ALL INDIA TEST SERIES

TEST - 7

JEE (Advanced)

Time Allotted: 3 Hours **Maximum Marks: 198**

General Instructions:

- The test consists of total 54 questions.
- Each subject (PCM) has 18 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 – 06, 19 – 24, 37– 42) contains **18 multiple** choice questions which have **ONLY ONE CORRECT ANSWER**. Each question carries **+3 marks** for correct answer and **–1 mark** for wrong answer.

  Section-A (07 – 12, 25 – 30, 43 – 48) *this section contains* ***18 multiple*** *choice questions.*
  Each question has FOUR options. ***ONE OR MORE THAN ONE*** *of these four option(s) is (are) correct answer(s).*
  For each question, choose the option(s) corresponding to (all) the correct answer(s)
  Answer to each question will be evaluated according to the following marking scheme:

  Full Marks **: +4** If only (all) the correct option(s) is (are) chosen:
  Partial Marks **: +3** If all the four options are correct but ONLY three options are chosen;
  Partial Marks **: +2** If three or more options are correct but ONLY two options are chosen and both of which are correct;
  Partial Marks **: +1** If two or more options are correct but ONLY one option is chosen and it is a correct option;
  Zero Marks **: 0** If none of the options is chosen (i. e. the question is unanswered);
  Negative Marks **: –2** In all other cases.

  Section-C (13 – 18, 31– 36, 49 – 54) *contains* ***18 Numerical*** *answer type questions with answer XXXXX.XX and each question carries* ***+4 marks*** *for correct answer and* ***–0 marks*** *for wrong answer.*

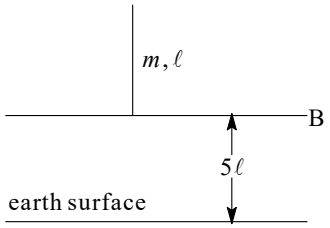
Physics

PART – I

SECTION – A
(One Options Correct Type)

This section contains **06 multiple choice questions**. Each question has **four choices** (A), (B), (C) and (D), out of which **ONLY ONE** option is correct.

1. Consider a situation in which a uniform gravitation field is present below line AB and no gravity above line AB. Then the speed with which a rod shown in the figure will strikes earth surface when released from the position shown is:



(A) $\sqrt{g\ell}$

(B) $2\sqrt{g\ell}$

(C) $3\sqrt{g\ell}$

(D) $4\sqrt{g\ell}$

2. In hydrogen atom spectrum, when an electron de-excites from higher energy level $n >> 1$ to lower energy level then first few frequencies of light that is emitted (e. g. $n = n$ to $n-1, n$ to $n-2$, n to $n-3$ etc.) are very nearly:

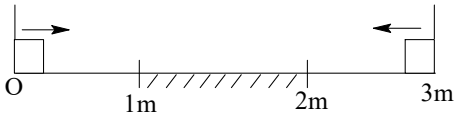
(A) in AP (Arithmetic progression)

(B) in GP (Geometric progression)

(C) in HP (Harmonic progression)

(D) in $1^2 : 2^2 : 3^2$ ratio

3. Two identical small blocks each of mass 1kg are given velocity 4 m/s towards each other. All collision are elastic and surface between 1m to 2m is rough $(\mu = 0.7)$ and rest part is smooth. Then:



(A) Speed of each block after first collision is $\sqrt{2}\, m/s$

(B) Speed of each block after first collision is $4\, m/s$

(C) Separation between blocks when they stop is $2/7\, m$

(D) Separation between blocks when they stop is $5/7\, m$

4. A photon of wavelength λ is incident on a photoelectric plate and the most energetic electron from photoelectric plate is incident on a target metal of X-ray tube. If the minimum wavelength of photon emitted from target material is 2λ then work function of photoelectric plate is:

(A) $\dfrac{hc}{\lambda}$

(B) $\dfrac{hc}{2\lambda}$

(C) $\dfrac{hc}{4\lambda}$

(D) $\dfrac{hc}{8\lambda}$

5. In a polytropic $\left(PV^x = \text{constant}\right)$ when the volume of a mono-atomic gas was increased four times, simultaneously pressure decreases 8 times:

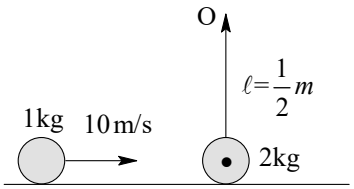
(A) Molar specific capacity of gas is $2R$

(B) Molar specific heat capacity of gas if R

(C) Molar specific heat capacity of gas is $-\frac{R}{2}$

(D) Molar specific heat capacity of gas is $\frac{5R}{2}$

6. A moving ball collides a pendulum bob as shown, the coefficient of restitution so that bob performs vertical circular motion about 0 is (g = 10 m/s^2)



(A) 1

(B) $\frac{1}{4}$

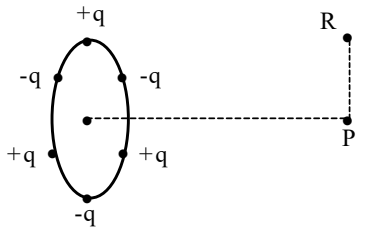
(C) $\frac{1}{8}$

(D) $\frac{1}{2}$

(One or More than one correct type)

This section contains **06** multiple choice questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four options is(are) correct.

7. Six charges of equal magnitude but opposite sign are fixed on an insulating ring at equal separation. P is a general point on the axis of ring at large distance from the centre of ring. PR is a path perpendicular to the axis of the ring and R is at infinite separation from P.



(A) Amount of work done to bring a charge from R to P via RP is zero.

(B) Net dipole moment is zero and electric field is conservative field.

(C) Amount of work done to bring a charge from R to P via RP is zero because net dipole moment is zero and electric field is conservative field.

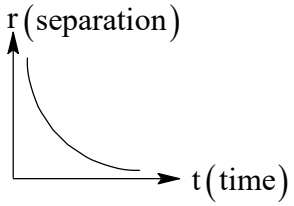
(D) Amount of work done to bring a charge from R to P via RP is zero not because of net dipole moment is zero and electric field is conservative field.

8. A radioactive point source has a decay constant λ. When this source moves towards small area counter kept at large distance from source, then counter records count/second which turns out to be constant:

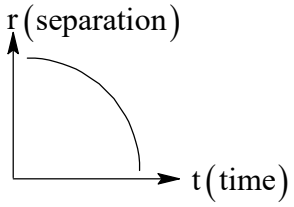
(A) When separation between source and counter becomes half of initial value, number of nuclei left undecayed will be $\frac{3}{4}\text{th}$ of initial value

(B) When separation between source and counter becomes half of initial value, number of nuclei left undecayed will be $\frac{1}{4}\text{th}$ of initial value

(C) Graph showing variation of separation between source and counter with time is as shown

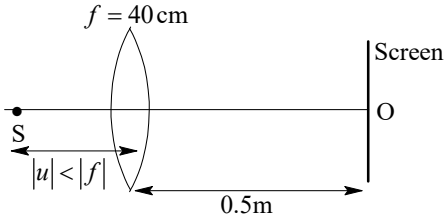


(D) Graph showing variation of separation between source and counter with time is as shown



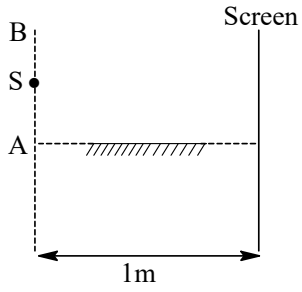
9. A diatomic gas is kept in a closed container of constant volume. Due to increase in temperature some molecules dissociates into atoms. Neglecting vibrational degrees of freedom:
(A) Specific heat capacity of mixture will increase.
(B) Specific heat capacity of mixture will decrease.
(C) Specific heat capacity of mixture can change by a maximum value of 8%
(D) Specific heat capacity of mixture can change by a maximum value of 20%

10. A lens of focal length $f=40\,\text{cm}$ is cut along the diameter into two equal halves. In this process, a layer of thickness $t=1mm$ is lost, then halves are put together to form a composite lens. In between focal plane and the composite lens a narrow slit is placed very close to the focal plane $|u|<|f|$. The slit is emitting monochromatic light of wavelength $0.6\,\mu m$. Behind the lens a screen is located at a distance $L=0.5m$ from it as shown:



(A) Fringe width is $0.12\,mm$
(B) Fringe width is $0.24\,mm$.
(C) Length of interference pattern is $1/8\,cm$
(D) Length of interference pattern is $1/16\,cm$

11. In an interference experiment as shown in the figure, the source plane and screen are separated by a distance 1m. At a certain position of source, fringe width is $1/4\,\text{mm}$ and by moving the source away from mirror along the line AB by $0.6\,\text{mm}$, the fringe width changed to $1/6\,\text{mm}$:



(A) Wavelength of light used is 5000Å
(B) Wavelength of light used is 6000Å
(C) Initial distance of source from A is $1.2\,\text{mm}$
(D) Initial distance of source from A is $0.6\,\text{mm}$

12. A particle of mass $6.6\times10^{-30}\text{kg}$ starts $(t=0)$ moving on a straight line with velocity $10\,\text{m/s}$. Its velocity decreases with time, however rate of change of de-Broglie wavelength associated with particle remains constant at $10^{-4}\,\text{m/s}$. (take $h=6.6\times10^{-34}$ J-s):

(A) Velocity of particle at $t=0.9s$ is $1m/s$

(B) Velocity of particle at $t=0.9s$ is $6\,\text{m/s}$

(C) Magnitude of retardation of particle at $t=0.9\,\text{s}$ is $4\,\text{m/s}^2$

(D) Magnitude of retardation of particle at $t=0.9s$ is $1\,\text{m/s}$

SECTION – C
(Numerical Answer Type)

This section contains **06** questions. The answer to each question is a **NUMERICAL VALUE.** For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the **second decimal place**; e.g. XXXXX.XX).

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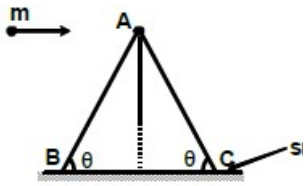
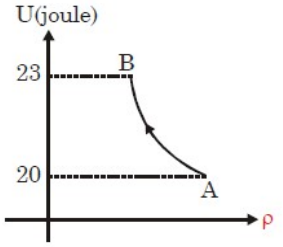
13. A particle of mass 0.1 kg moving horizontally with velocity 20 m/s strikes a stationary sedge of mass 0.05 kg near the apex of the wedge and comes to rest immediately after the collision. The wedge is free to move on the smooth floor. Second collision of particle with wedge occurs at B. If the length AB of wedge is $\frac{10\text{K}}{\sqrt{5}}$ meter, then find K.



Take $\theta=\cot^{-1}(2)$. Neglect the toppling of wedge.

14. Graph shows variation of internal energy U with density ρ of one mole of an ideal monoatomic gas. Process AB is a part of rectangular hyperbola. Find work done in the process (in Joules)

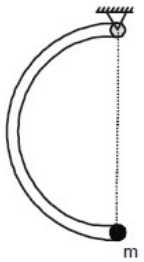


15. A radioactive nucleus X decays into a nucleus Y which itself is radioactive. Y decays into a stable nucleus Z.

$$X \xrightarrow[=\frac{3}{2}hour]{Half\ Life} Y \xrightarrow[=\frac{3}{8}hour]{Half\ Life} Z$$

Initially the sample has only nuclei X & number count of Y is zero. Find time (in minutes) when number of count for Y is maximum.

16. Half ring of mass m and radius R is released from the position shown in diagram. A small point mass of same mass is also fixed at the end as shown in figure. If the initial acceleration of point mass m is $\frac{g}{\beta\pi}$ then find the value of β.



17. In YDSE, if sources are incoherent, the intensity on screen is $13I_0$. When these sources are coherent then minimum intensity on screen is I_0. If maximum intensity produced by these coherent sources on screen is nI_0, then find n.

18. A vessel of volume V_0 is evacuated by means of a piston air pump. One piston stroke captures the volume $\Delta V = 0.2V_0$. If process is assumed to be isothermal then find the minimum number of strokes after which pressure in the vessel becomes $\left(\frac{1}{1.728}\right)(P_{initial})$.

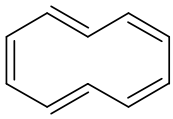
Chemistry

PART – II

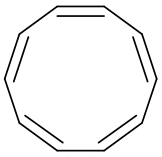
SECTION – A
(One Options Correct Type)

This section contains **06 multiple choice questions**. Each question has **four choices** (A), (B), (C) and (D), out of which **ONLY ONE** option is correct.

19. The following two compound are:



(I)



(II)

(A) Identical isomers
(B) conformational isomers
(C) geometrical isomers
(D) Optical isomers

20. If mercuric iodide is added to an aqueous solution of KI, the:
(A) freezing point increased
(B) freezing point is lowered
(C) boiling point does not change
(D) Osmotic pressure increased

21. Which of the following is weaker base?
(A) $N\left(SiH_3\right)_3$
(B) $N\left(CH_3\right)_3$
(C) $NH\left(CH_3\right)_3$
(D) All are equally basic

22. Which of the following ions is expected to be colourless?
(A) Ni^{2+}
(B) Mn^{+2}
(C) Zn^{2+}
(D) Cu^{2+}

23. A definite mass of a monoatomic ideal gas at 1 bar and 27°C expands isothermally against vacuum from 1.2 dm^3 to 2.4 dm^3. The change in free energy of the gas, $\Delta G,$ is (R = 0.80 bar – L/K-mol, ln 2 = 0.7)
(A) 0
(B) $-64\,\mathrm{bar}-1$
(C) $+84\,J$
(D) $-84\,J$

24. In the system, $LaCl_3(s)+H_2O(g)+\text{heat} \rightleftharpoons LaClO(s)+2HCl(g)$, equilibrium is established. More water vapour is added to disturb the equilibrium. If the pressure of water vapour at new equilibrium is double of that at initial equilibrium, the factor by which pressure of HCl is changed is:

(A) 2 times

(B) $\sqrt{2}$ times

(C) $\frac{1}{\sqrt{2}}$ times

(D) 4 times

(One or More than one correct type)

This section contains **06** multiple choice questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four options is(are) correct.

25. Which of the following statement/statements is/are correct?

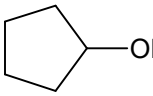
(A) in the $NaCl$ structures, each Na^+ ion is surrounded by $6Cl^-$ ions as nearest neighbours and twelve Na^+ ions as next nearest neighbours.

(B) the co-ordination number of cation generally increases as the radius ratio increases

(C) packing efficiencies higher than 0.74 are possible only with cation and anion of different sizes

(D) during a crystal defect electrical neutrality should be maintained.

26. An optically active alcohol $A(C_8H_{16}O)$ on oxidation gives B. A on acidic heating gives $C(C_8H_{14})$ as major product. C on ozonolysis produces $D(C_5H_8O)$ and

. D on reduction with $LiAlH_4$ gave

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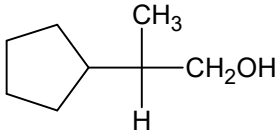
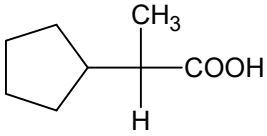
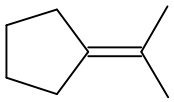
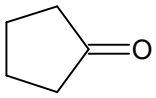
Identify correct answer:

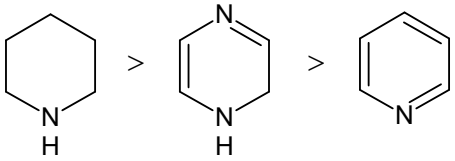
(A) A is


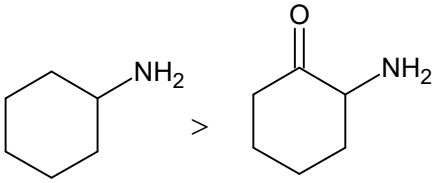
(B) B is


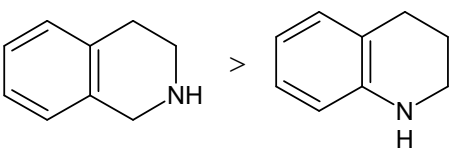
(C) C is


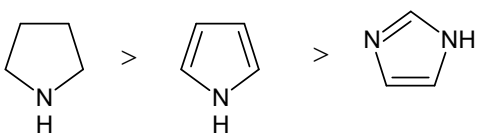
(D) D is


27. Which of the following order for basic strength is/are correct?

(A)


(B)


(C)


(D)


28. When 5 mL of a 1.0 M HCl solution is mixed with 5 mL of a $0.1M$ $NaOH$ solution, temperature of solution increases by $t°C$. Which of the following(s) can be predicted from this observation:

(A) If $5mL$ of $0.1M$ HCl is mixed with 5 mL 0.1 M NH_3 solution, the temperature rise will be less than $t°C$

(B) If 5 mL 0.1 M CH_3COOH is mixed with 5 mL 0.1 M $NaOH$, the temperature rise will be less than $t°C$

(C) If 10 mL of 1.0 M HCl is mixed with 10 mL of 0.1 M NaOH, the temperature rise will be $2t°C$.

(D) If 10 mL of 0.1 M HCl is mixed with 10 mL of 0.1 M NaCl, the temperature rise will be $t°C$

29. Which of the following is/are can produce H_2O_2 on hydrolysis?

(A) BaO_2

(B) PbO_2

(C) MnO_2

(D) Na_2O_2

30. The correct statement/statements is/are:

(A) The distance between two octahedral voids of a cubic close packing of atoms with radius r is 2r

(B) The distance between two tetrahedral voids of a cubic close packing of atoms with radius r is $\sqrt{6}\times r$ at the body diagonal axes

(C) The distance between tetrahedral and octahedral void is $\sqrt{\frac{3}{2}}\times r$, where is the radius of atom forming the close packing

(D) The distance between the surfaces of atoms fcc arrangement along an edge is $2\left(\sqrt{2}-1\right)r$

SECTION – C
(Numerical Answer Type)

This section contains **06** questions. The answer to each question is a **NUMERICAL VALUE.** For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the **second decimal place**; e.g. XXXXX.XX).

31. One mole of nitrogen gas at 0.8 atm takes 38 seconds on diffuse through a pinhole, whereas one mole of a compound of xenon with fluorine at 1.6 atm takes 57 seconds to diffuse through the same hole. Calculate molecular weight of the compound.

32. Calculate $\Delta_f H°$ (magnitude only) for chloride ion (aq.) from the following data: (in kJ)

$$\frac{1}{2}H_2(g)+\frac{1}{2}Cl_2(g)\rightarrow HCl(g);\qquad \Delta_f H°=-92.4\,kJ$$

$$HCl(g)+H_2O(\ell)\rightarrow H_3O^+(aq)+Cl^-(aq);\qquad \Delta H°=-74.8\,kJ$$

$$\Delta_f H°\ of\ H^+(aq)=0.0\,kJ$$

33. K_{sp} of $PbBr_2$ (Molar mass $= 367$) is 3.2×10^{-5}. If the salt is 80% dissociated in solution, calculate the solubility of salt in gram per litre. (in litre^{-1})

34. At 20°C, the vapour pressure of 0.1 molal aqueous solution of urea is 0.03 mm less than that of water and the vapour pressure of 0.1 molal solution if KCl is 0.0594 mm less than that of water. The apparent percentage dissociation of KCl in water at the given temperature is (Neglect the moles of solute particles in comparison to the moles of water in both solutions).

35. If x and y are total number of electrons which are present in non-axial and axial set of d-orbitals respectively in Ni cation of $\left[\text{Ni}\left(\text{DMG}\right)_2\right]$, then calculate value of $\frac{2x^2}{y}$.

36. Total energy of an atom when electron is in the 1st orbit of hydrogen atom is -13.6 eV/atom. Kinetic energy of electron in the 1st excited state of Li^{2+} ion in eV is:

Mathematics

PART – III

SECTION – A
(One Options Correct Type)

This section contains **06 multiple choice questions**. Each question has **four choices** (A), (B), (C) and (D), out of which **ONLY ONE** option is correct.

37. Conditions so that equation $(a_1x^2+b_1x+c_1)(a_2x^2+b_2x+c_2)=0$, $(a_1a_2>0)$ have fours real roots if
(i) $c_1c_2>0$ (ii) $a_1c_2<0$ (iii) $a_2c_1<0$
(A) only (i) is sufficient
(B) either of two statements are sufficient
(C) either of two statements are necessary and sufficient
(D) all the three statements are sufficient

38. In a ΔABC, the incircle touches the sides BC, CA and AB at D, E, F respectively. If radius of incircle is 4 units and BD, CE and AF are in A.P. with common difference 1, then area of ΔABC is
(A) 84 sq. units
(B) 42 sq. units
(C) 168 sq. units
(D) data insufficient

39. Let A be the area between co-ordinate axis, $y^2=x-1$, $x^2=y-1$ and the line which makes the shortest distance between two parabolas and A′ be the area between $x=0$, $x^2=y-1$, $x=y$ and the shortest distance between $y^2=x-1$ and $x^2=y-1$, then
(A) A=A′
(B) $A=(A')^{1/2}$
(C) $A=2A'$
(D) can't say anything

40. a,b,c are in G.P. and the equation $(a+di)x^2+2(b+ei)x+(c+if)=0$ have one real root then $\frac{a}{d},\frac{b}{e},\frac{c}{f}$ are in, $(a,b,c,d,e,f\in R)$
(A) AP
(B) GP
(C) HP
(D) none of these

41. $\int \sec^{p/3}x\,\mathrm{cosec}^{q/3}x\,dx=(p,q\in I^+$ and $p+q=12)$
(A) $\dfrac{\tan^{\frac{-p}{3}+1}x}{\frac{-p}{3}+1}+c$
(B) $\dfrac{\tan^{\frac{-p}{3}+1}x}{\frac{-p}{3}+1}+c+\dfrac{\tan^{\frac{-p}{3}+3}x}{\frac{-p}{3}+3}+c$
(C) $\dfrac{\tan^{\frac{-p}{3}+3}x}{\frac{-p}{3}+3}+c$
(D) none of these

42. A square ABCD of a diagonal 2a is folded along the diagonal AC, so that the planes DAC, BAC are at right angle. The shortest distance between DC and AB is

(A) $\sqrt{\frac{2}{3}}$a

(B) $\frac{2a}{\sqrt{3}}$

(C) $\sqrt{\frac{2a}{3}}$

(D) none of these

(One or More than one correct type)

This section contains **06** multiple choice questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four options is(are) correct.

43. $\int_{-1}^{1}\left(e^{x^3}+e^{-x^3}\right)dx$ is less than

(A) 2

(B) $2e+\frac{2}{e}$

(C) $e+\frac{1}{e}+2$

(D) 2e

44. Let $f(x)=e^{-\frac{1}{x^2}}+\int_{0}^{\frac{\pi x}{2}}\sqrt{1+\sin t}\,dt \forall x\in(0,\infty)$ then-

(A) f' exists and is continuous $\forall x\in(0,\infty)$

(B) f'' exists $\forall x\in(0,\infty)$

(C) f' is bounded

(D) There exists $\alpha>0$ such that $|f(x)|>|f'(x)|\forall x\in(\alpha,\infty)$

45. Let x,y,z are positive real numbers and ℓ_1 is the least value of $2x^4+2y^4+4z^4-8xyz$ and ℓ_2 is the least value of $x^4y+xy^4+\frac{4}{x^2y^3}+\frac{1}{x^3y^2}+8$, then-

(A) $\ell_1=-1$

(B) $\ell_2>-1$

(C) $\ell_2=10$

(D) $\ell_2>10$

46. Consider the equation in x, $8x^4-16x^3+16x^2-8x+a=0$, then sum of all the non-real roots of equation can be $(a\in R)$

(A) 1
(B) 2
(C) $\frac{1}{2}$
(D) None of these

47. For the equation $\frac{40}{x-1}-\frac{160}{x-4}-\frac{200}{x-5}+\frac{320}{x-8}=6x^2-27x$

(A) Number of real solution of above equation is 3
(B) If E denotes the product of non-zero or complex roots of equation, then sum of divisors of E is 2904
(C) It S denotes the set of all real roots of equation then, sum of elements of S taken two at a time is 81
(D) If $\alpha_1,\alpha_2\in R$ be two roots of equation such that $\log_{\alpha_2}(2\alpha_1)$ is defined it must be 1.

48. Let a, b, c be the positive integers such that a<b<c. If the two curves $y=|x-a|+|x-b|+|x-c|\ and\ 2x+y=2003$ have exactly one point in common, then-

(A) least possible value of c is 1002
(B) greatest possible value of b is 1001
(C) least possible value of b is 1002
(D) greatest possible of a is 1000

SECTION – C
(Numerical Answer Type)

This section contains **06** questions. The answer to each question is a **NUMERICAL VALUE.** For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the **second decimal place**; e.g. XXXXX.XX).

49. Mr. A lists all the positive divisors of the number $N(2010)^2$ and selects two divisors from the list then the probability that exactly one of the selected divisors is perfect squares is:

50. If $\frac{(x-3)^{\frac{-|x|}{x}}\sqrt{(x-4)^2}\,(17-x)}{\sqrt{-x}\left(-x^2+x-1\right)\left(|x|-32\right)}<0$ then no. of integers x satisfying the inequality is:

51. Let f be real function defined on R (the set of real numbers) such that $f'(x)=100\,(x-1)(x-2)^2(x-3)^3.....(x-100)^{100}$, for all $x\in R$. If g is a function defined on R such that $\int_a^x e^{f(t)}dt=\int_0^x g(x-t)dt+2x+3$, If some of the all the values of x for which g(x) has a local extremum be λ then find $\frac{\lambda}{3}$

52. On a normal standard die one of the 21 dots from any one of the six faces is removed at random with each dot equally likely to be chosen. The die is then rolled. If the probability that the top face has an odd number of dots is $\frac{p}{q}$ where p and q are in their lowest form, find $\frac{(\mathrm{p}+\mathrm{q})}{4}$

53. A function f is defined on the complex number by $f(z)=(a+bi)z$, where 'a' and 'b' are positive numbers. This function has the property that the image of each point in the complex plane is equidistant from that point and the origin. Given that $|a+bi|=8$ and that $b^2=\frac{u}{v}$ where u and v are coprimes. Find the value of (u + v)-250.

54. If $\begin{bmatrix} 1 & 2 & \mathrm{a} \\ 0 & 1 & 4 \\ 0 & 0 & 1 \end{bmatrix}^{\mathrm{n}} = \begin{bmatrix} 1 & 18 & 2007 \\ 0 & 1 & 36 \\ 0 & 0 & 1 \end{bmatrix}$ then find the value of $\frac{(\mathrm{n}+\mathrm{a})}{100}$.

ALL INDIA TEST SERIES

TEST - 7

JEE (Advanced)

ANSWERS, HINTS & SOLUTIONS

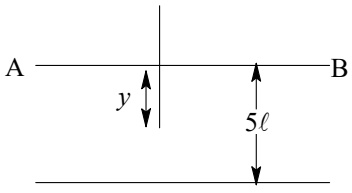
Physics

PART – I

SECTION – A

1. C

Sol. $a=\dfrac{\frac{m}{\ell}yg}{m}=\dfrac{gy}{\ell}$



$$\int_0^u v dv=\frac{g}{\ell}\int_0^{\ell} y\ dy$$

$$u=\sqrt{g\ell}.....(1)$$

$$v^2=u^2+2g(4\ell)$$

$$u=3\sqrt{gl}$$

2. A

Sol. $v=\dfrac{C}{\lambda}=RC\left[\dfrac{1}{(n-m)^2}-\dfrac{1}{n^2}\right]=\dfrac{RC}{n^2}\left[\left(1-\dfrac{m}{n}\right)^{-2}-1\right]=\left(\dfrac{2RC}{n^3}\right)m$

For m = 1, 2, 3

v is in A.P.

3. D

Sol. $-(0.7)(10)\left(\frac{1}{2}\right)=\frac{1}{2}(1)v^2-\frac{1}{2}(1)4^2$

$V=3m/s$

$-(0.7)(10)\left(\frac{1}{2}\right)=\frac{1}{2}u^2-\frac{1}{2}3^2$

$v^2=2$

$\Rightarrow -(0.7)(10)x'=0-\frac{1}{2}\times 2,\quad x'=\frac{1}{7}$

So final separation $=2\left(\frac{1}{2}-\frac{1}{7}\right)=\frac{5}{7}m$

4. B

Sol. Work function $=\frac{hC}{\lambda}-\frac{hC}{2\lambda}=\frac{hC}{2\lambda}$

5. C

Sol. $PV^x=\frac{P}{8}(4V)^x$

$8=(4)^x$

$3\ln 2=x2\ln 2$

$x=\frac{3}{2}$

$C=\frac{R}{\frac{5}{3}-1}+\frac{R}{1-\frac{3}{2}}=\frac{3R}{2}-2R=-\frac{R}{2}$

6. D

Sol. $v_1+2v_2=10$

$\frac{v_1-v_2=-e(10)}{3v_2=10(1+e)}$

$3\sqrt{5(10)\left(\frac{1}{2}\right)}=10(1+e)\Rightarrow e=\frac{1}{2}$

7. ABC

Sol. $\Delta w=q\Delta V$

8. BC

Sol. $\frac{N}{r^2}=\text{constant}$

$\frac{N_0}{r^2}=\frac{N}{r^2},\quad N=\frac{N_0}{4}$

Also $\frac{N_0 e^{-\lambda t}}{r^2} = \text{constant}$

9. AD

Sol. $2\left(C_V\right)_{\text{monoatomic}} > \left(C_V\right)_{\text{diatomic}}$

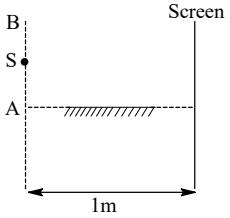
Maximum change $= \frac{(2)\left(\frac{3R}{2}\right) - (1)\left(\frac{5R}{2}\right)}{\frac{5R}{2}} = \frac{1}{5}$

$\%\,\text{change} = 20\%$

10. BC

11. BC

Sol. Let $AS = h$



$\frac{1}{4} = \frac{\lambda(1)}{2h} \ldots\ldots (i)$

$\frac{1}{6} = \frac{\lambda(1)}{2(h+0.6)} \ldots\ldots (ii)$

$\frac{\frac{1}{4}}{\frac{1}{6}} = \frac{h+0.6}{h}$

$\frac{3}{2} = \frac{h+0.6}{h} \Rightarrow h = 1.2mm$

$\frac{1}{4}mm = \frac{\lambda(1m)}{2\times(1.2)mm} \Rightarrow \lambda = 6000\,\text{Å}$

12. AD

SECTION – C

13. 00000.40

Sol. Apply COM

14. 00002.00

Sol. $\text{U}.\rho. = \text{Constant}$

$\frac{\text{T}}{\text{V}} = \text{constant}$

P=constant

$W=nR\Delta T \quad .....(i)$

$n(C_V)\Delta T=3$

$n\left(\frac{3R}{2}\right)\Delta T=3 \Rightarrow W=2\,joule$

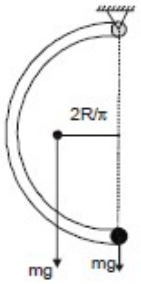
15. 00060.00

16. 00001.50

Sol. $\tau = I_0\alpha$

$mg\frac{2R}{\pi}=\left(2mR^2+4mR^2\right)\alpha$

$\alpha=\frac{mg2R}{\pi 6mR^2}=\frac{g}{3\pi R};\ a_m=2R\times\alpha=\frac{2g}{3\pi}$



17. 00025.00

Sol. $I_1+I_2=13I_0$

$\left(\sqrt{I_1}-\sqrt{I_2}\right)^2=I_0$

$I_1+I_2-2\sqrt{I_1}\sqrt{I_2}=I_0$

$2\sqrt{I_1}\sqrt{I_2}=12I_0$

$I_{max}=13I_0+12I_0=25I_0=(5)^2 I_0$

18. 00003.00

Sol. Let P_1 be density after first stroke $VP=(V+\Delta V)P_1=\frac{V}{(V+\Delta V)}P$

After nth stroke

$P_n=\left(\frac{V}{V+\Delta V}\right)^n P,\quad \frac{P_n}{P}=\left(\frac{V}{V+\Delta V}\right)^n$

Pressure $\propto$ density

$\frac{P_n}{P}=\left(\frac{V}{V+\Delta V}\right)^n$

$\frac{1}{1.728}=\left(\frac{V_0}{1.2V_0}\right)^n$

$(1.2)^n=(1.2)^3$

$n=3$

SECTION – A

19. C

Sol. (I) is trans and (II) is cis form

20. A

Sol. $\underbrace{2KI}_{\text{Four ions}} + HgI_2 \longrightarrow \underbrace{K_2[HgI_4]}_{\text{three ions}}$

21. A

Sol. Due to back bonding (A) is a weaker base.

22. C

Sol. Fully filled d-subshell is colourless in nature.

23. D

Sol. $\Delta S = nRln\frac{V_2}{V_1}$

$\Delta H = 0$

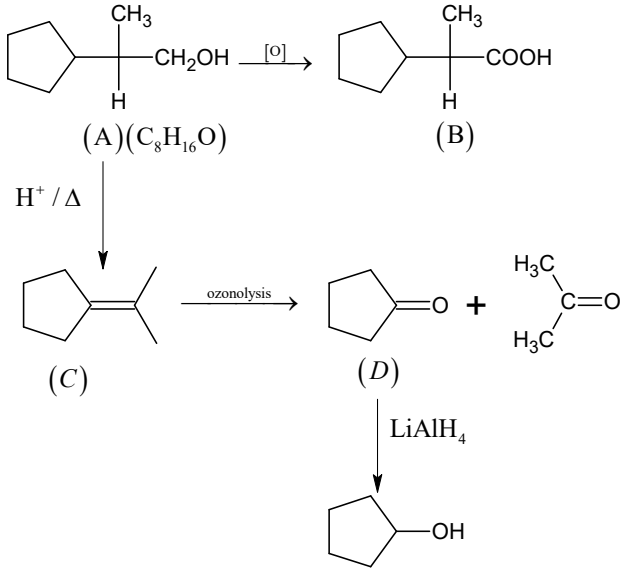
$\Delta G = \Delta H - T\Delta S$

24. C

25. ABCD

26. ABCD

Sol.



27. BC

Sol. A lone pair of N-atom participating in resonance will be less basic

28. AB

Sol. Reaction proceeds by limiting reagent only. Enthalpy of neutralization decreases, when acid or base or both are weak:

29. AD

Sol. BaO_2 and Na_2O_2 are peroxides

30. ABCD

SECTION – C

31. 00252.00

Sol. $$\frac{r_1}{r_2}=\sqrt{\frac{M_2}{M_1}}\times\frac{P_1}{P_2}$$

Or $$\frac{n_1}{t_1}\times\frac{t_2}{n_2}=\sqrt{\frac{M_2}{M_1}}\times\frac{P_1}{P_2} \qquad \text{Or} \qquad \frac{1}{38}\times\frac{57}{1}=\sqrt{\frac{M}{28}}\times\frac{0.8}{1.6}$$

$\therefore\ M=252$

32. 00167.20

Sol. Given,

$$\frac{1}{2}H_2(g)+(Aq)\rightarrow H^+(aq); \qquad \Delta H^\circ=0.....(\text{i})$$

$$\frac{1}{2}H_2(g)+\frac{1}{2}Cl_2(g)\rightarrow HCl(g); \qquad \Delta H^\circ=-92.4kJ.....(\text{ii})$$

$$HCl(g)+H_2O(l)\rightarrow H_3O^+(aq)+Cl^-(aq); \qquad \Delta H=-74.8kJ.....(\text{iii})$$

By inspection method: $\text{Eqs.}(\text{ii})+(\text{iii})-(\text{i})$ reveals that

$$\frac{1}{2}Cl_2(g)+(Aq)\rightarrow Cl^-(aq); \qquad \Delta H=-167.2kJ$$

i.e. Heat of formation of $Cl^-(aq)=-167.2kJ$

33. 00009.17

Sol. Let solubility of $PbBr_2$ is $S\ mol\ litre^{-1}$

$$PbBr_2(s)+aq\rightleftharpoons PbBr_2(aq)\rightleftharpoons \underset{\frac{S\times80}{100}}{Pb^{2+}}+\underset{\frac{2S\times80}{100}}{2Br^-}$$

Since, $PbBr_2$ ionises to 80% only.

Now $$K_{sp}=\left[Pb^{2+}\right]\left[Br^-\right]^2$$

Or $$3.2\times10^{-5}=\left[\frac{S\times80}{100}\right]\left[\frac{2S\times80}{100}\right]^2$$

$$S=0.025\,mol\,litre^{-1}$$

$$=0.025\times367\,g\,litre^{-1}$$

$$=9.175\,g\,litre^{-1}$$

34. 00098.00

Sol. $T = 20°C$ $0.1m$ solution of urea ΔP=0.03mm

$KCl \to 0.1m \quad \Delta P = 0.0594$

$$\frac{\Delta P}{P} = x_\beta \to 0.1 mole in 1kg$$

$$\frac{0.03}{P} = \frac{0.1}{0.1+55.5}$$

$$P = \frac{0.03 \times 55.65}{0.1} = 16.695$$

$$\frac{\Delta P}{P} = iX_\beta$$

$$\frac{0.0594}{16.695} = i\left[0.00179\right]$$

$$i = 1.987$$

35. 00036.00

36. 00030.60

Sol. $$KE = 13.6 \times \frac{Z^2}{n^2}$$

$$= 13.6 \times \frac{3^2}{2^2} = 30.6\text{eV}$$

SECTION – A

37. B

38. A

Sol. As s–b, s–c, s–a are in AP with common difference =1

$\Rightarrow$ a,c, b are in AP with common difference equal to 1.

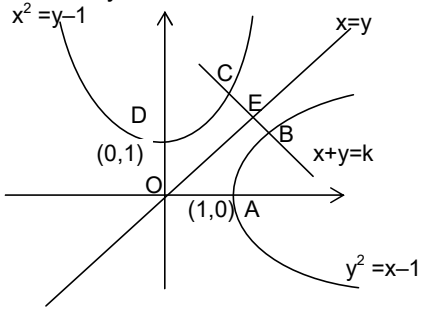
$\Rightarrow c = a+1,\ b = a+2 \quad \Rightarrow s = \frac{a+a+1+a+2}{2} = \frac{3(a+1)}{2} \Rightarrow \Delta = \sqrt{\frac{3}{2}(a+1).\frac{a+3}{2}.\frac{a+1}{2}.\frac{a-1}{2}}$

Also $r = \Delta/s \Rightarrow a^2 + 2a - 195 = 0 \Rightarrow (a+15)(a-13)=0$

A = 13, c=14, b=15 $\Rightarrow \Delta$ = 84 sq. units

39. C

Sol. Line of shortest distance will be perpendicular to line x=y. Also both parabolas are symmetric about x=y.



A=area OABCDO

A′=area OECDO

$\Rightarrow$ A′ =A/2

40. C

Sol. Let α be the real root then $(a\alpha^2 + 2b\alpha + c) + i(d\alpha^2 + 2e\alpha + f) = 0 \quad \Rightarrow a\alpha^2 + 2b\alpha + c = 0 \Rightarrow \alpha = \frac{-\sqrt{c}}{\sqrt{a}}$

$\Rightarrow d\alpha^2 + 2e\alpha + f = 0 \quad \Rightarrow d.\frac{c}{a} - 2e\frac{\sqrt{c}}{\sqrt{a}} + f = 0 \quad \Rightarrow \frac{d}{a} - 2.\frac{e}{b} + \frac{f}{c} = 0$

41. B

Sol. $I = \int \tan^{-p/3} x.\sec^4 x\,dx \quad = \int \tan^{-p/3} x(1+\tan^2 x).\sec^2 x\,dx$

42. B

Sol. If equation of line AB is $\vec{r} = \vec{0} + \lambda(\sqrt{2}a\hat{j} - \vec{0}) = \lambda\hat{j}$

then equation of line DC is $\vec{r} = \sqrt{2}a\hat{i} + \mu\left(\frac{a}{\sqrt{2}}\hat{i} + \frac{a}{\sqrt{2}}\hat{j} + a\hat{k} - \sqrt{2}a\hat{i}\right)$

$\vec{r} = \sqrt{2}a\hat{i} + \mu\left(\frac{-1}{\sqrt{2}}\hat{i} + \frac{1}{\sqrt{2}}\hat{j} + \hat{k}\right) \Rightarrow$ S.D $= \left|\frac{(\vec{a}_2 - \vec{a}_1).(\vec{b}_1 \times \vec{b}_2)}{|\vec{b}_1 \times \vec{b}_2|}\right| = \frac{2a}{\sqrt{3}}$

43. BCD

Sol. $I=\int_{-1}^{1}\left(e^{x^3}+e^{-x^3}\right)dx>2$

Graph is concave upwards

$\Rightarrow I<f(0)+f(1)$

44. ACD

Sol. $f'(x)=e^{-\frac{1}{x^2}}.\frac{2}{x^3}+\frac{\pi}{2}\sqrt{1+\sin\frac{\pi x}{2}}$

$\lim_{x\to 0^+}\frac{e^{-\frac{1}{x^2}}}{x^3}=0$

And

Also $\lim_{x\to\infty}f(x)=\infty$

f''(x) does not exist for x=3, 7, 11….

45. AD

Sol. $\frac{2x^4+2y^4+4z^4+1}{4}\geq 2xyz$

And $x^4y+xy^4+\frac{4}{x^2y^3}+\frac{1}{x^3y^2}+8\geq 5-2$

$\Rightarrow \ell_2>10$ (equality cannot hold)

46. AB

Sol. (Put $x=y+\frac{1}{2}$)

47. AB

Sol. $\left(\frac{1}{x-1}+1\right)-\left(\frac{4}{x-4}+1\right)-\left(\frac{5}{x-5}+1\right)+\left(\frac{8}{x-8}+1\right)=\frac{6x^2-27x}{40}$

$\Rightarrow x=0$

Also $\frac{2x-9}{(x-1)(x-8)}-\frac{2x-9}{(x-4)(x-5)}=\frac{3}{40}(2x-9)$

And x=9

48. ABD

Sol. Condition is satisfied for (a, b+c-2a)

$\Rightarrow b+c=2003$

SECTION – C

49. 00000.32

50. 00031.00

Sol. $$\frac{(x-3)^{\frac{-|x|}{x}}\sqrt{(x-4)^2}\,(17-x)}{\sqrt{-x}\left(-x^2+x-1\right)\left(|x|-32\right)}<0$$

For $\sqrt{-x}$ to be defined $x<0$

$$\Rightarrow \frac{-|x|}{x}=1$$

Since $\sqrt{(x-4)^2},\sqrt{-x}$ are positive & $-x^2+x-1$ is always negative

$$\frac{(x-3)(x-17)}{x+32}>0$$

$$x<0 \quad \Rightarrow \frac{1}{x+32}>0 \Rightarrow x=31$$

51. 00833.33

Sol. $$\because \int_a^x e^{f(t)}dt=\int_0^x g(x-t)dt+2x+3$$

$$\Rightarrow \int_a^x e^{f(t)}dt=\int_0^x g(t)dt+2x+3 \qquad \text{(Using King Property)}$$

Differential both sides, we get

$$e^{f(x)}=g(x)+2$$

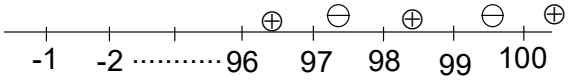
$$\Rightarrow g(x)=e^{f(x)}-2$$

$$\Rightarrow g'(x)=e^{f(x)}.f'(x)$$

$\because e^{f(x)}$ is always greater than zero.

$\therefore$ sign of g'(x) is same as sign of $f'(x)$.

$\therefore$ sign of g'(x)



Clearly, local extremum (maximum or minimum) will occur at x=99,97,95,….,3,1

$\therefore$ Sum of all the values=1+3+5+…+99= $\frac{50}{2}[2\times1+(50-1)\times2]=2500$

52. 00008.00

Sol. E_1 : Dot removed from odd face.

$$P(E_1)=\frac{9}{21}$$

E_2 : Dot removed from even face.

$$P(E_2)=\frac{12}{21}$$ E: Die shows odd numbers of dots.

$$P(E)=P(E\cap E_1)+P(E\cap E_2)=\frac{11}{21}$$

53. 00009.00

Sol. $\left|Z\left(a+bi\right)-Z\right|=\left|(a+bi)Z\right|$

$\Rightarrow a=\frac{1}{2}$

$a^2+b^2=64$

54. 00002.00

Sol. $\begin{bmatrix} 1 & 2n & na+8\sum_{k=0}^{n-1}k \\ 0 & 1 & 4n \\ 0 & 0 & 1 \end{bmatrix}$