

FIITJEE

ALL INDIA TEST SERIES

FULL TEST – I

JEE (Advanced)-2018-19

PAPER –2

Time Allotted: 3 Hours

Maximum Marks: 240

General Instructions:

- The test consists of total 60 questions.
- Each subject (PCM) has 20 questions.
- This question paper contains **Three Parts**.
- **Part-I** is Physics, **Part-II** is Chemistry and **Part-III** is Mathematics.
- Each **Part** is further divided into **Two Sections: Section-A & Section-C**.

Section-A (01 – 08, 21 – 28, 41 – 48) contains 24 multiple choice questions which have one or more correct answer. Each question carries **+4 marks** for correct answer and **-2 marks** for wrong answer.

Section-A (09 – 12, 29 – 32, 49 – 52) contains 12 paragraphs with each having 2 questions with one or more than one correct answer. Each question carries **+4 marks** for correct answer and **-2 marks** for wrong answer.

Section-C (13 – 20, 33 – 40, 53 – 60) contains 24 Numerical based questions with answers as numerical value from 0 to 9 and each question carries **+4 marks** for correct answer. There is no negative marking.

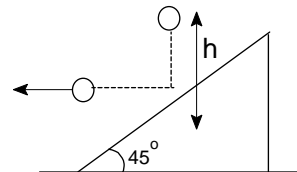
Physics

PART – I

SECTION – A
(One OR More Than One Choice Type)

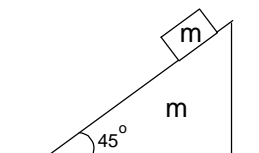
This section contains **8 multiple choice questions**. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which only **one or more than one** is/are correct

1. A body dropped over a fixed rough inclined plane of inclination 45° from height h . If after collision velocity of body becomes horizontal then co-efficient of restitution if co-efficient of friction is $1/2$.



- (A) $\frac{1}{2}$ (B) $\frac{1}{3}$
(C) $\frac{1}{4}$ (D) 1
2. A body is moving along straight line such that its velocity represented through x and velocity gradient is represented through y then relation between x and y for movement under constant acceleration may be
- (A) $xy = \text{const}$ (B) $x^2 - y^2 = \text{const}$
(C) $x^2 + y^2 = \text{const}$ (D) $y^2 = 4ax$

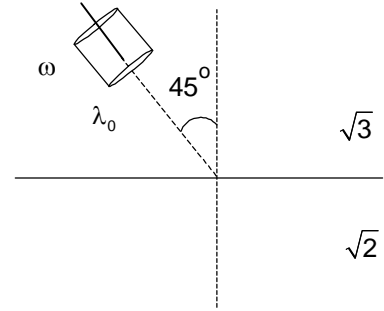
3. A block having mass m is placed over an inclined plane of same mass and inclination 45° if co-efficient of friction between all surfaces is same and it is μ . Now system set free to move then
- (A) For $\mu > 1$ block over incline will move but wedge won't
(B) For $0.2 < \mu < 1$ block will move but wedge will not
(C) For $\mu = 0.15$ both will move
(D) It is not possible to move wedge without moving block over wedge



4. Let 1.0 kg of super cooled water at temp -10°C kept in a container and crushed ice at temp $\theta = -20^\circ\text{C}$ kept in another container. How much ice have to add the water so that whole water freezes. Specific heat of water $S_w = 4.2 \times 10^3 \text{ J/kg-K}$. Specific heat of ice $S_i = 2.1 \times 10^3 \text{ J/kg-K}$. Latent heat of melting ice $L = 336 \text{ kJ/kg}$ melting point $\theta = 0^\circ\text{C}$. Neglecting Heat capacity of vessel and surrounding.
- (A) 14 kg (B) 7 kg
(C) 5 kg (D) can't find

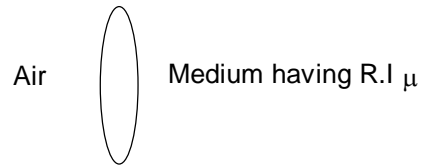
Space for Rough work

5. A Beam of light having wavelength λ_0 and wattage ω falls over a surface separating two medium of refractive index $\sqrt{3}$ and $\sqrt{2}$ respectively as shown in figure. Force exerted by beam of light over and along surface are F_{\perp} and f_{\parallel}



- (A) $\frac{(\sqrt{3}-1)}{\sqrt{6}} \frac{\omega}{C} = F_{\perp}$
 (B) $F_{\parallel} = 2\sqrt{3} \frac{\omega}{C}$
 (C) $\frac{(\sqrt{3}+1)}{\sqrt{6}} \frac{\omega}{C} = F_{\perp}$
 (D) $F_{\parallel} = 0$

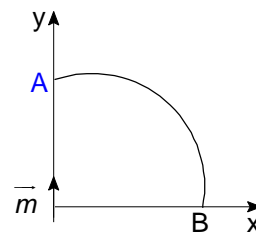
6. An equiconvex lens of focal length 20 cm having a glass of refractive index $3/2$ is used in a medium air on left side and another medium having refractive index μ on a right side of lens as shown in figure.



- (A) Character of lens will be diverging for $\mu > 2$
 (B) Focal length of lens will be 40 cm for $\mu = 4$ and character will be diverging
 (C) Object distance and image distance with respect to lens will be same for $\mu = 2$
 (D) Character of lens can't be explained
7. A solid metal cylinder rotates with angular speed ω about its axis of symmetry. The cylinder is in a region having uniform magnetic field B along its axis then
- (A) Electric field inside cylinder will be proportional to $\perp r$ distance from axis of rotation if $\omega \neq \frac{eB}{m}$
 (B) Electric field, inside cylinder is radially away from axis of rotation of $\omega > \frac{eB}{m}$
 (C) Charge density inside the cylinder may be positive, negative or zero accordingly ω and direction of magnetic field
 (D) For $\omega = \frac{eB}{m}$ and $\vec{B} \parallel \vec{\omega}$ charge density inside cylinder is zero.

Space for Rough work

8. A quarter circular conducting ring of large radius R with centre at origin where a magnetic dipole of moment \vec{m} is placed as shown in figure. When the ring rotates at angular velocity ω about the y axis electromotive force induced between its end is



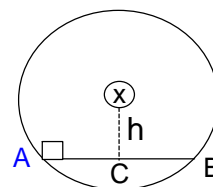
- (A) Zero
 (B) $\frac{\mu_0 m \omega}{2\pi r}$
 (C) $\frac{\mu_0 m \omega}{4\pi r}$
 (D) $\frac{\mu_0 m \omega}{8\pi r}$

(Paragraph Type)

This section contains **TWO** paragraphs. Based on the paragraph, there are **TWO** questions of each paragraph. Each question has **FOUR** options (A), (B), (C) and (D). **One OR More than One** of these four options is/are correct.

Paragraph for Questions 09 & 10

A small insect having mass m is in rest at one end of a horizontal platform placed inside a circular cage as shown in figure. Circular cage is pivot about its centre and cage inner surface is smooth. Now insect start its motion on platform such that platform and cage is in rest. Radius of cage is R .



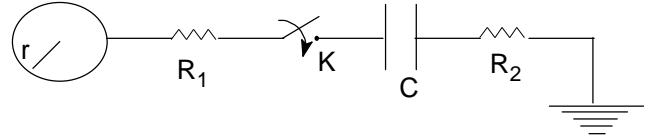
9. Time taken by insect to move from A to B on platform
 (A) $\pi\sqrt{\frac{h}{g}}$
 (B) $2\pi\sqrt{\frac{h}{g}}$
 (C) $\left\{\frac{\sqrt{R^2 - h^2}}{g}\right\}^{\frac{1}{2}}$
 (D) can't find
10. Speed of insect when it passes is
 (A) $\sqrt{\frac{gh}{2}}$
 (B) $\sqrt{2gh}$
 (C) $h\sqrt{\frac{g}{h}}$
 (D) $\sqrt{R^2 - h^2}\sqrt{\frac{g}{h}}$

Space for Rough work

Paragraph for Questions 11 & 12

A charged spherical shell of radius r is connected to a capacitor of capacity C through two resistances R_1 and R_2 as shown in figure. Initially charged on sphere is Q_0 .

11. Charge on capacitor C after long time as switch k gets closed.
 (A) zero
 (B) Q_0
 (C) $\frac{cQ_0}{c + 4\pi\epsilon_0 r}$
 (D) can't find



12. Heat energy developed across resistor R_1 after long time interval as switch gets closed.
- (A) $\frac{Q_0^2 c}{8\pi\epsilon_0 r(c + 4\pi\epsilon_0 r)} \left(\frac{R_1}{R_1 + R_2} \right)$ (B) $\frac{R_1 Q_0^2 4\pi\epsilon_0 r}{c(R_1 + R_2)(c + 4\pi\epsilon_0 r)}$
 (C) $\frac{Q_0^2}{2c}$ (D) $\frac{Q_0^2 R_1 c}{4\pi\epsilon_0 r(c + 4\pi\epsilon_0 r)(R_1 + R_2)}$

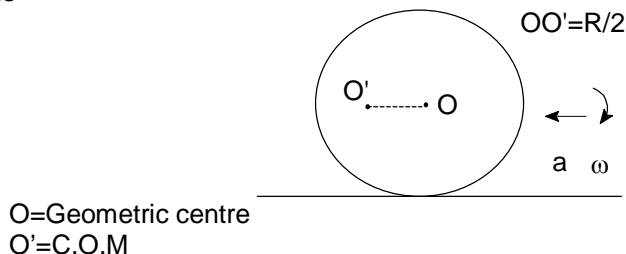
SECTION – C
(One Integer Value Correct Type)

This section contains **8 questions**. Each question, when worked out will result in **one integer** from 0 to 9 (both inclusive).

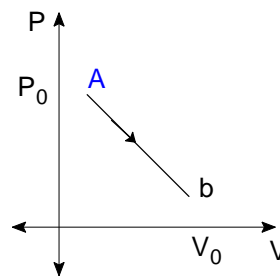
13. If a tap above empty rectangular basin able to fill it in time $t_1=3$ min and small hole at bottom able to make it completely empty from filled stage in time $t_2=2$ min. Now both tap and hole are opened simultaneously (At initial stage basin is completely empty). The maximum height up to which liquid may filled in basin is $\frac{H_0}{n}$ find n { $H_0 = \text{Height of basin}$ }

Space for Rough work

14. A non uniform sphere of radius $R=50$ cm accelerating over a rough horizontal surface with $a = 10 \text{ m s}^{-2}$ and angular velocity $\omega = 5\sqrt{2} \text{ rad s}^{-1}$ such that it rolls without slipping over surface. If minimum coefficient of friction for given motion is $\mu = \frac{1}{k}$. Then k (position of C.O.M is given in figure) is



15. One mole of monoatomic gas undergoes a linear process A→B shown in P-V diagram. Volume of gas from where process turn from an endothermic to an exothermic is $\frac{n}{(2n-2)} V_0$ find n.



16. A small positively charged ball of mass m is suspended by insulator thread of negligible mass. Another similar positively charged small ball moved very slowly from large distance until it is in original position of first ball. As a result first ball rises by height h . Work done in this process is $nmg h$ then n is
17. An observer moving with uniform velocity towards a stationary sound source observes frequency $f=170$ Hz over a distance of $x=80$ m. If frequency of sound is $f_0=160$ Hz and sound travel with speed $c = 340 \text{ m s}^{-1}$. Then duration of beep emitted by source is n . Find n .

Space for Rough work

18. Water drop is stuck between two plates of glass. Distance between plates of glass is d where diameter of water drop disc $D \gg d$. If surface tension of water is T and angle of contact is 0° . Force between plates is $\left\{ T \frac{\pi D^2}{d} \right\} \times \frac{1}{K}$. Find K .
19. One night a person of height $h=1.8$ m is standing on the bank of a straight canal. There is no wind and no ripples on water surface. On the opposite bank a lamp is installed at height $H=5.4$ m on a lamppost. Light emanated from the lamp, appears as a bright spot after reflection from the water surface. When a person starts walking along the bank the spot appears to him moving at constant speed u_0 relative to ground. Speed of person is $\frac{(n+1)}{n} u_0$. Find n .
20. Let current I uniformly distributed uniformly over circumference of hollow cylinder of L and radius R . If $L \gg R$ then force exerted by one half of cylinder on other is $\frac{\mu_0 I^2}{K \pi^2 R} \cdot L$. Find K .

Space for Rough work

Chemistry

PART – II

SECTION – A (One OR More Than One Choice Type)

This section contains **8 multiple choice questions**. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which only **one or more than one** is/are correct

21. Select the correct matches.

(Ions)		(Reagents)		(Colour/Precipitate obtained)	
(A)	Cu^{2+}	(I)	$\text{Na}_2\text{S}_2\text{O}_3$	(X)	Violet colour which disappear slowly
(B)	Fe^{3+}	(II)	$\text{K}_4[\text{Fe}(\text{CN})_6]$	(Y)	Blue
(C)	Fe^{2+}	(III)	$\text{K}_3[\text{Fe}(\text{CN})_6]$	(Z)	Chocolate brown

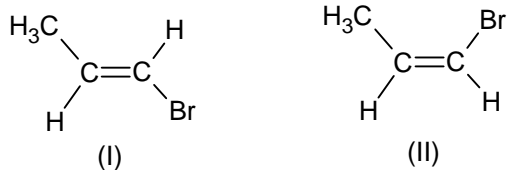
(A) A – (I)- Y, B-(II)-Z, C-(III)-Y

(B) A –(III)-Z, B-(I)-X, C-(III)-Y

(C) A-(II)-Z, B-(II)-Y, C-(III)-Y

(D) A-(III)-Y, B-(III)-Y, C-(II)-Y

22. Consider the molecules



Which of the following is/are true regarding (I) and (II).

(A) Dipole moment: I > II

(B) Melting point: I > II

(C) Solubility in H_2O : I > II

(D) Stability: I > II

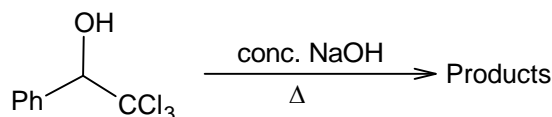
23. The possible product formed is/are

(A) PhCOONa

(B) PhCH_2OH

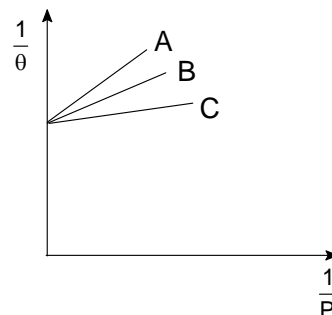
(C) HCOONa

(D) $\text{Ph}-\text{C}-\text{CH}_3$



Space for Rough work

24. $^{14}\text{CH}_2 = \text{CH} - \text{CH}_2\text{OH} \xrightarrow{\text{SOCl}_2}$ Major product is
 (A) $^{14}\text{CH}_2 = \text{CH} - \text{CH}_2 - \text{Cl}$ (B) $\text{CH}_2 = \text{CH} - ^{14}\text{CH}_2 - \text{Cl}$
 (C) (A) and (B) are in equal ratio (D) $^{14}\text{CH}_3 - \underset{\text{Cl}}{\text{CH}} - \text{CH}_3$
25. $\text{A} \xrightarrow{\text{High T \& P}} 3\text{B}$ is a first order reaction. If A is a strong monoprotic acid and B is strong diprotic acid and reaction kinetic is studied by using a standard solution of NaOH required to neutralise reaction mixture at different instant of time, when initially we had taken some concentration of A. Now, it was observed that volume required after 970 sec was double that required initially, then half life of reaction is
 (A) 485 sec (B) 1942 sec
 (C) 3010 sec (D) 971 sec
26. Which of the following is/are true about the salt bridge?
 (A) doesn't participate chemically in the cell reaction
 (B) ensures mixing of the two electrolytic solution
 (C) the ionic mobility of cation and anion of salt in salt bridge must be same
 (D) in IUPAC cell notation, it is not written if the electrolyte is same in both half cell having equal concentration
27. Which of the following overlapping can be of two types either (σ, π) or (π, δ) or (σ, δ) with appropriate internuclear axis as per the requirement of overlapping?
 (A) $d_{x^2-y^2} + d_{x^2-y^2}$ (B) $s + p_x$
 (C) $d_{xy} + d_{xy}$ (D) $p_z + p_z$
28. Adsorption isotherms of three gases A, B and C are shown in the following figure, where θ is the percentage of surface area of adsorbent (powdered charcoal) covered by the gas and P is the partial pressure of the gas over the adsorbent, then which of the following statement(s) is/are correct? (Consider only monolayer formation)
 (A) At any finite value of pressure, A shows the highest extent of adsorption
 (B) At any finite value of pressure, C shows the highest extent of adsorption
 (C) Gas A has the highest critical temperature
 (D) Gas C has the highest critical temperature



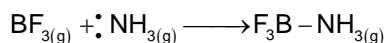
Space for Rough work

(Paragraph Type)

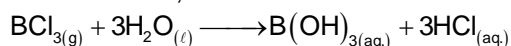
This section contains **TWO** paragraphs. Based on the paragraph, there are **TWO** questions of each paragraph. Each question has **FOUR** options (A), (B), (C) and (D). **One OR More than One** of these four options is/are correct.

Paragraph for Questions 29 & 30

All the boron trihalides except BI_3 may be prepared by direct reaction between the elements. Boron trihalides consist of trigonal – planar BX_3 molecules. Unlike the halides of the other elements in the group they are monomeric in the gas, liquid and solid states, BF_3 and BCl_3 are gases, BBr_3 is a volatile liquid and BI_3 is a solid. Boron trihalides are Lewis acids because they form Lewis complexes with suitable bases.



However, boron chlorides, bromides and iodides are susceptible (sensitive) to protolysis by mild proton sources such as water, alcohols and even amines for example BCl_3 undergoes rapid hydrolysis.



It is supposed that the first step in the above reaction is the formation of the complex $\text{Cl}_3\text{B} \leftarrow \text{OH}_2$ which then eliminates HCl and reacts further with water.

29. Which is correct about the hydrolysis of BX_3 ?
- (A) All BX_3 undergo hydrolysis to produce $\text{B(OH)}_{3(aq)}$ and $\text{HX}_{(aq)}$
- (B) BF_3 does not undergo complete hydrolysis due to formation of $\text{H}^+ [\text{BF}_3\text{OH}]^-$
- (C) BBr_3 does not undergo hydrolysis at all because it can not form H-bonds with water
- (D) All of the above are correct
30. Which of the following is correct?
- (A) $\text{B(OCH}_3)_3$ is much weaker Lewis acid than BBr_3
- (B) $\text{B(OH)}_{3(aq)}$ behaves as a triprotic acid
- (C) $[\text{H}_2\text{BO}_3]^-_{(aq)}$ is a conjugate base of $\text{H}_3\text{BO}_{3(aq)}$
- (D) BF_3 does not react with ethers

Space for Rough work

Paragraph for Questions 31 & 32

The structure of unit cell of perovskite - a salt of lanthanum (La), manganese (Mn) and oxygen (O), has Mn^{+2} at each corner, oxide on every edge centre and lanthanum ion at the body centre.

31. What are the coordination numbers of Mn, La and O respectively?
 (A) 6, 2, 8 (B) 6, 4, 12
 (C) 8, 4, 8 (D) 6, 12, 2
32. Considering the closed packed arrangement of ions, which of the following statement regarding the ionic radius is the most appropriate?
 (A) $r_{La^{+4}} > r_{O^{2-}}$ (B) $r_{La^{+4}} > r_{Mn^{+2}}$
 (C) edge length of unit cell = $r_{Mn^{+2}} + r_{O^{2-}}$ (D) None of these

SECTION – C
(One Integer Value Correct Type)

This section contains **8 questions**. Each question, when worked out will result in **one integer** from 0 to 9 (both inclusive).

33. Consider the following list of reagents:
 Acidified $K_2Cr_2O_7$, alkaline $KMnO_4$, $CuSO_4$, H_2O_2 , Cl_2 , O_3 , $FeCl_3$, HNO_3 and $Na_2S_2O_3$. The total number of reagents that can oxidise aqueous iodide to iodine is:
34. Assuming covalent radii to be additive property. What is the iodine – iodine distance in p-di-iodo benzene. Given the C – C bond length in C_6H_6 are 1.40 \AA and covalent radius of iodine and carbon atom are 1.33 \AA and 0.77 \AA .
35. Consider the statements:-
 (a) Inversion temperature (T_i) = $x \times$ Boyle's temp (T_b)
 (b) Boyle's temp is determined by Virial equation when the value of 2nd virial coefficient = y
 (c) The value of compressibility factor (Z) at critical condition = $\frac{z}{w}$
 Find the value of $z + w - x - y$.

Space for Rough work

36. 2 mols of an ideal gas of unknown heat capacity are in a piston fitted cylinder at 300K. The piston has a mass on the top of it that supplies a constant pressure. The piston is then brought into contact with a thermostat. Heat flows into the system causing the gas to both expand and change temperature. After the temperature has equilibrated, the work done by the gas on the surrounding was found to be 3.32 kJ. Also 14.94 kJ of heat flows into the system. What is the atomicity of the gas. Take $R = 8.3 \text{ J K}^{-1} \text{ mol}^{-1}$
37. At 25°C , K_{sp} of AgCN is 4×10^{-16} while K_a of HCN is 4×10^{-10} . The value of molar solubility of AgCN in 0.01 M HNO_3 is 10^{-x} . The value of x is.....
38. A certain hydrocarbon effuses $\sqrt{2}$ times slower as compared to N_2 gas under identical conditions. The number of carbon atoms in one molecule of hydrocarbon is 'p' and index of hydrogen deficiency is 'q'. Find the value of 'p × q'.
39. Consider the following sequence of reaction:

$$(\text{CH}_3)_2\text{CH}-\underset{\text{O}}{\underset{\parallel}{\text{C}}}-\text{NH}_2 \xrightarrow[\Delta]{\text{P}_4\text{O}_{10}} \text{A} \xrightarrow{\text{H}_3\text{O}^+} \text{B} \xrightarrow{\text{Br}_2/\text{P}} \text{C} \xrightarrow{\text{AgOH}} \text{D} \xrightarrow{\Delta} \text{E}$$
- The no. of O-atoms in final product 'E' = x
 The no. of geometrical isomer of final product E = y
 Find the value of x + y.
40. If n is the total number of pentasachharides of D – glucose obtained by $\text{C}_1 - \text{C}_4$ glycosidic linkage between successive pyranose from of D – glucose, then the value of n divided by 4 is equal to

Space for Rough work

44. If $(f(x)-1)(x^2+x+1)^2 - (f(x)+1)(x^4+x^2+1) = 0$ is true for all $x \in \mathbb{R} - \{0\}$, then which of the following statement(s) is/are true?
 (A) $|f(x)| \geq 2, \forall x \in \mathbb{R} - \{0\}$
 (B) $f(x)$ has local maxima at $x = -1$
 (C) $f(x)$ has local minima at $x = 1$
 (D) The value of definite integral $\int_{-\pi}^{\pi} (\cos x)f(x)dx = 0$
45. Let a, b, c, d be non – zero distinct digits. The number of 4 digit numbers ‘abcd’ such that $ab + cd$ is even is divisible by
 (A) 3 (B) 4
 (C) 7 (D) 11
46. In a triangle ABC, if $\tan A = 2\sin 2C$ & $3\cos A = 2\sin B \cdot \sin C$ then possible value of C is/are
 (A) $\frac{\pi}{8}$ (B) $\frac{\pi}{6}$
 (C) $\frac{\pi}{4}$ (D) $\frac{\pi}{3}$
47. Let the function $f(x)$ be trice differentiable and satisfies $f(f(x)) = 1 - x \forall x \in [0, 1]$
 If $J = \int_0^1 f(x)dx$ and $f''\left(\frac{4}{5}\right) = 0$
 Then which of the following is(are) true?
 (A) $f\left(\frac{1}{3}\right) + f\left(\frac{2}{3}\right) = 1$
 (B) $J = \frac{1}{2}$
 (C) $f''(x) = 0$ has at least one root in $x \in \left(\frac{1}{4}, \frac{3}{4}\right)$
 (D) $f''(x) = 0$ at least one root in $x \in \left(\frac{1}{2}, \frac{4}{5}\right)$

Space for Rough work

48. If P is any point on the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, whose foci are S_1 & S_2 . Let $\angle PS_1S_2 = \alpha$ & $\angle PS_2S_1 = \beta$ then,
- (A) $PS_1 + PS_2 = 2a$, if $a > b$
 (B) $PS_1 + PS_2 = 2b$, if $a < b$
 (C) $\tan \frac{\alpha}{2} \cdot \tan \frac{\beta}{2} = \frac{1-e}{1+e}$
 (D) $\tan \frac{\alpha}{2} \cdot \tan \frac{\beta}{2} = \frac{\sqrt{a^2 - b^2}}{b^2} \left[a - \sqrt{a^2 - b^2} \right]$

(Paragraph Type)

This section contains **TWO** paragraphs. Based on the paragraph, there are **TWO** questions of each paragraph. Each question has **FOUR** options (A), (B), (C) and (D). **One OR More than One** of these four options is/are correct.

Paragraph for Questions 49 & 50

Let $g(x) = x^C \cdot e^{Cx}$ & $f(x) = \int_0^x te^{2t} (1+3t^2)^{\frac{1}{2}} dt$

If $L = \lim_{x \rightarrow \infty} \frac{f'(x)}{g'(x)}$ is non-zero finite number.

49. The value of C is
- (A) 7 (B) $\frac{3}{2}$
 (C) 2 (D) 3
50. The value of L is,.
- (A) $\frac{2}{7}$ (B) $\frac{1}{2}$
 (C) $\frac{\sqrt{3}}{4}$ (D) $= \frac{\sqrt{3}}{2}$

Space for Rough work

Paragraph for Questions 51 & 52

$y = f(x)$ is parabola of the form $f(x) = x^2 + bx + 1$, b is a constant. The tangent line is drawn at the point where $f(x)$ cuts $y - axis$, also touches $x^2 + y^2 = r$. It is also given that at least one tangent can be drawn from point P to $y = f(x)$, where D is a point at which $y = |x - \alpha|$ is non - differentiable $\forall \alpha \in R$.

51. For maximum value of b , the area of circle is
 (A) $\frac{\pi}{10}$ (B) $\frac{\pi}{5}$
 (C) π (D) 5π
52. The value of L is,
 (A) $y = 1 - x^2 \forall x \in [-1, 1], y \in [-1, 0]$ (B) $y = 1 - x^2 \forall x \in [-2, 2], y \in [0, 1]$
 (C) $y = 1 - x^2 \forall x \in [-2, 2], y \in [-3, 1]$ (D) $y = 1 - x^2 \forall x \in [-1, 1], y \in [0, 1]$

SECTION – C
(One Integer Value Correct Type)

This section contains **8 questions**. Each question, when worked out will result in **one integer** from 0 to 9 (both inclusive).

53. Let $y = f(t)$ be a solution to the differential equation $\frac{dy}{dt} + 2ty = t^2$, then $16 \lim_{t \rightarrow \infty} \frac{y}{t}$ is
54. If $\alpha + \frac{1}{\alpha}$ & $2 - \beta - \frac{1}{\beta}$ ($\alpha, \beta > 0$) are the roots of the quadratic equation $x^2 - 2(a+1)x + a - 3 = 0$, then the sum of integral value of 'a'.
55. If A & B are points on the parabola $y^2 = 4ax$ with vertex O such that OA is perpendicular to OB and having length r_1 & r_2 respectively, then find the value of $\frac{r_1^4 r_2^4}{2 \left(r_1^3 + r_2^3 \right) a^2}$

Space for Rough work

56. Let $P(a, b, c)$ be any point on the plane $3x + 2y + z = 7$ then find the least value of $2(a^2 + b^2 + c^2)$.
57. If $f(x)$ is continuous function and

$$F(x) = \int_0^x \left((2t+3) \cdot \int_t^2 f(x) dx \right) dt,$$
 Then $|F''(2) / f(2)|$ is.....
58. Let A and B be two 3×3 invertible matrices such that A is an idempotent matrix and
 $\det(\text{adj } B) = \det(A)^{12} + \det(A - A^T)^{13} + \det(\text{adj } A - I)^{14} + L$
 where $L = \lim_{x \rightarrow \infty} \frac{\int_0^{\sin^2 x} \ln(1+t^3) dt}{\int_0^x (e^t - 1 - t)(\tan t - t)(1 - \cos t) dt}$
 Then the value of $\det(B)$
59. Let r be the positive real zero of $P(x) = 9x^5 + 7x^2 - 9$. If the sum
 $S = r^4 + 2r^9 + 3r^{14} + 4r^{19} + \dots + \infty$ can be expressed as the rational number $\left(\frac{a}{b}\right)$ in the lowest term, then the sum of digits in $(a + b)$
60. T_1, T_2 & T_3 are three different taxis, each having 3 duly numbered seats for the passenger. Seven passenger are to accommodated in these taxis. If probability that taxis T_1 & T_2 are used to their full capacity is $\frac{m}{n}$, $m, n \in \mathbb{N}$, then the least value of $(n - 4m)$ is.....

Space for Rough work