CODE - A

TEST ID 002013

NTPL

ALL INDIA TEST SERIES

JEE (Main) - 2020

Batch - 2001+2002+2003+2005+2007

PART TEST - 3

Time : 3 Hours ***Maximum Marks : 300***

Syllabus Covered

Physics : Rotation, Transient current, Alternative current.
Chemistry : Equilibrium I & II, Gaseous state, Hydrocarbons.
Mathematics : Indefinite Integration, Definite Integration, Area, Differential Equation.

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 **75 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 & Marking Scheme :

9. The question paper consists of **3 parts** (Physics, Chemistry and Mathematics).
10. **Section I** contains **20 questions**. Each question has 4 choices (A), (B), (C) and (D), for its answer, out of which ***ONLY ONE*** is correct. Each question carries **+4 marks** for correct answer and **-1 mark** for wrong answer.
11. **Section II** contains **5 questions**. The answer to each question is a ***NUMERICAL VALUE.*** Each question carries **+4 marks** for correct answer. In all other cases **zero (0)** mark will be awarded for incorrect answer 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: 80)

This section contains **TWENTY (20)** questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** is correct. Each question carries **+4 marks** for correct answer and **–1 mark** for wrong answer.

1. From a disc of radius R and mass M, a circular hole of diameter R, whose rim passes through the centre is cut. What is the moment of inertia of remaining part of the disc about a perpendicular axis, passing through the centre?

(a) $\frac{13}{32}MR^2$ (b) $\frac{11}{32}MR^2$ (c) $\frac{9}{32}MR^2$ (d) $\frac{15}{32}MR^2$

2. A wire of length l and mass M is bent in the form of a circular ring. The moment of inertia about its axis is

(a) $\frac{Ml^2}{8\pi^2}$ (b) $8\pi^2\ ML^2$ (c) $\frac{M\,l^2}{4\pi^2}$ (d) $4\ \pi^2\ ML^2$

3. A particle moves so that its position vector is given by $\vec{r} = \cos\omega t\,\hat{x} + \sin\omega t\,\hat{y}$, where ω is a constant. Which of the following is true?

(a) velocity and acceleration both are perpendicular to $\vec{r}$

(b) velocity and acceleration both are parallel to $\vec{r}$

(c) velocity is perpendicular to $\vec{r}$ and acceleration is directed towards the origin

(d) velocity is perpendicular to $\vec{r}$ and acceleration is directed away from the origin

4. Two discs of moment of inertia l_1 and l_2 and angular speeds ω_1 and ω_2 are rotating along collinear axes passing through their c.m. and perpendicular to their plane. If the two are made to rotate combined along the same axis the rotational KE of system will be

(a) $\frac{l_1\omega_1 + l_2\omega_2}{2(l_1 + l_2)}$ (b) $\frac{(l_1 + l_2)(\omega_1 + \omega_2)}{2}$ (c) $\frac{(l_1\omega_1 + l_1\omega_2)^2}{2(l_1 + l_2)}$ (d) none of these

5. The moments of inertia of two freely rotating bodies A and B are I_A and I_B respectively. $I_A > I_B$ and their angular momenta are equal. If K_A and K_B are their kinetic energies, then

(a) $K_A = K_B$ (b) $K_A = K_B$ (c) $K_A < K_B$ (d) $K_A = 2K_B$

6. A uniform rod of length l and mass m us free to rotate in a vertical plane about A. The rod initially in horizontal position is released. The initial angular acceleration of the rod is

(a) $\frac{mgl}{2}$ (b) $\frac{3g}{2l}$ (c) $\frac{2l}{3g}$ (d) $\frac{3g}{2l^2}$

7. A solid sphere rolls down two different inclined plane of same height, but of different inclinations. In both cases

(a) speed and time of descent will be same

(b) speed will be same, but time of descent will be different

(c) speed will be different, but time of descent will be same

(d) speed and time of descent both are different

8. A sphere of mass m and radius r rolls on a horizontal plane without slipping with the speed u. Now it rolls up vertically. The maximum height it would attain will be

(a) $3u^2/4g$ (b) $5u^2/2g$ (c) $7u^2/10g$ (d) $11u^2/9g$

9. The r.m.s. value of $i = I_1 \sin \omega t + I_2 \cos \omega r$ is

(a) $\frac{I_1 + I_2}{2}$ (b) $\sqrt{\frac{I_1^2 + I_2^2}{2}}$ (c) $\frac{\sqrt{I_1^2 + I_2^2}}{2}$ (d) $\frac{I_1 - I_2}{2}$

10. An AC source has voltage and time variation is SI units given by $V = 120 \sin(100\pi t)\cos(100\pi t)$. The maximum voltage and frequency are

(a) 120, V, 100 Hz (b) $\frac{120}{\sqrt{2}} V, 100\,Hz$ (c) $60V, 200\,Hz$ (d) $60V, 100\,Hz$

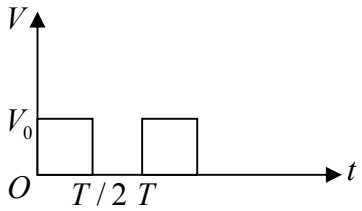
11. The r.m.s. value of potential differential V shown in Fig. is

(a) V_0

(b) $V_0/2$

(c) $V_0/\sqrt{2}$

(d) $V_0/\sqrt{3}$



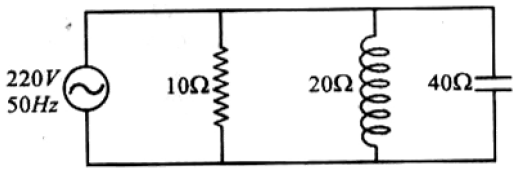
12. The value of conductance in the adjoining circuit shown in Fig. is

(a) 0.1 mho

(b) 0.025 mho

(c) 0.103 mho

(d) 9.7 mho



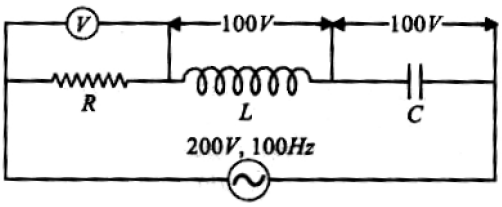
13. In the circuit shown in Fig. what will be the reading of the voltmeter?

(a) 300 V

(b) 900 V

(c) 200 V

(d) 400 V



14. If the current in an inductor is tripled, by what factor does the stored energy change?

(a) 4.5 (b) 2 (c) $\frac{1}{9}$ (d) 9

15. Power dissipated in an LCR series circuit connected to an A.C. source of emf ε is

(a) $\dfrac{\varepsilon^2\sqrt{R^2+\left(L\omega-\dfrac{1}{C\omega}\right)^2}}{R}$ (b) $\dfrac{\varepsilon^2\left[\sqrt{R^2+\left(L\omega-\dfrac{1}{C\omega}\right)^2}\right]}{R}$

(c) $\dfrac{\varepsilon^2 R}{R^2+\left(L\omega-\dfrac{1}{C\omega}\right)^2}$ (d) $\dfrac{\varepsilon^2 R}{\sqrt{\left[R^2+\left(L\omega-\dfrac{1}{C\omega}\right)^2\right]}}$

16. If a direct current of a units is superimposed with an alternating current $I = b \sin \omega t$, then the effect value of resulting current is

(a) $\left(a^2+b^2\right)^{1/2}$ (b) $\left(\dfrac{a^2+b^2}{2}\right)^{1/2}$ (c) $\left(a^2+\dfrac{b^2}{2}\right)^{1/2}$ (d) $\left(\dfrac{a^2}{2}+b^2\right)^{1/2}$

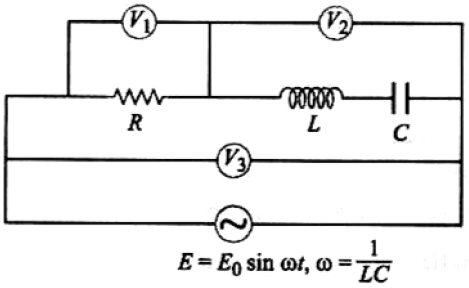
17. In the circuit shown here readings of voltmeters V_1, V_2, V_3 at resonance are given by

(a) $V_1 = V_2 = V_3 = E_0$

(b) $V_1 = V_3 = \frac{E_0}{\sqrt{2}}, V_2 = 0$

(c) $V_1 = V_3 = E_0, V_2 = 0$

(d) $V_1 = \frac{E_0}{\sqrt{2}}, V_2 = V_3 = 0$



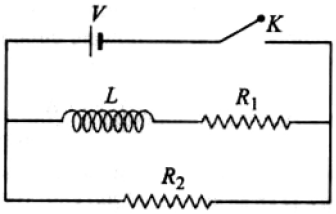
18. In the circuit shown in Fig. the key K is closed at $t = 0$. The current through the battery is

(a) $\frac{V}{R_2}$ at $t = 0$ and $\frac{V(R_1 + R_2)}{R_1 R_2}$ at $t = \infty$

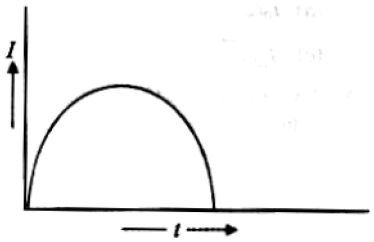
(b) $\frac{V}{R_2}$ at $t = 0$ and $\frac{V R_1 R_2}{\sqrt{R_1^2 + R_2^2}}$ at $t = \infty$

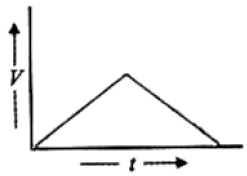
(c) $\frac{V R_1 R_2}{R_1 R_2}$ at $t = 0$ and $\frac{V}{R_2}$ at $t = \infty$

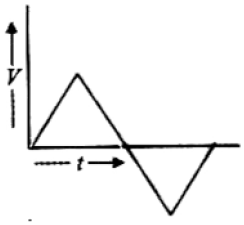
(d) $\frac{V R_1 R_2}{\sqrt{R_1^2 + R_2^2}}$ at $t = 0$ and $\frac{V}{R_2}$ at $t = \infty$

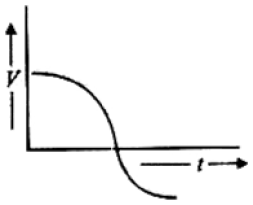


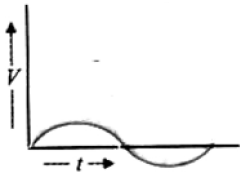
19. The alternating current I in an in inductance coil varies with time according to graph given in fig. Which one of the following graphs, fig gives the variation of voltage with time?



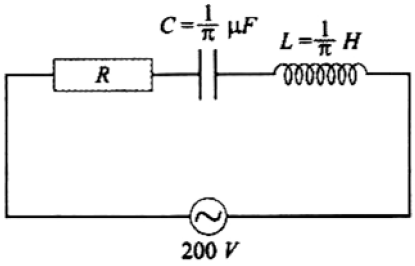
(a) 

(b) 

(c) 

(d) 

20. In the circuit shown in Fig. the supply has a constant rms value V but variable frequency *f*. The frequency at which the voltage drop across *R* is maximum is:



(a) 100 Hz

(b) 300 Hz

(c) 500 Hz

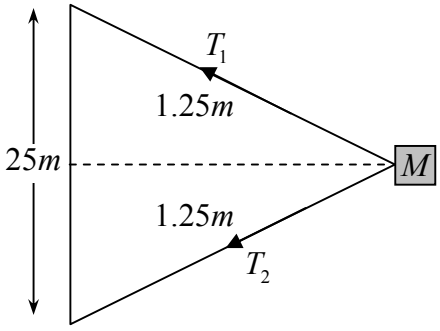
(d) None of these

SECTION 2 (Maximum Marks: 20)

This section contains **FIVE (05)** questions. The answer to each question is a **NUMERICAL VALUE.** Each question carries **+4 marks** for correct answer. In all other cases **zero (0)** mark will be awarded for incorrect answer in this section.

21. A wheel has angular acceleration of 3.0 rad/sec. In a time of 2 sec it has rotated through an angle (In radian) of

22. Two strings are tied 2 m apart on a rod and on the other end, a mass 200 g is tied as shown in fig. Each string is 1.25 m long. Find the tensions T_1, if the mass is rotated with 60 rpm about the rod.



23. An inductive circuit contains a resistance of 10 ohm and an inductance of 2.0 henry. If an ac voltage of 120 volt and frequency of 60 Hz is applied to this circuit, the current in the circuit would be nearly.

24. A coil of $R=10\Omega$ and $L=5\,H$ is connected to a 100 V battery, then energy stored is

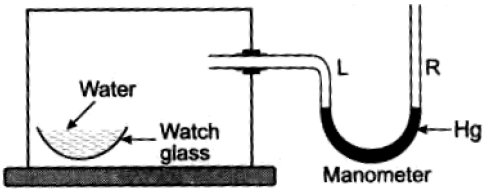
25. An inductor 20 mH, a capacitor 100 μF and a resistor 50 Ω are connected in series across a source of $emf.\ V=10\sin 314\,t$. The power loss in the circuit is

PART - II CHEMISTRY

SECTION 1 (Maximum Marks: 80)

This section contains **TWENTY (20)** questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** is correct. Each question carries **+4 marks** for correct answer and **–1 mark** for wrong answer.

26. In the following diagram, the chamber is treated with anhydrous $CaCl_2$ to remove all moisture. Now, a watch glass is introduced that has a small quantity of water in it. What will be observed in the manometer?



(a) Hg will rise in L side

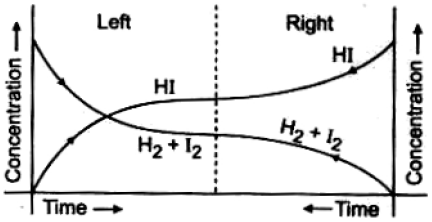
(b) Hg will rise in R side

(c) Hg will rise in both L and R sides

(d) Hg will remain where it is

27. Which of the following facts are correct for the plot shown below for

$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$?



(a) Right part shows decomposition of HI (g) to produce H_2 (g) and I_2 (g).

(b) Left part shows reaction of H_2 (g) and I_2 (g) to produce HI (g).

(c) Equilibrium can be attained from both sides.

(d) All of the above

28. For the reversible reaction

$$A + B \rightleftharpoons C + D$$

(I) Guldberg and Waage gave equilibrium equation:

$$\text{Eqm. Constt. } K_c = \frac{[C][D]}{[A][B]}$$

(II) $\frac{[C][D]}{[A][B]}$ is called equilibrium constant expression

(III) For the reaction, $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

$$K_c = \frac{\left[NH_3(g)\right]^2}{\left[N_2(g)\right]\left[H_2(g)\right]^3}$$

Select the correct choice :

(a) only (I) is correct

(b) (I) and (III) both are correct

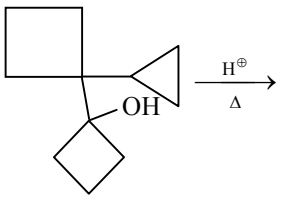
(b) (I) and (III) both are correct

(d) (I), (II) and (III) all are correct

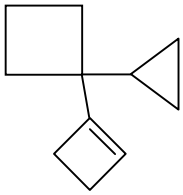
29. PCl_5, PCl_3 and Cl_2 are at equilibrium at 500 K and having concentrations 1.59 M PCl_3, 1.59 M Cl_2 and 1.41 MPCl_5 .K_c for the reaction,

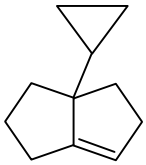
$$PCl_5 \rightleftharpoons PCl_3 + Cl_2, \text{ is:}$$

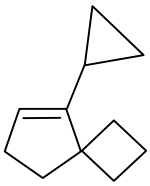
(a) 9.17 (b) 1.79 (c) 7.19 (d) 9.71

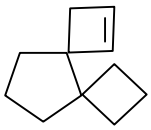
30. 

Rearranged alkene product after rearrangement will be (mainly) –

(a) 

(b) 

(c) 

(d) 

31. Select the correct choice for the following rules I, II and III. At equilibrium :

I. $K_c > 10^3 \Rightarrow$ Products are negligible

II. $K_c < 10^{-3} \Rightarrow$ Reactants are negligible

III. $10^{-3} < K < 10^3 \Rightarrow$ Reactants and products both are present in considerable quantities.

(a) I and II both are correct

(b) only III is correct

(c) All of these are correct

(d) All of these are not correct

32. Which of the following statements (I), (II) and (III) is/are correct?

(I) When ΔG is negative, the driving force makes the reaction go forward.

(II) When ΔG is positive, the forward reaction is not possible. Instead ΔG will have negative value for the reverse reaction and products will give back the reactants.

(III) When ΔG is zero, the reaction has no energy left to drive the forward or reverse reaction, i.e., the reaction is at equilibrium.

(a) Only (I) is correct (b) Only (III) is correct

(c) (I) and (II) both are correct (d) (I), (II) and (III) all are correct

33. Keeping all conditions constant which of the following will increase the yield of NH_3?

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

(a) Increase the amount of $N_2(g)$ (b) Increase the amount of $H_2(g)$

(c) Decrease the amount of $NH_3(g)$ (d) All of the above

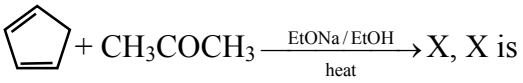
34. Acetic acid is only about 5% dissociated in water. H^+ and CH_3COO^- ions are in equilibrium with undissociated molecules of CH_3COOH

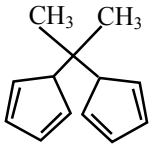
$$CH_3COOH(aq) \rightleftharpoons H^+(aq) + CH_3COO^-(aq)$$

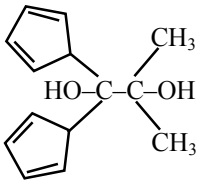
Such equilibria are known as :

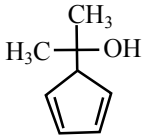
(a) chemical equilibria (b) ionic equilibria (c) physical equilibria (d) all (a), (b) and (c)

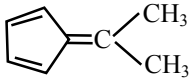
35. In the reaction



(a) 

(b) 

(c) 

(d) 

36. Solids and liquids resist compression because :

(a) molecules are already very close.

(b) inter electronic forces do not allow the molecules of solids and liquids to come further close.

(c) inter-nuclear repulsive forces do not allow the molecules to come still more closer

(d) all of the above

37. Which of the following statements is correct?

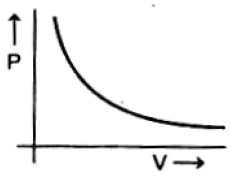
(a) Gaseous state is the simplest state of matter.

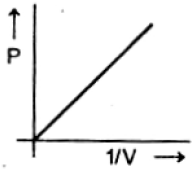
(b) The part of atmosphere, we live in, contains O_2, N_2, CO_2, etc.

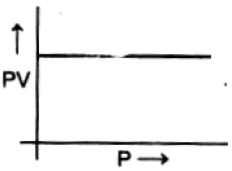
(c) The thin layer of atmosphere, we live in, protects us from harmful radiations.

(d) All of the above are correct.

38. Which of the following graph(s) represent(s) Boyle's law?

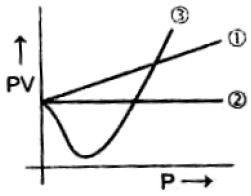
(a) 

(b) 

(c) 

(d) All of these

39. With reference to the graph which is/are not correct?

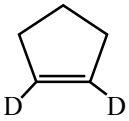


(I) (1) shows real gas and +ve deviation.

(II) (2) shows ideal gas behaviour.

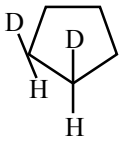
(III) (3) shows super ideal gas behaviour. Negative deviation at high pressure and positive deviation at low temperature.

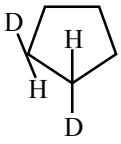
(a) (I) and (II) (b) Only (I) (c) Only (II) (d) Only (III)

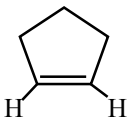
40. 

$\xrightarrow{H_2/Ni}$ A. A is –

(a) $CH_3 - (CH_2)_4 - CH_3$

(b) 

(c) 

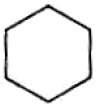
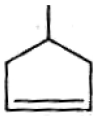
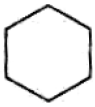
(d) 

41. The product of reaction between 1,1,2,2-tetrachloro propane and Zn dust/Δ -

(a) Propyne (b) Propene (c) Iso propene (d) Acetylene

42. What are' A' and' B' as major compounds in the following reaction?

$$CH_3(CH_2)_4CH_3 \underset{\text{Anhyd. } AlCl_3/HCl/35atm/25^\circ C}{\overset{\text{Anhyd. } AlCl_3/HCl/35atm/400^\circ C}{\rightleftharpoons}} A + B$$

	A	B
(a)	$CH_3-\underset{\displaystyle CH_3}{\underset{\vert}{CH}}-CH_2-CH_2-CH_3$	
(b)		
(c)	$CH_3-\underset{\displaystyle CH_3}{\underset{\vert}{CH}}-CH_2-CH_2-CH_3$	$CH_3-CH_2-\underset{\displaystyle CH_3}{\underset{\vert}{CH}}-CH_2-CH_3$
(d)		

43. What form of alkene are 'A' and 'B'?

(I) $R-C\equiv C-R \xrightarrow{Na/NH_3} 'A'$

(II) $R-C\equiv C-R \xrightarrow[\text{or } H_2/Pd/BaCO_3]{H_2/Pd-C} 'B'$

	A	B
(a)	*cis*	*cis*
(b)	*trans*	*trans*
(c)	*cis*	*trans*
(d)	*trans*	*cis*

44. $CH_3-CH=CH_2$ → 1% Alk. $KMnO_4/110^\circ C$ → *'A'*; $KMnO_4/H^+/\Delta$ → *'B'*; $K_2Cr_2O_7/H^+/\Delta$ → *'C'*

What are A, B and C as major products?

	A	B	C
(a)	$CH_3-\underset{\underset{OH}{|}}{CH}-\underset{\underset{OH}{|}}{CH_2}$	$CH_3-\underset{\underset{OH}{|}}{CH}-CH_3$	$CH_3-CH_2-\underset{\underset{OH}{|}}{CH_2}$
(b)	CH_3COOH	CH_3COOH	CH_3COOH
(c)	CH_3COOH	$CH_3-\underset{\underset{O}{\|\|}}{C}-CH_3$	CH_3-CH_2-CHO
(d)	$CH_3-\underset{\underset{OH}{|}}{CH}-\underset{\underset{OH}{|}}{CH_2}$	CH_3COOH	CH_3COOH

45. Supply the product 'A' and 'B' of the following reaction

$$CH_3-CH=\!=CH_2 \xrightarrow[(ii)\ Zn/H_2O]{(i)\ O_3/CH_2Cl_2/-77^\circ C} A + B$$

	A	B
(a)	CH_3COOH	HCOOH
(b)	CH_3CHO	HCHO
(c)	CH_3COOH	HCHO
(d)	CH_3CHO	HCOOH

SECTION 2 (Maximum Marks: 20)

This section contains **FIVE (05)** questions. The answer to each question is a **NUMERICAL VALUE.** Each question carries **+4 marks** for correct answer. In all other cases **zero (0)** mark will be awarded for incorrect answer in this section.

46. At 20°C, two balloons both have equal volume and porosity are filled to a pressure of 2 atm. One with 14 kg N_2 and other with 1 kg of H_2. The N_2 balloon leaks to a pressure of 0.5 atm in 1 hr. How long (in minute) (.....) will it take for H_2 balloon to reach a pressure of 0.5 atm.

47. For gaseous homogeneous reaction

$2A(g) + B(g) \rightleftharpoons 2C(g) + 2D(g)$

$\Delta G^\circ = 0.693\ RT$ at TK. Find Kp for the reaction in k Pa [1 k Pa = 10^3 Pa]

48. A gas is heated in a cyllinder fitted with a nozzle from 27°C for 20 minutes. It is found that $\frac{2}{3}$rd of the original gas is diffused out through the nozzle. What would be the difference in temperature (give your answer in terms of multiples of 100K) between initial and final states?

49. Two vessels of equal volume are connected to each other by a value of negligible volume. One of the containers has 2.8 g of N_2 12.7 g of I_2 at a temperature T_1. The other container is completely evacuated. The container that has N_2 and I_2 is heated to temperature T_2 while the evacuated container is heated $T_2/3$. The value is now opened. Calculate the mass of N_2 in container (B) after a very long time I_2 sublimes at T_2. (report your answer in nearst integer form in grams)

50. In a container of volume 1 litre 10^{23} gas molecules are present at the r. m. s. speed equal to 10^3 m/s. Determine the total kinetic energies of the gas molecules in kJ in nearest possible integers.

Given : $N_A = 6 \times 10^{23}$ and mass of one molecule = 10^{-22} gm

PART - III MATHEMATICS

SECTION 1 (Maximum Marks: 80)

This section contains **TWENTY (20)** questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** is correct. Each question carries **+4 marks** for correct answer and **–1 mark** for wrong answer.

51. If $\int f(x)dx = F(x)$, then $\int x^3 f(x^2)dx$ is equal to

(a) $\frac{1}{2}\left[x^2\{F(x)\}^2 - \int\{F(x)\}^2 dx\right]$ (b) $\frac{1}{2}\left[x^2F(x^2) - \int F(x^2)d(x^2)\right]$

(c) $\frac{1}{2}\left[x^2F(x) - \frac{1}{2}\int\{F(x)\}^2 dx\right]$ (d) None of the above

52. $\int \frac{x^2-1}{x^3\sqrt{2x^4-2x^2+1}}dx$ is equal to

(a) $\frac{\sqrt{2x^4-2x^5+1}}{x^2}+C$ (b) $\frac{\sqrt{2x^4-2x^2+1}}{x^3}+C$

(c) $\frac{\sqrt{2x^4+2x^2+1}}{x}+C$ (d) $\frac{\sqrt{2x^4-2x^2+1}}{2x^2}+C$

53. $\int \tan^4 x dx = A\tan^3 x + B\tan x + f(x)$, then

(a) $A=\frac{1}{3}, B=-1, f(x)=x+C$ (b) $A=\frac{2}{3}, B=-1, f(x)=x+C$

(c) $A=\frac{1}{3}, B=1, f(x)=x+C$ (d) $A=\frac{2}{3}, B=1, f(x)=-x+C$

54. $\int \frac{e^{\tan^{-1}x}}{(1+x^2)}\left[\left(\sec^{-1}\sqrt{1+x^2}\right)^2 + \cos^{-1}\left(\frac{1-x^2}{1+x^2}\right)\right]dx, (x>0)$ is equal to

(a) $e^{\tan^{-1}x}\cdot\tan^{-1}x + C$ (b) $\frac{e^{\tan^{-1}x}\cdot(\tan^{-1}x)^2}{2}+C$

(c) $e^{\tan^{-1}x}\cdot\left(\sec^{-1}\left(\sqrt{1+x^2}\right)\right)^2 + C$ (d) $e^{\tan^{-1}x}\cdot\left(\text{cosec}^{-1}\left(\sqrt{1+x^2}\right)\right)^2 + C$

55. The area enclosed by the curve $|y| = \sin 2x$, when $x \in [0, 2\pi]$ is

(a) 1 sq unit (b) 2 sq units (c) 3 sq units (d) 4 sq units

56. The value of $\int_2^3 \frac{\sqrt{x}}{\sqrt{5-x}+\sqrt{x}}dx$ is equal to

(a) 1/2 (b) 1/3 (c) 1/4 (d) None of these

57. $\lim\limits_{x\to\frac{\pi}{4}} \frac{\int_2^{\sec^2 x} f(t)dt}{x^2 - \frac{\pi^2}{16}}$ is equal to

(a) $\frac{8}{\pi}f(2)$ (b) $\frac{2}{\pi}f(2)$ (c) $\frac{2}{\pi}f\left(\frac{1}{2}\right)$ (d) $4f(2)$

58. The value of the definite integral $\int_0^\infty \frac{dx}{(1+x^a)(1+x^2)}(a>0)$ is

(a) $\frac{\pi}{4}$ (b) $\frac{\pi}{2}$

(c) π (d) Some function of a

59. Let $I_n = \int \tan^n x\,dx, (n>1). I_4 + I_6 = a\tan^5 x + bx^5 + C,$ where C is a constant of integration, then the ordered pair (a, b) is equal to

(a) $\left(-\frac{1}{5}, 0\right)$ (b) $\left(-\frac{1}{5}, 1\right)$ (c) $\left(\frac{1}{5}, 0\right)$ (d) $\left(\frac{1}{5}, -1\right)$

60. **Statement I** The value of the integral $\int_{\pi/6}^{\pi/3} \frac{dx}{1+\sqrt{\tan x}}$ is equal to $\pi/6$.

Statement II $\int_a^b f(x)dx = \int_a^b f(a+b-x)dx$

(a) Statement I is true; Statement II is true; Statement II is a true explanation for Statement I

(b) Statement I is true; Statement II is true; Statement II is not a true explanation for Statement I

(c) Statement I is true; Statement II is false

(d) Statement I is false; Statement II is true

61. The area bounded by $y = 2 - |2 - x|$ and $y = \frac{3}{|x|}$ is

(a) $\frac{4 + 3\ln 3}{2}$ (b) $\frac{19}{8} - 3\ln 2$ (c) $\frac{3}{2} + \ln 3$ (d) $\frac{1}{2} + \ln 3$

62. If the area bounded between X-axis and the graph of $y = 6x - 3x^2$ between the ordinates $x = 1$ and $x = a$ is 19 sq units, then 'a' can take the value

(a) 4 or –2 (b) two values are in (2, 3) and one in (–1, 0)

(c) two values one in (3, 4) and one in (–2, –1) (d) None of the above

63. The area bounded between the parabolas $x^2 = \frac{y}{4}$ and $x^2 = 9y$ and the straight line $y = 2$ is

(a) $20\sqrt{2}$ (b) $\frac{10\sqrt{2}}{3}$ (c) $\frac{20\sqrt{2}}{3}$ (d) $10\sqrt{2}$

64. The area bounded by the curves $y = \cos x$ and $y = \sin x$ between the ordinates $x = 0$ and $x = \frac{3\pi}{2}$ is

(a) $\left(4\sqrt{2} - 2\right)$ sq units (b) $\left(4\sqrt{2} + 2\right)$ sq units

(c) $\left(4\sqrt{2} - 1\right)$ sq units (d) $\left(4\sqrt{2} + 1\right)$ sq units

65. The area of the region enclosed by the curves $y = x,\ x = e,\ y = \frac{1}{x}$ and the positive X-axis is

(a) 1 sq unit (b) $\frac{3}{2}$ sq units (c) $\frac{5}{2}$ sq units (c) $\frac{1}{2}$ sq unit

66. The order of the differential equation of family of curves $y = C_1 \sin^{-1} x + C_2 \cos^{-1} x + C_3 \tan^{-1} x + C_4 \cot^{-1} x$ (where C_1, C_2, C_3 and C_4 are arbitrary constants) is

(a) 2 (b) 3 (c) 4 (d) None of these

67. The differential equation corresponding to the family of curves $y = e^x (ax + b)$ is

(a) $\frac{d^2y}{dx^2} + 2\frac{dy}{dx} - y = 0$ (b) $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = 0$

(c) $\frac{d^2y}{dx^2} + 2\frac{dy}{dx} + y = 0$ (d) $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} - y = 0$

68. The function $y = f(x)$ is the solution of the differential equation $\frac{dy}{dx} + \frac{xy}{x^2-1} = \frac{x^2+2x}{\sqrt{1-x^2}}$ in (–1, 1) satisfying $f(0) = 0$. Then, $\int_{-\frac{\sqrt{3}}{2}}^{\sqrt{3}/2} f(x)\,dx$ is

(a) $\frac{\pi}{3} - \frac{\sqrt{3}}{2}$ (b) $\frac{\pi}{3} - \frac{\sqrt{3}}{4}$ (c) $\frac{\pi}{6} - \frac{\sqrt{3}}{4}$ (d) $\frac{\pi}{6} - \frac{\sqrt{3}}{2}$

69. If a curve $y = f(x)$ passes through the point $(1, -1)$ and satisfies the differential equation, $y(1+xy)\,dx = x\,dy$, then $f\left(-\frac{1}{2}\right)$ is equal to

(a) $-\frac{2}{5}$ (b) $-\frac{4}{5}$ (c) $\frac{2}{5}$ (d) $\frac{4}{5}$

70. Let the population of rabbits surviving at a time t be governed by the differential equation $\frac{dp(t)}{dt} = \frac{1}{2}p(t) - 200$. If $p(0) = 100$, then $p(t)$ is equal to

(a) $400 - 300e^{\frac{t}{2}}$ (b) $300 - 200e^{\frac{t}{2}}$ (c) $600 - 500e^{\frac{t}{2}}$ (d) $400 - 300e^{-\frac{t}{2}}$

SECTION 2 (Maximum Marks: 20)

This section contains **FIVE (05)** questions. The answer to each question is a **NUMERICAL VALUE.** Each question carries **+4 marks** for correct answer. In all other cases **zero (0)** mark will be awarded for incorrect answer in this section.

71. If $\int \frac{(2x+3)\,dx}{x(x+1)(x+2)(x+3)+1} = C - \frac{1}{f(x)}$, where $f(x)$ is of the form of $ax^2 + bx + c$, then $(a+b+c)$ equals to …….

72. The integral $\int_2^4 \frac{\log x^2}{\log x^2 + \log(36 - 12x + x^2)}\,dx$ is equal to

73. The area of the region bounded by the parabola $(y-2)^2 = x - 1$, the tangent to the parabola at the point (2, 3) and the X-axis is

74. Number of straight lines which satisfy the differential equation $\frac{dy}{dx} + x\left(\frac{dy}{dx}\right)^2 - y = 0$ is

75. If $\frac{dy}{dx} = y + 3 > 0$ and $y(0) = 2$, then $y(\log 2)$ is equal to

SOLUTION OF AITS JEE(MAIN) PART TEST – 3

PHYSICS

1. **(a)** 2. **(c)** 3. **(c)** 4. **(d)**
5. **(c)** 6. **(b)** 7. **(b)** 8. **(c)**
9. **(b)** 10. **(d)** 11. **(c)** 12. **(a)**
13. **(c)** 14. **(d)** 15. **(c)** 16. **(c)**
17. **(b)** 18. **(a)** 19. **(c)** 20. **(c)**
21. **(10)** 22. **(6.25)** 23. **(0.16)** 24. **(250)**
25. **(0.76)**

CHEMISTRY

26. **(b)**

Water will change to vapour which will press Hg in L side whereby the level will be raised in R side till $H_2O(\ell) \rightleftharpoons H_2O(g)$ equilibrium is reached.

27. **(d)**

28. **(d)**

29. **(b)**

$$K_c = \frac{[PCl_3][Cl_2]}{[PCl_5]} = \frac{1.59 \times 1.59}{1.41} = 1.79$$

30. **(b)**

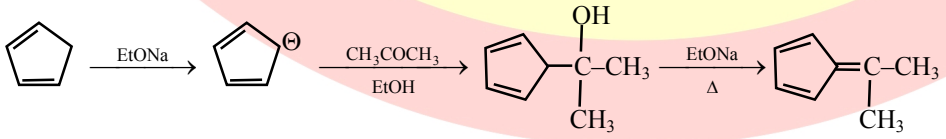
31. **(b)**

$K_c > 10^3 \Rightarrow$ very high yield

$K_c < 10^{-3} \Rightarrow$ negligible yield

32. **(d)** 33. **(d)** 34. **(b)**

35. **(d)**



36. **(d)** 37. **(d)** 38. **(d)**

39. **(d)**

There is no super ideal gas. It is a case of a real gas. At low pressure the deviation is negative from ideal behaviour while at high pressure the deviation is positive.

40. **(b)** 41. **(a)**

42. **(c)**

It is a reaction of isomerisation where high temperature gives simple branched compounds and the reverse reaction takes place at room temperature. Pressure of approximately 35 atm is maintained.

43. **(d)**

Na/NH_3 reaction (Birch reaction) give trans-isomer while $H_2/Pd/BaCO_3$ gives cis-isomer.

44. **(b)**

CH_3COOH in all cases.

45. **(b)**

$$CH_3-CH\overset{O}{\overset{\|}{=}}\overset{O}{}CH_2 \xrightarrow[\text{Ozonolysis}]{\text{Reductive}} CH_3CHO + HCHO$$

46. **(16)**

At constant V and T

For N_2, $\frac{P_1}{P_2} = \frac{w_1}{w_2}$

$\frac{2}{0.5} = \frac{14}{w_2} \Rightarrow w_2 = 3.5$ kg wt. of N_2 diffused $= 14 - 3.5 = 10.5$ kg

For H_2

$\frac{P_1}{P_2} = \frac{w_1}{w_2}$

$\frac{2}{0.5} = \frac{1}{w_2} \Rightarrow w_2 = 0.25$ kg

weight of H_2 diffused $1 - 0.25 = 0.75$ kg.

$$\frac{w_{H_2}}{w_{N_2}} \times \frac{t_{N_2}}{t_{H_2}} = \frac{r_{H_2}}{r_{N_2}} = \sqrt{\frac{M_{N_2}}{M_{H_2}}}$$

47. **(50)**

$\Delta G^\circ = -RT \ln K^\circ p = 0.693\ RT$

$\Rightarrow 1/K^\circ p = 2 \Rightarrow K^\circ p = 0.5$ bar

$= 0.5 \times 10^5 = 5 \times 10^4$ Pa $= 50$ k Pa

48. **(6)**

From $PV = nRT \Rightarrow nT = \frac{PV}{R} \Rightarrow nT =$ constant (at constant P, V)

$\Rightarrow n_1 T_1 = n_2 T_2 \Rightarrow \frac{n_1}{\frac{1}{3}n_1} = \frac{T_2}{300} \Rightarrow T_2 = 900$ K $\Rightarrow T_2 - T_1 = 600$ K $= 6$ Hundred Kelvin

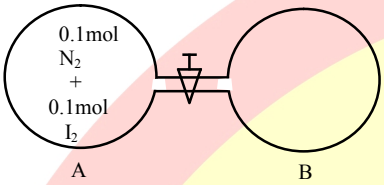
49. **(2)**

Number of moles of N_2 in vessel

(A) at $T_1 = \frac{2.8}{2.8} = 0.1$

Number of moles of I_2 in

Vessel (A) at $T_1 = \frac{12.7}{254} = 0.05$



Vessel (A) is heated to T_2 the evacuated vessel (B) is heated to $T_2/3$. On opening stop-cock I_2 sublimes in (A) and its vapours condense to solid I_2 in (B). Let the number of moles of N_2 moved from (A) to (B) at equilibrium be x.

Pressure of N_2 in (A) = Pressure of N_2 in (B) $= \frac{(0.1-x)RT_2}{V} = \frac{xRT_2}{3V}$

One solving, x = 0.075

$\therefore$ Mass of N_2 is vessel (A) = 0.7g

Mass of N_2 in vessel (B) = 2.1g

50. **(5)**

No. of moles of gas molecules present = $\frac{10^{23}}{6\times10^{23}} = \frac{1}{6}$.

Mol wt. of gas = $6 \times 10^{23} \times 10^{-22} = 60$ or $u_{rms} = \sqrt{\frac{3RT}{M}}$

$u_{rms}^2 = \frac{3RT}{M}$ or $\frac{Mu_{rms}^2}{3} = RT$

Per mol, KE = $\frac{3}{2}RT = \frac{3}{2} \times \frac{Mu_{rms}^2}{3} = \frac{1}{2}Mu_{rms}^2$

$\therefore$ for $\frac{1}{6}$ mol, total KE $= \frac{1}{2} \times M \times u_{rms}^2 \times \frac{1}{6}$

$= \frac{1}{2} \times 60 \times 10^{10} \times \frac{1}{6}$ Arg $= 5 \times 10^3$ J = 5 kJ

MATHS

51. **(b)** 52. **(d)** 53. **(a)**

54. **(c)**

Note that $\sec^{-1}\sqrt{1+x^2} = \tan^{-1}x$; $\cos^{-1}\left(\frac{1-x^2}{1+x^2}\right) = 2\tan^{-1}x$,

For $x > 0$

$\Rightarrow I = \int \frac{e^{\tan^{-1} x}}{1+x^2}\left\{\left(\tan^{-1} x\right)^2 + 2\tan^{-1} x\right\} dx,$

Put $\tan^{-1} x = t \;\; = \int e^t \left(t^2 + 2t\right) dt = e^t \cdot t^2 = e^{\tan^{-1} x}\left(\tan^{-1} x\right)^2 + C$

55. **(d)**

56. **(a)**

57. **(a)**

$$\lim_{x \to \frac{\pi}{4}} \frac{\int_2^{\sec^2 x} f(t)\,dt}{x^2 - \frac{\pi^2}{16}} = \lim_{x \to \frac{\pi}{4}} \frac{f\left(\sec^2 x\right) \cdot 2\sec^2 x \tan x - 0}{2x} \quad \text{(applying L'Hospital rule)}$$

$$= \frac{f(2) \cdot 4}{\pi/2} = \frac{8f(2)}{\pi}$$

58. **(a)** 59. **(c)** 60. **(d)** 61. **(b)**

62. **(c)** 63. **(c)** 64. **(a)** 65. **(b)**

66. **(c)**

Here, $y = C_1 \sin^{-1} x + C_2 \cos^{-1} x + C_3 \tan^{-1} x + C_4 \cot^{-1} x$

$$\Rightarrow y = C_1 \sin^{-1} x + C_2\left(\frac{\pi}{2} - \sin^{-1} x\right) + C_3 \tan^{-1} x + C_4\left(\frac{\pi}{2} - \tan^{-1} x\right)$$

$$= \left(C_1 - C_2\right)\sin^{-1} x + \left(C_3 - C_4\right)\tan^{-1} x + \left(C_3 - C_4\right)\frac{\pi}{2}$$

There are only two independent arbitrary constant order of the differential equation is 2.

67. **(b)** 68. **(b)** 69. **(d)** 70. **(a)**

71. **(5)** 72. **(1)** 73. **(9)** 74. **(2)**

75. **(7)**