# JEE MAIN - 2013

## Held on 07-04-2013

### PART A – MATHEMATICS

1. If the equations $x^2+2x+3=0$ and $ax^2+bx+c=0$, a, b, c $\in$ R, have a common root, then a : b : c is :

(1) 3 : 1 : 2

(2) 1 : 2 : 3

(3) 3 : 2 : 1

(4) 1 : 3 : 2

2. If the lines $\frac{x-2}{1}=\frac{y-3}{1}=\frac{z-4}{-k}$ and $\frac{x-1}{k}=\frac{y-4}{2}=\frac{z-5}{1}$ are coplanar, then k can have :

(1) exactly three values.

(2) any value.

(3) exactly one value.

(4) exactly two values.

3. If $x, y, z$ are in A.P. and $\tan^{-1}x$, $\tan^{-1}y$ and $\tan^{-1}z$ are also in A.P. , then :

(1) $6x=4y=3z$

(2) $x=y=z$

(3) $2x=3y=6z$

(4) $6x=3y=2z$

4. At present, a firm is manufacturing 2000 items. It is estimated that the rate of change of production P w.r.t. additional number of workers $x$ is given by $\frac{dP}{dx}=100-12\sqrt{x}$. If the firm employs 25 more workers, then the new level of production of items is :

(1) 4500

(2) 2500

(3) 3000

(4) 3500

5. The equation of the circle passing through the foci of the ellipse $\frac{x^2}{16}+\frac{y^2}{9}=1$, and having centre at (0, 3) is :

(1) $x^2+y^2-6y+5=0$

(2) $x^2+y^2-6y-7=0$

(3) $x^2+y^2-6y+7=0$

(4) $x^2+y^2-6y-5=0$

6. If $P=\begin{bmatrix}1 & \alpha & 3\\ 1 & 3 & 3\\ 2 & 4 & 4\end{bmatrix}$ is the adjoint of a $3\times3$ matrix A and $|A|=4$, then $\alpha$ is equal to :

(1) 0

(2) 4

(3) 11

(4) 5

**SPACE FOR ROUGH WORK**

7. Consider :

**Statement - I :** $(p \wedge \sim q) \wedge (\sim p \wedge q)$ is a fallacy.

**Statement - II :** $(p \rightarrow q) \leftrightarrow (\sim q \rightarrow \sim p)$ is a tautology.

(1) Statement - I is false; Statement - II is true.

(2) Statement - I is true; Statement - II is true; Statement - II is a correct explanation for Statement - I.

(3) Statement - I is true; Statement - II is true; Statement - II is not a correct explanation for Statement - I.

(4) Statement - I is true; Statement - II is false.

8. The $x$-coordinate of the incentre of the triangle that has the coordinates of mid points of its sides as (0, 1) (1, 1) and (1, 0) is :

(1) $1 - \sqrt{2}$

(2) $2 + \sqrt{2}$

(3) $2 - \sqrt{2}$

(4) $1 + \sqrt{2}$

9. The real number $k$ for which the equation, $2x^3 + 3x + k = 0$ has two distinct real roots in [0, 1]

(1) does not exist.

(2) lies between 1 and 2.

(3) lies between 2 and 3.

(4) lies between $-1$ and 0.

10. If $\int f(x)\,dx = \Psi(x)$, then $\int x^2 f(x^3)\,dx$ is equal to :

(1) $\frac{1}{3}\left[x^3\Psi(x^3) - \int x^3\Psi(x^3)\,dx\right] + c$

(2) $\frac{1}{3}\left[x^3\Psi(x^3) - \int x^2\Psi(x^3)\,dx\right] + c$

(3) $\frac{1}{3}x^3\Psi(x^3) - 3\int x^3\Psi(x^3)\,dx + c$

(4) $\frac{1}{3}x^3\Psi(x^3) - \int x^2\Psi(x^3)\,dx + c$

11. The number of values of k, for which the system of equations :

$(k+1)x + 8y = 4k$

$kx + (k+3)y = 3k - 1$

has no solution, is :

(1) 3

(2) infinite

(3) 1

(4) 2

12. Let $T_n$ be the number of all possible triangles formed by joining vertices of an n-sided regular polygon. If $T_{n+1} - T_n = 10$, then the value of n is :

(1) 8

(2) 7

(3) 5

(4) 10



SPACE FOR ROUGH WORK

13. Given : A circle, $2x^2+2y^2=5$ and a parabola, $y^2=4\sqrt{5}\,x$.

**Statement - I :** An equation of a common tangent to these curves is $y = x+\sqrt{5}$.

**Statement - II :** If the line, $y = mx+\frac{\sqrt{5}}{m}$ $(m\neq 0)$ is their common tangent, then m satisfies $m^4-3m^2+2=0$.

(1) Statement - I is false; Statement - II is true.

(2) Statement - I is true; Statement - II is true; Statement - II is a **correct** explanation for Statement - I.

(3) Statement - I is true; Statement - II is true; Statement - II is **not** a correct explanation for Statement - I.

(4) Statement - I is true; Statement - II is false.

14. The area (in square units) bounded by the curves $y=\sqrt{x}$, $2y-x+3=0$, $x$-axis, and lying in the first quadrant is :

(1) $\frac{27}{4}$

(2) 9

(3) 36

(4) 18

15. The expression $\frac{\tan A}{1-\cot A}+\frac{\cot A}{1-\tan A}$ can be written as :

(1) $\sec A+\operatorname{cosec} A$

(2) $\sin A\cos A+1$

(3) $\sec A\operatorname{cosec} A+1$

(4) $\tan A+\cot A$

16. **Statement - I :**

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

**Statement - II :**

$\int_a^b f(x)dx=\int_a^b f\,(a+b-x)dx$.

(1) Statement - I is false ; Statement - II is true.

(2) Statement - I is true ; Statement - II is true; Statement - II is a **correct** explanation for Statement - I.

(3) Statement - I is true; Statement - II is true; Statement - II is **not** a correct explanation for Statement - I.

(4) Statement - I is true; Statement - II is false.

17. If $y=\sec(\tan^{-1}x)$, then $\frac{dy}{dx}$ at $x=1$ is equal to :

(1) $\sqrt{2}$

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

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

(4) 1

18. If $z$ is a complex number of unit modulus and argument $\theta$, then arg $\left(\frac{1+z}{1+\bar{z}}\right)$ equals :

(1) $\pi-\theta$

(2) $-\theta$

(3) $\frac{\pi}{2}-\theta$

(4) $\theta$



SPACE FOR ROUGH WORK

19. All the students of a class performed poorly in Mathematics. The teacher decided to give grace marks of 10 to each of the students. Which of the following statistical measures will not change even after the grace marks were given ?

(1) variance

(2) mean

(3) median

(4) mode

20. A ray of light along $x + \sqrt{3}y = \sqrt{3}$ gets reflected upon reaching $x$-axis, the equation of the reflected ray is :

(1) $\sqrt{3}y = x - 1$

(2) $y = x + \sqrt{3}$

(3) $\sqrt{3}y = x - \sqrt{3}$

(4) $y = \sqrt{3}x - \sqrt{3}$

21. The sum of first 20 terms of the sequence 0.7, 0.77, 0.777, ....., is :

(1) $\frac{7}{9}\left(99 + 10^{-20}\right)$

(2) $\frac{7}{81}\left(179 - 10^{-20}\right)$

(3) $\frac{7}{9}\left(99 - 10^{-20}\right)$

(4) $\frac{7}{81}\left(179 + 10^{-20}\right)$

22. A multiple choice examination has 5 questions. Each question has three alternative answers of which exactly one is correct. The probability that a student will get 4 or more correct answers just by guessing is :

(1) $\frac{10}{3^5}$

(2) $\frac{17}{3^5}$

(3) $\frac{13}{3^5}$

(4) $\frac{11}{3^5}$

23. The term independent of $x$ in expansion of $\left(\frac{x+1}{x^{2/3} - x^{1/3} + 1} - \frac{x-1}{x - x^{1/2}}\right)^{10}$ is :

(1) 310

(2) 4

(3) 120

(4) 210

24. Let A and B be two sets containing 2 elements and 4 elements respectively. The number of subsets of $A \times B$ having 3 or more elements is :

(1) 211

(2) 256

(3) 220

(4) 219



SPACE FOR ROUGH WORK

25. If the vectors $\overrightarrow{AB} = 3\hat{i} + 4\hat{k}$ and $\overrightarrow{AC} = 5\hat{i} - 2\hat{j} + 4\hat{k}$ are the sides of a triangle ABC, then the length of the median through A is :

(1) $\sqrt{45}$

(2) $\sqrt{18}$

(3) $\sqrt{72}$

(4) $\sqrt{33}$

26. The intercepts on $x$- axis made by tangents to the curve, $y = \int_0^x |t|\,dt$, $x \in R$, which are parallel to the line $y = 2x$, are equal to :

(1) $\pm 4$

(2) $\pm 1$

(3) $\pm 2$

(4) $\pm 3$

27. $\lim\limits_{x \to 0} \dfrac{(1 - \cos 2x)(3 + \cos x)}{x \tan 4x}$ is equal to :

(1) 2

(2) $-\dfrac{1}{4}$

(3) $\dfrac{1}{2}$

(4) 1

28. The circle passing through (1, $-2$) and touching the axis of $x$ at (3, 0) also passes through the point :

(1) $(-2, 5)$

(2) $(-5, 2)$

(3) $(2, -5)$

(4) $(5, -2)$

29. Distance between two parallel planes $2x + y + 2z = 8$ and $4x + 2y + 4z + 5 = 0$ is :

(1) $\dfrac{9}{2}$

(2) $\dfrac{3}{2}$

(3) $\dfrac{5}{2}$

(4) $\dfrac{7}{2}$

30. ABCD is a trapezium such that AB and CD are parallel and $BC \perp CD$. If $\angle ADB = \theta$, $BC = p$ and $CD = q$, then AB is equal to :

(1) $\dfrac{(p^2 + q^2)\sin\theta}{(p\cos\theta + q\sin\theta)^2}$

(2) $\dfrac{(p^2 + q^2)\sin\theta}{p\cos\theta + q\sin\theta}$

(3) $\dfrac{p^2 + q^2\cos\theta}{p\cos\theta + q\sin\theta}$

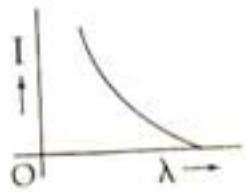
(4) $\dfrac{p^2 + q^2}{p^2\cos\theta + q^2\sin\theta}$

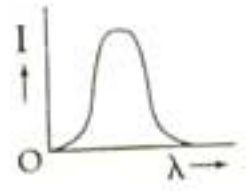


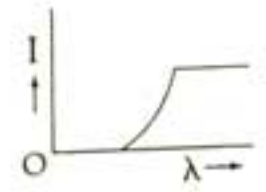
SPACE FOR ROUGH WORK

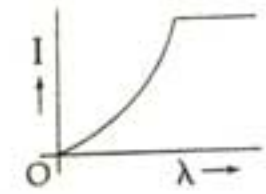
## PART B – PHYSICS

31. The anode voltage of a photocell is kept fixed. The wavelength λ of the light falling on the cathode is gradually changed. The plate current I of the photocell varies as follows :

(1) 


(2) 


(3) 


(4) 


32. A circular loop of radius 0.3 cm lies parallel to a much bigger circular loop of radius 20 cm. The centre of the small loop is on the axis of the bigger loop. The distance between their centres is 15 cm. If a current of 2.0 A flows through the smaller loop, then the flux linked with bigger loop is :

(1) $6.6 \times 10^{-9}$ weber

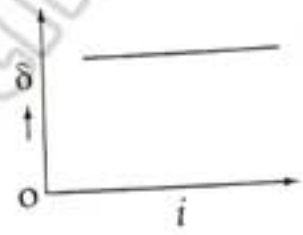
(2) $9.1 \times 10^{-11}$ weber

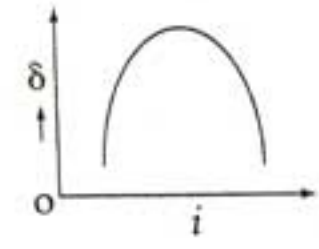
(3) $6 \times 10^{-11}$ weber

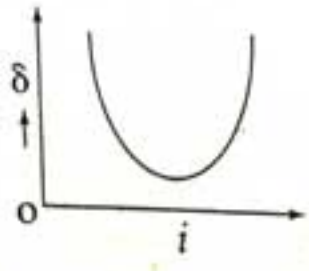
(4) $3.3 \times 10^{-11}$ weber

33. The graph between angle of deviation (δ) and angle of incidence (*i*) for a triangular prism is represented by :

(1) 


(2) 

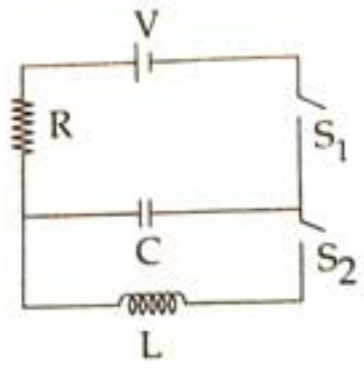

(3) 


(4) 




SPACE FOR ROUGH WORK

34. In an LCR circuit as shown below both switches are open initially. Now switch $S_1$ is closed, $S_2$ kept open. (q is charge on the capacitor and $\tau = RC$ is Capacitive time constant). Which of the following statement is correct ?




(1) At $t = \frac{\tau}{2}$, $q = CV(1 - e^{-1})$

(2) Work done by the battery is half of the energy dissipated in the resistor

(3) At $t = \tau$, $q = CV/2$

(4) At $t = 2\tau$, $q = CV(1 - e^{-2})$

35. Two short bar magnets of length 1 cm each have magnetic moments 1.20 $Am^2$ and 1.00 $Am^2$ respectively. They are placed on a horizontal table parallel to each other with their N poles pointing towards the South. They have a common magnetic equator and are separated by a distance of 20.0 cm. The value of the resultant horizontal magnetic induction at the mid - point O of the line joining their centres is close to
(Horizontal component of earth's magnetic induction is $3.6 \times 10^{-5}$ $Wb/m^2$)

(1) $5.80 \times 10^{-4}$ $Wb/m^2$

(2) $3.6 \times 10^{-5}$ $Wb/m^2$

(3) $2.56 \times 10^{-4}$ $Wb/m^2$

(4) $3.50 \times 10^{-4}$ $Wb/m^2$

36. *This question has Statement I and Statement II. Of the four choices given after the Statements, choose the one that best describes the two Statements.*

**Statement - I** : Higher the range, greater is the resistance of ammeter.

**Statement - II** : To increase the range of ammeter, additional shunt needs to be used across it.

(1) Statement - I is false, Statement - II is true.

(2) Statement - I is true, Statement - II is true, Statement -II is the **correct** explanation of Statement - I.

(3) Statement - I is true, Statement - II is true, Statement - II is **not** the correct explanation of Statement - I.

(4) Statement - I is true, Statement - II is false.

37. An ideal gas enclosed in a vertical cylindrical container supports a freely moving piston of mass M. The piston and the cylinder have equal cross sectional area A. When the piston is in equilibrium, the volume of the gas is $V_0$ and its pressure is $P_0$. The piston is slightly displaced from the equilibrium position and released. Assuming that the system is completely isolated from its surrounding, the piston executes a simple harmonic motion with frequency :

(1) $\frac{1}{2\pi}\sqrt{\frac{MV_0}{A\gamma P_0}}$

(2) $\frac{1}{2\pi}\frac{A\gamma P_0}{V_0 M}$

(3) $\frac{1}{2\pi}\frac{V_0 M P_0}{A^2\gamma}$

(4) $\frac{1}{2\pi}\sqrt{\frac{A^2\gamma P_0}{MV_0}}$

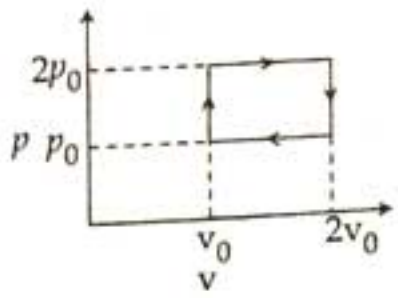
38. Let $[\epsilon_0]$ denote the dimensional formula of the permittivity of vacuum. If M = mass, L = length, T = time and A = electric current, then :

(1) $[\epsilon_0]=[M^{-1}L^2T^{-1}A]$

(2) $[\epsilon_0]=[M^{-1}L^{-3}T^2A]$

(3) $[\epsilon_0]=[M^{-1}L^{-3}T^4A^2]$

(4) $[\epsilon_0]=[M^{-1}L^2T^{-1}A^{-2}]$

39. 


The above $p$-v diagram represents the thermodynamic cycle of an engine, operating with an ideal monoatomic gas. The amount of heat, extracted from the source in a single cycle is :

(1) $4p_0v_0$

(2) $p_0v_0$

(3) $\left(\frac{13}{2}\right)p_0v_0$

(4) $\left(\frac{11}{2}\right)p_0v_0$

40. A projectile is given an initial velocity of $\left(\hat{i}+2\hat{j}\right)$ m/s, where $\hat{i}$ is along the ground and $\hat{j}$ is along the vertical. If $g = 10\ m/s^2$, the equation of its trajectory is :

(1) $4y=2x-25x^2$

(2) $y=x-5x^2$

(3) $y=2x-5x^2$

(4) $4y=2x-5x^2$

41. A beam of unpolarised light of intensity $I_0$ is passed through a polaroid A and then through another polaroid B which is oriented so that its principal plane makes an angle of 45° relative to that of A. The intensity of the emergent light is :

(1) $I_0/8$

(2) $I_0$

(3) $I_0/2$

(4) $I_0/4$

42. A diode detector is used to detect an amplitude modulated wave of 60% modulation by using a condenser of capacity 250 pico farad in parallel with a load resistance 100 kilo ohm. Find the maximum modulated frequency which could be detected by it.

(1) 5.31 kHz

(2) 10.62 MHz

(3) 10.62 kHz

(4) 5.31 MHz

43. The supply voltage to a room is 120 V. The resistance of the lead wires is 6 Ω. A 60 W bulb is already switched on. What is the decrease of voltage across the bulb, when a 240 W heater is switched on in parallel to the bulb ?

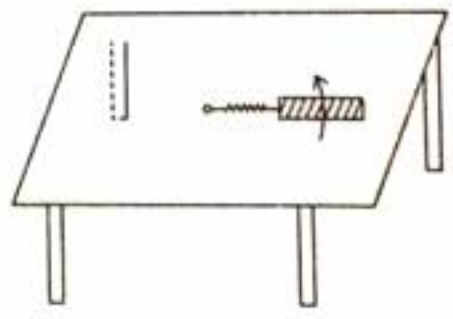
(1) 10.04 Volt

(2) zero Volt

(3) 2.9 Volt

(4) 13.3 Volt

44. A metallic rod of length 'l' is tied to a string of length 2l and made to rotate with angular speed ω on a horizontal table with one end of the string fixed. If there is a vertical magnetic field 'B' in the region, the e.m.f. induced across the ends of the rod is :



(1) $\frac{5B\omega l^2}{2}$

(2) $\frac{2B\omega l^2}{2}$

(3) $\frac{3B\omega l^2}{2}$

(4) $\frac{4B\omega l^2}{2}$

45. The magnetic field in a travelling electromagnetic wave has a peak value of 20 nT. The peak value of electric field strength is :

(1) 12 V/m

(2) 3 V/m

(3) 6 V/m

(4) 9 V/m

46. A sonometer wire of length 1.5 m is made of steel. The tension in it produces an elastic strain of 1%. What is the fundamental frequency of steel if density and elasticity of steel are $7.7\times10^3$ kg/m$^3$ and $2.2\times10^{11}$ N/m$^2$ respectively ?

(1) 770 Hz

(2) 188.5 Hz

(3) 178.2 Hz

(4) 200.5 Hz

47. *This question has Statement I and Statement II. Of the four choices given after the Statements, choose the one that best describes the two Statements.*

**Statement - I :** A point particle of mass m moving with speed $v$ collides with stationary point particle of mass M. If the maximum energy loss possible is given as $f\left(\frac{1}{2}mv^2\right)$ then $f=\left(\frac{m}{M+m}\right)$.

**Statement - II :** Maximum energy loss occurs when the particles get stuck together as a result of the collision.

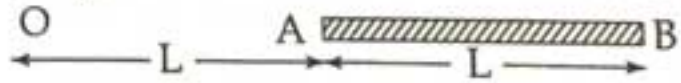
(1) Statement - I is false, Statement - II is true.

(2) Statement - I is true, Statement - II is true, Statement - II is a **correct** explanation of Statement - I.

(3) Statement - I is true, Statement - II is true, Statement - II is **not** a correct explanation of Statement - I.

(4) Statement - I is true, Statement - II is false.

48. A charge Q is uniformly distributed over a long rod AB of length L as shown in the figure. The electric potential at the point O lying at a distance L from the end A is :




(1) $\frac{Q\ln2}{4\pi\epsilon_0 L}$

(2) $\frac{Q}{8\pi\epsilon_0 L}$

(3) $\frac{3Q}{4\pi\epsilon_0 L}$

(4) $\frac{Q}{4\pi\epsilon_0 L\ln2}$

49. A uniform cylinder of length L and mass M having cross - sectional area A is suspended, with its length vertical, from a fixed point by a massless spring, such that it is half submerged in a liquid of density $\sigma$ at equilibrium position. The extension $x_0$ of the spring when it is in equilibrium is :

(1) $\frac{Mg}{k}\left(1+\frac{LA\sigma}{M}\right)$

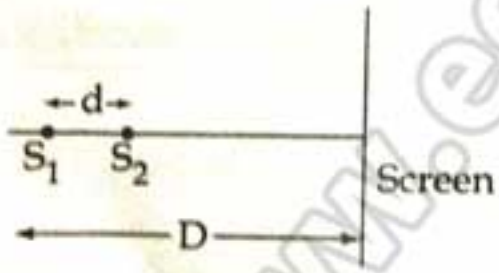
(2) $\frac{Mg}{k}$

(3) $\frac{Mg}{k}\left(1-\frac{LA\sigma}{M}\right)$

(4) $\frac{Mg}{k}\left(1-\frac{LA\sigma}{2M}\right)$

(Here k is spring constant)

50. Two coherent point sources $S_1$ and $S_2$ are separated by a small distance 'd' as shown. The fringes obtained on the screen will be :




(1) concentric circles

(2) points

(3) straight lines

(4) semi - circles

51. A hoop of radius r and mass m rolling with an angular velocity $\omega_0$ is placed on a rough horizontal surface. The initial velocity of the centre of the hoop is zero. What will be the velocity of the centre of the hoop when it ceases to slip ?

(1) $r\omega_0$

(2) $\frac{r\omega_0}{4}$

(3) $\frac{r\omega_0}{3}$

(4) $\frac{r\omega_0}{2}$

52. The amplitude of a damped oscillator decreases to 0.9 times its original magnitude in 5s. In another 10s it will decrease to $\alpha$ times its original magnitude, where $\alpha$ equals :

(1) 0.6

(2) 0.7

(3) 0.81

(4) 0.729



SPACE FOR ROUGH WORK

53. Assume that a drop of liquid evaporates by decrease in its surface energy, so that its temperature remains unchanged. What should be the minimum radius of the drop for this to be possible ? The surface tension is T, density of liquid is $\rho$ and L is its latent heat of vaporization.

(1) $2T/\rho L$

(2) $\rho L/T$

(3) $\sqrt{T/\rho L}$

(4) $T/\rho L$

54. What is the minimum energy required to launch a satellite of mass m from the surface of a planet of mass M and radius R in a circular orbit at an altitude of 2R ?

(1) $\frac{GmM}{3R}$

(2) $\frac{5GmM}{6R}$

(3) $\frac{2GmM}{3R}$

(4) $\frac{GmM}{2R}$

55. In a hydrogen like atom electron makes transition from an energy level with quantum number n to another with quantum number $(n-1)$. If $n>>1$, the frequency of radiation emitted is proportional to :

(1) $\frac{1}{n^3}$

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

(3) $\frac{1}{n^2}$

(4) $\frac{1}{n^{3/2}}$

56. Two charges, each equal to q, are kept at $x=-a$ and $x=a$ on the $x$ - axis. A particle of mass m and charge $q_0=\frac{q}{2}$ is placed at the origin. If charge $q_0$ is given a small displacement ($y << a$) along the $y$ - axis, the net force acting on the particle is proportional to :

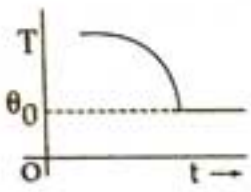
(1) $-\frac{1}{y}$

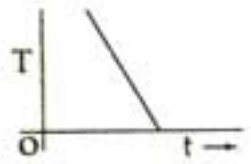
(2) $y$

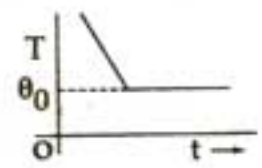
(3) $-y$

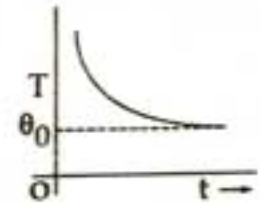
(4) $\frac{1}{y}$

57. If a piece of metal is heated to temperature $\theta$ and then allowed to cool in a room which is at temperature $\theta_0$, the graph between the temperature T of the metal and time t will be closest to :

(1) 


(2) 


(3) 


(4) 


58. Two capacitors $C_1$ and $C_2$ are charged to 120 V and 200 V respectively. It is found that by connecting them together the potential on each one can be made zero. Then :

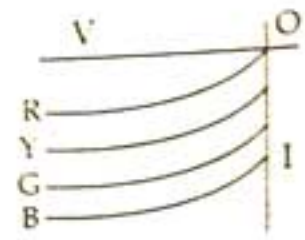
(1) $9C_1 = 4C_2$

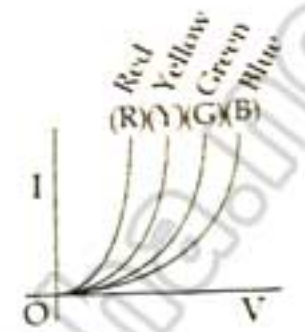
(2) $5C_1 = 3C_2$

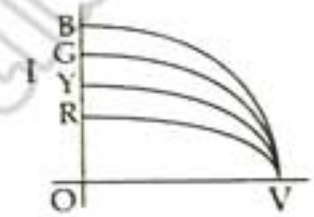
(3) $3C_1 = 5C_2$

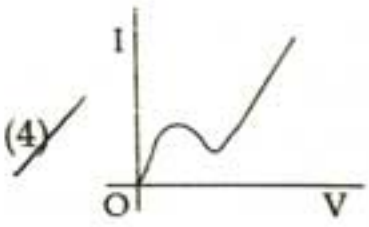
(4) $3C_1 + 5C_2 = 0$

59. The I - V characteristic of an LED is :

(1) 


(2) 


(3) 


(4) 


60. Diameter of a plano - convex lens is 6 cm and thickness at the centre is 3 mm. If speed of light in material of lens is $2 \times 10^8$ m/s, the focal length of the lens is :

(1) 10 cm

(2) 15 cm

(3) 20 cm

(4) 30 cm

## PART C – CHEMISTRY

61. Which of the following represents the correct order of increasing first ionization enthalpy for Ca, Ba, S, Se and Ar ?

(1) Ca < Ba < S < Se < Ar

(2) Ca < S < Ba < Se < Ar

(3) S < Se < Ca < Ba < Ar

(4) Ba < Ca < Se < S < Ar

62. A compound with molecular mass 180 is acylated with $CH_3COCl$ to get a compound with molecular mass 390. The number of amino groups present per molecule of the former compound is :

(1) 6

(2) 2

(3) 5

(4) 4

63. Energy of an electron is given by $E = -2.178 \times 10^{-18} J \left(\frac{Z^2}{n^2}\right)$. Wavelength of light required to excite an electron in an hydrogen atom from level $n = 1$ to $n = 2$ will be :

($h = 6.62 \times 10^{-34}$ Js and $c = 3.0 \times 10^{8}$ $ms^{-1}$)

(1) $8.500 \times 10^{-7}$ m

(2) $1.214 \times 10^{-7}$ m

(3) $2.816 \times 10^{-7}$ m

(4) $6.500 \times 10^{-7}$ m

64. An unknown alcohol is treated with the "Lucas reagent" to determine whether the alcohol is primary, secondary or tertiary. Which alcohol reacts fastest and by what mechanism :

(1) tertiary alcohol by $S_N2$

(2) secondary alcohol by $S_N1$

(3) tertiary alcohol by $S_N1$

(4) secondary alcohol by $S_N2$

65. A gaseous hydrocarbon gives upon combustion 0.72 g. of water and 3.08 g. of $CO_2$. The empirical formula of the hydrocarbon is :

(1) $C_7H_8$

(2) $C_2H_4$

(3) $C_3H_4$

(4) $C_6H_5$

66. A solution of (−)−1−chloro−1−phenylethane in toluene racemises slowly in the presence of a small amount of $SbCl_5$, due to the formation of :

(1) free radical

(2) carbanion

(3) carbene

(4) carbocation

67. Which one of the following molecules is expected to exhibit diamagnetic behaviour ?

(1) $S_2$

(2) $C_2$

(3) $N_2$

(4) $O_2$

68. Which of the following exists as covalent crystals in the solid state ?

(1) Phosphorus

(2) Iodine

(3) Silicon

(4) Sulphur

69. Given

$E^0_{Cr^{3+}/Cr} = -0.74$ V; $E^0_{MnO_4^-/Mn^{2+}} = 1.51$ V

$E^0_{Cr_2O_7^{2-}/Cr^{3+}} = 1.33$ V; $E^0_{Cl/Cl^-} = 1.36$ V

Based on the data given above, strongest oxidising agent will be :

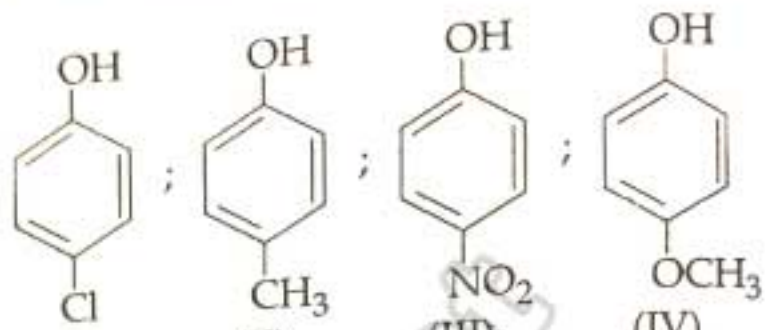
(1) $MnO_4^-$

(2) $Cl^-$

(3) $Cr^{3+}$

(4) $Mn^{2+}$

70. Arrange the following compounds in order of decreasing acidity :




(I) (II) (III) (IV)

(1) IV > III > I > II

(2) II > IV > I > III

(3) I > II > III > IV

(4) III > I > II > IV

71. The molarity of a solution obtained by mixing 750 mL of 0.5(M)HCl with 250 mL of 2(M)HCl will be :

(1) 0.975 M

(2) 0.875 M

(3) 1.00 M

(4) 1.75 M

72. For gaseous state, if most probable speed is denoted by $C^*$, average speed by $\overline{C}$ and mean square speed by C, then for a large number of molecules the ratios of these speeds are :

(1) $C^* : \overline{C} : C = 1 : 1.225 : 1.128$

(2) $C^* : \overline{C} : C = 1.225 : 1.128 : 1$

(3) $C^* : \overline{C} : C = 1.128 : 1.225 : 1$

(4) $C^* : \overline{C} : C = 1 : 1.128 : 1.225$

73. Which of the following is the wrong statement ?

(1) Ozone is diamagnetic gas.

(2) ONCl and $ONO^-$ are not isoelectronic.

(3) $O_3$ molecule is bent.

(4) Ozone is violet-black in solid state.

74. An organic compound A upon reacting with $NH_3$ gives B. On heating, B gives C. C in presence of KOH reacts with $Br_2$ to give $CH_3CH_2NH_2$. A is :

(1) $CH_3CH_2COOH$

(2) $CH_3COOH$

(3) $CH_3CH_2CH_2COOH$

(4) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-COOH$

75. Four successive members of the first row transition elements are listed below with atomic numbers. Which one of them is expected to have the highest $E^0_{M^{3+}/M^{2+}}$ value ?

(1) Co(Z = 27)

(2) Cr(Z = 24)

(3) Mn(Z = 25)

(4) Fe(Z = 26)

76. In which of the following pairs of molecules/ions, both the species are not likely to exist ?

(1) $H_2^-, He_2^{2+}$

(2) $H_2^+, He_2^{2-}$

(3) $H_2^-, He_2^{2-}$

(4) $H_2^{2+}, He_2$

77. The gas leaked from a storage tank of the Union Carbide plant in Bhopal gas tragedy was :

(1) Phosgene

(2) Methylisocyanate

(3) Methylamine

(4) Ammonia

78. Consider the following reaction :

$$x MnO_4^- + y C_2O_4^{2-} + z H^+ \rightarrow$$

$$x Mn^{2+} + 2y CO_2 + \frac{z}{2} H_2O$$

The values of $x$, $y$ and $z$ in the reaction are, respectively :

(1) 5, 2 and 8

(2) 5, 2 and 16

(3) 2, 5 and 8

(4) 2, 5 and 16

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$$x Mn^{2+} + 2y CO_2 + \frac{z}{2} H_2O$$

The values of $x$, $y$ and $z$ in the reaction are, respectively :

(1) 5, 2 and 8

(2) 5, 2 and 16

(3) 2, 5 and 8

(4) 2, 5 and 16

85. Stability of the species $Li_2$, $Li_2^-$ and $Li_2^+$ increases in the order of :

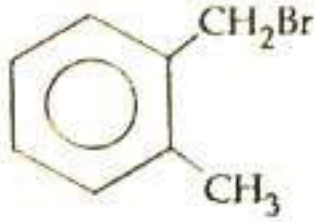
(1) $Li_2^- < Li_2 < Li_2^+$

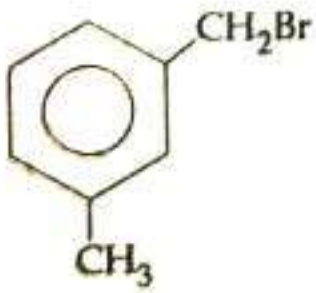
(2) $Li_2 < Li_2^+ < Li_2^-$

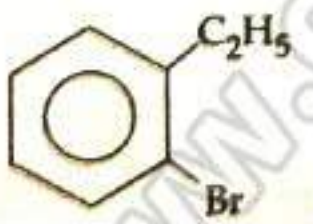
(3) $Li_2^- < Li_2^+ < Li_2$

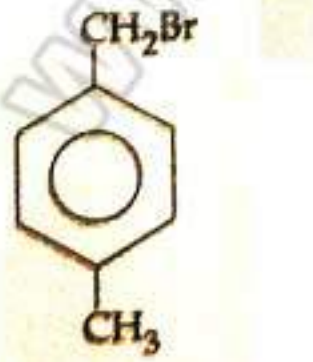
(4) $Li_2 < Li_2^- < Li_2^+$

86. Compound (A), $C_8H_9Br$, gives a white precipitate when warmed with alcoholic $AgNO_3$. Oxidation of (A) gives an acid (B), $C_8H_6O_4$. (B) easily forms anhydride on heating. Identify the compound (A).

(1) 


(2) 


(3) 


(4) 


87. Which of the following arrangement does **not** represent the correct order of the property stated against it ?

(1) $Sc < Ti < Cr < Mn$ : number of oxidation states

(2) $V^{2+} < Cr^{2+} < Mn^{2+} < Fe^{2+}$ : paramagnetic behaviour

(3) $Ni^{2+} < Co^{2+} < Fe^{2+} < Mn^{2+}$ : ionic size

(4) $Co^{3+} < Fe^{3+} < Cr^{3+} < Sc^{3+}$ : stability in aqueous solution

88. Experimentally it was found that a metal oxide has formula $M_{0.98}O$. Metal M, is present as $M^{2+}$ and $M^{3+}$ in its oxide. Fraction of the metal which exists as $M^{3+}$ would be :

(1) 5.08%

(2) 7.01%

(3) 4.08%

(4) 6.05%

89. A piston filled with 0.04 mol of an ideal gas expands reversibly from 50.0 mL to 375 mL at a constant temperature of 37.0°C. As it does so, it absorbs 208J of heat. The values of q and w for the process will be :

(R = 8.314 J/mol K) (ln 7.5 = 2.01)

(1) $q = +208$ J, $w = +208$ J

(2) $q = +208$ J, $w = -208$ J

(3) $q = -208$ J, $w = -208$ J

(4) $q = -208$ J, $w = +208$ J

90. Synthesis of each molecule of glucose in photosynthesis involves :

(1) 6 molecules of ATP

(2) 18 molecules of ATP

(3) 10 molecules of ATP

(4) 8 molecules of ATP

- o 0 o -

**SPACE FOR ROUGH WORK**

# JEE (MAINS)-2013 'PAPER-1' KEY

| Q.No. | CODE-P | CODE-Q | CODE-R | CODE-S |
|---|---|---|---|---|
| 1 | 2 | 1 | 2 | 2 |
| 2 | 4 | 1 | 4 | 4 |
| 3 | 4 | 1 | 2 | 4 |
| 4 | 2 | 4 | 4 | 1 |
| 5 | 2 | 2 | 2 | 1 |
| 6 | 3 | 3 | 3 | 1 |
| 7 | 2 | 2 | 3 | 2 |
| 8 | 2 | 1 | 3 | 1 |
| 9 | 1 | 3 | 1 | 1 |
| 10 | 3 | 1 | 2 | 2 |
| 11 | 1 | 4 | 3 | 2 |
| 12 | 1 | 1 | 3 | 1 |
| 13 | 3 | 1 | 3 | 2 |
| 14 | 4 | 3 | 2 | 3 |
| 15 | 2 | 2 | 3 | 2 |
| 16 | 3 | 4 | 1 | 3 |
| 17 | 3 | 4 | 2 | 2 |
| 18 | 3 | 2 | 4 | 4 |
| 19 | 4 | 4 | 1 | 3 |
| 20 | 3 | 3 | 3 | 4 |
| 21 | 4 | 3 | 4 | 3 |
| 22 | 2 | 2 | 4 | 3 |
| 23 | 4 | 2 | 4 | 1 |
| 24 | 1 | 4 | 4 | 1 |
| 25 | 4 | 2 | 4 | 4 |
| 26 | 4 | 1 | 2 | 2 |
| 27 | 3 | 3 | 1 | 4 |
| 28 | 1 | 4 | 4 | 2 |
| 29 | 2 | 3 | 4 | 2 |
| 30 | 4 | 2 | 2 | 4 |
| 31 | 3 | 2 | 1 | 2 |
| 32 | 2 | 4 | 2 | 4 |
| 33 | 3 | 1 | 4 | 4 |
| 34 | 4 | 1 | 4 | 4 |
| 35 | 1 | 3 | 3 | 1 |
| 36 | 1 | 4 | 1 | 3 |
| 37 | 3 | 2 | 4 | 2 |
| 38 | 3 | 4 | 3 | 4 |
| 39 | 1 | 1 | 3 | 3 |
| 40 | 2 | 4 | 3 | 1 |
| 41 | 1 | 2 | 4 | 1 |
| 42 | 4 | 1 | 2 | 1 |
| 43 | 3 | 4 | 1 | 1 |
| 44 | 3 | 1 | 1 | 4 |
| 45 | 4 | 3 | 3 | 4 |
| 46 | 3 | 3 | 3 | 3 |
| 47 | 2 | 1 | 1 | 1 |
| 48 | 1 | 2 | 1 | 1 |
| 49 | 2 | 3 | 4 | 1 |
| 50 | 3 | 1 | 1 | 3 |
| 51 | 1 | 1 | 4 | 3 |
| 52 | 4 | 4 | 4 | 1 |
| 53 | 4 | 2 | 1 | 1 |
| 54 | 4 | 2 | 2 | 3 |
| 55 | 2 | 2 | 1 | 3 |
| 56 | 4 | 2 | 2 | 4 |
| 57 | 2 | 2 | 4 | 4 |
| 58 | 2 | 4 | 3 | 1 |
| 59 | 1 | 2 | 2 | 2 |
| 60 | 2 | 2 | 4 | 2 |
| 61 | 3 | 2 | 4 | 1 |
| 62 | 3 | 4 | 3 | 2 |
| 63 | 3 | 3 | 2 | 3 |
| 64 | 3 | 2 | 3 | 3 |
| 65 | 3 | 4 | 1 | 2 |
| 66 | 4 | 2 | 4 | 2 |
| 67 | 3 | 3 | 3 | 4 |
| 68 | 2 | 3 | 3 | 4 |
| 69 | 2 | 3 | 1 | 1 |
| 70 | 1 | 3 | 4 | 1 |
| 71 | 3 | 3 | 2 | 4 |
| 72 | 1 | 2 | 4 | 1 |
| 73 | 2 | 1 | 4 | 4 |
| 74 | 3 | 1 | 1 | 1 |
| 75 | 4 | 1 | 1 | 4 |
| 76 | 4 | 3 | 4 | 2 |
| 77 | 1 | 4 | 2 | 3 |
| 78 | 3 | 1 | 2 | 3 |
| 79 | 2 | 1 | 4 | 4 |
| 80 | 3 | 2 | 1 | 1 |
| 81 | 1 | 2 | 2 | 1 |
| 82 | 2 | 3 | 3 | 2 |
| 83 | 3 | 4 | 3 | 4 |
| 84 | 1 | 2 | 1 | 2 |
| 85 | 2 | 4 | 3 | 4 |
| 86 | 1 | 3 | 1 | 3 |
| 87 | 2 | 2 | 2 | 3 |
| 88 | 1 | 2 | 3 | 1 |
| 89 | 2 | 1 | 2 | 3 |
| 90 | 4 | 1 | 2 | 2 |



జెఇఇ (మెయిన్స్)-2013 'కీ' అందించిన వారు

**Max. Marks: 360** **JEE MAINS 2013_P1 (CODE-Q)** **Date:07-04-2013**

# SOLUTIONS

## CHEMISTRY

1. Tertiary alcohol can form stable carbocation.
2. Ionisation potential of a neutral atom is magnetudely equal to electron gain enthalpy of its unipositive ion with opposite sign.
3. $Li_2 \rightarrow \sigma 1s^2 \overset{*}{\sigma} 1s^2 \sigma 2s^2 \; BO = \frac{4-2}{2} = 1$

   $Li_2^- \rightarrow \sigma 1s^2 \overset{*}{\sigma} 1s^2 \sigma 2s^2 \overset{*}{\sigma} 2s^1 \; BO = \frac{4-3}{2} = \frac{1}{2}$

   $Li_2^+ \rightarrow \sigma 1s^2 \overset{*}{\sigma} 1s^2 \sigma 2s^1 \; BO = \frac{3-2}{2} = \frac{1}{2}$
4. Resulting solution molarity $= \frac{M_1V_1 + M_2V_2}{V_1 + V_2} = \frac{750 \times 0.5 + 250 \times 20.875}{1000}$
5. Conceptual
6. Conceptual
7. Molecule foerms stable carbocation $\left( Ph - \overset{+}{C}H - CH_3 \right)$
8. As the charge over the cation increases coagulating power increases.
9. $10^{-1} \times 1 = 10^{-2} \times V$

   $V = 10L$

   Value of water to be added $= 10 - 1 = 9L$
10. $N_2 \; \sigma 1s^2 \overset{*}{\sigma} 1s^2 \sigma 2s^2 \overset{*}{\sigma} 2s^2 \; \pi py^2 \; \sigma 2px^2 \quad \pi pz^2$

    even angular releasing
11. $V \xrightarrow{2+} 3d^3 4s^0, \; n = 3$

    $Cr \xrightarrow{2+} 3d^4 4s^0, \; n = 4$

    $Th \xrightarrow{2+} 3d^5 4s^0, \; n = 5$

    $Fe \xrightarrow{2+} 3d^6 4s^0, \; n = 4$

    When $n \rightarrow$ number of unpaired electrons
12. Conceptual
13. $M.wt = 180(x)$ $M.wt$ of acetylated derivative = 390y

    $\left( \frac{y-x}{42} \right)$

14. Conceptual
15. EWG increases acedic strength
16. $\log 2 = \frac{E_a}{2.303 \times 8.314}\left[\frac{10}{300 \times 310}\right] = 0.3010 \times 2.303 \times 8.314 \times 300 \times 3 = 53598.5J$

    $= 53.598J$
17. Conceptual
18. Conceptual
19. $W = -2.303 \times 0.04 \times 8.314 \times 310 \log\left(\frac{375}{50}\right) = -2.01 \times 0.04 \times 8.314 \times 310 = -208J$
20. $\%C = \frac{12}{44} \times \frac{3.08}{O.C} \times 100$

    $\%H = \frac{2}{18} \times \frac{0.72}{O.C} \times 100$

    $\%C : \%H = 0.84 = 0.08 = \frac{0.84}{12} : \frac{0.08}{1} = 0.07 : 0.08$

    $C : H = 7 : 8$

    $C_7H_8$
21. Conceptual
22. Conceptual
23. $C^* = \sqrt{\frac{2RT}{m}}$

    $\overline{C} = \sqrt{\frac{8RT}{m}}$

    $\overline{C} = \sqrt{\frac{3RT}{m}}$

    $C : \overline{C} : C = \sqrt{2} : \sqrt{\frac{8}{\pi}} : \sqrt{3} = 1 : 1.1y : 1.1225$
24. MIC : $CH_3 - NCO$
25. $MnO_4^- + C_2O_4^{2-} + H^+ \rightarrow$

    $Mn^{2+} + CO_2 + H_2O$

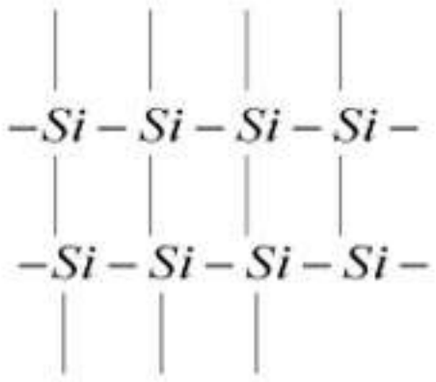
    $+7 \qquad +2$

    $MnO_4^- + C_2O_4^{2-} \rightarrow Mn^{2+} + CO_2$

    $+3 \qquad +2$

    $2MnO_4^- + 5C_2O_4^{2-} \rightarrow 2Mn^{2+} + 10CO_2$

    $2MnO_4^{(-)} + 5C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$
26. 'Si' has exist 8 molecular (or)
    Polymers which exists on



27. Conceptual

28. $\Delta E = E_2 - E_1 = 2.178\times10^{-18}\left[1-\frac{1}{4}\right] = 2.178\times10^{-8}\left[\frac{3}{4}\right]$

$\Delta E = \frac{3}{4}\times 2.178\times10^{-18} J$

$\Delta E = \frac{hc}{E} = \frac{hc}{\Delta E} = \frac{6.62\times10^{-34}\times3\times10^{8}}{\frac{3}{4}\times 2.178\times10^{-18}} = 1.214\times10^{-7} m$

29. Conceptual

30. $H_2^{2+} : \sigma 1S^0$ ' ', $B.O = 0$

$He_2 : \sigma 1s^2 \overset{*}{\sigma} 1s^2; B.O. = \frac{2-2}{2} = 0$

$\therefore$ Both Can't exist

## MATHS

31. Equation of circle is $(x-3)^2 + y^2 + 2\lambda y = 0$ ..... (1)

It passes through $(1,-2) \Rightarrow \lambda = 2$

verifty options

32. Standard result

33. $y = mx + \frac{a}{m}$ then apply r = d

34. slope of required line


= – slope of given line

35. Varianced is unaltered by charge of origin.

36. $2y = x + 2, 2\tan^{-1} y = \tan^{-1} x + \tan^{-1} z$

By applying this x,y,z are in G.P.

$\Rightarrow x = y = z$

37. $\int x^5 f(x^3) dx = \frac{1}{3}\int x^3 f(x^3)(3x^2) dx$

applying by parts

38. focii $= (\pm ae, 0)$

$$e = \sqrt{\frac{16-9}{16}} = \frac{\sqrt{7}}{4}$$

$ae = \sqrt{7}$

39. Vertices of a triangle are (0,0), (2,0)

$$(0,2), r = \frac{\Delta}{s} = \frac{\frac{1}{2}\times 2\times 2}{2+\sqrt{2}} = \left(2-\sqrt{2}\right)$$

40. $\frac{dy}{dx} = |x| \Rightarrow |x| = 2 \Rightarrow x = \pm 2$

when $x = 2$, $y = 2$, when $x = -2$, $y = 2$

equations of tangents are $2x - y = \pm 2$

x - intercepts $\pm 1$

41. $$\frac{7}{9}\left[\frac{9}{10}+\frac{99}{102}+\frac{999}{103}+.....+20\text{ terms}\right]$$

$$=\frac{7}{9}\left[20-\left(\frac{1}{10}+\frac{1}{10^2}+\frac{1}{10^3}+.....\text{upto }20\text{ terms}\right)\right]$$

42. Use truth table

43. $$\text{Area} = \int_0^9 \left(\sqrt{x}\right)dx - \frac{1}{2}\times 6\times 3$$

44. Put $A = 30^\circ$

45. $f'(x) = 6x^2 + 3$

$\Delta < 0$

f(x) is monotonic function

It cantains only one red root

46. $$\lim_{x\to 0}\frac{1-\cos ax}{x^2} = \frac{a^2}{2}$$

47. ${}^{(x+1)}C_3 - {}^{n}C_3 = 10$

48. $p = 100x - 12\times x^{\frac{3}{2}}\times\frac{2}{3} + c$

Put $x = 0$ $P = 2000$

find P when $x = 25$

49. Statement - I

$$\int_{\pi/6}^{\pi/3}\frac{dx}{1+\sqrt{\tan x}} = \frac{\pi}{12}$$

50. $|A|^2 = \begin{vmatrix} 1 & \alpha & 3 \\ 1 & 3 & 3 \\ 2 & 4 & 4 \end{vmatrix} = 16$

Find $\alpha$

51. $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$

52. $y = \sqrt{1+x^2}$

$\frac{dy}{dx} = \frac{x}{\sqrt{1+x^2}}, \left(\frac{dy}{dx}\right)_{x=1} = \frac{1}{\sqrt{2}}$

53. $\begin{vmatrix} 1 & -1 & -1 \\ 1 & 1 & -k \\ k & 2 & 1 \end{vmatrix} = 0$

54. $8c_3 + 8c_4 + 8c_5 + \ldots\ldots\ldots + 8c_8 = 2^8 - (8c_0 + 8c_1 + 8c_2)$

55. $\frac{1}{2}\left|\left(\overrightarrow{AB} + \overrightarrow{AC}\right)\right|$

56. $5c_4 \times \left(\frac{1}{3}\right)^4 \times \left(\frac{2}{3}\right) + 5c_5 \left(\frac{1}{3}\right)^5$

57. $\frac{1+z}{1+\bar{z}} = \frac{1+\cos\theta+i\sin\theta}{1+\cos\theta-i\sin\theta}$

58. $\Delta < 0$, imagining roots

$\frac{a}{1} = \frac{b}{2} = \frac{c}{3}$

59. $\frac{|d_1 - d_2|}{\sqrt{a^2+b^2+c^2}}$

60. $\left(x^{1/3} - \frac{1}{x^{1/2}}\right)^{10}$

$T_5$ terms is independent term

$T_5 = 10c_4$

## PHYSICS

61. As only $S_1$ is closed we have charging $RC\,(DC)$ circuit

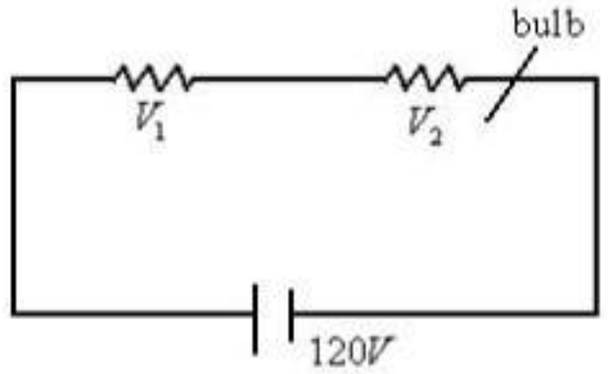
$q = q_0\left(1 - e^{-t/\tau}\right)$

for $\tau = 2\tau \quad q = CV\left(1 - e^{-2}\right)$

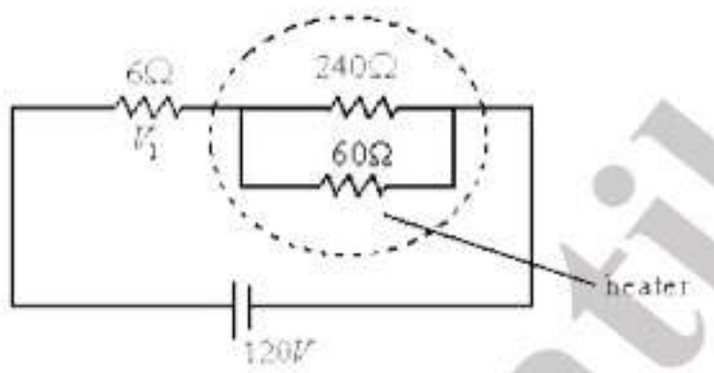
62. Out of syllabus

63. Resistance of bulb $= R_B = \frac{V^2}{P} = \frac{120^2}{60} = 240\Omega$

Resistance of heater $= R_H = \frac{V^2}{P} = \frac{120^2}{240} = 60\Omega$




$$V_2 = \frac{240\times120}{(240+6)} = \frac{240\times120}{246}\ volts$$



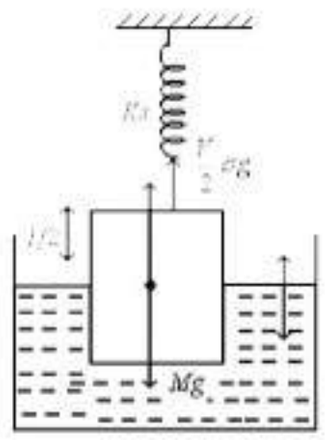

Resultant resistance of bulb and heater is $R_p$.

heater $\qquad R_p = \frac{240\times60}{240+60} = 48\Omega$

$$V_2^1 = \frac{48\times120}{(48+6)} = \frac{48\times120}{54}\ volts$$

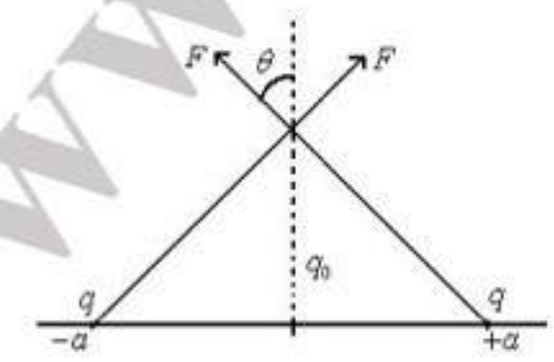
Decrease in voltage in bulb $= V_2 - V_2^1 = \frac{240\times120}{246} - \frac{48\times120}{54} = 117.07 - 106.67 = 10.4\Omega$

64.




$$kx = Mg - \frac{V}{2}\sigma g = Mg - \frac{M}{2\rho}\sigma g \qquad Mg\left[1 - \frac{\sigma AL}{2M}\right]$$

65.




$$F_{\text{resultant}} = 2F\cos\theta = 2\frac{1}{4\pi\in_0}\frac{qq_0}{(a^2+y^2)}\frac{y}{\sqrt{(a^2+y^2)}} \Rightarrow F_{res} \ \alpha \ y.$$

66. After passing through 1st polaroid

$$I_1 = \frac{I_0}{2}$$

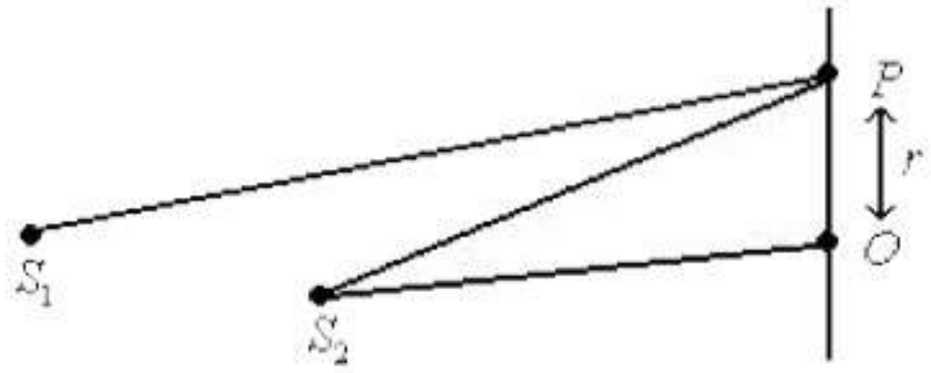
for 2nd polaroid

$$I_2 = I_1 \cos^2\theta = \frac{I_0}{2}\left(\frac{1}{\sqrt{2}}\right)^2 = \frac{I_0}{4}$$

67. Current exists only for $\lambda > \lambda_0$

Option (3) is most appropirate

68.




If we get a maxima at P; All points a same distance r on screen from O will be maximas. indicating concentric (at O) circular fringes.

69. $$\epsilon = \frac{Bw(3p)^2}{2} - \frac{Bw(2l)^2}{2} = \frac{5Bwl^2}{2}$$

70. $$v = \frac{C}{\lambda} = CR\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

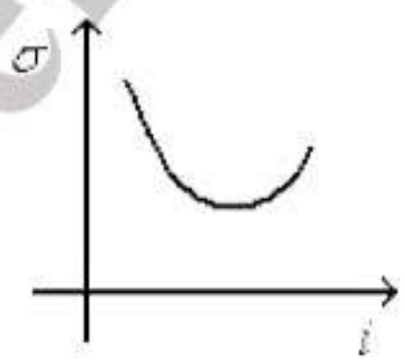
$$v = CR\left(\frac{1}{(n-1)^2} - \frac{1}{n^2}\right) = CR\left[\frac{2n}{n^4}\right]$$

71. Surface energy $\geq mL$

(as temperature does not change)

$$4\pi r^2 \times T \geq \frac{4}{3}\pi r^3 \rho L \Rightarrow r \leq \frac{3T}{\rho L}$$

72.

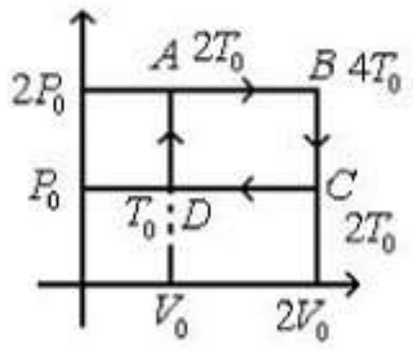



Conceptual

73. $$F = \frac{1}{g\pi\epsilon_0}\frac{q_1 q_2}{r^2}$$

$$[t_0] = \frac{ATAT}{MLT^{-2}L^2} = M^{-1}L^{-3}T^4A^2$$

74.




$P_0V_0 = nRT_0$

for AB $dQ_1 = nC_p dT = n\frac{5R}{2}2T_0$

for DA $dQ_2 = nC_v dT = n\frac{3R}{2}T_0 = \frac{3}{2}P_0V_0$

for BC & CD heat is taken in

$\therefore dQ = dQ_1 + dQ_2 = \frac{13}{2}P_0V_0.$

75. $l = 1.5$ m

$\frac{\Delta l}{l} = 1\% = \frac{1}{100}$

$\rho = 7.7\times10^3\ kgm^{-3},\ Y = 2.2\times10^{11}\ Nm^{-2}$

$n = \frac{1}{2l}\sqrt{\frac{T}{A\rho}} = \frac{1}{2l}\sqrt{\frac{stress}{\rho}}$

$n = \frac{1}{2l}\sqrt{\frac{Y}{\rho}\frac{\Delta l}{l}} = \frac{1}{2\times1.5}\sqrt{\frac{2.2\times10^{11}}{7.7\times10^{3}}\times\frac{1}{100}}$

n = 178.2 Hz

76. Conceptual

77. Energy required = Change in total energy of satellite

= Total energy at a height (2R) - Total energy on the surface

$= \left(-\frac{GMm}{2\times3R}\right) - \left(-\frac{GMm}{6R}\right) = \frac{5}{6}\frac{GMm}{R}$

Energy required $= \frac{5}{6}\frac{GMm}{R}$

78. $\vec{u} = i + 2j\ m/s$

$x = u_x t = t$

$y = u_y t - \frac{1}{2}gt^2 = 2t - 5t^2$ $\qquad \therefore y = 2x - 5x^2$

79. $V_{common} = \frac{C_1V_1 - C_2V_2}{C_1 + C_2} = 0$

$\Rightarrow C_1V_1 - C_2V_2 = 0 \Rightarrow C_1120 = C_2200$

$3C_1 = 5C_2$

80. By conservation of angular momentum about the lower most point

$$Iw_0 = mvR + Iw \quad \left(w = \frac{v}{R}\right)$$

$$mR^2 w_0 = mvR + m\frac{R^2 v}{R} \Rightarrow v = \frac{Rw_0}{2}$$

81. As the process is adiabatic

$$PV^\gamma = cont.$$

$$\Rightarrow P\gamma V^{\gamma-1}dv + V^\gamma dp = 0 \Rightarrow dp = -\frac{\gamma P dV}{V} \Rightarrow dp = -\frac{\gamma P_0 A}{V_0}dx$$

$$\therefore f_{res} = dpA = -\frac{\gamma P_0}{V_0}A^2 dx$$

$$\therefore f = \frac{1}{2\pi}\sqrt{\frac{k}{m}} = \frac{1}{2\pi}\sqrt{\frac{\gamma P_0 A^2}{V_0 m}}$$

82. $$\therefore dV = \frac{1}{4\pi\varepsilon_0}\frac{\frac{Q}{L}dx}{x} \qquad \therefore V = \int_L^{2L} dV = \frac{1}{4\pi\varepsilon_0}\frac{Q}{L}\ln 2$$

83. If current passes through big loop flux in same loop is same as the flux in bigger loop when current passes through small loop. (reciprocity theorem)

$$\therefore \phi = BA$$

$$= \frac{\mu_0 n i r_b^2}{2(r_b^2 + x^2)^{3/2}}.\pi r_s^2 = 9.1\times 10^{-11} Wb$$

84. By newtons law of cooling

$$\frac{d\theta}{df} \propto -(\theta - \theta_0) \qquad \therefore \int \frac{d\theta}{\theta - \theta_0} = -\int_0^t K dt$$

$$\left[\ln(\theta - \theta_0)\right]_{\theta-\theta_0}^{\theta-\theta_0} = -Kt$$

Where $\theta_i$ is inital temp. $\qquad \therefore \theta - \theta_0 = (\theta_i - \theta_0)e^{-KT}$

exponential decay

85. LED works in Forward Bias

86. For perfect inelastic collision

loss of energy is maximum and

$$\text{loss of energy} = \frac{1}{2}\frac{m_1 m_2}{m_1 + m_2}(u_1 - u_2)^2$$

$$\Delta E = \frac{1}{2}\frac{mM}{(M+m)}(v-0)^2 = \left(\frac{M}{M+m}\right).\frac{1}{2}mv^2 = f\left(\frac{1}{2}mv^2\right)$$

$$f = \frac{M}{M+m}$$

$\therefore$ Statement I is wrong and II is correct

87. For damped oscillation

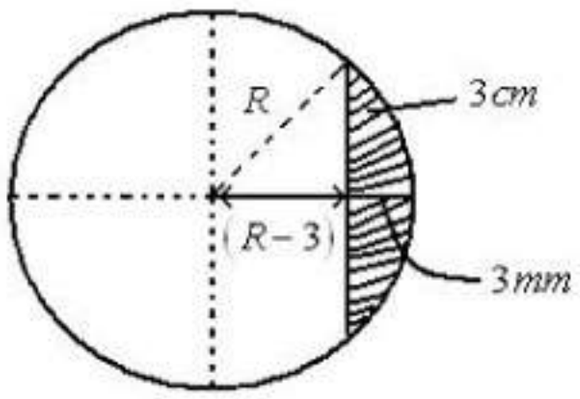
$$A = A_0 e^{-bt}$$

$$0.9A_0 = A_0 e^{-b5}$$

$$\alpha A_0 = A_0 e^{-b15} = A_0 \left(e^{-5b}\right)^3$$

$$\alpha = (0.9)^3 = 0.729$$

88.




$$R^2 = (R-3)^2 + 30^2$$

$$R^2 = R^2 + 3^2 - 6R + 30^2$$

$$6R = 909 \Rightarrow R = 151.5\,mm \;\; = 15.15\,cm$$

$$\mu_g = \frac{C_0}{C} = \frac{3\times10^8}{2\times10^8} = \frac{3}{2}$$

$$\frac{1}{f} = (\mu_g - 1)\left(\frac{1}{R}\right) = \left(\frac{3}{2} - 1\right)\left(\frac{1}{15.15}\right) = \frac{1}{2}\times\frac{1}{15.15}$$

$$f = 30.3\ cm$$

89. $$c = \frac{E_0}{B_0}$$

$$E_0 = cB_0 = 6V$$

90. $$B_{net} = B_E = B_1 + B_2$$

$$= 3.6\times10^{-5} + \frac{\mu_0}{4\pi}\frac{(M_1 + M_2)}{r^3} = 3.6\times10^{-5} + 10^{-7}\frac{2.2}{10^{-3}} = 0.36\times10^{-4} + 2.2\times10^{-4} = 2.56\times10^{-4}T$$

* * *

ఈ 'కీ' ని హైదరాబాద్ లోని శ్రీ గాయత్రి విద్యాసంస్థల నిపుణుల బృందం రూపొందించింది.)