## Section-I (PHYSICS)

***Single Correct Type Question* (1 *to* 20)**

**1.** A projectile can have the same range $R$ for two angles of projection. If $t_1$ and $t_2$ be the time of flight in the two cases, then what is the product of two times of flight?

(1) $t_1 t_2 \propto R^2$

(2) $t_1 t_2 \propto R$

(3) $t_1 t_2 \propto 1/R$

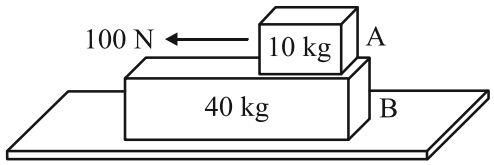
(4) $t_1 t_2 \propto 1/R^2$

**2.** A balloon of mass $M$ is descending at a constant acceleration $\alpha$. When a mass $m$ is released from the balloon it starts rising with the same acceleration $\alpha$. Assuming that its volume does not change, what is the value of $m$?

(1) $\left[\frac{\alpha}{\alpha+g}\right]M$ (2) $\left[\frac{2\alpha}{\alpha+g}\right]M$

(3) $\left[\frac{\alpha+g}{\alpha}\right]M$ (4) $\left[\frac{\alpha+g}{2\alpha}\right]M$

**3.** A 40 kg slab rests on a frictionless floor as shown in the figure. A 10 kg block rests on the top of the slab. The static coefficient of friction between the block and slab is 0.60 while the kinetic friction is 0.40. The 10 kg block is acted upon by a horizontal force 100 N. If g = 9.8 m/s$^2$, the resulting acceleration of the slab will be




(1) 0.98 m/s$^2$

(2) 1.47 m/s$^2$

(3) 1.52 m/s$^2$

(4) 6.1 m/s$^2$

**4.** A block rests on a horizontal table, which is executing SHM in the horizontal direction with an amplitude $a$. If the coefficient of friction is $\mu$, then the block just starts to slip when the frequency of oscillation is

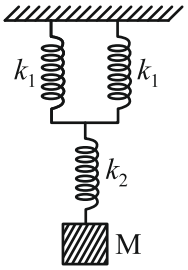
(1) $\frac{1}{2\pi}\sqrt{\frac{\mu g}{a}}$

(2) $2\pi\sqrt{\frac{a}{\mu g}}$

(3) $\frac{1}{2\pi}\sqrt{\frac{a}{\mu g}}$

(4) $\sqrt{\frac{a}{\mu g}}$

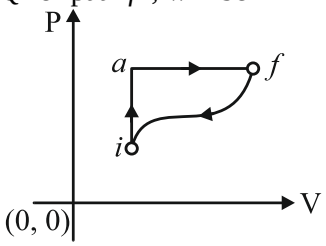
**5.** What will be the force constant of the spring system shown in the figure?




(1) $\frac{k_1}{2}+k_2$ (2) $\left(\frac{1}{2k_1}+\frac{1}{k_2}\right)^{-1}$

(3) $\frac{1}{2k_1}+\frac{1}{k_2}$ (4) $\left[\frac{2}{k_1}+\frac{1}{k_2}\right]^{-1}$

**6.** In the diagram shown $Q_{iaf} = 80$ cal and $W_{iaf} = 50$ cal. If $W = -30$ cal for the curved path $f\,i$, value of $Q$ for path $f\,i$, will be




(1) 60 cal (2) 30 cal

(3) –30 cal (4) –60 cal

**7.** A wire of length $l$ and mass $m$ is bent in the form of a rectangle $ABCD$ with $(AB/BC) = 2$. The moment of inertia of this wire about the side $BC$ is

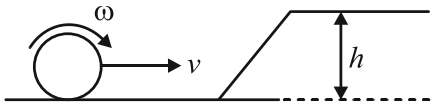
(1) 11/252 ml$^2$

(2) 8/203 ml$^2$

(3) 5/136 ml$^2$

(4) 7/162 ml$^2$

**8.** A solid sphere is rolling on a frictionless surface, shown in figure with a translational velocity $v$ m/s. If it is to climb the inclined surface then $v$ should be




(1) $\geq\sqrt{\frac{10}{7}gh}$

(2) $\geq\sqrt{2gh}$

(3) $2gh$

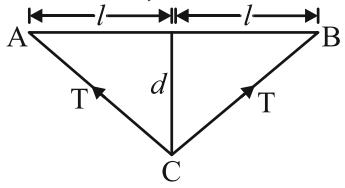
(4) $\frac{10}{7}gh$

**9.** The ratio of the radii of planets $A$ and $B$ is $K_1$ and ratio of acceleration due to gravity on them is $K_2$. The ratio of escape velocities from them will be

(1) $K_1K_2$ (2) $\sqrt{K_1K_2}$

(3) $\sqrt{K_1/K_2}$ (4) $\sqrt{K_2/K_1}$

**10.** A wire of radius $r$ stretched without tension along a straight line is lightly fixed at $A$ and $B$. What is the tension in the wire when it is pulled into the shape $ACB$? (Assume Young's modulus of the material of the wire to be $Y$ and $d < l$)



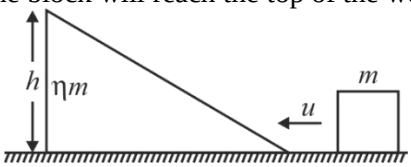

(1) $\frac{Yd^2}{2\pi r^2 l^2}$

(2) $\frac{Y\pi r^2 d^2}{2l^2}$

(3) $\frac{Y\pi r^2}{2l^2 d^2}$

(4) $\frac{Y\pi r^2 l^2}{2d^2}$

**11.** A block of mass $m$ is pushed towards a movable wedge of mass $\eta m$ and height $h$, with a velocity $u$. All surface are smooth. The minimum value of $u$ for which the block will reach the top of the wedge is




(1) $\sqrt{2gh}$

(2) $\eta\sqrt{2gh}$

(3) $\sqrt{2gh\left(1+\frac{1}{\eta}\right)}$

(4) $\sqrt{2gh\left(1-\frac{1}{\eta}\right)}$

**12.** An insect of mass $m$ is initially at one end of a stick of length $L$ and mass $M$, which rests on a smooth floor. The coefficient of friction between the insect and the stick is $k$. The minimum time in which the insect can reach the other end of the stick is $t$. Then $t^2$ is equal to

(1) $\frac{2L}{kg}$ (2) $\frac{2Lm}{kg(M+m)}$

(3) $\frac{2LM}{kg(M+m)}$ (4) $\frac{2Lm}{kgM}$

**13.** A uniform rod of mass $m$ and length $l$ makes a constant angle $\theta$ with an axis of rotation which passes through one end of the rod. Its moment of inertia about this axis is

(1) $\frac{ml^2}{3}$ (2) $\frac{ml^2}{3}\sin\theta$

(3) $\frac{ml^2}{3}\sin^2\theta$ (4) $\frac{ml^2}{3}\cos^2\theta$

**14.** A wheel of radius $r$ rolls without slipping with a speed $v$ on a horizontal road. When it is at point $A$ on the road, a small blob of mud separates from the wheel at its highest point and lands at point $B$ on the road.

(1) $AB = v\sqrt{\frac{r}{g}}$ (2) $AB = 2v\sqrt{\frac{r}{g}}$

(3) $AB = 4v\sqrt{\frac{r}{g}}$

(4) If $v > \sqrt{4rg}$, the blob of mud will land on the wheel and not on the road.

**15.** A simple pendulum has time period $T$. A uniform rod, whose length is the same as that of the pendulum, undergoes small oscillations about its upper end. Its time period of oscillation will be

(1) $< T$

(2) $T$

(3) $> T$

(4) may be (1), (2) or (3) depending on whether $T$ is <, equal to or > 2 seconds.

**16.** The escape velocity for a planet is $V$. A tunnel is dug along its diameter and a particle is dropped into the tunnel. At the centre of the planet, the speed of the particle will be

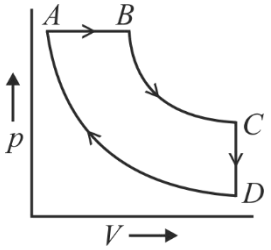
(1) $V$

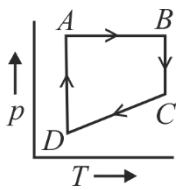
(2) $\frac{V}{2}$

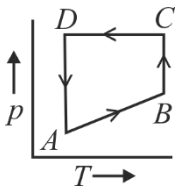
(3) $\frac{V}{\sqrt{2}}$

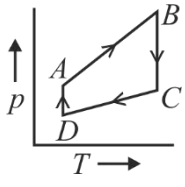
(4) $\frac{V}{2\sqrt{2}}$

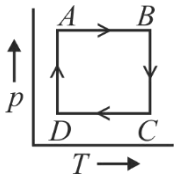
**17.** A cyclic process $ABCD$ is shown in the $p$-$V$ diagram. Which of the following curves represents the same process?




(1) 


(2) 


(3) 


(4) 

**18.** Two identical containers $A$ and $B$ have frictionless pistons. They contain the same volume of an identical ideal gas at the same temperature. The mass of the gas in $A$ is $m_A$ and that in $B$ is $m_B$. The gas in each cylinder is now allowed to expand isothermally to double the initial volume. The changes in the pressure in $A$ and $B$ are found to be $\Delta p$ and $1.5\Delta p$ respectively. Then

(1) $4m_A = 9m_B$
(2) $2m_A = 3m_B$
(3) $3m_A = 2m_B$
(4) $9m_A = 4m_B$

**19.** A point source of heat of power $P$ is placed at the centre of a spherical shell of mean radius $R$. The material of the shell has thermal conductivity $k$. If the temperature difference between the outer and inner surfaces of the shell is not to exceed $T$, the thickness of the shell should not be less than

(1) $\frac{4\pi kR^2T}{P}$ (2) $\frac{4\pi kR^2}{TP}$

(3) $\frac{4\pi R^2T}{kP}$ (4) $\frac{4\pi R^2P}{kT}$

**20.** Sounds from two identical sources $S_1$ and $S_2$ reach a point $P$. When the sounds reach directly, and in the same phase, the intensity at $P$ is $I_0$. The power of $S_1$ is now reduced by 64%, and the phase difference between $S_1$ and $S_2$ is varied continuously. The maximum and minimum intensities recorded at $P$ are now $I_{max}$ and $I_{min}$. Then

(1) $I_{max} = 0.64\ I_0$
(2) $I_{min} = 0.36\ I_0$
(3) $I_{max}/I_{min} = 16$
(4) $I_{max}/I_{min} = 1.64/0.36$

***Integer Type Question* (21 to 30):**

**21.** A uniform thermometer scale is at steady state with its 0 cm mark at 20°C and 100 cm mark at 100°C. Temperature of the 60 cm mark is

**22.** A body weighs 72 N on surface of the earth. When it is taken to a height of $h = 2R$, where $R$ is radius of earth, it would weigh (in $N$)

**23.** A 2 kg block drops vertically from a height of 40 cm on a spring whose force constant $K$ is 1960 Newton per metre. Then, the maximum compression of the spring (in cm) is:

**24.** Power supplied to a particle of mass 2 kg varies with time as $P = \frac{3t^2}{2}$ watt. Here, $t$ is in seconds.
If velocity of particle at $t = 0$ is $v = 0$, the velocity of particle at time $t = 2$s will be
(in m/s):

**25.** Two wires $A$ and $B$ have the same length and area of cross-section. But Young's modulus of $A$ is two times the Young's modulus of $B$. Then the ratio of force constant of $A$ to that of $B$ is:

**26.** A layer of glycerine of thickness 1 mm is present between a large surface area and a surface area of 0.1 $m^2$. With what force (in N) the small surface is to be pulled, so that it can move with a velocity of 1 m/s? (Given that coefficient of viscosity = 0.07 kg $m^{-1}\ s^{-1}$)

**27.** 80 gm of water at 30°C is poured on a large block of ice at 0°C. The mass of ice (in gm) that melts is:

**28.** The total KE of all the molecules of helium having a volume $V$ exerting a pressure $P$ is 1500 J. The total KE (in joules) of all the molecules of $N_2$ having the same volume $V$ and exerting a pressure $2P$ is:

**29.** For a certain organ pipe three successive resonance frequencies are observed at 425 Hz, 595 Hz and 765 Hz respectively. If the speed of sound in air is 340 m/s, then the length of the pipe is (in m):

**30.** Two factories are sounding their sirens at 800 Hz. A man goes from one factory to the other at a speed of 2 m/s. The velocity of the sound is 320 m/s. The number of beats (in "$H_z$") heard by the person will be

## Section-II (CHEMISTRY)

***Single Correct Type Question* (31 *to* 50)**

**31.** When $N_2$ is converted into $NH_3$, the equivalent weight of nitrogen will be:

(1) 1.6 (2) 2.67
(3) 3.67 (4) 4.67

**32.** 0.30 g of an organic compound containing C, H and O on combustion yields 0.44 g $CO_2$ and 0.18 g $H_2O$. If one mol of compound weights 60, then molecular formula of the compound is

(1) $C_3H_8O$ (2) $C_2H_4O_2$
(3) $CH_2O$ (4) $C_4H_6O$

**33.** 10 g of $MgCO_3$ decomposes on heating to 0.1 mole $CO_2$ and 4 g MgO. The per cent purity of $MgCO_3$ is

(1) 24% (2) 44%
(3) 54% (4) 84%

**34.** The work function of a metal is 5 eV. What is the kinetic energy of the photoelectron ejected from the metal surface if the energy of the incident radiation is 6.2 eV? (1 eV = $1.6 \times 10^{-19}$ J)

(1) $6.626 \times 10^{-19}$ J (2) $8.01 \times 10^{-19}$ J
(3) $1.92 \times 10^{-19}$ J (4) $8.010 \times 10^{-18}$ J

**35.** Which of the following rules could explain the presence of three unpaired electrons in N-atom?
(1) Hund's rule
(2) Aufbau's principle
(3) Heisenberg's uncertainty principle
(4) Pauli's exclusion principle

**36.** $Be^{3+}$ and a proton are accelerated by the same potential, their de-Broglie wavelengths have the ratio (assume mass of proton = mass of neutron):
(1) 1 : 2 (2) 1 : 4
(3) 1 : 1 (4) $1:3\sqrt{3}$

**37.** For one of the element various successive ionisation enthalpies (in kJ $mol^{-1}$) are given below:

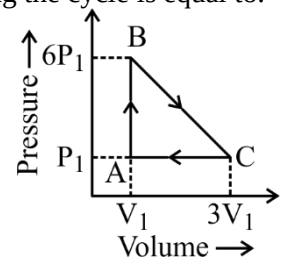
| I.E. | 1st | 2nd | 3rd | 4th | 5th |
|---|---|---|---|---|---|
| | 577.5 | 1810 | 2750 | 11,580 | 14,820 |

The element is
(1) P (2) Mg
(3) Si (4) Al

**38.** For $BF_3$ molecule which of the following is true?
(1) B-atom is $sp^2$ hybridised
(2) There is a pπ-pπ back bonding in this molecule
(3) Observed B–F bond length is found to be less than the expected bond length
(4) All of these

**39.** At identical temperature and pressure, the rate of diffusion of hydrogen gas is $3\sqrt{3}$ times that of a hydrocarbon having molecular formula $C_nH_{2n-2}$. What is the value of n?
(1) 1 (2) 4
(3) 3 (4) 8

**40.** An ideal gas is taken around the cycle ABCA as shown in P-V diagram. The net work done by the gas during the cycle is equal to:




(1) 12 $P_1V_1$ (2) 6 $P_1V_1$
(3) 5 $P_1V_1$ (4) $P_1V_1$

**41.** The equilibrium constant, $K_p$ for the reaction $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ is 4.0 $atm^{-1}$ at 1000 K. What would be the partial pressure of $O_2$ if at equilibrium the moles of $SO_2$ and $SO_3$ are the same?
(1) 16.0 atm (2) 0.25 atm
(3) 1 atm (4) 0.75 atm

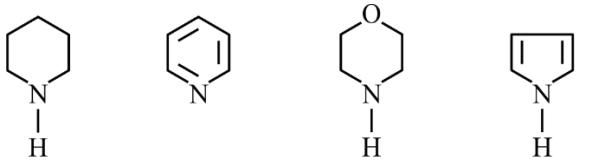
**42.** Which of the following can not decompose on heating to give $CO_2$ in a dry test tube?
(1) $Li_2CO_3$ (2) $Na_2CO_3$
(3) $KHCO_3$ (4) $BeCO_3$

**43.** Amorphous boron on burning in air forms:
(1) $B(OH)_3$
(2) Mixture of $B_2O_3$ and BN
(3) Only $B_2O_3$
(4) Only BN

**44.** In which of the following reaction, $H_2O_2$ is acting as a reducing agent?
(1) $PbS + 4H_2O_2 \rightarrow PbSO_4 + 4H_2O$
(2) $2KI + H_2O_2 \rightarrow 2KOH + I_2$
(3) $H_2O_2 + SO_2 \rightarrow H_2SO_4$
(4) $Ag_2O + H_2O_2 \rightarrow 2Ag + H_2O + O_2$

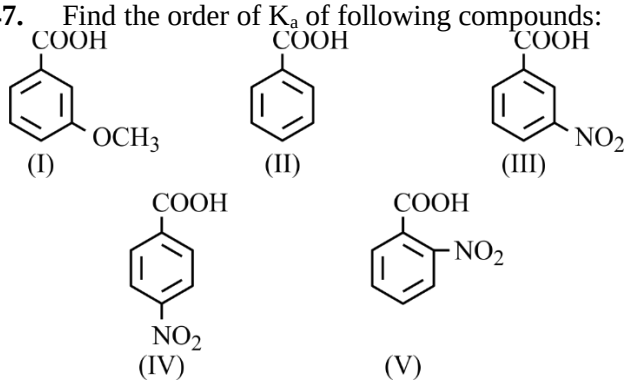
**45.** Air pollutants that produce photochemical oxidants include:
(1) $CO_2$, CO and $SO_2$
(2) $N_2O$, NO and $HNO_3$
(3) $O_2$, $Cl_2$ and $HNO_3$
(4) $O_3$, $Cl_2$ and $SO_2$

**46.** Select basic strength order of following molecules?




(1) IV > I > III > IV
(2) III > I > IV > II
(3) II > I > III > IV
(4) I > III > II > IV

**47.** Find the order of $K_a$ of following compounds:




(1) I < II < III < IV < V
(2) IV < I < III < II < V
(3) III < II < I < IV < V
(4) II < I < III < IV < V

**48.** Which of the following group show +M > –I effect?
(1) –F (2) $-\overset{\overset{O}{\|}}{O}-C-R$
(3) $-\overset{\overset{O}{\|}}{C}-R$ (4) –COOH

**49.** Which of the following anions is present in the simple single chain structure of silicate?

(1) $SiO_4^{4-}$ (2) $Si_2O_7^{6-}$

(3) $(Si_2O_5^{2-})_n$ (4) $(SiO_3^{2-})_n$

**50.** For the reaction,

$2Fe(NO_3)_3 + 3Na_2CO_3 \rightarrow Fe_2(CO_3)_3 + 6NaNO_3$

Initially if 2.5 mole of $Fe(NO_3)_2$ and 3.6 mole of $Na_2CO_3$ is taken. If 6.3 mole of $NaNO_3$ is obtained, then % yield of given reactions is:

(1) 50 (2) 84

(3) 87.50 (4) 100

***Integer Type Question* (51 to 60):**

**51.** The equivalent weight of a metal is double that of oxygen. How many times is the weight of its oxide greater than weight of the metal?

(Report your answer by multiplying 10)

**52.** An element has atomic number 29. It belongs to x period and y group. Given value of 2x + y:

**53.** Find out total number of π bond in following xenon compounds.

$XeOF_2$, $XeO_2F_4$, $XeO_3$, $XeO_4$, $XeO_3F_2$, $XeOF_4$, $XeO_2F_2$

**54.** The *rms* velocity of molecules of a gas density 4 $kgm^{-3}$ and pressure $1.2 \times 10^5$ $Nm^{-2}$ is

(Report your answer by dividing 10)

**55.** One mole of non-ideal gas undergoes a change of state (1.0 atm, 3.0 L, 200 K) to (4.0 atm, 5.0, L 250 K) with a change in internal energy ($\Delta U$) = 40 L-atm. The change in enthalpy of the process in L-atm.

**56.** Upon mixing equal volume of two solution of strong acids having pH values 2 & 4, resulting solution will have pH.

(Report your answer by multiplying 10)

**57.** For alkali metal M:

$M_2O + H_2O \rightarrow x$

$M_2O_2 + H_2O \rightarrow x + y$

$MO_2 + H_2O \rightarrow x + y + z$

Sum of the number of atoms present in one molecule each of x, y, z.

**58.** For Boron family (B, A*l*, Ga, In and T*l*)

x: Number of elements which are solid at 40°C

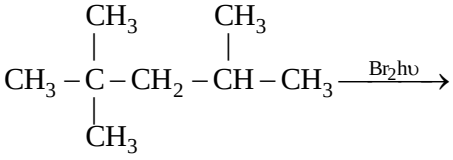
y: Period number of element which has greater ionization energy than element just above and below it in periodic table.

z: Period number of most abundant element of group 13.

Report your answer x + 2y + 3z

**59.** The number of possible enantiomer pairs that can be produced during monochlorination of 2-Methylbutane is:

**60.** For the given reaction how many products are optically active (all isomers):



## Section-III (MATHEMATICS)

***Single Correct Type Question* (61 *to* 80)**

**61.** A pair of tangents are drawn from a point *P* to the circle $x^2 + y^2 = 1$. If the tangents make an intercept of 2 on the line $x = 1$, then locus of *P* is:

(1) straight line (2) pair of lines

(3) circle (4) parabola

**62.** The value of $\sum_{k=1}^{10}\left(\sin\frac{2\pi k}{11} - i\cos\frac{2\pi k}{11}\right)$ is (where $i = \sqrt{-1}$)

(1) 1 (2) –1

(3) $i$ (4) $-i$

**63.** For the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$, distance between the foci is 10 units. From the point $(2, \sqrt{3})$, perpendicular tangents are drawn to the hyperbola, then the value of $\left|\frac{b}{a}\right|$ is

(1) 0.25 (2) 5

(3) 0.75 (4) 1

**64.** If $p \Rightarrow (q \vee r)$ is false, then the truth values of *p*, *q* and *r* respectively are (here, T is true and F is false)

(1) T F F

(2) F F F

(3) F T T

(4) T T F

**65.** If *x* is rational and $4\left(x^2 + \frac{1}{x^2}\right) + 16\left(x + \frac{1}{x}\right) - 57 = 0$, then the product of all possible value of *x*.

(1) 4 (2) 3

(3) 2 (4) 1

**66.** The geometric mean of 6 observations was calculated as 13. It was later observed that one of the observations was recorded as 28 instead of 36. The correct geometric mean is

(1) $\left(\frac{9}{7}\right)^{1/6}$ (2) $3\left(\frac{9}{7}\right)^{1/6}$

(3) $13\left(\frac{9}{7}\right)^{1/6}$ (4) $13\left(\frac{7}{9}\right)^{1/6}$

**67.** If the standard deviation of 0, 1, 2, …, 9 is $k$, then the standard deviation of 10, 11, 12, …,19 is

(1) $k$ (2) $k + 10$

(3) $k+\sqrt{10}$ (4) $10k$

**68.** The line $2x + y = 3$ intersects the ellipse $4x^2 + y^2 = 5$ at two points. The point of intersection of the tangents to the ellipse at these points is

(1) $\left(\frac{5}{6},\frac{5}{6}\right)$ (2) $\left(\frac{5}{3},\frac{5}{6}\right)$

(3) $\left(\frac{5}{6},\frac{5}{3}\right)$ (4) $\left(\frac{5}{3},\frac{5}{3}\right)$

**69.** A tangent drawn to the hyperbola $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$ at $P\left(a\sec\frac{\pi}{6},b\tan\frac{\pi}{6}\right)$ form a triangle of area $3a^2$ sq. units with the coordinate axes. Then eccentricity of the hyperbola $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$ of is

(1) $\sqrt{17}$ (2) $\frac{\sqrt{17}}{4}$

(3) $\frac{\sqrt{17}}{2}$ (4) $\frac{8}{\sqrt{17}}$

**70.** Let two numbers have an arithmetic mean 9 and geometric mean 4, then these numbers are the roots of the quadratic equation

(1) $x^2 + 18x – 16 = 0$ (2) $x^2 – 18x + 16 = 0$

(3) $x^2 + 18x + 16 = 0$ (4) $x^2 – 18x – 16 = 0$

**71.** The sum to 10 terms of the series $1 + 2(1.1) + 3(1.1)^2 + 4(1.1)^3 + \cdots$ is

(1) 85.12 (2) 92.5

(3) 96.75 (4) 100

**72.** Let the line $y = mx$ and the ellipse $2x^2 + y^2 = 1$ intersect at a point $P$ in the first quadrant. If the normal to this ellipse at $P$ meets the co-ordinate axes at $\left(-\frac{1}{3\sqrt{2}},0\right)$ and $(0,\beta)$, then $\beta$ is equal to

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

(3) $\frac{2\sqrt{2}}{3}$ (4) $\frac{\sqrt{2}}{3}$

**73.** If $p$ : 4 is an odd number and $q$ : $4^3$ is an even number are two statements, then which of the following statements is equivalent to $\sim(p \Rightarrow q)$ ?

(1) 4 is an odd number and $4^3$ is an even

(2) The negation of the statement 4 is not an odd number or $4^3$ is not an even number

(3) Both (4 is an odd number and $4^3$ is an even number) and (The negation of the statement 4 is not an odd number or $4^3$ is not an even number)

(4) 4 is an odd number and $4^3$ is not an even number

**74.** The length of the chord $y=\sqrt{3}x-2\sqrt{3}$ intercepted by the parabola $y^2 = 4(x – 1)$ is equal to

(1) $4\sqrt{3}$ units (2) $\frac{8}{3}$ units

(3) $\frac{16}{3}$ units (4) $\frac{4}{\sqrt{3}}$ units

**75.** Let $C_1$ and $C_2$ be two circles of radius $r_1$ and $r_2$ respectively ($r_1 > r_2$) touching both the axes. If the two circles are orthogonal, then $\frac{r_1}{r_2}$ is equal to

(1) 2 (2) $2+\sqrt{3}$

(3) $3+\sqrt{2}$ (4) 3

**76.** If $x^y . y^x = 16$, then the value of $\frac{dy}{dx}$ at (2, 2) is

(1) –1 (2) 0

(3) 1 (4) 2

**77.** The length of the latus rectum of the curve represented by $x = 3(\cos t + \sin t)$ and $y = 4(\cos t – \sin t)$, is

(1) $\frac{9}{2}$ units (2) $9\sqrt{2}$ units

(3) $\frac{32\sqrt{2}}{3}$ units (4) $\frac{9}{\sqrt{2}}$ units

**78.** The values of $\lambda$ for which one root of the equation $x^2+(1-2\lambda)x+(\lambda^2-\lambda-2)=0$ is greater than 3 and the other smaller than 2 are given by

(1) $2<\lambda<5$

(2) $1<\lambda<4$

(3) $1<\lambda<5$

(4) $2<\lambda<4$

**79.** The sum of four numbers in an arithmetic progression is 48 and the ratio of the product of the extremes to the product of the two middle terms is 27 : 35, then the largest term of this arithmetic progression is

(1) 10 (2) 12

(3) 14 (4) 18

**80.** If $|a| < 1$ and $|b| < 1$, then the sum of the series $a(a + b) + a^2(a^2 + b^2) + a^3(a^3 + b^3) + .....$ is

(1) $\frac{a}{1-a}+\frac{ab}{1-ab}$ (2) $\frac{a^2}{1-a^2}+\frac{ab}{1-ab}$

(3) $\frac{b}{1-b}+\frac{a}{1-a}$ (4) $\frac{b^2}{1-b^2}+\frac{ab}{1-ab}$

***Integer Type Question* (81 to 90):**

**81.** In the binomial expansion of $\left(\sqrt[3]{2}+\frac{1}{\sqrt[3]{3}}\right)^n$, the ratio of the $7^{th}$ term from the beginning to the $7^{th}$ term from the end is 1 : 6; then find $n$.

**82.** Find the maximum value of $12\sin\theta - 9\sin^2\theta$

**83.** When $2^{301}$ is divided by 5, then find least positive remainder.

**84.** Find the value of
$$\frac{\cos 20° + 8\sin 70° \sin 50° \sin 10°}{\sin^2 80°}$$

**85.** If the number of terms in the expansion of $(1 + x)^{101} (1 + x^2 - x)^{100}$ is $n$, then the value of $n/101$ is equal to

**86.** Find the number of integers lying in the domain of the function
$$f(x) = \sqrt{\log_{(0.5)}\left(\frac{5-2x}{x}\right)} \text{ is}$$

**87.** A teacher takes three children from her class to the zoo at a time, but she does not take the same children to the zoo more than once. She finds that she went to the zoo 84 times more than a particular child has gone to the zoo. Find the number of children in her class.

**88.** If three normals are drawn from the point ($c$, 0) to the parabola $y^2 = 4x$ and two of which are perpendicular, then the value of $c$ is equal to

**89.** If the range of the function $f(x) = 6^x + 3^x + 6^{-x} + 3^{-x} + 2$ is $[k, \infty)$, then the value of $k$ is

**90.** If $\frac{\sin 3\theta + \sin 5\theta + \sin 7\theta + \sin 9\theta}{\cos 3\theta + \cos 5\theta + \cos 7\theta + \cos 9\theta} = \tan k\theta$, then find the value of $k$.