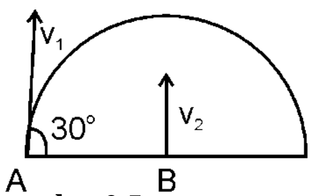
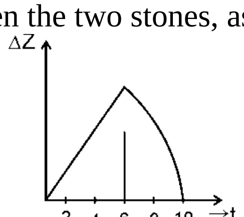
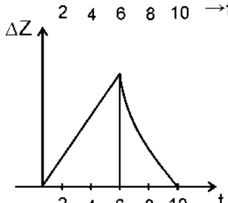
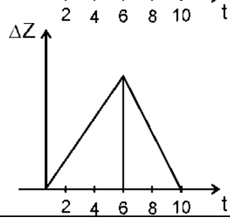
School Name:	**UDAAN**
Test Name:	**Weekly Assessment Class XI Week 6**
Total Questions:	**45**
Marks:	**45**
Duration:	**90 minutes**

Instructions for Assessment:

- The test is of **1 1/2 hours (90 minutes) duration.**
- The test consists of **45 questions.**
- There are three parts in the question paper **A, B, C consisting of Physics, Chemistry and Mathematics** having 15 questions in each part of equal weightage.
- There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response.
- No candidate is allowed to use any textual material, printed or written, pager, mobile, any electronic device, etc

Section: Physics	
Questions: 15	**Marks: 15**

1.	A projectile is thrown with a velocity of 10 m/s at the angle of 60^o with the horizontal. The interval between moments when speed is $\sqrt{5g}$ m/s is (g = 10 m/s^2) **a.** 4 sec **b.** 3 sec **c.** 2 sec **d.** 1 sec	**1.0**
2.	A body is projected with velocity v_1 from the point A as shown in the figure. At the same time, another body is projected vertically upwards from B with the velocity v_2. The point B lies vertically below the highest points. For both the bodies to collide, $\frac{v_1}{v_2}$ should be  **a.** 2 **b.** 0.5 **c.** $\sqrt{\frac{3}{2}}$ **d.** 1	**1.0**
3.	A projectile is moving with speed 60 m/s at its highest point, where it breaks into two equal parts due to internal explosion. One part moves vertically up at 50 m/s with respect to ground. The other part will move with **a.** $10\sqrt{61}$ m/sec **b.** 110 m/sec **c.** 120 m/sec **d.** 130 m/sec	**1.0**
4.	A juggler keeps 5 balls going up within one hand, so that at any instant, 4 balls are in air and one ball in the hand. If each ball rises to a height of 20 m, then the time for which each ball stays in the hand is-$\left(g = 10\ m/s^2\right)$ **a.** 1.0 sec **b.** 1.5 sec **c.** 2.0 sec **d.** 4.0 sec	**1.0**
5.	An open elevator is ascending with constant speed of 10 m/s. A ball is thrown vertically up by a boy on elevator when it is at a height of 40 m from the ground. The velocity of projection with respect to the elevator is 30 m/s. The maximum height attained by the ball is-(g=10 m/s^2) **a.** 85 m **b.** 60 m **c.** 120 m **d.** 45 m	**1.0**
6.	From the top of a tower of height of 50 m a ball is thrown vertically upwards with a certain	**1.0**

	velocity. It hits the ground in 10 s after it is thrown up. How much time does it take to reach from A to B, where A and B are two points 20 m and 40 m below the edge of the tower? **a.** 2.0 sec **b.** 1.0 sec **c.** 0.5 sec **d.** 0.4 sec	
7.	A ball is dropped from the 9^{th} storey of a multistoried building. In the first second of free fall another ball is dropped from the 7^{th} storey 15 m below the 9^{th} storey. If both the balls reach same time, then height of the building is-$\left(g = 10\ m/s^2\right)$ **a.** 10 m **b.** 16 m **c.** 20 m **d.** 25 m	**1.0**
8.	Two particles start from the same point with different speeds. One particle moves along y=a sin wx and other moves along y = a cos wx. Which of the following statements is true? **a.** They never collide with each other. **b.** They must collide after some time. **c.** They may collide at a point P$\left(\frac{\pi}{4w}, \frac{a}{\sqrt{2}}\right)$ **d.** They may collide at a point P$\left(\frac{\pi}{2w}, \frac{a}{\sqrt{2}}\right)$	**1.0**
9.	A person, sitting on the top of a tall building, of height 125m, is dropping balls at regular intervals of one second each. The height of the 4^{th} ball above the ground, when the 6^{th} ball is being just dropped, would be (Take g$\simeq$ 10m/s^2) **a.** 80 m **b.** 105 m **c.** 20 m **d.** 125 m	**1.0**
10.	Two stones are thrown vertically up, simultaneously, with initial speeds of u_1 = 15 m/s and u_2 = 30 m/s, from the edge of a cliff of height 200 m. Take g ~ 10 m/s^2 and assume that the stones do not rebound when they hit the ground. The graph, representing the relative vertical separation, between the two stones, as a function of time, would be the graph labeled as graph **a.**  **b.**  **c.** 	**1.0**

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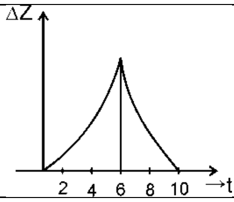
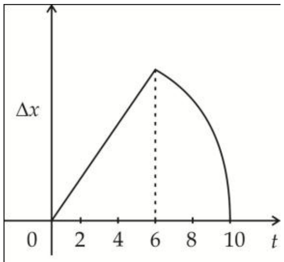
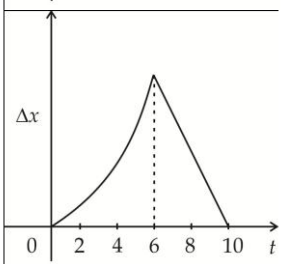
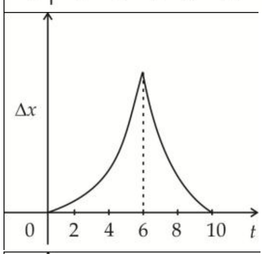
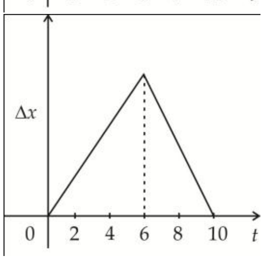
<tr><td></td><td>d. </td><td></td></tr>
<tr><td>11.</td><td>Two stones are thrown up simultaneously with initial speed of u_1 and u_2 ($u_2 > u_1$). They hit the ground after 6s and 10s respectively. Which graph correctly represents the variation of $\Delta x = (x_2 - x_1)$, their relative separation with time up to t = 10 s?
Assume that the stones do not rebound after hitting the ground.
a. 
b. 
c. 
d. </td><td>1.0</td></tr>
<tr><td>12.</td><td>To a man walking at the rate of 5 km/h the rain appears to fall vertically. When he increases his speed to 10 km/h it appears to meet him at an angle of 45^0 with vertical. The actual speed of rain is:
a. $5\sqrt{3}$ km/h
b. $5\sqrt{2}$ km/h
c. $10\sqrt{2}$ km/h
d. $\sqrt{75}$ km/h</td><td>1.0</td></tr>
<tr><td>13.</td><td>A stationary man observes that the rain is falling vertically downward. When he starts running with a velocity of 15km/h, he observes that the rain is falling at an angle of 45^0 with the vertical. The actual velocity of the rain is
a. 10 km/h</td><td>1.0</td></tr>
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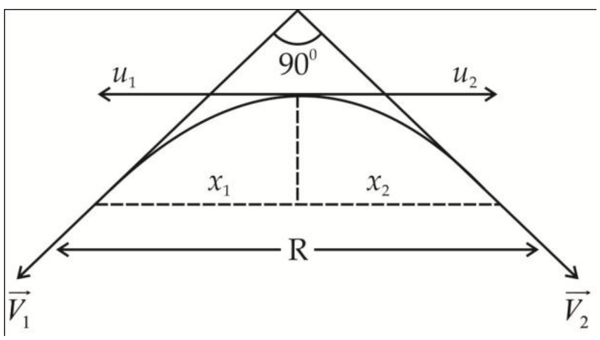
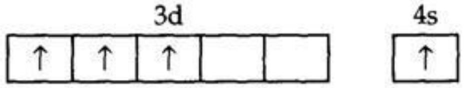
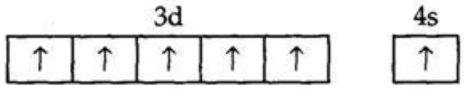
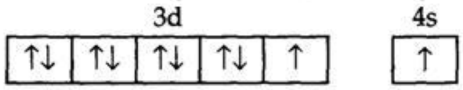
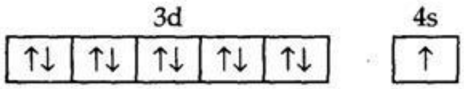
	b. $15\sqrt{3}$ km/h **c.** 15 km/h **d.** $15\sqrt{2}$ km/h	
14.	A tiger charges directly towards a hunter with a constant speed of 15 m/s. At the instant the tiger is 100 m away, the hunter fires an arrow at 30° with the horizontal. The initial speed of the arrow if it is to strike the target should be **a.** $52.2ms^{-1}$ **b.** $26.1/\sqrt{2}\,ms^{-1}$ **c.** $26.1\sqrt{3}/2$ **d.** $26.1ms^{-1}$	**1.0**
15.	Two particles have been projected under gravity horizontally in two opposite directions from the same height with speed 'u_1' &'u_2' as shown. The separation between them when they are moving perpendicularly is  **a.** $\sqrt{u_1u_2}/g$ **b.** $u_1\sqrt{u_2}/g$ **c.** $(u_1+u_2)\sqrt{u_1u_2}/g$ **d.** $\lvert u_1-u_2\rvert\sqrt{u_1u_2}/g$	**1.0**

Section: Chemistry	
Questions: 15	**Marks: 15**

16.	Which quantum number is ***not*** related with Schrodinger equation? **a.** Principal **b.** Azimuthal **c.** Magnetic **d.** Spin	**1.0**
17.	Which of the following statements is ***not*** correct, as per quantum mechanics? **a.** Every object emits radiation whose predominant frequency depends on its temperature. **b.** The quantum energy of a wave is proportional to its frequency. **c.** Photons are quanta of light. **d.** The value of the Planck constant depends on energy.	**1.0**
18.	The ratio of area covered by second orbital to the first orbital is **a.** 1 : 2 **b.** 1 : 16 **c.** 8 : 1 **d.** 16 : 1	**1.0**
19.	Which of the following options represents quantum numbers of last electron of Berylliums ? n m l s **a.** 1 0 0 +1/2 **b.** 1 1 +1 +1/2 **c.** 2 0 0 – 1/2 **d.** 2 1 0 +1/2	**1.0**
20.	The magnitude of spin angular momentum of an electron is given by **a.** $S=\sqrt{s(s+1)}\frac{h}{2\pi}$ **b.** $S=s\frac{h}{2\pi}\times T$ **c.** $S=\pm\frac{1}{2}\times\frac{h}{2\pi}\times\upsilon$ **d.** $S=\pm\frac{1}{2}\times\frac{h}{2\pi}\times\lambda$	**1.0**
21.	A filled or half-filled set of *p* or *d* orbitals is spherically symmetric. Which of the following has spherical symmetry? **a.** Na **b.** C **c.** Cl^{-} **d.** Fe	**1.0**
22.	The maximum number of electrons in a subshell is given by the expression **a.** $4l-2$ **b.** $4l+2$ **c.** $2l+1$ **d.** $2n^2$	**1.0**
23.	The total number of subshells in the nth energy level is	**1.0**

	a. n^2 **b.** $2n^2$ **c.** n – 1 **d.** n	
24.	Which of the following options ***does not*** represent a permissible set of quantum numbers (n, l, m and s)? **a.** 3, 2, - 2, $\frac{1}{2}$ **b.** 3, 3, 1, -$\frac{1}{2}$ **c.** 3, 2, 1, $\frac{1}{2}$ **d.** 3, 1, 1,- $\frac{1}{2}$	**1.0**
25.	In a multi-electron atom, which of the following orbitals will have the same energy in the absence of magnetic and electric fields? (1) $n=1, l=0, m=0$ (2) $n=2, l=0, m=0$ (3) $n=1, l=0, m=0$ (4) $n=3, l=2, m=0$ (5) $n=3, l=0, m=0$ **a.** (1) and (2) **b.** (2) and (3) **c.** (3) and (4) **d.** (4) and (5)	**1.0**
26.	In a multi electron atom, which of the following orbitals described by the three quantum numbers will have the same energy in the absence of magnetic field? i) n = 1, l = 0, m = 0 ii) n = 2, l = 1, m = 1 iii) n = 2, l = 0, m = 0 iv) n = 3, l = 2, m = 0 v) n = 3, l = 2, m = 1 **a.** (i) and (ii) **b.** (ii) and (iii) **c.** (iii) and (iv) **d.** (iv) and (v)	**1.0**
27.	Which of the following is the least stable? **a.** Li^- **b.** Be^- **c.** B^- **d.** C^-	**1.0**

28.	Which of the following electronic configurations have the highest exchange energy? **a.**  **b.**  **c.**  **d.** 	**1.0**
29.	The conclusion that an orbital can accommodate only two electrons is derived from **a.** Heisenberg’s principle. **b.** Aufbau rules. **c.** Pauli’s exclusion principle. **d.** Hund’s rule.	**1.0**
30.	Assuming that Hund’s rule is violated, the bond order and magnetic nature of the diatomic molecule B_2 is **a.** 1 and diamagnetic **b.** 0 and diamagnetic **c.** 1 and paramagnetic **d.** 0 and paramagnetic	**1.0**

Section: Mathematics	
Questions: 15	**Marks: 15**

31.	If $\tan\theta = \dfrac{x\sin\phi}{1-x\cos\phi}$ and $\tan\phi = \dfrac{y\sin\theta}{1-y\cos\theta}$, then $\dfrac{x}{y} =$ **a.** $\dfrac{\sin\phi}{\sin\theta}$ **b.** $\dfrac{\sin\theta}{\sin\phi}$ **c.** $\dfrac{\sin\theta}{1-\cos\theta}$ **d.** $\dfrac{\sin\theta}{1-\cos\phi}$	**1.0**
32.	If $\sin(y+z-x)$, $\sin(z+x-y)$ and $\sin(x+y-z)$ are in A.P., then tan x, tan y & tan z are in **a.** AP **b.** GP **c.** HP **d.** None of these	**1.0**
33.	If $\sin\alpha+\sin\beta+\sin\gamma=0$ and $\cos\alpha+\cos\beta+\cos\gamma=0$, then the value of $\cos(\alpha-\beta)+\cos(\beta-\gamma)+\cos(\gamma-\alpha)$ is : **a.** $-\dfrac{3}{2}$ **b.** –1 **c.** $-\dfrac{1}{2}$ **d.** 0	**1.0**
34.	Solution of the system of equations $x+y=\dfrac{\pi}{4}$, $\tan x+\tan y=1$ is **a.** $x=\dfrac{\pi}{2}-n\pi, y=n\pi$ **b.** $x=\dfrac{\pi}{4}-n\pi, y=n\pi$ **c.** $x=\dfrac{\pi}{4}-n\pi, y=2n\pi$ **d.** None of these	**1.0**
35.	Find the minimum value of $5\cos\theta+3\cos\left(\theta+\dfrac{\pi}{3}\right)+3$ **a.** -4 **b.** 3 **c.** 10 **d.** None of these	**1.0**

36.	If $\cos(A-B)=\frac{3}{5}$ & $\tan A \tan B = 2$, then **a.** $\cos A \cos B = \frac{1}{5}$ **b.** $\cos A \cos B = \frac{-1}{5}$ **c.** $\sin A \sin B = \frac{-1}{5}$ **d.** None of these	**1.0**
37.	An Aeroplane flying horizontally 1 km above the ground is observed at an elevation of 60°. If after 10 seconds the elevation is observed to be 30°, then the uniform speed per hour for the Aeroplane is : **a.** $2400\sqrt{3}$ km / sec **b.** $240\sqrt{3}$ km / hr **c.** $240\sqrt{3}$ m / sec **d.** None of the above	**1.0**
38.	The upper $\frac{3}{4}$th portion of a vertical pole subtends an angle $\tan^{-1}\left(\frac{3}{5}\right)$ at a point in the horizontal plane through its foot and at a distance 40m from the foot. A possible height of the vertical pole is: **a.** 20 m **b.** 40 m **c.** 60 m **d.** 80 m	**1.0**
39.	The longer side of a parallelogram is 10cm and the shorter side is 6cm. If the longer diagonal makes an angle of 30° with the longer side, the length of the longer diagonal is: **a.** $\left(5\sqrt{3}+\sqrt{11}\right)cm$ **b.** $\left(4\sqrt{3}+\sqrt{11}\right)cm$ **c.** $\left(5\sqrt{3}+\sqrt{13}\right)cm$ **d.** None of these	**1.0**
40.	A spherical balloon of radius 'r' subtends an angle α at the eye of the observer, while the angle of elevation of its centre is β. Then the height of the centre of the balloon is **a.** $r\sin\frac{\alpha}{2}\sin\beta$ **b.** $r\left(\operatorname{cosec}\frac{\alpha}{2}\right)\sin\beta$ **c.** $r\sin\beta$ **d.** None of these	**1.0**
41.	If upper part of a tree broken over by the wind makes an angle of 30° with the ground, and the distance from the root to the point where the top of the tree touches the ground is 10m, the height of the tree is: **a.** $20\sqrt{3}$m **b.** $10\sqrt{3}$m **c.** $15\sqrt{3}$m **d.** None of these	**1.0**

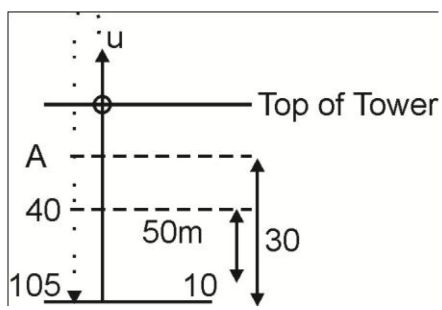
42.	The general solution for the equation $\cos^7 x + \sin^4 x = 1$ is **a.** $x = \pi$ **b.** $x = 2n\pi$ **c.** $x = \frac{\pi}{2}$ **d.** None of these	**1.0**
43.	If $\alpha + \beta = 90°$, then the maximum value of $sin\alpha\, sin\beta\, is$ **a.** 1 **b.** 1/2 **c.** 3/2 **d.** None of these	**1.0**
44.	The equation $\sin^4 x - (K-2)\sin^2 x - (K+3) = 0$ possesses a solution if : **a.** K > –3 **b.** K < –2 **c.** $-3 \leq K \leq -2$ **d.** K is any positive integer	**1.0**
45.	If $-\frac{\pi}{4} \leq x < \frac{\pi}{4}$ and $\frac{1+\tan x}{1-\tan x} = 1 + \sin 2x$, then tan x is equal to **a.** -1 **b.** 0 **c.** 1 **d.** 2	**1.0**

Key

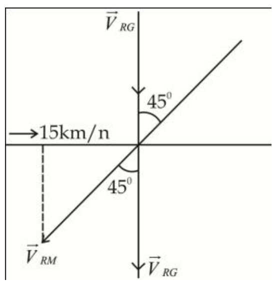
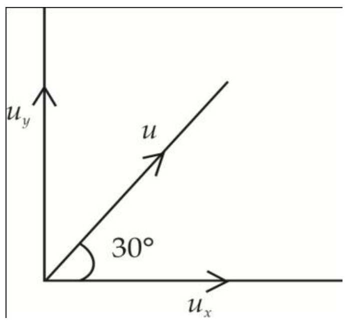
Question Number	Correct Option	Question Number	Correct Option	Question Number	Correct Option
1.	D	16.	D	31.	B
2.	B	17.	D	32.	A
3.	D	18.	D	33.	A
4.	A	19.	C	34.	B
5.	C	20.	A	35.	A
6.	D	21.	C	36.	A
7.	C	22.	B	37.	B
8.	A	23.	D	38.	B
9.	B	24.	B	39.	A
10.	A	25.	D	40.	B
11.	A	26.	D	41.	B
12.	B	27.	B	42.	B
13.	C	28.	B	43.	B
14.	D	29.	C	44.	C
15.	C	30.	A	45.	A

Explanation

Question Number	Explanation
1.	speed of projectile $v=\sqrt{5g}$ $\therefore v_x = u_x \ cos60^0 = 10 \times \frac{1}{2} = 5 \ m/s$ $v_y = u_y \sin\theta - gt - 10 = 10\sin 60^\circ + gt = (5\sqrt{3} - 10t)$ $\therefore \therefore v = \sqrt{v_x^2 + v_y^2} = \sqrt{5^2 + (5\sqrt{3} - 10t)^2}$ $5 \times 10 = 25 + (5\sqrt{3} - 10t)^2$ Solve for t, we get two results $t_1 = \left(\frac{5\sqrt{3}-5}{10}\right) and \ t_2 = \left(\frac{5\sqrt{3}-5}{10}\right)$ $t_1 - t_2 = \left(\frac{5\sqrt{3}-5}{10}\right) - \left(\frac{5\sqrt{3}-5}{10}\right) = 1s$
2.	The two bodies will collide at the highest point if both cover the same vertical height in the same time. So $\frac{v_1^2 sin^2 30^\circ}{2g} = \frac{v_2^2}{2g}$ $\Rightarrow \frac{v_2}{v_1} = \sin 30^\circ = 0.5$
3.	Using laws of conservation of linear momentum Velocity of second part $v = \sqrt{(50)^2 + (120)^2} = 130 m/s$
4.	Number of balls = 5 Y = 20 m $g = 10 \ m/s^2$ $\therefore$ n balls are projected vertically upward but (n-1) balls remain in the air. Time period of one ball $t = \frac{T}{N-1}$ But

	$y = 2gt^2$ $t = \frac{\sqrt{2y}}{g} = \sqrt{\frac{2\times 20}{10}}$ $= 2$ $T = 2\times t = 2\times 2 = 4$ $\therefore t = \frac{T}{n-1} = \frac{4}{4} = 1s$
5.	h = 40 m, u wrt elevator = 30 m/s Velocity of elevator = 10 m/s Vel. wrt ground = 30 +10 = 40 m/s From $v^2 = u^2 + 2as \Rightarrow 0 = 1600 + 2(-10)h$ h = 80 m Total height from the ground = 80 + 40 = 120 m
6.	$\therefore s = ut + \frac{1}{2}at^2$ $50 = -u\times 10 + \frac{1}{2}\times 10\times 10^2$ $u = 45 m/s$ if t_1 and t_2 are timings taken by the ball to reach points A and B respectively then $20 = -45\,t_1 + \frac{1}{2}\times 10 \times t_1^2$ $40 = -45\,t_2 + \frac{1}{2} + 10\,t_2^2$ $t_1 = 9.4s$ $t_2 = 9.8s$ $t_2 - t_1 = 0.4s$ 
7.	$h = gt^2$ & $h - 15 = \frac{1}{2}g\,(t-1)^2$ On equating, we get t=2 second Here $h = \frac{1}{2}gt^2 = 20\,m$
8.	y = a sin wx $Y = a \cos wx$ *On colliding* $a \sin wx = a \cos wx \Rightarrow a \sin(\pi/2 - wx)$

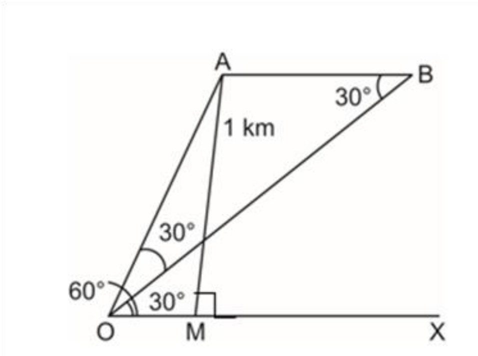
	$wx = (\pi/2 - wx) \Rightarrow x = \pi/4w$ $y = a \sin w(\pi/4w) = a\sqrt{2}$ $P = (\frac{\pi}{4w}, \frac{a}{\sqrt{2}})$
9.	The first ball is dropped at t = 0 s $\therefore$ The fourth ball is dropped at t = 3 s and the sixth ball would be dropped at t = 5 s The fourth ball, therefore, has moved downwards for a time of (5-3) s = 2 s downward distance moved by it in $2s$ $= \frac{1}{2} g (2)^2$ = 20 m Height of building = 125 m $\therefore$ Its position from the ground = (125 – 20) m = 105 m (above the ground)
10.	The vertical heights of the two, above the ground, at a time t, would be $z_1 = 200 + 15t - 5t^2$ $z_2 = 200 + 30t - 5t^2$ $\therefore$ The separation, between the two, as a function of time, is give by $z = z_2 - z_1 = 15t$ (Before either of the stones hits the ground & This implies a linear graph. at a time given $0 = 200 + 15 + t^2$ $This\ gives\ t = 8s$ $\therefore After\ t = 8s,\ z1 = 1, z = z2 = 200 + 30t - 5t$ The graph, beyond t = 8s, would be a curved graph. Hence graph A is the correct graph.
11.	From t = 0 to 6 s, relative acceleration between them is zero, so distance between them will increase linearly. At t = 6s, one stone strikes the ground. From t = 6 s to 10 s, relative acceleration = g, so distance will decrease parabolically.
12.	Let $v_r = x\hat{i} + y\hat{j}$ $v_m = 5\hat{i}$ $v_{rm} = v_r - v_m = (x-5)\hat{i} + y\hat{j}$ It seems to be in vertical direction.

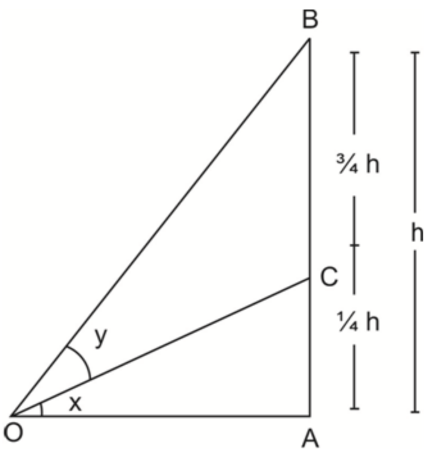
	$\therefore x-5=0$ or $x=5$ for second case $v_m = 10\hat{i}$ $\therefore v_{rm} = x-10\hat{i}+y\hat{j}\left(5-10\right)\hat{i}+y\hat{j}=-5\hat{i}+y\hat{j}$ This seems to be at 45^0 with vertical $\therefore$ y = 5 $\vec{v}_r = -5\hat{i}+5\hat{j}$ $v_r = \sqrt{(5)^2+(5)^2} = 5\sqrt{2}$ km/h
13.	From diagram $\tan 45^\circ = \frac{\left\|\vec{V}_{MG}\right\|}{\left\|\vec{V}_{RG}\right\|}$ $1 = \frac{15}{V_{RG}} \Rightarrow V_{RG} = 15 km/n$ 
14.	$ux = u\cos 30^\circ = 0.866u$ $Uy = u\sin 30^\circ = 0.5u$ small u and suffix y $Ux(relative) = 0.866u + 15m/s$ small u and suffix x $t_1 \frac{100}{0.866u+15}$ $\left[Time = \frac{D}{Velocity}\right]$ $t_2 = \frac{2u_y}{g} = \frac{u}{9.8}$ $t_1 = t_2$ $0.866u^2 + 15u - 980 = 0$ $solving, u = 26.1m/s$ 
15.	As $\vec{u_1}.\vec{u_2} = 0$ $\Rightarrow \left(\vec{u_1}+\vec{g}t\right).\left(\vec{u_2}+\vec{g}t\right) = 0$ $\Rightarrow \vec{u_1}.\vec{u_2} + g^2t^2 + t\left(\vec{u_1}\vec{g} + \vec{u_2}\vec{g}\right) = 0$ As $\vec{u_1}$ & $\vec{u_2} \perp \vec{g}$ $\Rightarrow u_1u_2\cos 180^\circ + g^2t^2 = 0$ $g^2t^2 = u^1u^2$

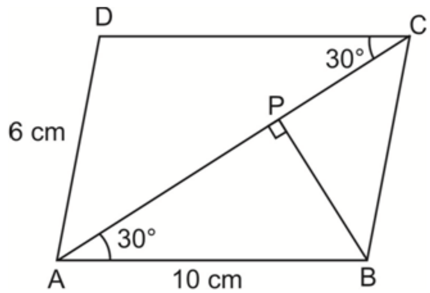
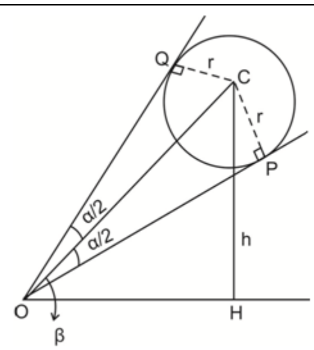
	$t=\sqrt{\dfrac{u_1u_2}{g}}$ Now $R = x_1 + x_2$ $= u_1t + u_2t$ $=\left(u_1+u_2\right)\dfrac{\sqrt{u_1u_2}}{g}$
16.	Spin quantum no. is decided arbitrarily.
17.	Plank's constant does not depend on energy (It has a constant value)
18.	$r_n\,\alpha\,n^2$ $\therefore A_n\,\alpha\,n^4$ $\dfrac{A_2}{A_1}=\dfrac{n_2^4}{n_1^4}=\dfrac{2^4}{1^4}=\dfrac{16}{1}=16:1$
19.	Beryllium has 4 electrons. Fourth electron will be in second shell with $2s^2$ electronic configuration. Hence n= 2, l = 0, m = 0 and s = – ½
20.	
21.	Cl^- have $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$ electronic configuration i.e. fully filled p -orbitals hence it has spherical symmetry.
22.	Maximum no. of orbital in a subshell = 2l+1 Hence maximum electrons will be twice of it i.e. 2(2l+1)
23.	In nth energy level total no. of subshells = n.
24.	Azimuthal quantum number is always less than Principal Quantum number
25.	(4) and (5) belong to d -orbital which are of same energy.
26.	In the presence of external magnetic field, the energies of orbitals are different otherwise in the absence of magnetic field same value of $(n+l)$ orbitals will have same magnetic field value.
27.	The electronic configuration of Be^- is $1s^2 2s^2 2p^1$. Be has completely filled 2s orbital which is stable, while in the anion the electron goes to the next subshell 2p. Therefore the increase in energy is the most and the stability is the least.
28.	Unpaired electrons can exchange their energy with unpaired while paired can exchange with paired electrons. Option D has maximum number of paired electrons, so more energy would be needed for exchange
29.	According to Pauli's exclusion principle no two electrons can have the same values of all the four quantum numbers. An orbital has a fixed value of *n*, *l* and *m*. However, an electron can have any one of the two spin quantum numbers, + ½ and – ½. So an orbital can be occupied by two electrons with the same values of *n*, *l* and *m* but different values of spin quantum numbers. If the third electron goes into the same orbital it will have all four quantum numbers same with either

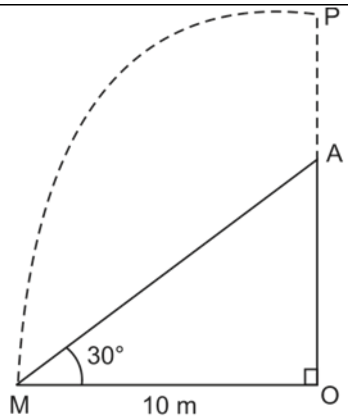
	one of the two electrons already present. Since it is not allowed by the Pauli's exclusion principle, only two electrons can occupy one orbital.
30.	The electronic configuration of B_2 (Z = 5, total no. of electrons 10) when Hund's rule is not followed is $\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \pi 2p_x^{\,2}$ Bond order = ½(Number of electrons occupying bonding molecular orbitals – Number of electrons occupying antibonding molecular orbitals) = ½ (6-4) = 1. Since Hund's rule is not followed, all the electrons are paired. Therefore, the molecule is diamagnetic.
31.	Now $\tan\theta = \dfrac{x\sin q}{1 - x\cos\theta} \Rightarrow \tan\theta - x\tan\theta\cos\phi = x\sin\phi$ $\Rightarrow x = \dfrac{\tan\theta}{\sin\phi + \cos\phi\tan\theta}$ $= \dfrac{\sin\theta}{\cos\theta\sin\phi + \cos\phi\sin\theta}$ $= \dfrac{\sin\theta}{\sin(\theta+\phi)}$ Similarly, $y = \dfrac{\sin\phi}{\sin(\theta+\phi)}$ $\therefore \dfrac{x}{y} = \dfrac{\sin\theta}{\sin\phi}$
32.	As, $\sin(y+z-x)$, $\sin(z+x-y)$ & $\sin(x+y-z)$ are in A.P. $\therefore \sin(z+x-y) - \sin(y+z-x)$ $\sin(x+y-z) - \sin(z+x-y)$ $\Rightarrow 2\cos z\sin(x-y) = 2\cos x\sin(y-z)$ Dividing both sides by 2 *cos x cos y cox z*, we get $\dfrac{\sin x\cos y - \cos x\sin y}{\cos x\cos y} = \dfrac{\sin y\cos z - \sin z\cos y}{\cos y\cos z}$ $\Rightarrow \tan x - \tan y = \tan y - \tan z$ $\Rightarrow 2\tan y = \tan x + \tan z \quad ---(i)$ $\therefore \tan x, \tan y, \tan z$ our in A.P.
33.	Now, $\sin\alpha + \sin\beta = 0\sin\gamma$ and $\cos\alpha + \cos\beta = -\cos\gamma$. $\therefore (\sin\alpha + \sin\beta)^2 + (\cos\alpha + \cos\beta)^2$ $= \sin^2\gamma + \cos^2\gamma = 1 \quad ----(1)$

	Also, $(\sin\gamma+\sin\beta)^2+(\cos\alpha+\cos\beta)^2$ $=1+2\sin\alpha\sin\beta+1+2\cos\alpha\cos\beta$ $=2+2\cos(\alpha-\beta) \quad ----(\text{ii})$ From (i) & (ii), $1=2+2\cos\ \alpha-\beta$ $\Rightarrow 1+2\cos(\alpha-\beta)=0$ $\Rightarrow \cos(\alpha-\beta)=-\frac{1}{2}$ Similarly, $\cos(\beta-\gamma)=\cos(\gamma-\gamma a)=-\frac{1}{2}$ $\therefore \cos(\alpha-\beta)+\cos(\beta-\gamma)+\cos(\gamma-\alpha)=-\frac{3}{2}$
34.	Given : $x+y=\frac{\pi}{4}, \tan x+\tan y=1$ Now, $\tan x+\tan y=\tan(x+y)(1-\tan x\tan y)=1$ $\Rightarrow \tan(x+y)(1-\tan x\tan y)=1$ Now $x+y=\frac{\pi}{4}$ $\therefore \tan\left(\frac{\pi}{4}\right)(1-\tan x\tan y)=1$ $\Rightarrow 1-\tan x\tan y=1$ $\Rightarrow \tan x\tan y=0$ $\Rightarrow$ either $\tan x=0$ or $\tan y=0$ $\Rightarrow$ either $x=n\pi$ and so $y=\frac{\pi}{4}-x=\frac{\pi}{4}-n\pi$ OR $y=n\pi$ & so $x=\frac{\pi}{4}-n\pi$
35.	$5\cos\theta+3\cos\left(\theta+\frac{\pi}{3}\right)+3$ $=5\cos\theta+3\left(\cos\theta\cos\frac{\pi}{3}-\sin\theta\sin\frac{\pi}{3}\right)+3$ $=5\cos\theta+\frac{3}{2}\cos\theta-3\frac{\sqrt{3}}{2}\sin\theta+3$ $=\frac{13}{2}\cos\theta-\frac{3\sqrt{3}}{2}\sin\theta+3$ $=\ r\cos\alpha\cos\theta-r\sin\alpha\sin\theta\ +3$,

	Where $r\cos\alpha = \frac{13}{2}$ $r\sin\alpha = \frac{3\sqrt{3}}{2}$ Squaring and adding, $r^2 = \frac{169}{4} + \frac{27}{4} = 49$ $\therefore r = 7$ Now $-1 \le \cos(\theta+\alpha) \le 1$ $-7 \le 7\cos(\theta+\alpha) \le 7$ Adding 3 on all sides $-7+3 \le 7\cos(\theta+\alpha)+3 \le 7+3$ $-4 \le 7\cos(\theta+\alpha)+3 \le 10$
36.	Given $\tan A.\tan B = 2 \;\&\; \cos(A-B) = \frac{3}{5}$ $\Rightarrow \cos A\cos B + \sin A\sin B = \frac{3}{5}$ $\Rightarrow \cos A\cos B(1+\tan A\tan B) = \frac{3}{5}$ $\Rightarrow \cos A\cos B(1+2) = \frac{3}{5}$ $\Rightarrow \cos A\cos B = \frac{1}{5} \quad ----(i)$
37.	 $\angle AOM = 60^\circ$ (given) $\angle BOM = 30^\circ$ (after 10 sec) $\angle ABO = 30^\circ = \angle AOB$ $\therefore AB = OA$ $= AM\text{cosec } 60^\circ$

	$=1.\left(\frac{2}{\sqrt{3}}\right)=\frac{2}{\sqrt{3}}\text{km}$ $\therefore$ Speed of the aeroplane = $\frac{2}{\sqrt{3}}\times\frac{3600}{10}\text{km/hr}$ $=240\sqrt{3}\ \text{km/hr}$
38.	Given : $y=\tan^{-1}\left(\frac{3}{5}\right)$  $\Rightarrow \tan y=\frac{3}{5}$ In $\Delta AOC, \tan x=\frac{AC}{OA}=\frac{\frac{1}{4}h}{40}=\frac{h}{160}$ In $\Delta AOB, \tan(x+y)=\frac{AB}{OA}=\frac{h}{40}$ $\Rightarrow \frac{\tan x+\tan y}{1-\tan x\tan y}=\frac{h}{40}$ $\Rightarrow \frac{\frac{h}{160}+\frac{3}{5}}{1-\frac{h}{160}\times\frac{3}{5}}=\frac{h}{40}$ Solving, we get $h^2-200h+6400=0$ ----(1) h = 40 satisfies the equation.
39.	Draw BP $\perp$ AC, the longer diagonal. In right angled triangle APB, we have $\frac{AP}{AB}=\cos 30^\circ$ $\Rightarrow AP=AB\ \sin 30^\circ=10\times\frac{\sqrt{3}}{2}=5\sqrt{3}\text{cm}$

	Also, $\frac{BP}{AB}=\sin 30^\circ$  $\Rightarrow BP = AB\cos 30^\circ = 10\times\frac{1}{2} = 5\text{cm}$ In ΔBPC, $BP^2+PC^2=BC^2$ $\Rightarrow 5^2+PC^2=6^2$ $\Rightarrow PC^2=6^2-5^2=11$ $\therefore AC = AP+PC = 5\sqrt{3}+\sqrt{11}$ cm $\therefore$ Option (a) is correct
40.	 C $\rightarrow$ centre of the balloon, r = radius, O $\rightarrow$ eye of the observer. $\angle POQ = \alpha$ By geometry, $\angle POC = \angle QOC = \frac{\alpha}{2}$ $\angle COH = \beta$ $Height\ of\ the\ centre = h = CH = OC\ \sin\beta = CP\ cosec\left(\frac{\alpha}{2}\right)\sin\beta = r$ $cosec\left(\frac{\alpha}{2}\right)\sin\beta$ $\therefore h = r\,\text{cosec}\left(\frac{\alpha}{2}\right)\sin\beta\ ---\ (1)$
41.	Let OAP be the tree. When broken by the wind at A, let its top P strike the ground at M so that OM = 10 m.

	 $\angle OMA = 30^\circ$, $AP = AM$ $\therefore$ in rt.$\angle$d ΔAOM, we have, $\tan 30^0 = \frac{OA}{OM}$ $= OA = OM \times \tan 30^\circ = 10 \times \frac{1}{\sqrt{3}} = \frac{10}{\sqrt{3}} m$ Also, $\frac{AM}{OM} = \sec 30^\circ \Rightarrow \frac{AM}{10} = \frac{2}{\sqrt{3}}$ $\Rightarrow AM = \frac{20}{\sqrt{3}} m$ $\therefore$ Height of the tree = OP = OA + AP = OA + AM (1) $= \frac{10}{\sqrt{3}} + \frac{20}{\sqrt{3}} = \frac{30}{\sqrt{3}} m$ Height $10\sqrt{3} m$
42.	We have $\cos^7 x + \sin^4 x = 1$ Now, $\cos^7 x \le \cos^2 x \quad (\because -1 \le \cos x \le 1)$ $\& \sin^4 x \le \sin^2 x$ $\therefore \cos^7 x + \sin^4 x \le \cos^2 x + \sin^2 x = 1 \quad ---(i)$ $\therefore \cos^7 x + \sin^4 x \le 1$ Now equality in(i) holds if $\cos^7 x = \cos^2 x \quad ---(ii)$ And $\sin^4 x = \sin^2 x \quad ---(iii)$ (ii) is satisfied if $\cos^2 x(\cos^5 x - 1) = 0$ $\Rightarrow \cos x = 0$ or $\cos x = 1 \quad ---(iv)$ Similarly (iii) holds if $\sin^4 x - \sin^2 x = 0$ $\Rightarrow \sin^2 x(\sin^2 x - 1) = 0$ $\Rightarrow \sin x = 0$ or $\sin^2 x = 1 \quad ---(v)$

	Now $\cos x = 0 \Rightarrow \sin^2 x = 1$ And $\cos x = 1 \Rightarrow \sin x = 0$ $\Rightarrow x = 2n\pi; \quad x = n\pi + \frac{\pi}{2} n \in I$
43.	*let* $y = \sin\alpha \sin\beta$ $= \frac{1}{2}\ 2\sin\alpha\sin\beta$ $= \frac{1}{2}\ \cos(\alpha-\beta) - \cos(\alpha+\beta)$ $= \frac{1}{2}\ \cos(\alpha-\beta) - \cos 90°$ $= \frac{1}{2}\ \cos(\alpha-\beta)$ Now $\cos(\alpha-\beta) \le 1$ $\therefore y = \frac{1}{2}\cos(\alpha-\beta) \le \frac{1}{2}$ $\therefore$ maximum value is $\frac{1}{2}$
44.	We have, $\sin^4 x - (K-2)\sin^2 x - (K+3) = 0$ $\Rightarrow \sin^2 x = \frac{(K+2) \pm \sqrt{(K+2)^2 + 4(K+3)}}{2}$ $= \frac{(K+2) \pm (K+4)}{2}$ $\Rightarrow \sin^2 x = K+3$ or $\sin^2 x = -1$ $\sin^2 x = -1$ is not possible $\therefore \sin^2 x = K+3$ Now $0 \le \sin^2 x \le 1$ $\Rightarrow 0 \le K+3 \le 1$ $\Rightarrow -3 \le K \le -2$
45.	$\frac{1+\tan x}{1-\tan x} = 1 + \sin 2x \quad ----(i)$ $\Rightarrow \frac{1+\tan x}{1-\tan x} = 1 + \frac{2\tan x}{1+\tan^2 x}$ $\Rightarrow \frac{1+y}{1-y} = 1 + \frac{2y}{1+y^2}$ where $y = \tan x$

	$\Rightarrow (1+y)(1+y^2) = \left[(1+y^2)+2y\right]\ 1-y$ $\Rightarrow (1+y)(1+y^2) = (1+y)^2(1-y)$ $\Rightarrow (1+y)\left[1+y^2-(1-y^2)\right] = 0$ $\Rightarrow (1+y)(1+y^2-1+y^2) = 0$ $\Rightarrow (1+y)(2y^2 = 0 \ \Rightarrow y = -1, 0$ $y = 0 \ gives \ \sin 2x = 0 \Rightarrow 3x = n\pi$ $\Rightarrow x = \frac{n\pi}{2}, \ But \frac{-\pi}{4} \le x < \frac{\pi}{4}, \ n \in I$ $\therefore y \ne 0$ $\Rightarrow \tan x = -1$ is the correct option.