NTPL

ALL INDIA TEST SERIES

**CODE - A**

**TEST ID 001930**

# JEE (Advanced) - 2019

## FULL TEST - 3 (Paper-II)

***Time : 3 Hours*** ***Maximum Marks : 186***

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

## INSTRUCTIONS

**A. General :**

1. This booklet is your Question Paper containing **54 questions**.
2. The Question Paper **CODE & TEST ID** is printed on the right hand top corner of this booklet. This should be entered on the OMR Sheet.
3. Fill the bubbles completely and properly using a **Blue/Black Ball Point Pen** only.
4. No additional sheets will be provided for rough work.
5. Blank papers, clipboards, log tables, slide rules, calculators, cellular phones, pagers, and electronic gadgets in any form are not allowed to be carried inside the examination hall.
6. The answer sheet, a machine-readable Optical mark recognition sheet (OMR Sheet), is provided separately.
7. DO NOT TAMPER WITH / MUTILATE THE OMR OR THE BOOKLET.
8. Do not break the seals of the question-paper booklet before being instructed to do so by the invigilator.

**B. Question Paper Format :**

9. The question paper consists of **3 parts (Part I: Physics, Part II: Chemistry & Part III: Maths)**. Each part has **3 sections**.
10. **Section I** contains **6 multiple choice questions**. Each question has 4 choices (A), (B), (C) and (D), for its answer, out of which ***ONLY ONE*** is correct.
11. **Section II** contains **8 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D), for its answer, out of which ***ONE OR MORE*** is/are correct.
12. **Section III** contains **2 paragraphs.** Based on each paragraphs, there are **2 questions**. Each question of a particular paragraph has four choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

**C. Marking Scheme :**

13. For each question in **Section I**, you will be **awarded 3 marks** if you darken the bubble(s) corresponding to the correct choice(s) for the answer, and **zero mark** if no bubble is darkened. In all other cases, **minus one (-1) mark** will be awarded.
14. For each question in **Section II,** you will be awarded **4 marks** if one the bubble(s) corresponding to the correct option(s) is(are) darkened, and **+1 marks** for darkening a bubble corresponding to each correct option, provided NO incorrect option is darkened. In all other cases, **minus one (-2) marks** will be awarded. **Zero marks** If none of the bubbles is darkened.
15. For each question in **Section III**, you will be awarded **3 marks** if you darken **ALL** the bubble(s) corresponding to the correct answer(s) **ONLY.** In all other cases **zero (0) marks** will be awarded. **No negative marks** will be awarded for incorrect answer(s) in this section.

Name of the Candidate (in Capitals) _____

Test Centre _____ Centre Code _____

Candidate's Signature _____ Invigilator's Signature _____

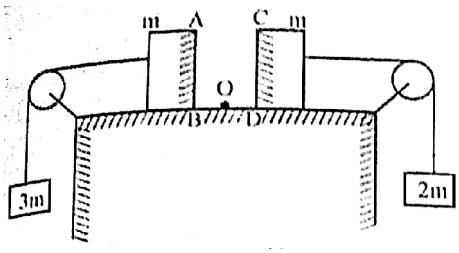
# PART I : PHYSICS

## SECTION 1 (Maximum Marks : 18)

- This section contains **SIX** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories :

| | | | |
|---|---|---|---|
| *Full Marks* | : | +3 | If one the bubble corresponding to the correct option is darkened. |
| *Zero Marks* | : | 0 | If none of the bubbles is darkened. |
| *Negative Marks* | : | –1 | In all other cases |

1. Two blocks each of mass m lie on a smooth table. They are attached to two other masses as shown in the figure. The pulleys and strings are light. An object 0 is kept at rest on the table. The sides AB and CD of the two blocks are made reflecting. Find the acceleration of two images formed in those two reflecting surfaces w.r.t. each other



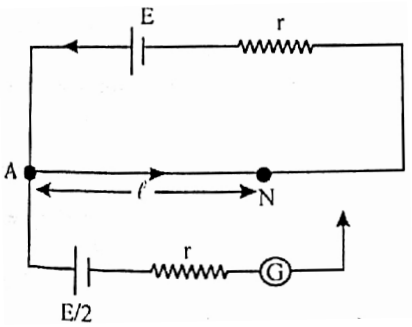

(a) 17g/6 (b) 7g/6

(c) 11g/6 (d) 5g/6

2. A small quantity of solution containing $Na^{24}$ radionuclide (half life 15 hours) of activity 1.0 microcurie is injected into the blood of volume 1 $cm^3$ taken after 5 hour shows an activity of 296 disintegrations per Minute. Determine the total volume of blood in the body of the person. Assume that the radioactive solution mixes uniformly in the blood of the person. (1 curie = $3.7\times10^{10}$ disintegrations per second).

(a) 5.91 litres (b) 0.91 litres (c) 3.21 litres (d) 4.12 litres

3. Consider the potentiometer circuit arranged as in figure. The potentiometer wire (resistance 15r) is 600 cm long. If the jockey touches the wire at a distance of 560 cm from A, what will be the current in the galvanometer?




(a) 3E/22r (b) 5E/22r

(c) 3E/11r (d) 5E/11r

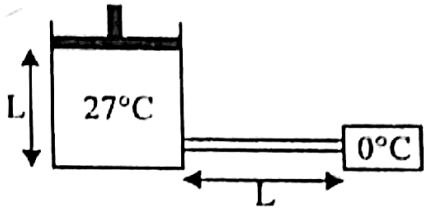
4. Three identical positive charges Q are arranged at the vertices of an equilateral triangle. The side of the triangle is a. Find the intensity of the field at the vertex of a regular tetrahedron of which of the triangle is the base.

(a) $\sqrt{6}\frac{KQ}{a^2}$ (b) $\sqrt{2}\frac{KQ}{a^2}$ (c) $\sqrt{3}\frac{KQ}{a^2}$ (d) None of these

5. A point source is emitting sound in all directions. Find the ratio of distance of two points from the point source where the difference in loudness levels is 3 dB. $\left(\log_{10} 2 = 0.3\right)$

(a) 2 (b) 3 (c) 1/2 (d) $1/\sqrt{2}$

6. 0.5 mole of an ideal gas at constant temperature 27ºC kept inside a cylinder of length L and cross-section area A closed by a massless piston.




The cylinder is attached with a conducting rod of length L, cross-section area (1/9) $m^2$ and thermal conductivity K, whose other end is maintained at 0ºC. If piston is moved such that rate of heat flow through the conducing rod is constant then velocity of piston when it is at height L/2 from the bottom of cylinder is

(a) $\left(\frac{K}{R}\right) m/\sec$ (b) $\left(\frac{K}{10R}\right) m/\sec$ (c) $\left(\frac{K}{100R}\right) m/\sec$ (d) $\left(\frac{K}{1000R}\right) m/\sec$

## SECTION 2 (Maximum Marks : 32)

- This section contains **EIGHT** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct.
- For each question, darken the bubble(s) corresponding to the correct option(s) in the ORS.
- For each question, marks will be awarded in one of the following categories :

| | | | |
|---|---|---|---|
| *Full Marks* | : | +4 | If one the bubble(s) corresponding to 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.

- 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.

7. If the first minima in a Young's double slit experiment occurs directly in front of one of the slits, (distance between slit and screen D = 12cm and distance between slits d = 5cm.) then the wavelength of the radiation used can be

(a) 2 cm (b) 4 cm (c) 2/3 cm (d) 4/3 cm

8. A small sphere of mass m suspended by a thread is first taken aside so that the thread forms the right angle with the vertical and then released, then

(a) total acceleration of sphere as a function of $\theta$ is $g\sqrt{1+3\cos^2\theta}$

(b) thread tension as a function of $\theta$ is $T = 3 \text{ mg } \cos\theta$

(c) The angle $\theta$ between the thread and the vertical at the moment when the total acceleration vector of the sphere is directed horizontally is $\cos^{-1} 1/\sqrt{3}$

(d) the thread tension at the moment when the vertical component of the sphere's velocity is maximum will be mg.

9. A horizontal plank has a rectangular block placed on it. The plank starts oscillating vertically and simple harmonically with an amplitude of 40 cm. The block just loses contact with the plank when the latter is at momentary rest. Then

(a) the period of oscillation is $(2\pi/5)$

(b) The block weight double its weight, when the plank is at one of the position of momentary rest

(c) The block weight 0.5 times its weight on the plank halfway up extreme.

(d) the block weight 1.5 times its weight on the plank halfway down extreme.

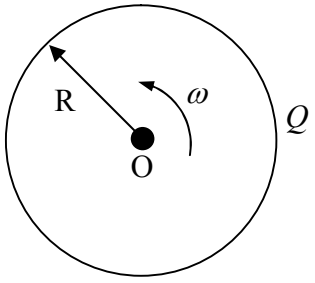
10. A nonconducting disc having uniform positive charge Q, is rotating about its axis with uniform angular velocity $\omega$. The magnetic field at the centre of the disc is

(a) directed outward

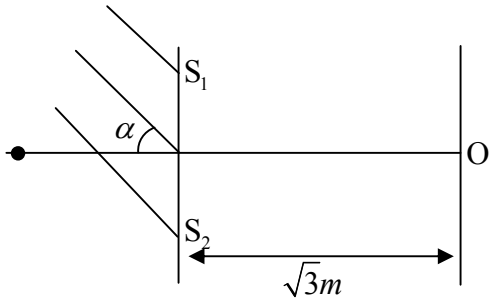
(b) having magnitude $\frac{\mu_0 Q\omega}{4\pi R}$

(c) directed inwards

(d) having magnitude $\frac{\mu_0 Q\omega}{2\pi R}$



11. A parallel beam of light $(\lambda = 5000\text{Å})$ is incident at an angle $\alpha = 30°$ with the normal to the slit plane in a Young's double slit experiment. Assume that the intensity due to each slit at any point on the screen is $I_0$. Point O is equidistant from $S_1$ and $S_2$. The distance between slits is 1 mm.




(a) the intensity at O is $4I_0$

(b) the intensity at O is zero

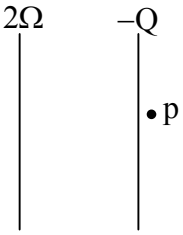
(c) the intensity at a point on the screen 1m below O is $4I_0$

(d) the intensity at a point on the screen lm below O is zero

12. A double star is a system of two stars of masses m and 2m, rotating about their centre of mass only under their mutual gravitational attraction. If r is the separation between these two stars then their time period of rotation about their centre of mass will be proportional to

(a) $r^{3/2}$ (b) $r$ (c) $m^{1/2}$ (d) $m^{-1/2}$

13. In the figure shown, the plates of a parallel plate capacitor have unequal charges. Its capacitance is C. P is a point outside the capacitor and close to the and close to the plate of charge –Q. The distance between the plate is'd'




(a) A point charge at point 'P' will experience electric force due to capacitor

(b) The potential difference between the plates will be 3Q/2C

(c) The energy stored in the electric field on the region between the plates is $9Q^2/8C$

(d) The force on one plate due to the other plate is $\frac{Q^2}{2\pi\varepsilon_0 d^2}$

14. Suppose the potential energy between electron and proton at a distance r is given by $-\frac{Ke^2}{3r^3}$. Application of Bohr's theory to hydrogen atom in this case shows that

(a) energy in the nth orbit is proportional to $n^6$

(b) energy is proportional to m~3 (m: mass of electron)

(c) energy in the nth orbit is proportional to $n^{-2}$

(d) energy is proportional to $m^3$ (m = mass of electron)

## SECTION 3 (Maximum Marks : 12)

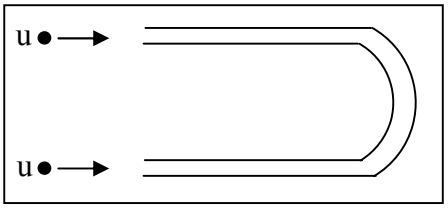
- This section contains **TWO** paragraphs.
- Based on each paragraph, there are **TWO** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct integer in the ORS.
- For each question, marks will be awarded in one of the following categories :

*Full Marks* : +3 If one the bubble corresponding to the correct option is darkened.

*Zero Marks* : 0 In all other cases.

### PARAGRAPH 1

A narrow U shaped tube of mass 2m is placed at rest on a smooth fixed horizontal surface. The curved surface of tube as shown is semicircular in shape. Two identical smooth spherical balls (of small size) each of mass m and of diameter slightly less than the inner diameter of tube enter into the tube simultaneously with a velocity u as shown. (Assume no less of energy anywhere and all collisions to be elastic).




15. Speed of each spherical ball, just before their collision

(a) $\frac{u}{\sqrt{3}}$ (b) $\frac{2u}{3\sqrt{3}}$

(c) $\frac{u}{2}$ (d) $\frac{\sqrt{3}u}{2}$

16. The angle between velocity vectors of both balls just before collision, as observed in the ground frame is

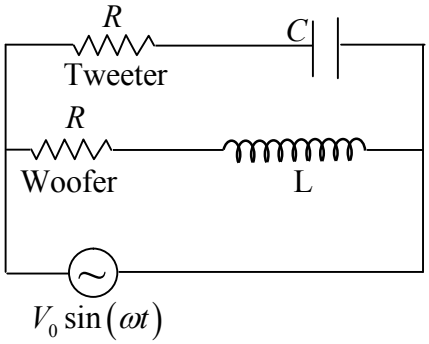
(a) $2\tan^{-1}\sqrt{2}$ (b) $2\tan^{-1}1/\sqrt{2}$

(c) $\tan^{-1}\sqrt{2}$ (d) $\pi$

## PARAGRAPH 2

A loudspeaker system uses alternating current to amplify sound of certain frequencies. It consists of 2 speakers.

Tweeter-which has smaller diameter produces high frequency sound. For purpose of circuit analysis, we can take both speakers to be of equal resistance R. The equivalent circuit is shown in the figure. The 2 speakers are connected to the amplifier via capacitance and inductance respectively. The capacitor in tweeter branch blocks the low frequency sound but passes the high frequency. The inductor in woffer branch does the opposite.




17. What is the frequency which is sounded equally loud by both speakers

(a) $\frac{1}{2\pi}\sqrt{\frac{R^2}{L^2}-\frac{1}{LC}}$ (b) $\frac{1}{2\pi}\sqrt{\frac{4R^2}{L^2}-\frac{1}{LC}}$ (c) $\frac{1}{2\pi}\sqrt{\frac{1}{LC}-\frac{R^2}{4L^2}}$ (d) $\frac{1}{2\pi\sqrt{LC}}$

18. For a combination of L, R and C the current in woofer and tweeter are always found to have a phase difference of $\pi/2$. What is the relation between L, R and C.

(a) $L = 2R^2C$ (b) $L = \sqrt{2}R^2C$ (c) $L = R^2C$ (d) $L = \frac{R^2C}{\sqrt{2}}$

# PART II : CHEMISTRY

## SECTION 1 (Maximum Marks : 18)

- This section contains **SIX** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories :

| | | | |
|---|---|---|---|
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| *Zero Marks* | : | 0 | If none of the bubbles is darkened. |
| *Negative Marks* | : | –1 | In all other cases |

19. Black Jack is an ore of:

(a) Cr (b) Sn (c) Zn (d) Ni

20. The correct order of decreasing acidic strength of oxides is:

(a) $Li_2O > BeO > B_2O_3 > CO_2 > NO_2$ (b) $N_2O_3 > CO_2 > B_2O_3 > BeO > Li_2O$

(c) $CO_2 > N_2O_3 > B_2O_3 > BeO > Li_2O$ (d) $B_2O_3 > CO_2 > N_2O_3 > Li_2O > BeO$

21. $C_5H_{13}N$ reacts with $HNO_2$ to give an optically active alcohol. The compound is:

(a) Pentan-1-amine (b) Pentan-2-amine

(c) N, N – dimethylpropan-2-amine (d) N – Methylbutan-2-amine

22. 1 mole of a gas $AB_3$ present in 10 lt container at pressure 2.5 atm and 273 K temperature. On increasing the temperature to 546 K, $AB_3$ dissociates into $AB_2(g)$ and $B_2(g)$. If the degree of dissociation of $AB_3$ is 80%, then final pressure at 546 K is :

(a) 5 atm (b) 1.25 atm (c) 10 atm (d) 6.25 atm

23. 1 mole of each of $CaC_2$, $Al_4C_3$, $Mg_2C_3$ reacts with excess water in separate open flasks work done during dissolution shows the order :

(a) $CaC_2 = Mg_2C_3 < Al_4C_3$ (b) $CaC_2 = Mg_2C_3 = Al_4C_3$

(c) $Mg_2C_3 < CaC_2 < Al_4C_3$ (d) $Mg_2C_3 < Al_4C_3 < CaC_2$

24. In which of the following pairs the two species are not isostructural?

(a) $PCl_4^+$ and $SiCl_4$ (b) $PF_5$ and $BrF_5$ (c) $AlF_6^{3-}$ and $SF_6$ (d) $CO_3^{2-}$ and $NO_3^-$

## SECTION 2 (Maximum Marks : 32)

- This section contains **EIGHT** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct.
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|---|---|---|---|
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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. |

- 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.

25. Which of the following reaction produces $N_2$ ?

(a) $NH_4ClO_4 \xrightarrow{\Delta}$ (b) $KIO_3 + N_2H_4 \xrightarrow{H^+}$ (c) $HN_3 + HNO_2 \rightarrow$ (d) $NH_2OH + CuO \rightarrow$

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

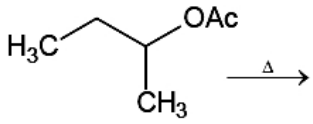
(a) For adiabatic expansion of an ideal gas, $TV^{\gamma-1}$ = constant.

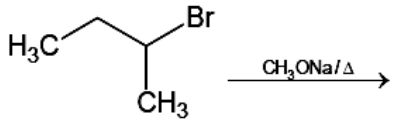
(b) Work done in reversible isothermal expansion is greater than that done in reversible adiabatic expansion for the same increase of volume.

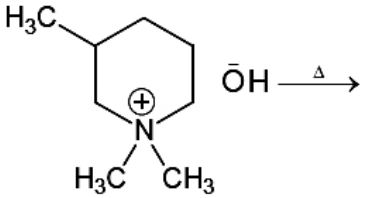
(c) Buffer capacity is maximum when concentration of weak acid and salt of its conjugate base is equal.

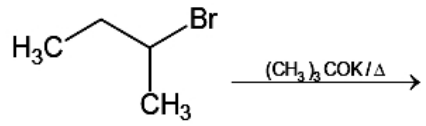
(d) Equilibrium constant of an exothermic reaction decreases with increase of temperature generally.

27. In which of the following reaction product formation takes place by Hofmann rule?

(a) 

(b) 

(c) 

(d) 

28. Select the correct statement(s):

(a) Ionization energies of 5d elements are greater than those of 3d and 4d elements.

(b) $[Fe(CN)_6]^{4-}$, $[Ni(CN)_4]^{2-}$ and $[Ni(CO)_4]$ all are diamagnetic.

(c) Holme's signal can be given by using ($Ca_3P_2$ + $CaC_2$).

(d) Nitrolim is a mixture of calcium cyanide and carbon.

29. Nitrogen (I) oxide is produced by

(a) thermal decomposition of ammonium nitrate

(b) disproportionation of $N_2O_4$

(c) thermal decomposition of ammonium nitrite

(d) interaction of hydroxyl amine with nitrous acid

30. For the reaction $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$; the forward reaction at constant temperature is favoured by

(a) Adding inert gas at constant volume

(b) Adding inert gas at constant pressure

(c) Adding $Cl_2$ at constant volume

(d) Increasing volume of the container

31. Which of the following statements are correct:

(a) The flocculating value of $PO_4^{3-}$ is less than that of $SO_4^{2-}$.

(b) Charcoal adsorbs gases with higher critical temperature more than gases with lower critical temperature.

(c) Chemisorption is multilayered.

(d) In the manufacture of $NH_3$ by Haber's process, molybdenum is used as promoter for the catalyst iron.

32. In which of the complex ions the central metal ion is $dsp^2$ hybridized?

(a) $[Cu(NH_3)_4]^{2+}$ (b) $[Ni(CN)_4]^{2-}$ (c) $[CuCl_4]^{2-}$ (d) $[NiCl_4]^{2-}$

## SECTION 3 (Maximum Marks : 12)

- This section contains **TWO** paragraphs.
- Based on each paragraph, there are **TWO** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct integer in the ORS.
- For each question, marks will be awarded in one of the following categories :

*Full Marks* : +3 If one the bubble corresponding to the correct option is darkened.

*Zero Marks* : 0 In all other cases.

### PARAGRAPH 1

A solid crystal is composed of X, Y and Z atoms, Z atoms (radius 200 pm) form cubic close packed structure, whereas X (radius 50 pm) and Y (radius 100 pm) occupy respective voids – Assume all the voids are occupied. Now answer the following questions.

33. If all the atoms along one body diagonal are removed, then the formula of the compound becomes :

(a) $X_8Y_4Z_5$ (b) $X_8Y_4Z_4$ (c) $X_6Y_3Z_3$ (d) $X_6Y_3Z_4$

34. Now in the crystal obtained in Q. No. 13 if all the atoms along another body diagonal are removed, then the formula of the compound becomes :

(a) $X_8Y_4Z_6$ (b) $X_8Y_6Z_5$ (c) $X_8Y_4Z_8$ (d) $X_8Y_6Z_7$

### PARAGRAPH 2

Buffer is a solution whose pH does not change significantly on addition of a small amount of acid or alkali or on dilution. Answer the following questions:

35. The amount of $(NH_4)_2SO_4$ to be added to 500 ml of 0.01 M $NH_4OH$ solution (pKa for $NH_4^+$ is 9.26) prepare a buffer of pH 8.26 is :

(a) 0.05 mole (b) 0.025 mole (c) 0.10 mole (d) 0.005 mole

36. The ratio of pH (approximately) of solution (I) containing 1 mole of $CH_3COONa$ and 1 mole of HCl and solution (II) containing 1 mole of $CH_3COONa$ and 1 mole of acetic acid in one litre is :

(a) 1 : 2 (b) 2 : 1 (c) 1 : 3 (d) 3 : 1

# PART III : MATHS

## SECTION 1 (Maximum Marks : 18)

- This section contains **SIX** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories :

| | | | |
|---|---|---|---|
| *Full Marks* | : | +3 | If one the bubble corresponding to the correct option is darkened. |
| *Zero Marks* | : | 0 | If none of the bubbles is darkened. |
| *Negative Marks* | : | –1 | In all other cases |

37. If $\alpha, \beta, \gamma$ be the roots of $x^3 + x^2 + x + 1 = 0$ then $\begin{vmatrix} 1+\alpha^2 & 1 & 1 \\ 1 & 1+\beta^2 & 1 \\ 1 & 1 & 1+\gamma^2 \end{vmatrix}$ is:

(a) 2 (b) –2 (c) 3 (d) None of these.

38. In a $\Delta ABC$, if $\cot A : \cot B : \cot C = 30 : 19 : 6$ then the sides $a$, $b$, $c$ are

(a) in A.P. (b) in G.P. (c) in H.P. (d) none of these

39. The minimum value of the function $f(x) = \frac{\sin x}{\sqrt{1-\cos^2 x}} + \frac{\cos x}{\sqrt{1-\sin^2 x}} + \frac{\tan x}{\sqrt{\sec^2 x - 1}} + \frac{\cot x}{\sqrt{\operatorname{cosec}^2 x - 1}}$ whenever it is defined is

(a) 4 (b) –2 (c) 0 (d) 2

40. If $f(x) = \begin{cases} e^{x^2+x}, & x > 0 \\ ax + b, & x \le 0 \end{cases}$ is differentiable at $x = 0$, then

(a) $a = 1, b = -1$ (b) $a = -1, b = 1$ (c) $a = 1, b = 1$ (d) $a = -1, b = -1$

41. The ratio in which the area bounded by curves $y^2 = 12x$ and $x^2 = 12y$ is divided by the line $x = 3$ is :

(a) 7 : 15 (b) 15 : 49 (c) 1 : 3 (d) 17 : 49

42. Let $P$ be the image of the point (3, 1, 7) with respect to the plane $x - y + z = 3$. Then the equation of the plane passing through $P$ and containing the straight line $\frac{x}{1} = \frac{y}{2} = \frac{z}{1}$ is

(a) $x + y - 3z = 0$ (b) $3x + z = 0$ (c) $x - 4y + 7z = 0$ (d) $2x - y = 0$

## SECTION 2 (Maximum Marks : 32)

- This section contains **EIGHT** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct.
- For each question, darken the bubble(s) corresponding to the correct option(s) in the ORS.
- For each question, marks will be awarded in one of the following categories :

| | | | |
|---|---|---|---|
| *Full Marks* | : | +4 | If one the bubble(s) corresponding to 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. |

- 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.

43. Consider the circle $x^2 + y^2 - 10x - 6y + 30 = 0$. Let O be the center of the circle and tangents at A(7, 3) and B(5, 1) meet at C. Let S = 0 represents the family of circles passing through A and B. Then:

(a) the area of quadrilateral OACB is 4

(b) the radical axis for the family of circles S = 0 is x + y = 10

(c) the smallest possible circle of the family S = 0 is $x^2 + y^2 - 12x - 4y + 38 = 0$

(d) the coordinates of point C are (7, 1)

44. Given $A \equiv (1,1)$ and AB is any line through it cutting the $x$-axis at B. If AC is perpendicular to AB and meets the $y$-axis in C, then the equation of the locus of midpoint P of BC is:

(a) $x + y = 1$ (b) $x + y = 2$ (c) $x + y = 2xy$ (d) $2x + 2y = 1$

45. If $f'(x)=(x-a)^{2n}(x-b)^{2m+1}$, where m and n are positive integers and a>b, is the derivative of a function $f$, then

(a) $x=a$ gives neither a maximum nor a minimum

(b) $x=a$ gives a maximum

(c) $x=b$ gives a minimum

(d) $x=b$ gives neither a maximum nor a minimum

46. If $\int_a^b |\sin x|\,dx=8$ *and* $\int_0^{a+b} |\cos x|\,dx=\frac{9}{2}$, then

(a) $a=\frac{\pi}{2}$ (b) $b=\frac{11\pi}{4}$ (c) $a=\frac{\pi}{4}$ (d) $b=\frac{17\pi}{4}$

47. The normals to the parabola $y^2=4ax$ from the point $(5a,2a)$ are

(a) $y=x-3a$ (b) $y=-2x+12a$ (c) $y=-3x+33a$ (d) $y=x+3a$

48. Let $a,\ \lambda,\ \mu\in\mathbb{R}$. Consider the system of linear equations

$$ax+2y=\lambda$$
$$3x-2y=\mu$$

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

(a) If $a=-3$, then the system has infinitely many solutions for all values of $\lambda$ and $\mu$

(b) If $a\neq -3$, then the system has a unique solution for all values of $\lambda$ and $\mu$

(c) If $\lambda+\mu=0$, then the system has infinitely many solutions for $a=-3$

(d) If $\lambda+\mu\neq 0$, then the system has no solution for $a=-3$

49. Let X and Y be two events such that $P(X)=\frac{1}{3}, P(X\mid Y)=\frac{1}{2}$ and $P(Y\mid X)=\frac{2}{5}$. Then :

(a) $P(Y)=\frac{4}{15}$ (b) $P(X'\mid Y)=\frac{1}{2}$ (c) $P(X\cup Y)=\frac{2}{5}$ (d) $P(X\cap Y)=\frac{1}{5}$

50. If $y(x)$ satisfies the differential equation $y'-y\tan x=2x\sec x$ and $y(0)=0$, then

(a) $y\left(\frac{\pi}{4}\right)=\frac{\pi^2}{8\sqrt{2}}$ (b) $y'\left(\frac{\pi}{4}\right)=\frac{\pi^2}{18}$ (c) $y\left(\frac{\pi}{3}\right)=\frac{\pi^2}{9}$ (d) $y'\left(\frac{\pi}{3}\right)=\frac{4\pi}{3}+\frac{2\pi^2}{3\sqrt{3}}$

## SECTION 3 (Maximum Marks : 12)

- This section contains **TWO** paragraphs.
- Based on each paragraph, there are **TWO** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct integer in the ORS.
- For each question, marks will be awarded in one of the following categories :

*Full Marks* : +3 If one the bubble corresponding to the correct option is darkened.
*Zero Marks* : 0 In all other cases.

### PARAGRAPH 1

Consider the standard equation of an ellipse whose focus and corresponding foot of directrix are $\left(\sqrt{7},0\right)$ and $\left(\frac{16}{\sqrt{7}},0\right)$ and a circle with equation $x^2+y^2=r^2$. If in the first quadrant, the common tangent to a circle of this family and the above ellipse meets the coordinate axes at A and B.

***On the basis of information, answer the following equation:***

51. If mid point of A and B is $\left(x_1,y_1\right)$ and slope of common tangent be $m$, then

(a) $2mx_1+y_1=0$ (b) $2my_1+x_1=0$ (c) $my_1+x_1=0$ (d) $mx_1+y_1=0$

52. The locus of mid point of A and B is

(a) $y=x\sqrt{\left(\frac{r^2-9}{16-r^2}\right)}$ (b) $y=x\sqrt{\left(\frac{16+r^2}{9-r^2}\right)}$ (c) $y=x\sqrt{\left(\frac{16-r^2}{r^2+9}\right)}$ (d) $y=x\sqrt{\left(\frac{r^2-9}{r^2-16}\right)}$

### PARAGRAPH 2

A box $B_1$ contains 1 white ball, 3 red balls and 2 black balls. Another box $B_2$ contains 2 white balls, 3 red balls and 4 black balls. A third box $B_3$ contains 3 white balls, 4 red balls and 5 black balls.

53. If 1 ball is drawn from each of the boxes $B_1$, $B_2$ and $B_3$, the probability that all 3 drawn balls are of the same colour is

(a) $\frac{82}{648}$ (b) $\frac{90}{648}$ (c) $\frac{558}{648}$ (d) $\frac{566}{648}$

54. If 2 balls are drawn (without replacement) from a randomly selected box and one of the balls is white and the other ball is red, the probability that these 2 balls are drawn from box $B_2$ is

(a) $\frac{116}{181}$ (b) $\frac{126}{181}$ (c) $\frac{65}{181}$ (d) $\frac{55}{181}$

# SOLUTION OF AITS JEE (ADVANCED) FULL TEST – 3

## PHYSICS

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. | **(a)** | 2. | **(a)** | 3. | **(a)** | 4. | **(a)** |
| 5. | **(d)** | 6. | **(c)** | 7. | **(a)** | 8. | **(b), (c)** |
| 9. | **(a), (b), (c), (d)** | 10. | **(a), (b)** | 11. | **(a), (c)** | 12. | **(a), (d)** |
| 13. | **(a), (b), (c), (d)** | 14. | **(a), (b)** | 15. | **(d)** | 16. | **(a)** |
| 17. | **(d)** | 18. | **(c)** | | | | |

## CHEMISTRY

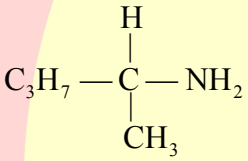
19. **(d)**

It is called Zinc blend

20. **(d)**

From left to right in a period acidic character increases due to increase in electronegativity.

21. **(d)**



22. **(b)**

| | $2AB_3(g)$ | $\rightleftharpoons$ | $2AB_2(g)$ | + | $B_2$ |
|---|---|---|---|---|---|
| t = 0 | 0.1 mol/lt | | 0 | | 0 |
| t = eq | 0.1 – 0.08 | | 0.08 | | 0.04 |

Total no. of moles per litre (n/v) = 0.14

$$P = \frac{n}{V} \times R \times T = 0.14 \times 0.082 \times 546 = 6.25\,atm$$

23. **(a)**

In $Al_4C_3$, three moles of $CH_4$ are formed.

24. **(d)**

$PF_5$ has $sp^3d$ hybridization (trigonal bipyramid)

$BrF_5$ has $sp^3d^2$ hybridization (square pyramidal).

25. **(a), (b), (c)**

$$2NH_4ClO_4 \longrightarrow N_2 + Cl_2 + 2O_2 + 4H_2O$$

$$IO_3^- + N_2H_4 + 2H^+ \longrightarrow I^+ + N_2 + 3H_2O$$

$$HN_3 + HNO_2 \longrightarrow N_2 + N_2O + H_2O$$

$$2NH_2OH + 4CuO \longrightarrow N_2O + 2Cu_2O + 3H_2O$$

26. **(a), (b), (c), (d)**

27. **(a), (c), (d)**

28. **(a), (b), (c)**

29. **(a), (d)**

$NH_4NO_3$ (aq) $\longrightarrow$ $N_2O + H_2O$

$NH_4OH + HNO_2 \longrightarrow N_2O + 2H_2O$

Hence, (a) and (d) are the correct answers.

30. **(b), (d)**

1. Addition of inert gas at constant pressure shifts the equilibrium in that direction which has more number of gaseous moles.
2. Increasing the volume of the container shifts the equilibrium in that direction which has more number of gaseous moles.

31. **(a), (b), (d)**

Chemisorption unimolecular layer.

32. **(a), (b)**

$[Cu(NH_3)_4]^{2+} \rightarrow dsp^2$

$[Ni(CN)_4]^{2-} \rightarrow dsp^2$

$[CuCl_4]^{2-} \rightarrow sp^3$

$[NiCl4]^{2-} \rightarrow sp^3$

33. **(a)**

In the original compound

Z atoms $\rightarrow$ form CCP

X atoms $\rightarrow$ present in tetrahedral void.

$\left(\frac{rX}{rZ} = \frac{50}{200} = 0.25\right)$

Y atoms $\rightarrow$ present in octahedral void

$\left(\frac{rY}{rZ} = \frac{100}{200} = 0.5\right)$

Assuming, all voids are occupied, formula of the original compound = $X_8Y_4Z_4$.

On removing atoms along one body diagonal,

We lose $\rightarrow$ 2Z atoms, 2X atoms, 1Y atom (body centre)

$\therefore$ The new formula becomes $\rightarrow$ $X_6\ Y_3Z_{3.75}$

Simplest formula $\rightarrow$ $X_8Y_4Z_5$

34. **(d)**

On removing atoms along another body diagonal, we lose

$\rightarrow$ 2Z atoms

$\rightarrow$ 2X atoms

$\therefore$ The new formula becomes = $X_4Y_3Z_{3.5}$

Simplest formula = $X_8Y_6Z_7$

35. **(b)**

$$pH = pKa + \log \frac{[Base]}{[Salt]}$$

$$[Base] = \frac{0.01 \times 500}{500} = 0.01$$

Let 'a' milli moles of $(NH_4)_2SO_4$

$$\left[NH_4^+\right] = \frac{a \times 2}{500}; \quad \because [Salt] = \left[NH_4^+\right]$$

$$pH = 9.26 + \log \left[\frac{0.01}{2a/500}\right]$$

$$8.26 = 9.26 + \log \left[\frac{0.01 \times 500}{2a}\right]$$

$a = 25$

$\therefore$ Moles of $(NH_4)_2SO_4$ added = 0.025

36. **(a)**

Solution (I) $\rightarrow$ $CH_3COONa + HCl \longrightarrow CH_3COOH + NaCl$

| | | | |
|---|---|---|---|
| 1 | 1 | 0 | 0 |
| 0 | 0 | 1 | 1 |

$$\therefore \left[CH_3COOH\right] = \frac{\text{No. of moles}}{\text{Volume of solution}} = \frac{1}{1} = 1$$

$$\left[H^+\right] = C\alpha = C\sqrt{\frac{K_a}{C}} = \sqrt{K_a.C} = \sqrt{K_a}$$

i.e. $pH_1 = \frac{1}{2}\log K_a = \frac{1}{2}pK_a$

Solution (II) $\rightarrow$ $CH_3COONa + CH_3COOH$

| | |
|---|---|
| 1 | 1 |

It is buffer.

$$\therefore pH_2 = pK_a + \log \left[\frac{CH_3COONa}{CH_3COOH}\right]$$

$$pH_2 = pK_a + \log\frac{1}{1}$$

$$pH_2 = pK_a$$

$$\therefore \frac{pH_1}{pH_2} = \frac{1}{2}$$

**MATHS**

37. **(d)**

38. **(a)**

39. **(b)**

$$f(x) = \frac{\sin x}{\sqrt{1-\cos^2 x}} + \frac{\cos x}{\sqrt{1-\sin^{2x}}} + \frac{\tan x}{\sqrt{\sec^2 x - 1}} + \frac{\cot x}{\sqrt{\text{cosec}^2 x - 1}}$$

$$= \frac{\sin x}{|\sin x|} + \frac{\cos x}{|\cos x|} + \frac{\tan x}{|\tan x|} + \frac{\cot x}{|\cot x|} = \begin{cases} 4, & x \in \text{ 1st quadrant} \\ -2, & x \in \text{ 2nd quadrant} \\ 0, & x \in \text{ 3rd quadrant} \\ -2, & x \in \text{ 4th quadrant} \end{cases}$$

$$f(x)_{\min} = -2$$

40. **(c)**

For $f(x)$ to be continuous at $x = 0$, we have

$$f(0^-) = f(0^+) \Rightarrow a(0) + b = 1 \Rightarrow b = 1$$

$$f'(0^+) = \lim_{h\to 0}\frac{f(h)-f(0)}{h} = \lim_{h\to 0}\frac{e^{h^2+h}-b}{h} = \lim_{h\to 0}\frac{e^{h^2+h}-1}{h} = \lim_{h\to 0}\frac{e^{h^2+h}-1}{h(h+1)}(h+1) = 1$$

$$\therefore \quad f'(0^-) = a$$

Hence, $a = 1$

41. **(b)**

42. **(c)**

43. **(a), (c), (d)**

The coordinates of O are (5, 3) and the radius is 2. The equation of tangent at A(7, 3) is

$$7x + 3y - 5(x+7) - 3(y+3) + 30 = 0$$

i.e., $2x - 14 = 0$

i.e., $x = 7$

The equation of tangent at B(5, 1) is

$$5x + y - 5(x+5) - 3(y+1) + 30 = 0$$

i.e, $-2y + 2 = 0$

i.e., $y = 1$

Therefore, the coordinates of C are (7, 1). So,

Area of OACB = 4

The equation of AB is $x-y=4$ (radical axis)

The equation of the smallest circle is

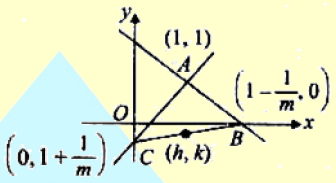
$(x-7)(x-5)+(y-3)(y-1)=0$

i.e., $x^2+y^2-12x-4y+38=0$

44. **(a)**

The equation of line $AB$ is $y-1=m(x-1)$. Therefore, the equation of line AC is:

$$y-1=-\frac{1}{m}(x-1)$$




$$2h=1-\frac{1}{m}$$

$$2k=1+\frac{1}{m}$$

Eliminating $m$, we have locus $x+y=1$

45. **(a), (c)**

46. **(c), (d)**

$$\int_a^b |\sin x|\,dx=8\Rightarrow b-a=4\pi$$

$$\because \text{period of } |\sin x| \text{ is } \pi \text{ and } \int_0^{\pi}|\sin x|\,dx=2$$

Also, $|\cos x|$ is periodic with period $\pi$ and

$$\int_0^{\pi/2}|\cos x|=1$$

$$so,\ \int_0^{a+b}|\cos x|\,dx=\frac{9}{2}\quad\Rightarrow\quad a+b=\frac{9\pi}{2}\quad\Rightarrow\quad b=\frac{17\pi}{4}\ and\ a=\frac{\pi}{4}$$

47. **(a), (b)**

Any normal to parabola $y^2=4ax$ may be taken as

$$y-2at=-t\left(x-at^2\right)$$

or $y+tx-2at-at^3=0$

If Eq. (i) passes through (5a, 2a), then

$2a+5at-2at-at^3=0$

or $t^3 - 3t - 2 = 0$

or $(t+1)(t^2 - t - 2) = 0$

$\Rightarrow t = -1,\ 2, -1$

$\therefore$ From Eq. (i) normals are

$y - x + 3a = 0$ and $y + 2x - 12a = 0$

48. **(b), (c), (d)**

49. **(a), (b)**

50. **(a), (d)**

51. **(d)**

$\because$ Mid point of A and B is $(x_1, y_1)$

$A \equiv (2x_1, 0)$ and $B \equiv (0, 2y_1)$

$\because$ Slope of AB is $m$ (given)

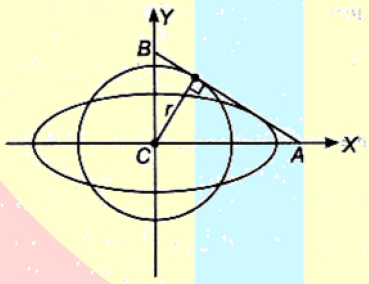
$\therefore \quad \dfrac{2y_1 - 0}{0 - 2x_1} = m$

$\Rightarrow y_1 + mx_1 = 0$

$\Rightarrow mx_1 + y_1 = 0$

52. **(a)**

Equation of tangent of ellipse $\dfrac{x^2}{16} + \dfrac{y^2}{9} = 1$ in terms of slope is




$y = mx + \sqrt{(16m^2 + 9)}$ ..... (i)

Here $m < 0$ (for first quadrant)

Which is also tangent of circle, then

$$\frac{\sqrt{(16m^2 + 9)}}{\sqrt{(m^2 + 1)}} = r$$

$\Rightarrow 16m^2 + 9 = m^2r^2 + r^2$

or $m = \pm\sqrt{\left(\frac{r^2-9}{16-r^2}\right)}$

$\Rightarrow m = -\sqrt{\left(\frac{r^2-9}{16-r^2}\right)}$ $\quad (\because m < 0)$

From above relation

$y_1 = -mx_1$

or $y_1 = x_1\sqrt{\left(\frac{r^2-9}{16-r^2}\right)}$

$\therefore$ Locus of mid point of AB is $y = x\sqrt{\left(\frac{r^2-9}{16-r^2}\right)}$

53. **(a)**

54. **(d)**