CODE - A

TEST ID 002013

NTPL

ALL INDIA TEST SERIES

JEE (Main) - 2020

Batch - 2008

PART TEST - 3

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

Syllabus Covered

Physics	: Work, Power & Energy, Rotation moment of inertia, Gravitation, Electric 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. A mass of M kg is suspended by a weightless string. The horizontal force required to displace it until the string makes an angle of 45° with the initial vertical direction is

(a) $\frac{Mg}{\sqrt{2}}$ (b) $Mg\left(\sqrt{2}-1\right)$ (c) $Mg\left(\sqrt{2}+1\right)$ (d) $Mg\sqrt{2}$

2. The potential energy of a 1 kg particle free to move along the x-axis is given by $V(x)=\left[\left(x^4/4\right)-\left(x^2/2\right)\right]J$. The total mechanical energy of the particle is 2 J. Then the maximum speed (in m/s) is

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

3. A body of mass m is accelerated uniformly from rest to a speed v in a time T. The instantaneous power delivered to the body as a function of time is given by

(a) $\frac{1}{2}\frac{mv^2}{T^2}t^2$ (b) $\frac{1}{2}\frac{mv^2}{T^2}t$ (c) $\frac{mv^2}{T^2}t^2$ (d) $\frac{mv^2}{T^2}t$

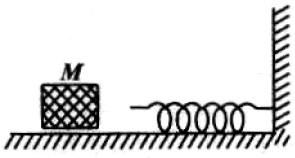
4. When a rubber-band is stretched by a distance x, it exerts a restoring force of magnitude $F=ax+bx^2$, where a and b are constants. The work done in stretching the unstretched rubber band by L is,

(a) $\frac{aL^2}{2}+\frac{bL^3}{3}$ (b) $\frac{1}{2}\left(\frac{aL^2}{2}+\frac{bL^3}{3}\right)$ (c) aL^2+bL^3 (d) $\frac{1}{2}\left(aL^2+bL^3\right)$

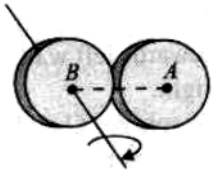
5. The block of mass M moving on a frictionless horizontal surface collides with a spring of spring constant K and compress it by length L. The maximum momentum of the block after collision is

(a) $\frac{ML^2}{K}$ (b) zero

(c) $\frac{KL^2}{2M}$ (d) $\sqrt{MKL}$



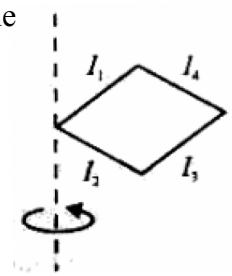
6. Two thin discs, each of mass M and radius r metre, are attached as shown in figure, to form a rigid body. The rotational inertia of this body about an axis perpendicular to the plane of disc B passing through its centre is



(a) $2Mr^2$ (b) $3Mr^2$

(c) $4Mr^2$ (d) $5Mr^2$

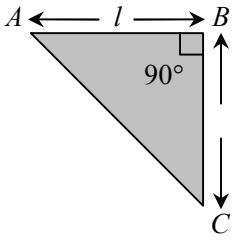
7. The moment of inertia of a system of four rods, each of length l and mass m, about the axis shown is



(a) $\frac{2}{3}ml^2$ (b) $2ml^2$

(c) $3ml^2$ (d) $\frac{8}{3}ml^2$

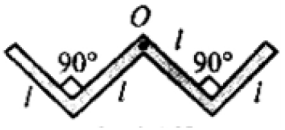
8. Figure shows a thin metallic triangular sheet ABC. The mass of the sheet is M. The moment of inertia of the sheet about side AC is



(a) $\frac{Ml^2}{18}$ (b) $\frac{Ml^2}{12}$

(c) $\frac{Ml^2}{6}$ (d) $\frac{Ml^2}{4}$

9. A thin rod of length $4l$ and mass $4m$ is bent at the points as shown in figure. What is the moment of inertia of the rod about the axis passing through point O and perpendicular to the plane of the paper.



(a) $\frac{Ml^2}{3}$ (b) $\frac{10Ml^2}{3}$

(c) $\frac{Ml^2}{12}$ (d) $\frac{Ml^2}{24}$

10. Let g be the acceleration due to gravity at earth's surface and K be the rotational kinetic energy of the earth. Suppose the earth's radius decreases by 2% keeping all other quantities same, then

(a) g decreases by 2% and K decreases by 4% (b) g decreases by 4% and K increases by 2%

(c) g increases by 4% and K increases by 4% (d) g decreases by 4% and K increases by 4%

11. If both mass and radius of the earth decrease by 1%, the value of the acceleration due to gravity will

(a) Decreases by 1% (b) Increase by 1%

(c) Increases by 2% (d) Remain unchanged

12. At what depth below the surface of the earth, acceleration due to gravity g will be half its value 1600 km above the surface of the earth?

(a) 4.2×10^6 m (b) 3.19×10^6 m (c) 1.59×10^6 m (d) None of these

13. The masses and radii of the earth and moon are M_1, R_1 and M_2, R_2, respectively. Their centres are distance d apart. The minimum velocity with which a particle of mass m should be projected from a point midway between their centres so that it escapes to infinity is

(a) $2\sqrt{\frac{G}{d}(M_1+M_2)}$ (b) $2\sqrt{\frac{2G}{d}(M_1+M_2)}$

(c) $2\sqrt{\frac{Gm}{d}(M_1+M_2)}$ (d) $2\sqrt{\frac{Gm(M_1+M_2)}{d(R_1+R_2)}}$

14. A body of mass m kg starts falling from a point $2R$ above the Earth's surface. Its kinetic energy when it has fallen to a point R above the Earth's surface [R : Radius of Earth, M : Mass of Earth. G : Gravitational Constant]

(a) $\frac{1}{2}\frac{GMm}{R}$ (b) $\frac{1}{6}\frac{GMm}{R}$ (c) $\frac{2}{3}\frac{GMm}{R}$ (d) $\frac{1}{3}\frac{GMm}{R}$

15. Gas escapes from the surface of a planet because it acquires an escape velocity. The escape velocity will depend on which of the following factors :

I. Mass of the planet II. Mass of the particle escaping

III. Temperature of the planet IV. Radius of the planet

Select the correct answer from the codes given below :

(a) I and II (b) II and IV (c) I and IV (d) I, III and IV

16. v_e and v_p denotes the escape velocity from the earth and another planet having twice the radius and the same mean density as the earth. Then

(a) $v_e = v_p$ (b) $v_e = v_p/2$ (c) $v_e = 2v_p$ (d) $v_e = v_p/4$

17. A missile is launched with a velocity less than the escape velocity. The sum of its kinetic and potential energy is

(a) Positive

(b) Negative

(c) Zero

(d) May be positive or negative depending upon its initial velocity

18. A satellite is moving around the earth with speed v in a circular orbit or radius r. If the orbit radius is decreased by 1%, its speed will

(a) increase by 1% (b) increase by 0.5%

(c) decrease by 1% (d) decrease by 0.5%

19. Two identical satellites are at R and $7R$ away from earth surface, the wrong statement is (R = Radius of earth)

(a) Ratio of total energy will be 4

(b) Ratio of kinetic energies will be 4

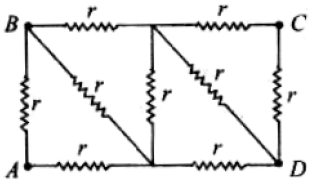
(c) Ratio of potential energies will be 4

(d) Ratio of total energy will be 4 but ratio of potential and kinetic energies will be 2

20. For the circuit shown in figure, the equivalent resistance between A and C is

(a) $\frac{12}{11}r$ (b) $\frac{13}{11}r$

(c) $\frac{14}{11}r$ (d) $\frac{15}{11}r$

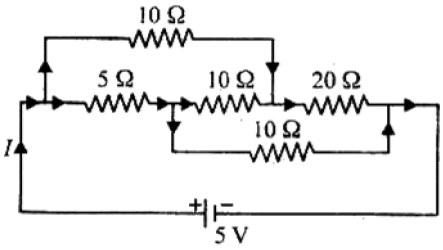


SECTION 2 (Maximum Marks: 20)

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 2 kg block slides on a horizontal floor with a speed of 4 m/s. It strikes an uncompressed spring, and compresses it till the block is motionless. The kinetic friction force is 15 N and spring constant is 10000 N/m. The spring compresses by (in cm)

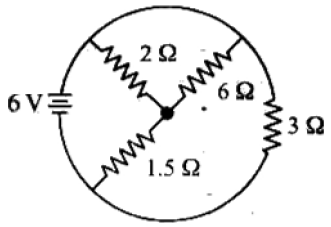
22. The current I drawn from a 5 V source is



23. The length of a given cylindrical wire is increased by 100%. Due to the consequent decrease in diameter, the change in the resistance of the wire will be

24. The resistance of the series combination of two resistances is S. When they are joined in parallel, the total resistance is P. If $S = nP$, then the minimum possible value of n is

25. The total current supplied to the circuit by the battery is

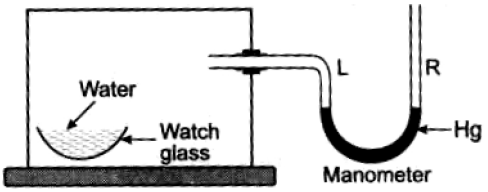


PART - II CHEMISTRY

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

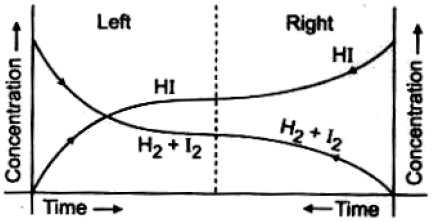
(b) Hg will rise in R side

(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

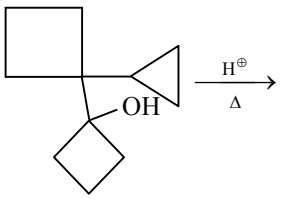
(b) (I) and (III) both are correct

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

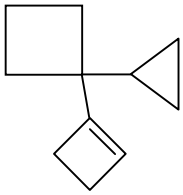
29. PCl_5, PCl_3 and Cl_2 are at equilibrium at 500 K and having concentrations 1.59 M PCl_3, 1.59 M Cl_2 and 1.41 MPCl_5 .K_c for the reaction,

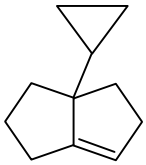
$$PCl_5 \rightleftharpoons PCl_3 + Cl_2, \text{ is:}$$

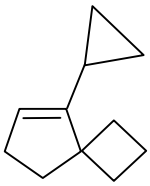
(a) 9.17 (b) 1.79 (c) 7.19 (d) 9.71

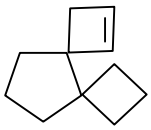
30. 

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

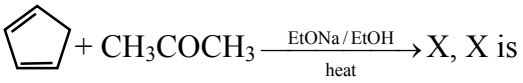
34. Acetic acid is only about 5% dissociated in water. H^+ and CH_3COO^- ions are in equilibrium with undissociated molecules of CH_3COOH

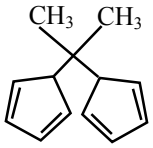
$$CH_3COOH(aq) \rightleftharpoons H^+(aq) + CH_3COO^-(aq)$$

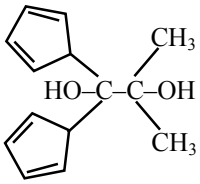
Such equilibria are known as :

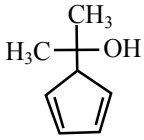
(a) chemical equilibria (b) ionic equilibria (c) physical equilibria (d) all (a), (b) and (c)

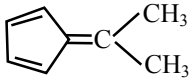
35. In the reaction



(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?

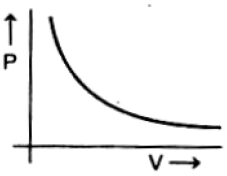
(a) Gaseous state is the simplest state of matter.

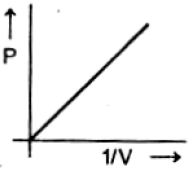
(b) The part of atmosphere, we live in, contains O_2, N_2, CO_2, etc.

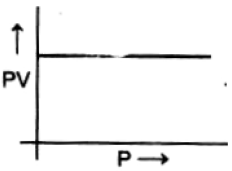
(c) The thin layer of atmosphere, we live in, protects us from harmful radiations.

(d) All of the above are correct.

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

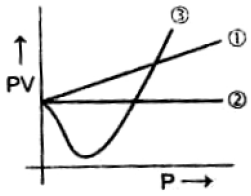
(a) 

(b) 

(c) 

(d) All of these

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

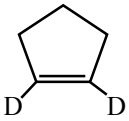


(I) (1) shows real gas and +ve deviation.

(II) (2) shows ideal gas behaviour.

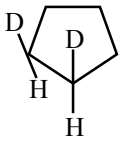
(III) (3) shows super ideal gas behaviour. Negative deviation at high pressure and positive deviation at low temperature.

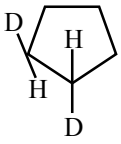
(a) (I) and (II) (b) Only (I) (c) Only (II) (d) Only (III)

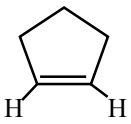
40. 

$\xrightarrow{H_2/Ni}$ A. A is –

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

(b) 

(c) 

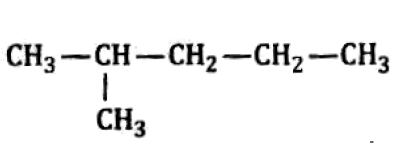
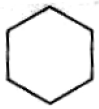
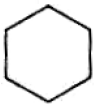
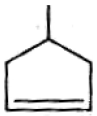
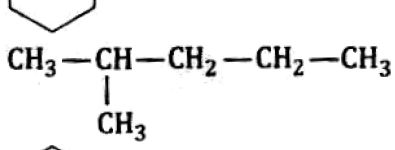
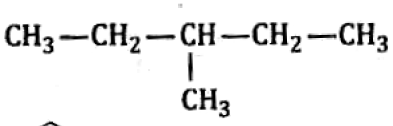
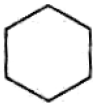
(d) 

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)		
(b)		
(c)		
(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°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. **(b)** 2. **(c)** 3. **(d)** 4. **(a)**
5. **(d)** 6. **(d)** 7. **(d)** 8. **(b)**
9. **(b)**
10. **(c)**

$g = \frac{GM}{R^2}$ and $K = \frac{L^2}{2I}$

If mass of the earth and its angular momentum remains constants then $g \propto 1/R^2$ and $K \propto 1/R^2$, i.e. if radius of earth decreases by 2%, then g and K both increases by 4%.

11. **(b)**

As $g = GM/R^2$ therefore, 1% decrease in mass will decreases the value of g by 1%.

But 1% decrease in radius will increase the value of g by 2%. As a whole value of g increase by 1%.

12. **(a)**
13. **(a)**
14. **(b)**

Potential energy, $U = \frac{-GMm}{r} = -\frac{GMm}{R+h}$

$U_{\text{initial}} = -\frac{GMm}{3R}$ and $U_{\text{final}} = -\frac{-GMm}{2R}$

Loss in PE = gain in KE = $\frac{GMm}{2R} - \frac{GMm}{3R} = \frac{GMm}{6R}$

15. **(c)**

$v_e = \sqrt{\frac{2GM}{R}}$, i.e., escape velocity depends upon the mass and radius of the planet.

16. **(b)** 17. **(b)** 18. **(b)** 19. **(d)**
20. **(d)** 21. **(5.5)** 22. **(0.5)** 23. **(300)**
24. **(4)** 25. **(4)**

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)**

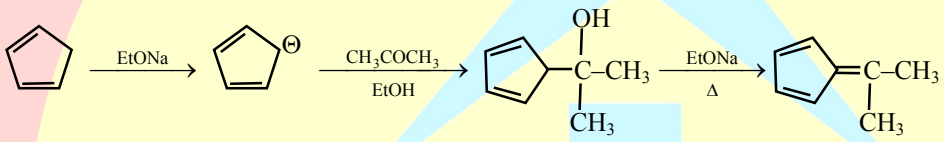
31. **(b)**

$K_c > 10^3 \Rightarrow$ 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)**

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

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.

$\frac{w_{H_2}}{w_{N_2}} \times \frac{t_{N_2}}{t_{H_2}} = \frac{r_{H_2}}{r_{N_2}} = \sqrt{\frac{M_{N2}}{M_{H2}}}$

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

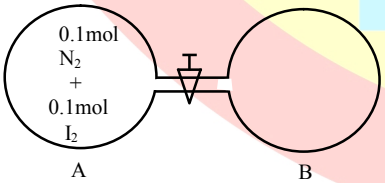
49. **(2)**

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

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

$\therefore$ 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 = 5×10^3 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)**

$\lim\limits_{x\to\frac{\pi}{4}} \frac{\int_2^{\sec^2 x} f(t)\,dt}{x^2 - \frac{\pi^2}{16}} = \lim\limits_{x\to\frac{\pi}{4}} \frac{f\left(\sec^2 x\right)\cdot 2\sec^2 x \tan x - 0}{2x}$ (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, $y = C_1 \sin^{-1} x + C_2 \cos^{-1} x + C_3 \tan^{-1} x + C_4 \cot^{-1} x$

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

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

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)**