Exam Code

# 11th JEE SET-8, 08.08.2020

Test Booklet Code

**1.** Which of the following cases the net force acting on the body is not zero?

(a) A drop of rain falling down with a constant speed
(b) A cork of mass $10g$ floating on the surface of water
(c) A car moving with a constant speed of $20kmh^{-1}$ on a Rough road:
(d) A pebble of mass $0.05kg$ is thrown vertically upwards

**2.** A ball of mass $m$ strikes a rigid wall with speed $u$ and rebounds with the same speed. The impulse imparted to the ball by the wall is

(a) $2mu$
(b) $Mu$
(c) Zero
(d) $-2mu$

**3.** The motion of particle of mass $m$ is given by $y = ut + \frac{1}{2}gt^2$

The force acting on the particle is

(a) $mg$
(b) $\frac{mu}{t}$
(c) $2mg$
(d) $\frac{2mu}{t}$

**4.** A constant retarding force of $50N$ is applied to a body of mass $10kg$ moving initially with a speed of $10ms^{-1}$. The body comes to rest after

(a) $2s$
(b) $4s$
(c) $6s$
(d) $8s$

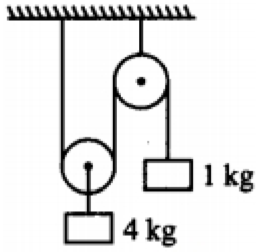
**5.** A car accelerates on a horizontal road due to the force exerted by:

(a) The engine of the car
(b) The driver of the car
(c) The car on earth
(d) The road on the car

**6.** A block of mass $m$ rests on a rough inclined plane. The coefficient of friction between the surface and the block is $\mu$. At what angle of inclination $\theta$ of the plane to the horizontal will the block just start to slide down the plane?

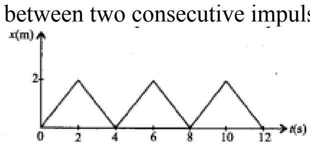
(a) $\theta = \tan^{-1} \mu$
(b) $\theta = \cos^{-1} \mu$
(c) $\theta = \sin^{-1} \mu$
(d) $\theta = \sec^{-1} \mu$

**7.** In the system shown in the figure, the acceleration of $1kg$ mass is :



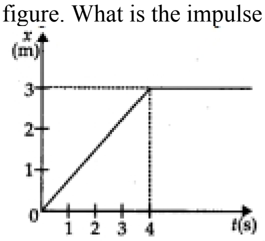

(a) $\frac{g}{4}$ downwards
(b) $\frac{g}{2}$ downwards
(c) $\frac{g}{2}$ upwards
(d) $\frac{g}{4}$ upwards

**8.** Figure shows the position-time (x-t) graph of one dimensional motion of a body of mass $500g$. What is the time interval between two consecutive impulses received by the body?



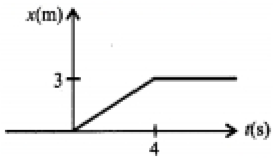

(a) $2s$
(b) $4s$
(c) $6s$
(d) $8s$

**9.** The position-time graph of a body of mass $2kg$ is as shown in figure. What is the impulse on the body at $t$ $4s?$



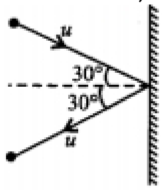

(a) $\frac{2}{3} kgms - 1$
(b) $-\frac{2}{3} kgms^{-1}$
(c) $\frac{3}{2} kgms^{-1}$
(d) $-\frac{3}{2} kgms^{-1}$

**10.** Figure shows the position-time graph of a particle of mass $\mathbf{4kg}$. Let the force on the particle for $t<0, 0<t<4\mathrm{s}, t\mathrm{F}_2>4\mathrm{s}$ be $F_1$, and $F_3$ respectively. Then:



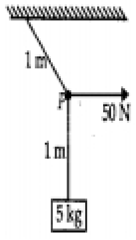

(a) $\mathrm{F}_1=\mathrm{F}_2=\mathrm{F}_3=0$
(b) $F_1>F_2=F_3$
(c) $\mathrm{F}_1>\mathrm{F}_2>\mathrm{F}_3$
(d) $\mathrm{F}_1<\mathrm{F}_2<\mathrm{F}_3$

**11.** A ball of mass $m$ strikes a rigid wall with speed $u$ at an angle of $30^{\circ}$ and get reflected with the same speed and at the same angle as shown in the figure. If the ball is in contact with the wall for time $t$, then the force acting on the wall is :




(a) $\frac{\mathrm{mu}\sin 30^{\circ}}{\mathrm{t}}$
(b) $\frac{2\mathrm{mu}\sin 30^{\circ}}{\mathrm{t}}$
(c) $\frac{\mathrm{mu}\cos 30^{\circ}}{\mathrm{t}}$
(d) $\frac{2\mathrm{mu}\cos 30^{\circ}}{\mathrm{t}}$

**12.** A block of mass $\mathbf{5kg}$ is suspended by a mass less rope of length $\mathbf{2m}$ from the ceiling. A force of $\mathbf{50N}$ is applied in the horizontal direction at the midpoint $\mathbf{P}$ of the rope, as shown in the figure :
The angle made by the rope with the vertical in equilibrium is (Take $\mathrm{g}=10\mathrm{ms}^{-2}$ )

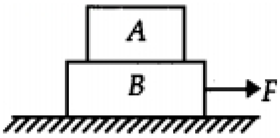



(a) $30^{\circ}$
(b) $40^{\circ}$
(c) $60^{\circ}$
(d) $45^{\circ}$

**13.** A body of mass $\mathbf{10kg}$ is acted upon by two perpendicular forces, $\mathbf{6N}$ and $\mathbf{8N}$. The resultant acceleration of the body is :

(a) $1\mathrm{ms}^{-2}$ at an angle of $\tan^{-1}\left(\frac{3}{4}\right)$ w.r.t. $\mathbf{8N}$ force
(b) $0.2\mathrm{ms}^{-2}$ at an angle of $\tan^{-1}\left(\frac{3}{4}\right)$ w.r.t. $\mathbf{8N}$ force
(c) $1\mathrm{ms}^{-2}$ at an angle of $\tan^{-1}\left(\frac{4}{3}\right)$ w.r.t. $\mathbf{8N}$ force
(d) $0.2\mathrm{ms}^{-2}$ at an angle of $\tan^{-1}\left(\frac{4}{3}\right)$ w.r.t. $\mathbf{8N}$ force

**14.** In figure, the coefficient of friction between the floor and the block $\mathrm{B}$ is $0.1$. The coefficient of friction between the blocks $\mathrm{B}$ and $\mathrm{A}$ is $0.2$. The mass of a is $\mathrm{m}/2$ and of $\mathrm{B}$ is $\mathrm{m}$. What is the maximum horizontal force $\mathbf{F}$ can be applied to the block $\mathrm{B}$ so that two blocks move together?

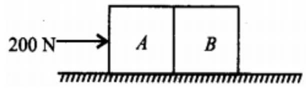



(a) $0.15\mathrm{mg}$
(b) $0.05\mathrm{mg}$
(c) $0.1\mathrm{mg}$
(d) $0.45\mathrm{mg}$

**15.** The minimum force required to start pushing a body up a rough (frictional coefficient $\mu$ ) inclined plane is $F_1$ while the minimum force needed to prevent it from sliding down is $\mathrm{F}_2$. If the inclined plane makes an angle $\theta$ with the horizontal such that $\tan\theta=2\mu$, then the ratio $\frac{\mathrm{F}_1}{\mathrm{F}_2}$ is :

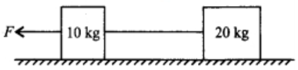
(a) 4
(b) 1
(c) 2
(d) 3

**16.** Two blocks $A$ and $B$ of masses $\mathbf{10kg}$ and $\mathbf{15kg}$ are placed in contact with cach other rest on a rough horizontal surface as shown in the figure. The coefficient of friction between the blocks and surface is $0.2$. A horizontal force of $\mathbf{200N}$ is applied to block $\mathbf{A}$. The acceleration of the system is : (Take $\mathrm{g}=10\mathrm{ms}^{-2}$ )



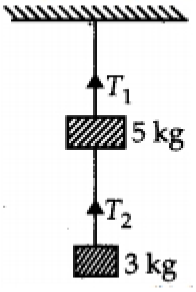

(a) $4\mathrm{ms}^{-2}$
(b) $6\mathrm{ms}^{-2}$
(c) $8\mathrm{ms}^{-2}$
(d) $10\mathrm{ms}^{-2}$

**17.** Two blocks of masses $10\mathrm{kg}$ and $20\mathrm{kg}$ are connected by a massless string and are placed on a smooth horizontal surface as shown in the figure. If a force $\mathrm{F}=600\mathrm{N}$ is applied to $10\mathrm{kg}$ block, then the tension in the string is :



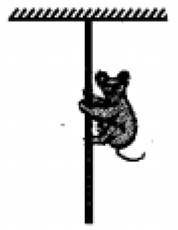

(a) $100\mathrm{N}$
(b) $200\mathrm{N}$
(c) $300\mathrm{N}$
(d) $400\mathrm{N}$

**18.** Two masses of $5\mathrm{kg}$ and $3\mathrm{kg}$ dare suspended with the help of massless inextensible strings as shown in figure. The whole system is going upwards with an acceleration of $2\mathrm{ms}^{-2}$. The tensions $\mathrm{T}_1$ and $\mathrm{T}_2$ are respectively (Take $\mathrm{g}=10\mathrm{ms}^{-2}$ )




(a) $96\mathrm{N}, 36\mathrm{N}$
(b) $36\mathrm{N}, 96\mathrm{N}$
(c) $96\mathrm{N}, 96\mathrm{N}$
(d) $36\mathrm{N}, 36\mathrm{N}$

**19.** A monkey of mass $40\mathrm{kg}$ climbs on a massless rope which can stand a maximum tension of $500\mathrm{N}$. In which of the following cases will the rope break? (Take $\mathrm{g}=10\mathrm{ms}^{-2}$ )

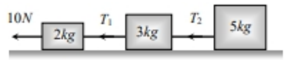


(a) The monkey climbs up with an acceleration of $5\mathrm{ms}^{-2}$
(b) The monkey climbs down with an acceleration of $5\mathrm{ms}^{-2}$
(c) The monkey climbs up with a uniform speed of $5\mathrm{ms}^{-2}$
(d) The monkey falls down the rope freely under gravity

**20.** A marble block of mass $2$ kg lying on ice when given a velocity of $6\mathrm{m}/\mathrm{s}$ is stopped by friction in $10\mathrm{s}$. Then the coefficient of friction is

(a) $0.01$
(b) $0.02$
(c) $0.03$
(d) $0.06$

**21.** Three blocks of masses $2\mathrm{kg}, 3\mathrm{kg}$ and $5\mathrm{kg}$ are connected to each other with light string and are then placed on a frictionless surface as shown in the figure. The system is pulled by a force $F=10N$, then tension $T_1=$

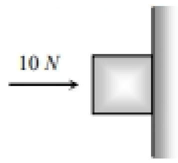



**22.** A block of mass $5\mathrm{kg}$ is moving horizontally at a speed of $1.5\mathrm{m}/\mathrm{s}$. A perpendicular force of $5\mathrm{N}$ acts on it for $4\mathrm{sec}$. What will be the distance of the block from the point where the force started acting

**23.** On the horizontal surface of a truck $(\mu=0.6)$, a block of mass $1\mathrm{kg}$ is placed. If the truck is accelerating at the rate of $5\mathrm{m}/\mathrm{sec}^2$ then frictional force on the block will be

**24.** A block of mass $10\mathrm{kg}$ is placed on a rough horizontal surface having coefficient of friction $\mu=0.5$. If a horizontal force of $100\mathrm{N}$ is acting on it, then acceleration of the block will be

**25.** A horizontal force of $10N$ is necessary to just hold a block stationary against a wall. The coefficient of friction between the block and the wall is $0.2$. The weight of the block is




**26.** How many neutrons are there in ${}^{88}_{38}\mathrm{Sr}$ ?

(a) $38$
(b) $50$
(c) $126$
(d) $88$

**27.** What is the electronic configuration of $\mathrm{O}^{2-}$ ion?

(a) $1\mathrm{s}^2 2\mathrm{s}^2 2\mathrm{p}^6$
(b) $1\mathrm{s}^2 2\mathrm{s}^2 2\mathrm{p}^4$
(c) $1\mathrm{s}^2 2\mathrm{s}^2 2\mathrm{p}^5$
(d) $1\mathrm{s}^2 2\mathrm{s}^2 2\mathrm{p}^3$

**28.** An element with mass number $81$ contains $31.7\%$ more neutrons as compared to protons. Find the symbol of the atom.

(a) $^{81}_{34}Se$
(b) $^{18}_{35}Br$
(c) $^{18}_{36}Kr$
(d) $^{18}_{37}Rb$

**29.** The radius of hydrogen atom in ground state is $0.53$Å. What will be the radius of $_3Li^{2+}$ in the ground state?

(a) $1.06$Å
(b) $0.265$Å
(c) $0.17$Å
(d) $0.53$Å

**30.** What will be the uncertainty in velocity of an electron when the uncertainty in its position is $1000$Å?

(a) $5.79 \times 10^2 ms^{-1}$
(b) $5.79 \times 10^8 ms^{-1}$
(c) $5.79 \times 10^4 ms^{-1}$
(d) $5.79 \times 10^{-10} ms^{-1}$

**31.** Few statements are given regarding nodes in the orbitals. Mark the statement which is not correct.

(a) In case of $P_z$ - orbital, xy plane is a nodal plane.
(b) $ns$- orbital has $(n+1)$ nodes.
(c) The number of angular nodes is given by $l$.
(d) The total number of nodes is given by $(n-1)$ i.e., sum of $1$ angular nodes and $(n-1-1)$ radial nodes.

**32.** In how many elements the last electron will have the following set of quantum numbers, $n=3$ and $l=1$?

(a) $2$
(b) $8$
(c) $6$
(d) $10$

**33.** An orbital described with the help of a wave function. Since many wave functions are possible for an electron, there are many atomic orbitals. When atom is placed in a magnetic field the possible number of orientations for an orbital of azimuthal quantum number $3$ is

(a) Three
(b) Two
(c) Five
(d) Seven

**34.** Which of the following quantum numbers are correct for the outermost electron of sodium atom?

(a) $n=4, 1=0, m=0, s=+1/2$
(b) $n=3, 1=0, m=0, s=-1/2$
(c) $n=3, l=1, m=+1, s=+1/2$
(d) $n=3, l=2, m=-1, s=-1/2$

**35.** If travelling at same speeds, which of the following matter waves have the shortest wavelength?

(a) Electron
(b) Alpha particle $(He^{2+})$
(c) Neutron
(d) Proton

**36.** A certain metal when irradiated by light $(v = 3.2 \times 10^6 Hz)$. Emits photoclectrons with twice $K.E$ . as did photoclectrons when the same metal is irradiated by light $(v = 2.0 \times 10^{16} Hz$ ). The $v_o$ of the metal is.

(a) $1.2 \times 10^{14} Hz$
(b) $8 \times 10^{15} Hzz$
(c) $1.2 \times 10^{16} Hz$
(d) $4 \times 10^{12} Hz$

**37.** The energy difference between the ground state of an atom and its excited state is $3 \times 10^{-19} J$. What is the wavelength of the photon required for this transition?

(a) $6.6 \times 10^{-34} m$
(b) $3 \times 10^{-8} m$
(c) $1.8 \times 10^{-7} m$
(d) $6.6 \times 10^{-7} m$

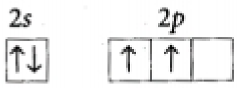
**38.** If the ionization energy of hydrogen atom is $13.6eV$, the energy required to excite it from ground state to the next higher state is approximately.

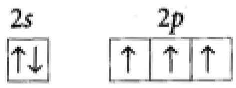
(a) $3.4eV$
(b) $10.2eV$
(c) $17.2eV$
(d) $13.6eV$

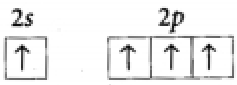
**39.** What will be the uncertainty in velocity of a bullet with a mass of $10g$ whose position is known with $\pm 0.01mm$?

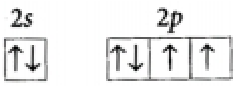
(a) $5.275 \times 10^{-33} ms^{-1}$
(b) $5.275 \times 10^{-25} ms^{-1}$
(c) $5.275 \times 10^{-5} ms^{-1}$
(d) $5.275 \times 10^{-28} ms^{-1}$

**40.** The orbital diagram in which the Aufbau principle is violated is

(a) 

(b) 

(c) 

(d) 

**41.** Assuming that a $25$ watt bulb emits monochromatic yellow light of wave length $0.57\mu$. The rate of emission of quanta per sec. will be

(a) $5.89 \times 10^{13} \sec^{-1}$
(b) $7.28 \times 10^{17} \sec^{-1}$
(c) $5 \times 10^{10} \sec^{-1}$
(d) $7.18 \times 10^{19} \sec^{-1}$

**42.** The wave number of first line of Balmer series of hydrogen atom is $15200 \mathrm{cm}^{-1}$. What is the wave number of first line of Balmer series of $Li^{3+}$ ion.

(a) $15200 \mathrm{cm}^{-1}$
(b) $6080 \mathrm{cm}^{-1}$
(c) $76000 \mathrm{cm}^{-1}$
(d) $1,36800 \mathrm{cm}^{-1}$

**43.** If the total encrgy of an electron in hydrogen like atom in excited state is $-3.4 \mathrm{eV}$, then the de Broglic wavelength of the clectron is

(a) $6.6 \times 10^{-10}$
(b) $3 \times 10^{-10}$
(c) $5 \times 10^{9}$
(d) $9.3 \times 10^{-12}$

**44.** The threshold frequency of a metal is $1 \times 10^{15} \mathrm{s}^{-1}$. The ratio of maximum kinetic energies of the photoelectrons when the metal is irradiated with radiations of frequencies $1.5 \times 10^{15}$ $\mathrm{s}^{-1}$ and $2.0 \times 10^{15} \mathrm{s}^{-1}$ respectively, would be -

(a) $3 : 4$
(b) $1 : 2$
(c) $2 : 1$
(d) $4 : 3$

**45.** Which of the following set of quantum numbers represents the highest energy of an atom ?

(a) $\mathrm{n}=3, l=0, \mathrm{m}=0, \mathrm{s}=+\frac{1}{2}$
(b) $\mathrm{n}=3, l=1, \mathrm{m}=1, \mathrm{s}=+\frac{1}{2}$
(c) $\mathrm{n}=3, l=2, \mathrm{m}=1, \mathrm{s}=+\frac{1}{2}$
(d) $\mathrm{n}=4, l=0, \mathrm{m}=0, \mathrm{s}=+\frac{1}{2}$

**46.** The number of electrons in sulphur atom having $n+\ell=3$?

**47.** Find out the degeneracy of hydrogen atom that has the energy equal $-\frac{R_H}{9}$. ($R_H-$ Rydberg constant).

**48.** How many maximum quantum number can be same for two electrons in an atom.

**49.** Find out the number of waves made by a Bohr electron in one complete revolution in its $3^{\text{rd}}$ orbit.

**50.** The number of spectral lines produced when an electron jumps from $5^{\text{th}}$ orbit in the hydrogen atom is.

**51.** If $\operatorname{cosec} A+\cot A=\frac{11}{2}$, then $\tan A=$

(a) $\frac{21}{22}$
(b) $\frac{15}{16}$
(c) $\frac{44}{117}$
(d) $\frac{117}{43}$

**52.** If $2 y \cos \theta=x \sin \theta$ and $2 x \sec \theta-y \operatorname{cosec} \theta=3$, then $x^2+4 y^2=$

(a) $4$
(b) $-4$
(c) $\pm 4$
(d) None of these

**53.** If $\tan A+\cot A=4$, then $\tan^4 A+\cot^4 A$ is equal to

(a) $110$
(b) $191$
(c) $80$
(d) $194$

**54.** If $x=a\cos^3\theta, y=b\sin^3\theta$, then

(a) $\left(\frac{a}{x}\right)^{2/3}+\left(\frac{b}{y}\right)^{2/3}=1$
(b) $\left(\frac{b}{x}\right)^{2/3}+\left(\frac{a}{y}\right)^{2/3}=1$
(c) $\left(\frac{x}{a}\right)^{2/3}+\left(\frac{y}{b}\right)^{2/3}=1$
(d) $\left(\frac{x}{b}\right)^{2/3}+\left(\frac{y}{a}\right)^{2/3}=1$

**55.** If $(\sec\alpha+\tan\alpha)(\sec\beta+\tan\beta)(\sec\gamma+\tan\gamma)=\tan\alpha\tan\beta\tan\gamma$, then $(\sec\alpha-\tan\alpha)(\sec\beta-\tan\beta)(\sec\gamma-\tan\gamma)=$

(a) $\cot\alpha\cot\beta\cot\gamma$
(b) $\tan\alpha\tan\beta\tan\gamma$
(c) $\cot\alpha+\cot\beta+\cot\gamma$
(d) $\tan\alpha+\tan\beta+\tan\gamma$

**56.** If $\tan\theta-\cot\theta=a$ and $\sin\theta+\cos\theta=b$, then $\left(b^2-1\right)^2\left(a^2+4\right)$ is equal to

(a) $2$
(b) $-4$
(c) $\pm4$
(d) $4$

**57.** If $\alpha=22^\circ 30'$, then $(1+\cos\alpha)(1+\cos3\alpha)\quad(1+\cos5\alpha)(1+\cos7\alpha)$ equals

(a) $1/8$
(b) $1/4$
(c) $\frac{1+\sqrt{2}}{2\sqrt{2}}$
(d) $\frac{\sqrt{2}-1}{\sqrt{2}+1}$

**58.** If $\pi<\alpha<\frac{3\pi}{2}$, then $\sqrt{\frac{1-\cos\alpha}{1+\cos\alpha}}+\sqrt{\frac{1+\cos\alpha}{1-\cos\alpha}}=$

(a) $\frac{2}{\sin\alpha}$
(b) $-\frac{2}{\sin\alpha}$
(c) $\frac{1}{\sin\alpha}$
(d) $-\frac{1}{\sin\alpha}$

**59.** If $\tan A=2\tan B+\cot B$, then $2\tan(A-B)=$

(a) $\tan B$
(b) $2\tan B$
(c) $\cot B$
(d) $2\cot B$

**60.** If $\sin A+\sin B=C, \cos A+\cos B=D$, then the value of $\sin(A+B)=$

(a) $CD$
(b) $\frac{CD}{C^2+D^2}$
(c) $\frac{C^2+D^2}{2CD}$
(d) $\frac{2CD}{C^2+D^2}$

**61.** If $y=(1+\tan A)(1-\tan B)$ where $A-B=\frac{\pi}{4}$, then $(y+1)^{y+1}$ is equal to

(a) $9$
(b) $4$
(c) $81$
(d) $81$

**62.** If $A+B=225^\circ$, then $\frac{\cot A}{1+\cot A}\cdot\frac{\cot B}{1+\cot B}=$

(a) $1$
(b) $-1$
(c) $0$
(d) $1/2$

**63.** $\frac{1}{\sin10^\circ}-\frac{\sqrt{3}}{\cos10^\circ}=$

(a) $0$
(b) $1$
(c) $2$
(d) $4$

**64.** $\dfrac{\sin^2 A-\sin^2 B}{\sin A\cos A-\sin B\cos B}=$

(a) $\tan(A-B)$
(b) $\tan(A+B)$
(c) $\cot(A-B)$
(d) $\cot(A+B)$

**65.** If $\cos(\alpha+\beta)=\dfrac{4}{5}, \sin(\alpha-\beta)=\dfrac{5}{13}$ and $\alpha,\beta$ lie between $0$ and $\dfrac{\pi}{4}$, then $\tan 2\alpha=$

(a) $\dfrac{16}{63}$
(b) $\dfrac{56}{33}$
(c) $\dfrac{28}{33}$
(d) None of these

**66.** If $\cos(A-B)=\dfrac{3}{5}$ and $\tan A\tan B=2,$ then

(a) $\cos A\cos B=\dfrac{1}{5}$
(b) $\sin A\sin B=-\dfrac{2}{5}$
(c) $\cos A\cos B=-\dfrac{1}{5}$
(d) $\sin A\sin B=-\dfrac{1}{5}$

**67.** If $\cos x+\cos y+\cos\alpha=0$ and $\sin x+\sin y+\sin\alpha=0,$ then $\cot\left(\dfrac{x+y}{2}\right)=$

(a) $\sin\alpha$
(b) $\cos\alpha$
(c) $\cot\alpha$
(d) $\sin\left(\dfrac{x+y}{2}\right)$

**68.** $\sec 50^\circ+\tan 50^\circ$ is equal to

(a) $\tan 20^\circ+\tan 50^\circ$
(b) $2\tan 20^\circ+\tan 50^\circ$
(c) $\tan 20^\circ+2\tan 50^\circ$
(d) $2\tan 20^\circ+2\tan 50^\circ$

**69.** $\tan 9^\circ-\tan 27^\circ-\tan 63^\circ+\tan 81^\circ=$

(a) $1/2$
(b) $2$
(c) $4$
(d) $8$

**70.** The minimum value of $3\sin\theta+4\cos\theta$ is

(a) $5$
(b) $1$
(c) $3$
(d) $-5$

**71.** $\cos(2001)\pi+\cot(2001)\dfrac{\pi}{2}+\sec(2001)\dfrac{\pi}{3}+\tan(2001)\dfrac{\pi}{4}+\text{cosec}(2001)\dfrac{\pi}{6}+2=\ldots\ldots$

**72.** If $15\sin^4\alpha+10\cos^4\alpha=6$ then value of $8\,\text{cosec}^6\alpha+27\sec^6\alpha-241$ is

**73.** The numerical value of Expression $\sin^2 A-\cos B(\cos B+\cos A\cos C)-\cos C(\cos C+\cos A\cos B)$ in a triangle is

**74.** The value of expression $\mathrm{E}=\cos^4\mathrm{x}-\mathrm{k}^2\cos^2 2\mathrm{x}+\sin^4\mathrm{x}$ which is independent of $\mathrm{x}$ is $\dfrac{1}{\mathrm{t}}$ then $\mathrm{t}$ equals

**75.** $(1-\cot 1^\circ)(1-\cot 2^\circ)(1-\cot 3^\circ)\ldots(1-\cot 44^\circ)=2^{\mathrm{n}}$ then $\mathrm{n}=10\mathrm{k}+\mathrm{k}.$ What is $\mathrm{k}$

Exam Code

# Answer Key

Test Booklet Code

**1. Answer:** d

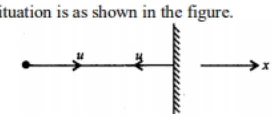
**Solution**

(d) : As the rain drop is falling down with a constant speed, its acceleration, a=0 Hence, net force on the drop = ma=0. As the cork is floating on the surface of water, its weight is balanced by the upthrust. Hence net force on the cork is zero.
The force exerted by the engine is balanced by the friction due to rough road. As the car is moving with constant velocity, it's acceleration a=0 Hence. Net force on the car, F=ma=0
Whenever a body is thrown vertically upwards gravitational pull of earth gives it a uniform acceleration a=g in downward direction.
Hence, net force on the pebble
$=mg=0.05\times10=0.5\,N$ vertically downwards

**2. Answer:** d

**Solution**

: The situation is as shown in the figure.




$p_{initial}=mu, p_{final}=-mu$
Impulse imparted to the ball = Change in momentum
$=p_{final}-p_{initial}=-mu-mu=-2mu$

**3. Answer:** a

**Solution**

: Here $y=ut+\frac{1}{2}gt^2$

velocity $v=\frac{dy}{dt}=u+gt$

Acceleration, $a=\frac{dv}{dt}=g$

The force acting on the particle is
$F=ma=mg$

**4. Answer:** a

**Solution**

: Here, F = -50 N
(-ve sing for retardation
$m=10kg, u=10ms^{-1}, v=0$
As F = ma+ +++++
$\therefore a=\frac{F}{m}=\frac{-50}{10kg}=-5ms^{-2}$
$v=u+at$
Using $\therefore t=\frac{v-u}{a}=\frac{0-10ms^{-1}}{-5ms^{-2}}=2s$

**5. Answer:** d

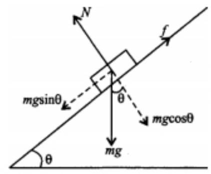
**Solution**

A car accelerates on a horizontal road due to the force exerted by the road on the car

**6. Answer:** a

**Solution**

The various forces acting on the block are as shown in the figure.



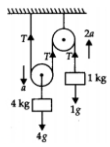

From figure
$mg\sin\theta=f$ ...... (i)
$mg\cos\theta=N$ ..... (ii)
Divide (i) by (ii) we get

$\tan\theta=\frac{f}{N}=\frac{\mu N}{N}$ or $\theta=\tan^{-1}(\mu)$

**7. Answer:** c

**Solution**

If a is downward acceleration of 4 kg block, the upward acceleration of 1 kg block must be 2a
Let T be tension in each part of string. The equation of motion on 4 kg block is




$4g-2T=4a$ ..... (i)
The equation of motion or 1 kg block is
$T-1g=1\times2a$ ...(ii)
Or $2T-2g=4a$ ....(iii)
Adding (i) and (iii) we get
$2g=8a$ or $a=\frac{g}{4}$
$\therefore$ Acceleration of 1 kg block
$=2a=\frac{g}{2}$ upwards.

**8. Answer:** a

**Solution**

figure shows that slope of x-t graph changes from positive to negative at $t=2$ s and it changes from negative to positive at $t=4s$ and so on. Thus direction of velocity is reversed after every two seconds. Hence, the body must be receiving consecutive impulses after every two seconds.

**9. Answer:** d

**Solution**

: At t=4s the body has constant velocity
$u=\frac{3}{4}ms^{-1}$
After $t=4\,s$ the body is at rest i.e. v= 0
$\therefore$ Impulse $=m(v-u)$
$=2kg(0-\frac{3}{4}ms^{-1})=-\frac{3}{4}kg\,ms^{-1}$

**10. Answer:** a

**Solution**

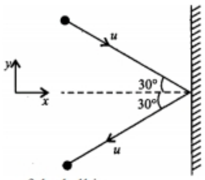
For $t<0$ and $t>4s$ the position of the particle is not chaining i.e. the particle is at rest so no force is acting on the particle at these intervals.

For $0<t<4s$ the position of the particle is continuously chaining. As the position – time graph is s straight line, the motion of the particle is uniform, so acceleration, a=0 Hence no force acts on the particle during this interval also.

**11. Answer:** d

**Solution**

(d)




Initial momentum of the ball is

$\overrightarrow{p_i} = mu\cos 30°\hat{i} - mu\sin\theta\hat{j}$

Final momentum of the ball is

$\overrightarrow{p_f} = -mu\cos 30°\hat{i} - mu\sin 30\hat{j}$

$\therefore$ Change in momentum

$\Delta\vec{p} = \overrightarrow{p_f} - \overrightarrow{p_i} = -2mu\cos 30°\hat{i}$

Impulse = Change in momentum = $-2mu\cos 30°\hat{i}$

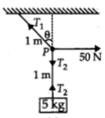
As impulse and force are in the same direction, therefore force on the ball due to the wall is normal to the wall along the negative x-axis. Using Newton's $3^{rd}$ law of motion the force on the wall due to the ball is normal to the wall along the positive x- direction

$$\therefore F = \frac{2mu\cos 30°}{t}$$

**12. Answer:** d

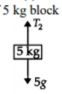
**Solution**

let $\theta$ be the angle made by rope with the vertical in equilibrium




(a)

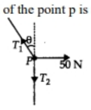
The free body diagram of 5 kg block is as shown in fig (b)




(b)

In equilibrium $T_2 = 5g = 5\times 10 = 50N$

The free body diagram of the point p is as shown in fig (c)




(c)

In equilibrium $T_1\sin\theta = 50N....(i)$

$T_1\cos\theta = T_2 = 50N....(ii)$

Dividing (i) by (ii) we get

$\tan\theta = \frac{50}{50} = 1$

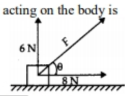
$\theta = \tan^{-1}(1) = 45°$

**13. Answer:** a

**Solution**

: Here m= 10 kg

The resultant force acting on the body is




$F = \sqrt{(8N)^2 + (6N)^2} = 10N$

Let the resultant force F makes an angle $\theta$ w.r.t 8N force

From figure $\tan\theta = \frac{6N}{8N} = \frac{3}{4}$

The resultant acceleration of the body is

$a = \frac{F}{m} = \frac{10N}{10kg} = 1ms^{-2}$

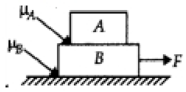
The resultant acceleration is along the direction of the resultant force

Hence, the resultant acceleration of the body is $1ms^{-2}$ at an angle of $\tan^{-1}\left(\frac{3}{4}\right)$ w.r.t. 8N force

**14. Answer:** d

**Solution**

: Here $m_A = \frac{m}{2}, m_B = m$




$\mu_A = 0.2, \mu_B = 0.1$

Let both the blocks are moving with common acceleration a then

$a = \frac{\mu_A m_A g}{m_A} = \mu_A g = 0.2g$

And

$F - \mu_B(m_B + m_A)g = (m_B + m_A)a$

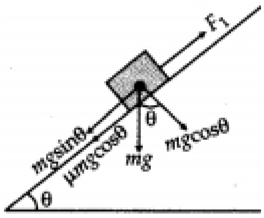
$F = (m_B + m_A)a + \mu_B(m_B + m_A)g$

$= \left(m + \frac{m}{2}\right)(0.2g) + (0.1)\left(m + \frac{m}{2}\right)g$

$= \left(\frac{3}{2}m\right)(0.2g) + \left(\frac{3}{2}m\right)(0.1g) = \frac{0.9}{2}mg = 0.45mg$

**15. Answer:** d

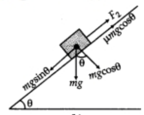
**Solution**




(a)

The minimum force required to start pushing a body up a rough inclined plane is

$F_1 = mg\sin\theta + \mu mg\cos\theta .......(i)$




(b)

Minimum force needed to prevent the body from sliding down the inclined plane is

$F_2 = mg\sin\theta - \mu mg\cos\theta .......(i)$

Divide (i) by (ii) we get

$\frac{F_1}{F_2} = \frac{\sin\theta + \mu\cos\theta}{\sin\theta - \mu\cos\theta} = \frac{\tan\theta + \mu}{\tan\theta - \mu}$

$= \frac{2\mu + \mu}{2\mu - \mu} = 3 \quad (\because \tan\theta = 2\mu(Given))$

**16. Answer:** b

**Solution**

(b) : Here Mass of block A,

$m_A = 10kg$

Mass of block B, $m_B = 15kg$

Coefficient of friction between the blocks and the surface, $\mu = 0.2$

Applied force =200N

Force of friction on

$A = \mu N_A = \mu m_A g = 0.2 \times 10 \times 10 = 20N$

Force of friction on

$B = \mu N_B = \mu m_B g = 0.2 \times 15 \times 10 = 30N$

Taking two blocks forming one system, therefore net force acting on the blocks is

$F = 200 - 20 - 30 = 150N$

Let a be common acceleration of the system

$\therefore a = \frac{F}{m_A + m_B} = \frac{150N}{(10+15)kg} = 6ms^{-2}$

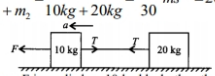
**17. Answer:** d

**Solution**

Here $m_1 = 10kg, m_2 = 20kg, F = 600N$

Let T be tension of the string and a be common acceleration of the system

$\therefore a = \frac{F}{m_1 + m_2} = \frac{600N}{10kg + 20kg} = \frac{600}{30} ms^{-2} = 20ms^{-2}$



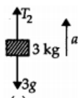

when a force F is applied on 10 kg block, then the tension in the string is

$T = m_2 a = (20kg)(20ms^{-2}) = 400N$

**18. Answer:** a

**Solution**

The free body diagram of 3 kg block is shown In the fig (a)




(a)

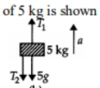
The equation of motion of 3 kg block is

$T_2 - 3g = 3a$

$T_2 - 3(a + g$

$= 3(2 + 10) = 36N$ ..... (i)

The free body diagram of 5 kg block is shown as in the fig (b)




(b)

The free body diagram of 5 kg block is

$T_1 - T_2 - 5g = 5a$

$T_1 = 5(a + g) + T_2$

$= 5(2 + 10)36$

$= 96N$

**19. Answer:** a

**Solution**

(a) Here mass of monkey m = 40kg

Maximum tension the rope can stand T = 500N

Tension in the rope will be equal to apparent weight of the monkey (R)

The rope will break when R exceeds T

(a) When the monkey climbs up with an acceleration $a = 5ms^{-2}$

$R = m(g + a) = 40(10 + 5) = 600N$

R>T

Hence the roe will break

(b) When the monkey climbs down with an acceleration

$a = 5ms^{-2}$

$R = m(g - a) = 40(10 - 5) = 200N$

R<T

Hence the rope will not break

(c) When the monkey climbs up with a uniform speed

$v = 5ms^{-1}$ its acceleration a=0

$\therefore R = mg = 40 \times 10 = 400N$

R<T

Hence the rope will not break

(d) When the monkey falls down the rope freely under gravity

$a = g$

$\therefore R = mg(g - a) = m(g - g) = zero$

Hence the rope will not break

**20. Answer:** d

**Solution**

$v = u - at = u - \mu g t = 0$

$\therefore \mu = \frac{u}{gt} = \frac{6}{10 \times 10} = 0.06$ .

**21. Answer:** 8

**Solution**

By comparing the above problem with general expression.

$T_1 = \frac{(m_2 + m_3)F}{m_1 + m_2 + m_3} = \frac{(3+5)10}{2+3+5} = 8\,Newton$

**22. Answer:** 10

**Solution**

In the given problem force is working in a direction perpendicular to initial velocity. So the body will move under the effect of constant velocity in horizontal direction and under the effect of force in vertical direction.

$S_x = u_x \times t = 1.5 \times 4 = 6m$

$S_y = u_y t + \frac{1}{2}at^2 = 0 + \frac{1}{2}(F/m)t^2 = \frac{1}{2}(5/5)(4)^2 = 8m$

$\therefore S = \sqrt{S_x^2 + S_y^2} = \sqrt{36 + 64} = \sqrt{100} = 10m$

**23. Answer:** 5

**Solution**

Limiting friction $= \mu_s R = \mu_s mg = 0.6 \times 1 \times 9.8 = 5.88N$

When truck accelerates in forward direction at the rate of $5m/s^2$ a pseudo force $(ma)$ of $5N$ works on block in back ward direction. Here the magnitude of pseudo force is less than limiting friction So, static friction works in between the block and the surface of the truck and as we know, static friction = Applied force = $5N$.

**24. Answer:** 5

**Solution**

$a = \frac{\text{Applied force} - \text{kinetic friction}}{\text{mass}} = \frac{100 - 0.5 \times 10 \times 10}{10}$

$= 5m/s^2$.

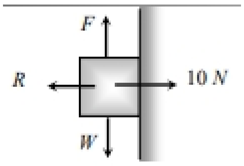
**25. Answer:** 2

**Solution**

For equilibrium

Weight ($W$) = Force of friction ($F$)

$W = \mu R = 0.2 \times 10 = 2N$




**26. Answer:** b

**Solution**

(b): $^{88}_{38}Sr$

Atomic number = No. of protons= No. of electrons = 38

Atomic mass = 88

Number of neutrons = 88 − 38 = 50

**27. Answer:** a

**Solution**

(a): $O^{2-}$ ion contains 2 electrons more than O. Hence its electronic configuration will be $1s^2 2s^2 2p^6$

**28. Answer:** b

**Solution**

(b): Mass number of the element = 81 i.e., p + n = 81 Let the number of protons be x.

Number of neutrons

$= x + \frac{31.7}{100} \times x = 1.317x$

$\therefore x + 1.317x = 81$ or $2.317x = 81$

or $x = \frac{81}{2.317} = 35$

symbol of the element $= ^{81}_{35}Br$

**29. Answer:** c

**Solution**

(c): Radius of n[th] orbit is given by $r_n = \frac{r_0 \times n^2}{Z}$

Fro $_3Li^{2+}, r = \frac{r_0}{3} = \frac{0.53}{3} = 0.176 \mathring{A}$

**30. Answer:** a

**Solution**

(a): $\Delta x . m \Delta v = \frac{h}{4\pi}$

$\Delta x = 1000 \mathring{A} = 1000 \times 10^{-10}$ m or $10^{-7}$ m

$\Delta v = \frac{6.626 \times 10^{-34} Js}{4 \times 3.14 \times 9.1 \times 10^{-31} kg \times 10^{-7} m} = 5.79 \times 10^2 m/s$

**31. Answer:** b

**Solution**

: ns orbital has (n -1) nodes.

**32. Answer:** c

**Solution**

(c): n = 3, l = 1 represents 3p orbital. Since p has three orientations $p_x, p_y$ and $p_z$, 6 electrons will show same quantum number values of n and l.

**33. Answer:** d

**Solution**

(d): When l = 3, magnetic quantum number has 7 values $m_l = (2l + 1)$. These values are represented as

$-3, -2, -1, 0, +1, +2, +3$

**34. Answer:** b

**Solution**

(b): $_{11}Na = 1s^2 2s^2 2p^6 3s^1$

For $3s^1, n = 3, l = 0, m_l = 0, s = -1/2$

**35. Answer:** b

**Solution**

(b): $\lambda = \frac{h}{mv}$ if v is same, then higher the value of m means lower will be the value of $\lambda$.

| Name | Electro n | Proton | Neutron | $\alpha$ - particle ($He^{2+}$) |
|---|---|---|---|---|
| Mass/ u | 0.00054 | 1.00727 | 1.00867 | 4.0026 |

Thus, $\alpha$ - particle has the largest mass i.e., shortest wavelength.

**36. Answer:** b

**Solution**

(b): $(K.E.)_1 = h\upsilon_1 - h\upsilon_0$

$(K.E.)_2 = h\upsilon_2 - h\upsilon_0$

As $(K.E.)_1 = 2 \times (K.E.)_2$

$\therefore (h\upsilon_1 - h\upsilon_0) = 2(h\upsilon_2 - h\upsilon_0)$

or $\upsilon_0 = 2\upsilon_2 - \upsilon_1$

$= 2 \times (2 \times 10^{16}) - (3.2 \times 10^{16})$

$= 0.8 \times 10^{16}$ Hz or $8 \times 10^{15}$ Hz

**37. Answer:** d

**Solution**

(d): $\Delta E = \frac{hc}{\lambda}$

$\lambda = \frac{6.6 \times 10^{-34} Js \times 3 \times 10^8 ms^{-1}}{3 \times 10^{-19} J} = 6.6 \times 10^{-7} m$

**38. Answer:** a

**Solution**

(a): $E_n = \frac{-E_1}{n^2}$

$E_{n1} = 13.6; E_{n_2} = \frac{13.6}{4} = 3.4eV$

**39. Answer:** d

**Solution**

(d): $\Delta x = \pm 0.01mm = 1\times10^{-5}m, m = 10g = 1\times10^{-2}kg$

$\Delta v = \frac{h}{4\pi m.\Delta x} = \frac{6.626\times10^{-34}Js}{4\times3.14\times10^{-2}kg\times10^{-5}m}$

$= 5.275\times10^{-28}ms^{-1}$

**40. Answer:** c

**Solution**

(c): The aufbau principle states that in the ground state of an atom, an electron enters the orbitals of lowest energy first and subsequent electrons are filled in the order of increasing energies. In the given orbital diagram, option (c) violates the aufbau principle as electrons switch to P orbitals without completely filling the s orbital which has comparatively lower energy.

**41. Answer:** d

**Solution**

Let n quanta are evolved per sec.

$n\left[\frac{hc}{\lambda}\right] = 25J\sec^{-1}$ ; $n\frac{6.626\times10^{-34}\times3\times10^{8}}{0.57\times10^{-6}} = 25$

$n = 7.18\times10^{19}\sec^{-1}$

**42. Answer:** d

**Solution**

For $Li^{3+}$ $\bar{\upsilon} = \bar{\upsilon}$ for $H\times z^2$ =15200 ×9= 1,36800 $cm^{-1}$

**43. Answer:** a

**Solution**

Total energy ($E_n$) = $\frac{E_1}{n^2} \Rightarrow -3.4$ eV = $\frac{-13.6}{n^2}$

$\Rightarrow n^2 = \frac{-13.6}{-3.4} = 4 \therefore n = 2$

The velocity of electron in 2nd orbit = $\frac{V_1}{2}$ =

$\frac{2.18\times10^6}{2}$ m/sec,

$\lambda = \frac{h}{mv} = \frac{6.625\times10^{-34}\times2}{9.1089\times10^{-31}\times2.18\times10^{6}} = 6.6\times10^{-12}$ m

$= 6.6\times10^{-10}$ cm

**44. Answer:** b

**Solution**

$$\frac{KE_1}{KE_2} = \frac{h(v_1 - v_0)}{h(v_2 - v_0)}$$

**45. Answer:** c

**Solution**

The electron have n + l higher value have hegher energy.

$n + l = 3 + 0 = 3$

$n + l = 3 + 1 = 4$

$n + l = 3 + 2 = 5$ (highest energy)

$n + l = 4 + 0 = 4$

**46. Answer:** 8

**47. Answer:** 9

**48. Answer:** 3

**Solution**

Maximum three quantum number can be same but fourth must be different.

**49. Answer:** 3

**Solution**

No of waves = principal quantum no.

**50. Answer:** 6

**Solution**

No. of spherical lines produced = $\frac{(n_2-n_1)(n_2-n_1+1)}{2} = \frac{(5-2)(5-2+1)}{2} = 6$

**51. Answer:** c

**Solution**

$\text{cosec} A + \cot A = \frac{11}{2} \Rightarrow \text{cosec} A - \cot A = \frac{2}{11}$

Therefore $2\cot A = \frac{117}{22} \Rightarrow \tan A = \frac{44}{117}$.

**52. Answer:** a

**Solution**

Given that $2y\cos\theta = x\sin\theta$ .....(i)

and $2x\sec\theta - y\,\text{cosec}\,\theta = 3$ .....(ii)

$\Rightarrow \frac{2x}{\cos\theta} - \frac{y}{\sin\theta} = 3$

$\Rightarrow 2x\sin\theta - y\cos\theta - 3\sin\theta\cos\theta = 0$ .....(iii)

Solving (i) and (iii), we get $y = \sin\theta$ and $x = 2\cos\theta$

Now, $x^2 + 4y^2 = 4\cos^2\theta + 4\sin^2\theta$

$= 4(\cos^2\theta + \sin^2\theta) = 4$.

**53. Answer:** d

**Solution**

$\tan A + \cot A = 4$

$\Rightarrow \tan^2 A + \cot^2 A + 2\tan A\cot A = 16$

$\Rightarrow \tan^2 A + \cot^2 A = 14 \Rightarrow \tan^4 A + \cot^4 A + 2 = 196$

$\Rightarrow \tan^4 A + \cot^4 A = 194$.

**54. Answer:** c

**Solution**

$\left(\frac{x}{a}\right)^{1/3} = \cos\theta, \left(\frac{y}{b}\right)^{1/3} = \sin\theta$

Now square and add.

**55. Answer:** a

**Solution**

Given : $(\sec\alpha + \tan\alpha)(\sec\beta + \tan\beta)(\sec\gamma + \tan\gamma)$

$= \tan\alpha \tan\beta \tan\gamma$ ...(i)

Let $x = (\sec\alpha - \tan\alpha)(\sec\beta - \tan\beta)(\sec\gamma - \tan\gamma)$ ...(ii)

Multiply both equations, (i) and (ii), we get

$(\sec^2\alpha - \tan^2\alpha)(\sec^2\beta - \tan^2\beta)(\sec^2\gamma - \tan^2\gamma)$

$= x.(\tan\alpha \tan\beta \tan\gamma)$

$\Rightarrow x = \frac{1}{\tan\alpha \tan\beta \tan\gamma}$ $\therefore x = \cot\alpha \cot\beta \cot\gamma$

**56. Answer:** d

**Solution**

Given that $\tan\theta - \cot\theta = a$ .....(i)

and $\sin\theta + \cos\theta = b$ .....(ii)

Now $(b^2 - 1)^2(a^2 + 4)$

$= \{(\sin\theta + \cos\theta)^2 - 1\}^2\{(\tan\theta - \cot\theta)^2 + 4\}$

$= [1 + \sin 2\theta - 1]^2[\tan^2\theta + \cot^2\theta - 2 + 4]$

$= \sin^2 2\theta(\text{cosec}^2\theta + \sec^2\theta)$

$= 4\sin^2\theta\cos^2\theta\left[\frac{1}{\sin^2\theta} + \frac{1}{\cos^2\theta}\right] = 4$.

Trick : Obviously the value of expression $(b^2 - 1)^2(a^2 + 4)$ is independent of $\theta$, therefore put any suitable value of $\theta$. Let $\theta = 45°$, we get $a = 0, b = \sqrt{2}$ so that $[(\sqrt{2})^2 - 1]^2 \ (0^2 + 4) = 4$.

**57. Answer:** a

**Solution**

We know, $\sin 22\frac{1°}{2} = \frac{1}{2}\sqrt{2 - \sqrt{2}}$ and $\cos 22\frac{1°}{2} = \frac{1}{2}\sqrt{2 + \sqrt{2}}$

$\therefore \left(1 + \cos 22\frac{1°}{2}\right)\left(1 + \cos 67\frac{1°}{2}\right)\left(1 + \cos 112\frac{1°}{2}\right)\left(1 + \cos 157\frac{1°}{2}\right)$

$= \left(1 + \frac{1}{2}\sqrt{2 + \sqrt{2}}\right)\left(1 + \frac{1}{2}\sqrt{2 - \sqrt{2}}\right)\left(1 - \frac{1}{2}\sqrt{2 - \sqrt{2}}\right)\left(1 - \frac{1}{2}\sqrt{2 + \sqrt{2}}\right)$

$= \left[1 - \frac{1}{4}(2 + \sqrt{2})\right]\left[1 - \frac{1}{4}(2 - \sqrt{2})\right] = \frac{(4 - 2 - \sqrt{2})(4 - 2 + \sqrt{2})}{16}$

$= \frac{(2 - \sqrt{2})(2 + \sqrt{2})}{16} = \frac{4 - 2}{16} = \frac{1}{8}$.

**58. Answer:** b

**Solution**

$\sqrt{\frac{1 - \cos\alpha}{1 + \cos\alpha}} + \sqrt{\frac{1 + \cos\alpha}{1 - \cos\alpha}} = \frac{1 - \cos\alpha + 1 + \cos\alpha}{\sqrt{1 - \cos^2\alpha}}$

$= \frac{2}{\pm\sin\alpha} = \frac{2}{-\sin\alpha}, \left(\text{since } \pi < \alpha < \frac{3\pi}{2}\right)$.

**59. Answer:** c

**Solution**

$2\tan(A - B) = 2\left(\frac{\tan A - \tan B}{1 + \tan A \tan B}\right)$

$= 2\frac{(2\tan B + \cot B - \tan B)}{1 + (2\tan B + \cot B)\tan B} = 2\frac{\tan B + \cot B}{2(1 + \tan^2 B)}$

$= \frac{\cot B(\tan^2 B + 1)}{(1 + \tan^2 B)} = \cot B$.

**60. Answer:** d

**Solution**

As given $\frac{\sin A + \sin B}{\cos A + \cos B} = \frac{C}{D}$

$\Rightarrow \frac{2\sin\frac{A+B}{2}.\cos\frac{A-B}{2}}{2\cos\frac{A+B}{2}.\cos\frac{A-B}{2}} = \frac{C}{D} \Rightarrow \tan\frac{A+B}{2} = \frac{C}{D}$

Thus, $\sin(A + B) = \frac{2\tan\frac{A+B}{2}}{1 + \tan^2\frac{A+B}{2}} = \frac{2\frac{C}{D}}{1 + \frac{C^2}{D^2}} = \frac{2CD}{(C^2 + D^2)}$.

**61. Answer:** c

**Solution**

$A - B = \frac{\pi}{4} \Rightarrow \tan(A - B) = \tan\frac{\pi}{4} \Rightarrow \frac{\tan A - \tan B}{1 + \tan A \tan B} = 1$

$\Rightarrow \tan A - \tan B - \tan A \tan B = 1$

$\Rightarrow \tan A - \tan B - \tan A \tan B + 1 = 2$

$\Rightarrow (1 + \tan A)(1 - \tan B) = 2 \Rightarrow y = 2$

Hence, $(y + 1)^{y+1} = (2 + 1)^{2+1} = (3)^3 = 27$.

Trick : Put suitable A and B as $A - B = \frac{\pi}{4}$

i.e., $A = \frac{\pi}{4}, B = 0 \ \therefore \left(1 + \tan\frac{\pi}{4}\right)(1 - \tan 0°) = 2(1) = 2$.

**62. Answer:** d

**Solution**

$\frac{\cot A}{1 + \cot A}.\frac{\cot B}{1 + \cot B} = \frac{1}{(1 + \tan A)(1 + \tan B)}$

$= \frac{1}{\tan A + \tan B + 1 + \tan A \tan B}$ $[\because \tan(A + B) = \tan 225°]$

$\Rightarrow \tan A + \tan B = 1 - \tan A \tan B]$

$= \frac{1}{1 - \tan A \tan B + 1 + \tan A \tan B} = \frac{1}{2}$.

**63. Answer:** d

**Solution**

$\frac{1}{\sin 10°} - \frac{\sqrt{3}}{\cos 10°} = \frac{2\left(\frac{1}{2}\cos 10° - \frac{\sqrt{3}}{2}\sin 10°\right)}{\frac{2}{2}\left(= \frac{\cos 10° - \sqrt{3}\sin 10°}{\sin 10° \cos 10°}\sin 10° \cos 10°\right)}$

$= \frac{4\sin(30° - 10°)}{\sin 20°} = \frac{4\sin 20°}{\sin 20°} = 4$.

**64. Answer:** b

**Solution**

$\frac{\sin^2 A - \sin^2 B}{\sin A \cos A - \sin B \cos B} = \frac{2\sin(A + B)\sin(A - B)}{\sin 2A - \sin 2B}$

$= \frac{2\sin(A + B)\sin(A - B)}{2\cos(A + B)\sin(A - B)} = \tan(A + B)$.

**65. Answer:** b

**Solution**

We have $\cos(\alpha + \beta) = \frac{4}{5}$ and $\sin(\alpha - \beta) = \frac{5}{13}$

$\Rightarrow \sin(\alpha + \beta) = \frac{3}{5}$ and $\cos(\alpha - \beta) = \frac{12}{13}$

$\Rightarrow 2\alpha = \sin^{-1}\frac{3}{5} + \sin^{-1}\frac{5}{13}$

$= \sin^{-1}\left[\frac{3}{5}\sqrt{1 - \frac{25}{169}} + \frac{5}{13}\sqrt{1 - \frac{9}{25}}\right]$

$\Rightarrow 2\alpha = \sin^{-1}\left(\frac{56}{65}\right) \Rightarrow \sin 2\alpha = \frac{56}{65}$

Now, $\tan 2\alpha = \frac{\sin 2\alpha}{\cos 2\alpha} = \frac{56/65}{33/65} = \frac{56}{33}$.

**66. Answer:** a

**Solution**

$\cos(A-B)=\frac{3}{5}$

$\therefore\ 5\cos A\cos B+5\sin A\sin B=3$ .....(i)

From 2nd relation,

$\sin A\sin B=2\cos A\cos B$ .....(ii)

$\therefore\ \cos A\cos B=\frac{1}{5}$ and $5\left(\frac{1}{2}+1\right)\sin A\sin B=3$.

**67. Answer:** c

**Solution**

Given equation $\cos x+\cos y+\cos\alpha=0$ and $\sin x+\sin y+\sin\alpha=0$. The given equation may be written a $\cos x+\cos y=-\cos\alpha$ and $\sin x+\sin y=-\sin\alpha$. Therefore

$2\cos\left(\frac{x+y}{2}\right)\cos\left(\frac{x-y}{2}\right)=-\cos\alpha$ .....(i)

$2\sin\left(\frac{x+y}{2}\right)\cos\left(\frac{x-y}{2}\right)=-\sin\alpha$ .....(ii)

Divide (i) by (ii), we get $\frac{2\cos\left(\frac{x+y}{2}\right)\cos\left(\frac{x-y}{2}\right)}{2\sin\left(\frac{x+y}{2}\right)\cos\left(\frac{x-y}{2}\right)}$

$=\frac{\cos\alpha}{\sin\alpha}\Rightarrow\cot\left(\frac{x+y}{2}\right)=\cot\alpha$.

**68. Answer:** c

**Solution**

$\sec 50^\circ+\tan 50^\circ$

$\Rightarrow\tan(70^\circ-20^\circ)=\frac{\tan 70^\circ-\tan 20^\circ}{1+\tan 70^\circ\tan 20^\circ}$

$\Rightarrow\tan 50^\circ+\tan 70^\circ\tan 20^\circ\tan 50^\circ=\tan 70^\circ-\tan 20^\circ$

$\Rightarrow\tan 50^\circ+\tan 50^\circ=\tan 70^\circ-\tan 20^\circ$ $[\because\tan 70^\circ=\cot 20^\circ]$

$\Rightarrow 2\tan 50^\circ+\tan 20^\circ=\tan 70^\circ$

$\Rightarrow 2\tan 50^\circ+\tan 20^\circ=\tan 50^\circ+\sec 50^\circ$.

**69. Answer:** c

**Solution**

$\tan 9^\circ-\tan 27^\circ-\tan 63^\circ+\tan 81^\circ$

$=\tan 9^\circ-\tan 27^\circ-\cot 27^\circ+\cot 9^\circ$

$=(\tan 9^\circ+\cot 9^\circ)-(\tan 27^\circ+\cot 27^\circ)$

$=\frac{\cos(9^\circ-9^\circ)}{\sin 9^\circ\cos 9^\circ}-\frac{\cos(27^\circ-27^\circ)}{\sin 27^\circ.\cos 27^\circ}=\frac{2}{\sin 18^\circ}-\frac{2}{\sin 54^\circ}$

$=2\left\{\frac{\sin 54^\circ-\sin 18^\circ}{\sin 18^\circ\sin 54^\circ}\right\}=2.\frac{2.\cos 36^\circ.\sin 18^\circ}{\sin 18^\circ.\sin 54^\circ}=4$

**70. Answer:** d

**Solution**

Minimum value of $(3\sin\theta+4\cos\theta)$ is $-\sqrt{3^2+4^2}$ i.e., –5.

**71. Answer:** 0

**72. Answer:** 9

**Solution**

Sol. Divide by $\cos^4\alpha$

$\Rightarrow 15\tan^4\alpha+10=6\sec^4\alpha$

$\Rightarrow 15\tan^4\alpha+10=6(1+\tan^2\alpha)^2$

$\Rightarrow(3\tan^2\alpha-2)^2=0$

$\therefore\ \tan^2\alpha=2/3$

**73. Answer:** 0

**Solution**

Sol .Use $\cos^2 A+\cos^2 B+\cos^2 C$

$=1-2\cos A\cos B\cos C$

**74. Answer:** 2

**Solution**

Sol. $\because$ $E=(\cos^2x+\sin^2x)^2-2\sin^2x\cos^2x-k^2(\cos^2x-\sin^2x)^2$

$=1-2\sin^2x\cos^2x-k^2[1-4\sin^2x\cos^2x]$

$=(1-k^2)-2\sin^2x\cos^2x(1-2k^2)$

$\therefore$ E is independent of x if $k^2=\frac{1}{2}$

$\therefore\ E=\frac{1}{2}$

$\therefore\ t=2$

**75. Answer:** 2

**Solution**

Sol. $(1-\cot 1^\circ)(1-\cot 44^\circ)=1-\cot 1^\circ-\cot 44^\circ+\cot 1^\circ\cot 44^\circ$

$\therefore\ \cot 45^\circ=\cot(1+44)=\frac{\cot 1^\circ\cot 44^\circ-1}{\cot 1^\circ+\cot 44^\circ}$

$=1-\cot 1^\circ-\cot 44^\circ+\cot 1^\circ\cot 44^\circ=2$

Similarly other pairs will give result Total pairs = 22

$(1-\cot 1^\circ)(1-\cot 2^\circ)\ldots\ldots\ldots\ldots(1-\cot 44^\circ)=2^{22}$

$\therefore\ k=2$