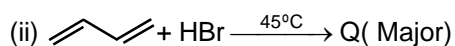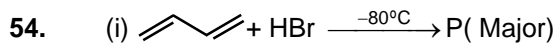**52.** On electrolysis, in which of the following, O_2 would be liberated at the anode ?

(A) dilute H_2SO_4 with Pt electrodes.

(B) aqueous $AgNO_3$ solution with Pt electrodes.

(C) dilute H_2SO_4 with Cu electrodes.

(D) aqueous NaOH solution with Fe cathode & Pt anode.

53. Correct statements for the given reactions is/are ?

$$\xleftarrow[X]{\text{SOCl}_2} OH \overset{\text{CH}_3}{\underset{\text{C}_2\text{H}_5}{\overset{|}{\underset{|}{C}}}}{}^{\cdots\cdots H} \xrightarrow[Y]{\text{PCl}_5}$$

$$Z \downarrow \text{Conc. HCl, ZnCl}_2$$

(A) Retention of configuration in the product of step - X

(B) Inversion of configuration in the product of step-Y

(C) Recemisation takes place in the products of step - Z

(D) Total four different products are obtained in the step-X, Y & Z.

Space for Rough Work

54. (i) $\diagup\!\diagdown\!\diagup$ + HBr $\xrightarrow{-80^{\circ}C}$ P(Major)

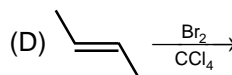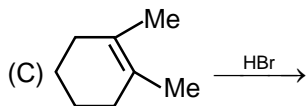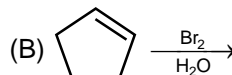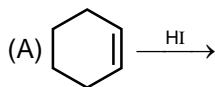(ii) $\diagup\!\diagdown\!\diagup$ + HBr $\xrightarrow{45^{\circ}C}$ Q(Major)

(A) Major product P is kinetic product formed by 1,2-addtion

(B) Major product Q is Thermodynamic product formed by 1,4-addtion

(C) Reaction intermediate of both (i) & (ii) reaction is carbocation.

(D) P is 1-Bromobut-2-ene & Q is 3-Bromobut-1-ene.

55. Benzyl alcohol can be oxidised to Benzaldehyde by the reagents.

(A) PCC

(B) $KmnO_4/H^+$

(C) Cu/Δ

(D) MnO_2/Δ

56. Which of the following reaction gives exclusively single product –

(A) [cyclohexene structure] $\xrightarrow{HI}$

(B) [cyclopentene structure] $\xrightarrow[H_2O]{Br_2}$

(C) [cyclohexene with two Me groups] $\xrightarrow{HBr}$

(D) [propene structure] $\xrightarrow[CCl_4]{Br_2}$

Space for Rough Work

SECTION – 3 : (Maximum Marks : 16)

Ñ   This section contains **TWO** paragraphs

Ñ   Based on each paragraph, there will be **TWO** questions.

Ñ1   Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct 1

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   :   +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   :   –2   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 –2 marks, as a wrong option is also darkened.

Paragraph for Question Nos. 57 to 58

The reaction $A(g) \longrightarrow B(g) + 2C(g)$ is a first order reaction with rate constant 2.772×10^{-3} sec^{-1}. Reaction is started with only 0.1 mol of A in a container with volume 2 litre and is allowed to take place at constant volume and at constant temperature 300 K. [R = 0.082 litre atm $mol^{-1}K^{-1}$]

(log 2 = 0.30)

Space for Rough Work

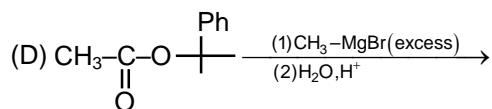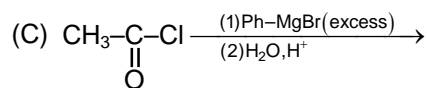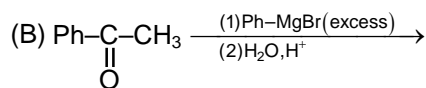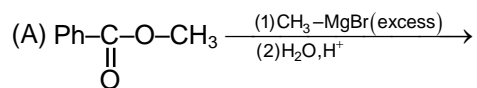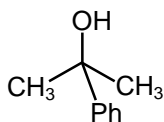**57.** Concentration of A after 250 sec will be :

(A) 0.125 M   (B) 0.0125 M   (C) 0.05 M   (D) 0.025 M

58. Select the correct statement(s) :

(A) Concentration of C after 250 sec will be 0.05 M

(B) Concentration of C after 250 sec will be 0.1 M

(C) Partial pressure of C after 250 sec will be 2.46 atm

(D) Partial pressure of C after 250 sec will be 1.23 atm
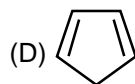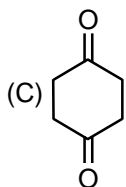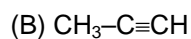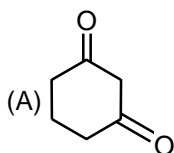
Paragraph for Question Nos. 59 to 60

Grignard reagents are σ-bonded organometallic compounds. There exists covalent bond between carbon and Magnesium atoms. Grignard reagent finds applications in the Synthesis of variety of compounds. Grignard reagent reacts as carbanion and the reaction of carbanion with the proton of an acid is acid – base reaction. Cabonyl compounds (including ester) on interaction with Grignard reagent generates alkoxide ion and thus can be converted into alcohols. Grignard reagent reacts with almost all functional groups. Notable exceptions are tertiary amines aliphatic and aromatic C=C bonds.

Space for Rough Work

59. Which of the following combination of reactants can be used to prepare the following given compound?

(A) $Ph-\underset{\underset{O}{\|}}{C}-O-CH_3$ $\xrightarrow[(2)H_2O,H^+]{(1)CH_3-MgBr(excess)}$

(B) $Ph-\underset{\underset{O}{\|}}{C}-CH_3$ $\xrightarrow[(2)H_2O,H^+]{(1)Ph-MgBr(excess)}$

(C) $CH_3-\underset{\underset{O}{\|}}{C}-Cl$ $\xrightarrow[(2)H_2O,H^+]{(1)Ph-MgBr(excess)}$

(D) $CH_3-\underset{\underset{O}{\|}}{C}-O-\underset{Ph}{\underset{|}{C}}$ $\xrightarrow[(2)H_2O,H^+]{(1)CH_3-MgBr(excess)}$

60. Which of the following compounds gives benzene as a major product on reaction with PhMgBr (1eq.).

(A)

(B) $CH_3-C{\equiv}CH$

(C)

(D)

Space for Rough Work