School Name:	**UDAAN**
Test Name:	**Weekly Assessment Class XI Week 5**
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.	If $\vec{A}_1$ & $\vec{A}_2$ are two non – collinear unit vectors and if $\left\|\vec{A}_1+\vec{A}_2\right\|=\sqrt{3}$, then the value of $\left(\vec{A}_1-\vec{A}_2\right).\left(2\vec{A}_1+\vec{A}_2\right)$ is **a.** 1 **b.** 1/2 **c.** 3/2 **d.** 2	**1.0**
2.	The magnitudes of x and y component of $\vec{A}$ are 7 and 6. The magnitudes of x and y component of $\vec{A}+\vec{B}$ are 11 and 2 respectively then the magnitude of $\vec{B}$ is **a.** 5 **b.** 6 **c.** 8 **d.** 9	**1.0**
3.	A particle moves in the x – y plane with velocity $v_x = 8t - 2$ and $v_y = 2$. If it passes through the point x = 14 and y = 4 at t = 2 s then the equation of the path is **a.** $X = y^3 - y^2 + 2$ **b.** $X = y^2 - y + 2$ **c.** $X = y^3 - 3y + 2$ **d.** $X = y^3 - 2y^2 + 2$	**1.0**
4.	A man is moving with velocity u in north east direction. The wind appears to blow from the north to the moving man. When the man doubles his velocity, the wind appears to move in the direction $\cot^{-1}(2)$ east of north. The actual velocity of the wind is **a.** $\frac{v}{\sqrt{2}}$ towards east **b.** $\frac{v}{\sqrt{2}}$ towards west **c.** $\sqrt{2}$ v towards west **d.** $\sqrt{2}$ v towards east	**1.0**
5.	The speed of boat is 5 km/h in still water. It crosses a (flowing) river of width 1 km along the shortest possible path in 15 minutes. The velocity of river is **a.** 4 km/h **b.** 3 km/h	**1.0**

	c. 1 km/h d. 6.94 km/h	
6.	A boat, going down stream, crosses a drifting raft at a point P. After two hours, the boat, it turned back and after some time, passed the same raft again at a distance 12 km from the point P. Assuming that the speed of the river, remains constant, the value of boat's speed, is a. 4 km/h b. 3 km/h c. Zero d. 1 km/h	**1.0**
7.	Two boats, a and b, move with constant velocities 5 m/s and 10 m/s along two mutually perpendicular straight tracks toward the intersection point of the two tracks O. At the moment t = 0, the boats were located at distances, 150 m and 200 m from O. The shortest distance, between the boats, would be (nearly) **a.** 65m **b.** 60m **c.** 62m **d.** 50m	**1.0**
8.	A police Van moving on a highway with a speed of 36 km/h fires a bullet at a thief's car speeding away in the same direction with a speed of 216 km/h. If the muzzle speed of the bullet is 150 m/s, with what speed does the bullet hits the thief car? **a.** 80 m/s **b.** 100 m/s **c.** 120 m/s **d.** 160 m/s	**1.0**
9.	A car and a truck, start moving (from rest) along the same straight track, at the same instant of time, from the same point. The car moves with a constant velocity of 50 m/s and the truck moves with a constant acceleration of 4 m/s^2. The separation, between the two, will have it greatest value (=s_0 metre, say), at a time t_0, after the start, where t_0 and s_0 equal, respectively. **a.** 12.5 s and 625 m **b.** 25 s and 312.5 m **c.** 12.5 s and 312.5 m **d.** 25 s and 625 m	**1.0**
10.	A car driver, travelling at 90 km/h sees the light turn red at the intersection. If her reaction time is 0.6s, and the car can decelerate at 5 $m/s^{2.}$ The stopping distance for the car would be **a.** 59.5 m **b.** 62.5 m **c.** 68.5 m	**1.0**

	d. 77.5 m	
11.	Ram is going eastward with a velocity of 4 km/h. The wind appears to blow directly from the north. He doubled his speed and the wind appears to come from north east. The actual velocity of the wind is **a.** $4\sqrt{2}km/h^{-1}$ towards north east **b.** $4\sqrt{2}km/h^{-1}$ towards north west **c.** $4\sqrt{2}km/h^{-1}$ towards south west **d.** $4\sqrt{2}km/h^{-1}$ towards south east	**1.0**
12.	A jet air plane travelling at a speed of 500 km/h ejects its products of combustion (gases) which appear at a speed of 1500 km/h, relative to the jet plane. What is the velocity of latter with respect to the ground? **a.** 1000 km/h along the direction of emission of gases **b.** 2000 km/h along the direction of emission of gases **c.** 1000 km/h opposite to the direction of emission of gases **d.** 2000 km/h opposite to the direction of emission of gases	**1.0**
13.	What are the speeds of two objects if (i) when they move uniformly towards each other, they get 4 m closer in each second, and (ii) when they move uniformly in the same direction, with their original speeds, they get 4m closer to each other after 10s? **a.** 4.4 m/s and 3.6 m/s **b.** 3.3 m/s and 2.7 m/s **c.** 4.4 m/s and 2.2 m/s **d.** 2.2 m/s and 1.8 m/s	**1.0**
14.	The motor of an electric train can give it an acceleration of $1 m/s^2$ and its brakes can give it a negative acceleration of $3\ m/s^2$. The shortest time in which the train, can make a trip between the two stations, 1215 m apart is **a.** 113.6 s **b.** 56.9 s **c.** 60 s **d.** 55 s	**1.0**
15.	A river is flowing from west to east at a speed of 5m/min. A man on the south bank of the river, capable of swimming at 10 m/min in still water, wants to swim across the river in the shortest time. He should swim in a direction? **a.** 30^0 west of north	**1.0**

	b. 30^0 east of north **c.** due north **d.** 60^0 east of north	

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

16.	The maximum probability of finding an electron in the d_{xy} orbital is **a.** Along the x-axis **b.** Along the y-axis **c.** At an angle of 45^o from the x and y axes **d.** At an angle of 90^o from the x and y axes	**1.0**
17.	The mathematical expression for the uncertainty principle is **a.** $\Delta x\,\Delta p \geq \frac{h}{4\pi}$ **b.** $\Delta E\,\Delta t \geq \frac{h}{4\pi}$ **c.** $\Delta x\,\Delta p \geq \frac{h}{p}$ **d.** $\Delta E\,\Delta t \geq \frac{h}{p}$	**1.0**
18.	If uncertainty in the position of an electron is zero, the uncertainty in its momentum would be **a.** Zero **b.** $< \frac{h}{2\lambda}$ **c.** $> \frac{h}{2\lambda}$ **d.** Infinite	**1.0**
19.	Which of the following is related to Uncertainty principle? **a.** Probability **b.** An orbital **c.** Wave function **d.** Energy Level	**1.0**
20.	The uncertainty in the position of a moving bullet of mass 10 gm is $10^{-5}\,m$. Calculate the uncertainty in its velocity **a.** $5.2\times10^{-28}\,m/\mathrm{s}$ **b.** $3.0\times10^{-28}\,m/\mathrm{s}$ **c.** $5.2\times10^{-22}\,m/\mathrm{s}$ **d.** $3.0\times10^{-22}\,m/\mathrm{s}$	**1.0**
21.	**Assertion (A):** The position of an electron can be determined exactly with the help of an electron microscope.	**1.0**

	Reason (*R*): The product of uncertainty in the measurement of its momentum and the uncertainty in the measurement of the position cannot be less than a finite limit. **a.** Both *A* and *R* are true and *R* is the correct explanation of *A* **b.** Both *A* and *R* are true but *R* is not the correct explanation of *A* **c.** *A* is true but *R* is false **d.** *A* is false but *R* is true	
22.	The uncertainties in the velocity of two particles A and B are 0.05 and 0.02 ms^{-1} respectively. The mass of B is five times the mass of A. The ratio of uncertainties in their positions is **a.** 0.5 **b.** 0.25 **c.** 4 **d.** 1	**1.0**
23.	When the electron of a hydrogen atom jumps from the n = 4 to the n = 1 state, the number of spectral lines emitted is **a.** 12 **b.** 6 **c.** 3 **d.** 4	**1.0**
24.	The energy of a radiation of wavelength 8000 Å is E_1 and energy of a radiation of wavelength 16000 Å is E_2 . What is the relation between these two **a.** $E_1 = 6E_2$ **b.** $E_1 = 2E_2$ **c.** $E_1 = 4E_2$ **d.** $E_1 = 1/2E_2$	**1.0**
25.	For a one-electron system, the wave number of any spectral line is directly proportional to **a.** $n_2^2 - n_2^2$ **b.** $\frac{1}{n_1^2} - \frac{1}{n_2^2}$ **c.** n^2Z^2 **d.** $n_2 - n_1$	**1.0**
26.	Excited hydrogen atom emits light in the ultraviolet region at $2.47 \times 10^{15} Hz$. With this frequency, the energy of a single photon is: $\left(h = 6.63 \times 10^{-34} J\ s\right)$ **a.** $8.041 \times 10^{-40} J$ **b.** $2.680 \times 10^{-19} J$ **c.** $1.640 \times 10^{-18} J$	**1.0**

	d. $6.111 \times 10^{-17} J$	
27.	The work function of some metals is listed below. Metal: Li, W, Pt, Mg Work function/eV: 2.4, 4.75, 6.3, 3.7 The metals which will show the photoelectric effect when light of 300 nm wave length falls on these are: **a.** Li and W **b.** W and Pt **c.** Mg and Pt **d.** Li and Mg	**1.0**
28.	The frequency of one of the lines in Paschen series of a hydrogen atom is $2.34 \times 10^{14} Hz$. The quantum number, which produces this transition is **a.** Three **b.** Four **c.** Six **d.** Five	**1.0**
29.	The line spectra of two elements are ***not*** identical, because **a.** The elements do not have the same number of neutrons **b.** They have different mass numbers **c.** Their outermost electrons are at different energy levels **d.** They have different valence electrons	**1.0**
30.	What is the lowest energy of the spectral line emitted by the hydrogen atom in the Lyman series? (h = Planck's constant, c = velocity of light R = Rydberg's constant) **a.** $\frac{5hcR}{36}$ **b.** $\frac{4hcR}{3}$ **c.** $\frac{3hcR}{4}$ **d.** $\frac{7hcR}{144}$	**1.0**

Section: Mathematics	
Questions: 15	Marks: 15

31.	If $k_1 = \tan 27\theta - \tan\theta$ and $k_2 = \frac{\sin\theta}{\cos 3\theta} + \frac{\sin 3\theta}{\cos 9\theta} + \frac{\sin 9\theta}{\cos 27\theta}$, then (a) $k_1 = 2k_2$ (b) $k_1 = k_2 + 4$ (c) $k_1 = k_2$ (d) none of these	1.0
32.	If $\frac{\cos x}{a} = \frac{\cos(x+\theta)}{b} = \frac{\cos(x+2\theta)}{c} = \frac{\cos(x+3\theta)}{d}$, then $\frac{a+c}{b+d}$ is equal to (a) a/d (b) c/d (c) b/c (d) d/a	1.0
33.	If $\sin\left(x+\frac{4\pi}{9}\right) = a; \frac{\pi}{9} < x < \frac{\pi}{3}$, then $\cos\left(x+\frac{7\pi}{9}\right)$ equals (a) $\frac{\sqrt{(1-a^2)} - a\sqrt{3}}{2}$ (b) $\frac{1-a^2+a\sqrt{3}}{2}$ (c) $\frac{a\sqrt{3}-\sqrt{(1-a^2)}}{2}$ (d) $\frac{-\sqrt{(1-a^2)} - a\sqrt{3}}{2}$	1.0
34.	If $a = \sin\frac{\pi}{18}\sin\frac{5\pi}{18}\sin\frac{7\pi}{18}$, and x is the solution of the equation $y = 2[x]+2$ and $y = 3[x-2]$, where $[x]$ denotes the integral part of x, then a is equal to (a) $[x]$ (b) $\frac{1}{[x]}$ (c) $2[x]$ (d) $[x]^2$	1.0
35.	Let n be a fixed positive integer such that $\sin\frac{\pi}{2n} + \cos\frac{\pi}{2n} = \frac{\sqrt{n}}{2}$, then (a) $n = 4$ (b) $n = 5$ (c) $n = 6$ (d) none of these	1.0

36.	In a quadrilateral if $\sin\left(\frac{A+B}{2}\right)\cos\left(\frac{A-B}{2}\right)+\sin\left(\frac{C+D}{2}\right)\cos\left(\frac{C-D}{2}\right)=2,$ then $\Sigma \cos\frac{A}{2}\cos\frac{B}{2}$ is equal to (a) 0 (b) 6 (c) 3 (d) 2	**1.0**
37.	If $x \sin a + y \sin 2a + z \sin 3a = \sin 4a$ $x \sin b + y \sin 2b + z \sin 3b = \sin 4b,$ $x \sin c + y \sin 2c + z \sin 3c = \sin 4c.$ Then the roots of the equation $t^3 - \left(\frac{z}{2}\right)t^2 - \left(\frac{y+2}{4}\right)t + \left(\frac{z-x}{8}\right) = 0, a, b, c \neq n\pi,$ are (a) $\sin a, \sin b, \sin c$ (b) $\cos a, \cos b, \cos c$ (c) $\sin 2a, \sin 2b, \sin 2c$ (d) $\cos 2a, \cos 2b, \cos 2c$	**1.0**
38.	If $a \sec\alpha - c \tan\alpha = d$ and $b \sec\alpha + d \tan\alpha = c$ then (a) $a^2 + c^2 = b^2 + d^2$ (b) $a^2 + d^2 = b^2 + c^2$ (c) $a^2 + b^2 = c^2 + d^2$ (d) $ab = cd$	**1.0**
39.	$\tan 7\frac{1}{2}^\circ$ is equal to (a) $\frac{2\sqrt{2}-(1+\sqrt{3})}{\sqrt{3}-1}$ (b) $\frac{1+\sqrt{3}}{1-\sqrt{3}}$ (c) $\frac{1}{\sqrt{3}}+\sqrt{3}$ (d) $2\sqrt{2}+\sqrt{3}$	**1.0**
40.	$\left(1+\cos\frac{\pi}{8}\right)\left(1+\cos\frac{3\pi}{8}\right)\left(1+\cos\frac{5\pi}{8}\right)\left(1+\cos\frac{7\pi}{8}\right)$ is equal to (a) 1/2 (b) $\cos \pi/8$ (c) 1/8 (d) $\frac{1+\sqrt{2}}{2\sqrt{2}}$	**1.0**
41.	If $\sin\theta_1 + \sin\theta_2 + \sin\theta_3 = 3,$ then $\cos\theta_1 + \cos\theta_2 + \cos\theta_3$ is equal to (a) 3 (b) 2 (c) 1 (d) 0	**1.0**
42.	The value of $\cos\frac{2\pi}{7} + \cos\frac{4\pi}{7} + \cos\frac{6\pi}{7}$ is equal to (a) 1 (b) -1 (c) 1/2 (d) $-1/2$	**1.0**

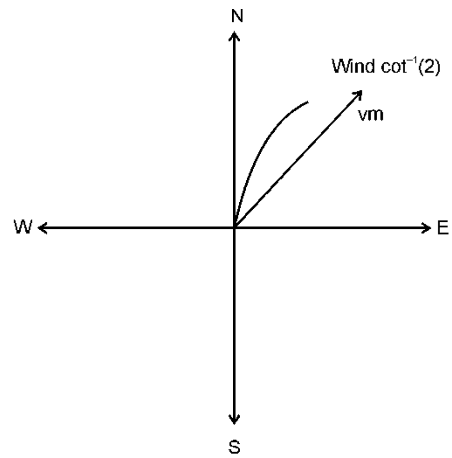
43.	If $\pi < \alpha < \frac{3\pi}{2}$, then the expression $\sqrt{(4\sin^4\alpha + \sin^2 2\alpha)} + 4\cos^2\left(\frac{\pi}{4} - \frac{\alpha}{2}\right)$ is equal to (a) $2 + 4\sin\alpha$ (b) $2 - 4\sin\alpha$ (c) 2 (d) none of these	1.0
44.	The value of $\cos\frac{\pi}{15}\cos\frac{2\pi}{15}\cos\frac{3\pi}{15}\cos\frac{4\pi}{15}\cos\frac{5\pi}{15}\cos\frac{6\pi}{15}\cos\frac{7\pi}{15}$ is equal to (a) $1/2^6$ (b) $1/2^7$ (c) $1/2^8$ (d) none of these	1.0
45.	The value of the expression $\cos\frac{\pi}{7}\cos\frac{2\pi}{7}\cos\frac{10\pi}{7} - \sin\frac{\pi}{14}\sin\frac{3\pi}{14}\sin\frac{5\pi}{14}$ is equal to (a) 0 (b) $-\frac{1}{4}$ (c) $\frac{1}{4}$ (d) $-\frac{1}{8}$	1.0

Key

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

Explanation

Question Number	Explanation
1.	$\therefore A_1^2 + A_2^2 + 2A_1A_2\cos\theta = (\sqrt{3})^2$ $2 + 2\cos\theta = 3 \Rightarrow \cos\theta = \frac{1}{2}\theta = 60^\circ$ $\left(\overline{A}_1 + \overline{A}_2\right).\left(2\overline{A}_1 - \overline{A}_2\right)$ $= 2A_1^2 - A_2^2 - A_1A_2\cos\theta = 2 - 1 - \frac{1}{2} = \frac{1}{2}$
2.	$\therefore \overline{A} = 7\bar{i} + 6\bar{j} \quad \overline{A} + \overline{B} = 11\bar{i} + 9\bar{j}$ $\therefore \overline{B} = \left(\overline{A} + \overline{B}\right) - \overline{A}$ $= 4\bar{i} + 3\bar{j}$ $\Rightarrow \left(\overline{B}\right) = 5$
3.	$V_x = 8t - 2$ $d_x = (8t - 2)dt$ $x = 4t^2 - 2t + c$ $At\ t = 2,\ x = 4\ so\ 14 = 4 \times 2^2 - 2\,x \times 2 + 2$ $X = 4t^2 - 2t + 2$ $Also\ \mathrm{v}_y = \frac{dy}{dt} = 2 \Rightarrow y = 2t + c$ $At\,t = 2,\ y = 4\ \&\ c^1 = 0$ $\therefore Y = 2t \Rightarrow t = \frac{y}{2}$ So that $x = \frac{4y^2}{4} - \frac{2y}{2} + 2 = y^2 - y + 2$
4.	$\vec{v}_m = \frac{v}{\sqrt{2}}\hat{i} + \frac{v}{\sqrt{2}}J$ $Let\ \vec{v}_m = a\hat{i} + bJ$

	$\vec{v}_{wm} = \vec{v}_m - \vec{v}_w$ $\left(a - \frac{v}{\sqrt{2)}}\right)\hat{\imath} + \left(b - \frac{v}{\sqrt{2)}}\right)J$ $tan = \frac{b - \sqrt{2}v}{a - v/\sqrt{2}}$ $a = \frac{v}{\sqrt{2}}$ $\vec{v}_w = \frac{v}{\sqrt{2}}\hat{\imath} + bJ$ $tan = \frac{b - \sqrt{2}v}{v/\sqrt{2 - \sqrt{2}v}}$ $\vec{v}_w = \frac{v}{\sqrt{2}}\hat{\imath}$ 
5.	$V_{BR} = \frac{1km/h}{15 minutes} = \frac{1km}{\frac{15}{60}h} = 4\ km/h$ $V^2B = \sqrt{V_R^2 + V_B R^2}$ $\therefore (5)2 = V_R^2 + (4)2$ $V_R^2 = 25 - 16$ $V^2{}_R = 9$ $V_R = 3km/h$
6.	In 2 hours, the distances travelled by the boat and raft, are 2 (u + v) and 2 u km. When the boat returns, its (relative) velocity becomes (v-u) km/h. Let the boat again meet the raft, t hours after turning back, then $We\ have = \left[2(u+v) - 2u\right] - [ut] = (v-u)\ t$ $or\quad 2u + 2v = 2u + ut + vt - ut$ $2v = vt$ $\therefore t = 2\ hours$ $2u + ut = 12$ $2u + 2u = 12$ $u = 4\ km/h$
7.	Let the shortest distance between the boats be l, at a time t, after the start. We have

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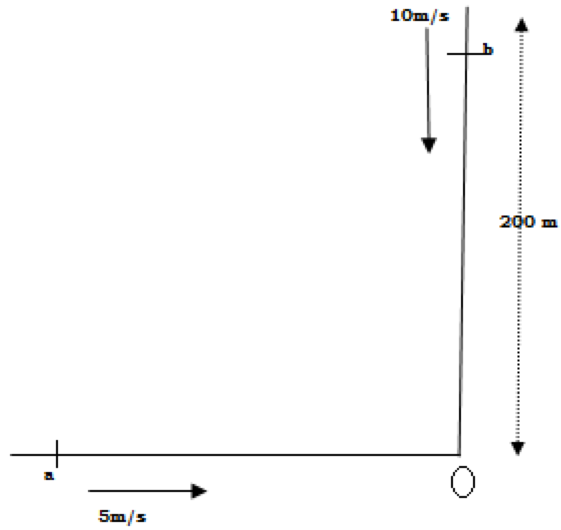
$l=\sqrt{(150-5t)^2+(200-12t)^2}$

Distance l is minimum when $\frac{dl}{dt}= \ 0$



$now\frac{dl}{dt}=\frac{d}{dt}\left[\left(150 \ - \ 5t\right)^2+ \ \left(200 \ - \ 12t\right)^2\right]^{1/2}$

$=\frac{1}{2}\left[\frac{\left(150-5t\right)\left(-5\right)+2\left(200-12t\right)\left(-12\right)}{\sqrt{\left(150-5t\right)^2+\left(200-12t\right)^2}}\right]$

$\therefore$ For minimum l, we have

-5550 + 313t = 0

$\therefore \ t=\frac{5550}{313}s=17.13s$

$\therefore \ Shortest \ distance \ = \ l_{min}\left(in \ metres\right)\sqrt{\left(150-5\times17.13\right)^2+\left(200-12\times17.13\right)^2}$

$=\sqrt{(150-85.65)^2+(200-205\times56)^2}=\sqrt{(64.35)^2+(5.56)^2} \ \sqrt{4140+30.96}$

$\sqrt{4170.91}$

$\therefore l_{min} = \ 65m \ \left(approx\right)$

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$V_p=10\,m/s,V_b=150\,m/s$

$V_{thief}=60\,m/s$

$\therefore|\vec{v}_{b'}|=|\vec{v}_{b^-}|+|\vec{v}_p|=150+10=160\,m/s|$

$\vec{v}_{bt}|=|\vec{v}_b|-|\vec{v}_t|=100\,m/s$

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9.	At any time t, after the start distance moved by the car $s_1 = 50t$ and distance moved by the truck = $s_2 = \frac{1}{2}4t^2$ Hence the separation, between the two, at time t, is $s = s_1 - s_2$ $= 50t - \frac{1}{2}(4t^2) = 50t - 2t^2$ $s = s_1 - s_2$ $= 50t - 2t^2$ The separation, s, is maximum when $\frac{\boldsymbol{ds}}{\boldsymbol{dt}} = 0$ $\therefore \quad \frac{\boldsymbol{ds}}{\boldsymbol{dt}} = 50 - 4\boldsymbol{t} = 0$ $\therefore \quad t \Rightarrow t_0 = 12.5s$ $\quad and\ s_0 = \left[50 \times 12.5 - 2 \times (12.5)^2\right]m$ $= [625 - 312.5]m = 312.5m$
10.	Initial speed = 90 km/h = 25m/s Distance travelled by the car during her reaction time = 25 x 0.6 = 15m After travelling 15m, car decelerates and $v_f = 0$ $\therefore 0^2 - 25^2 = 2(-5)s$ $s = \frac{625}{10}m = 62.5m$ Total stopping distance = 15 m + 62.5 m = 77.5 m
11.	The vector representation of velocity of Ram is given by

	$4km/h_{\overrightarrow{VR}}$ $\vec{v}_{A1}$ *is apparent velocity of wind in first case is* *Then* $\vec{v}_{A1} = \vec{v}_w - \vec{v}_R -----(1)$ $\vec{v}_w$ *is velocity of wind in the first case is* *Then* $\vec{v}_w \cos\theta = \vec{v}_{A1} ----(1a)$ *And* $\|v_w \sin\theta\| = \|v_1\| ----(1b)$ *In the second case, velocity of ram is* $\overrightarrow{2v_r} = \vec{v}_{r2}, \vec{v}_{A2}$*, the apparent velocity of the wind, in this case is given as fig* *Now* $\vec{v}_{A2} = v_w \vec{v}_{r2} ----(2)$ *figure* *Then* $8 - \vec{v}_w - \vec{v}_{R2} ----(2a)$ $v_w\, cos\theta = v_2 ---------(2b)$ *For* v_{A2} *towards sw,* $\|v_1\| = \|v_2\| -----(2c)$ *From* $(2c) 8 - v_w\, sin\theta = v_w\, cos\theta$ *using equation* $(1a)$ & $(1b)$ *in* $(2c)$ *we get* :– $4 = v_w \cos\theta ----(3a)$ *From equation* $(1b)$ $\tan\theta = 1$ $\theta = 45^\circ$ *using equation* $(3a)$ *or* $(3b)$ $4 = v \sin 45^\circ$ $\Rightarrow v_w = 4\sqrt{2}$ *hence the velocity of wind is* $4\sqrt{2}\ km/h$ *towards south east.*
12.	V_{GJ} = *Relative velocity of gases with respect to jet plane* $V_{GJ} = V_G - V_J$ $(+1500) = V_G - (-500)$ $1500 = V_G + 500$ $V_G = (1500 - 500)\ km/h$ $= 1000\ km/h$ $1000\ km/h$ *along the direction of emission of gases*
13.	V_A = velocity of the first object

	$V_B =$ *velocity of second object* *when moving towards each other, we have* $V_A + V_B = 4\ m/s$ ------------------ (1) *On moving uniformly in the same direction, their relive velocity* $\left({}^{4}/_{10}\right)\ m/s$ $V_A - V_B = 4/10$ -------------------- (2) $2\ V_A = 4.4$ *or* $V_A = 2.2\ m/s$ *Put* V_A *in eq.* (1) $2.2 + V_B = 4$ $V_B = (4 - 2.2)\ m/s$ $\therefore V_B = 1.8\ m/s$
14.	$\left[\frac{(s_1 t_1)}{1m/s^2}\ \frac{(s_1 t_2)}{3m/s^2}\right]$ Let V be the velocity of train after accelerating for a time t_1 $\therefore V = at_1 = 1\times t_1 = t_1 ----(1)$ $And\ s_1 = \frac{1}{2}at_1^2 = \frac{1}{2}\times 1\times t_1^2$ --------(2) $Also\ V = 3t_2 (\ for\ next\ path) -------(3)$ $S_2 = vt_2 - \frac{1}{2}\times 3\times t_1^2 = t_1 t_2 - \frac{3}{2}t_2^2$...........(4) $From\ equation\ (1)\ and\ (3)\ t_1 = 3t_2 or\ t_2 = t_1/3$ $\therefore S_1 + S_2 = 1215 = \frac{(t_1^2)}{2} + \frac{(t_1^2)}{3} - \frac{3}{2}\frac{(t_1^2)}{9} - \frac{2}{3}t_1^2$ $\therefore t_1 = 42.69s$ $Total\ time = t_1 + t_2 = (42.69 + \frac{42.69}{3}) = 56.92s$
15.	To cross the river in shortest time, man has to swim perpendicular to the river flow.
16.	d_{xy} lies in x and y axis at an angle 45^0 each.
17.	According to Heisenberg's uncertainty principle, if we calculate both velocity and position of an electron simultaneously then $\Delta x.\Delta P \geq \frac{h}{4\pi}$.
18.	infinite, put the values in formula

	$\Delta x.\Delta P \geq \frac{h}{4\pi}$ $if\ \Delta x = 0$ $\Delta P \geq \frac{h}{4\pi.\Delta x}$ $\Delta P \geq \frac{h}{0}$ $= \infty$ Any no. divided by zero is infinite.
19.	It gives concept of probability
20.	Uncertainty of moving bullet velocity $\Delta v = \frac{h}{4\pi \times m \times \Delta v} = \frac{6.625 \times 10^{-34}}{4 \times 3.14 \times .01 \times 10^{-5}}$ $= 5.2 \times 10^{-28}\ m/sec$
21.	Position of electron is uncertain, hence cannot be determine exactly by any instrument. Hence assertion is wrong but reason is true according to Heisenberg's Uncertainty principle
22.	From Heisenberg's uncertainty principle $\Delta x_A.\Delta p_A = \Delta x_B.\Delta p_B$ or $\Delta x_A.m_A.\Delta v_A = \Delta x_B.m_B.\Delta v_B$ Where Δx represents uncertainty in position, Δp in momentum and Δv in velocity. On calculation, we get $\Delta x_A : \Delta x_B = 1:2$
23.	When electron jumps from higher level to lower level, no of spectral lines produced are given by $= \frac{n(n+1)}{2}$ As n=4, there will be 6 lines. $4 \rightarrow 3,\ 3 \rightarrow 2,\ 2 \rightarrow 1,\ 4 \rightarrow 2,\ 4 \rightarrow 1,\ 3 \rightarrow 1.$
24.	$E \alpha \frac{1}{\lambda}; E_1 = \frac{1}{8000}; E_2 = \frac{1}{16000}$ $\frac{E_1}{E_2} = \frac{16000}{8000} = 2$ $\Rightarrow E_1 = 2E_2$

25.	$\bar{v} = \frac{1}{\lambda} = \frac{v}{c} = R\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$ here $\bar{v}$ is wave no.
26.	Energy of photon with frequency v is given by the relation $E = h\upsilon$ $= 6.63 \times 10^{-34} J\ s \times 2.47 \times 10^{15} s^{-1}$ $= 16.37 \times 10^{-19} J = 1.64 \times 10^{-18} J$
27.	The metal will show photoelectric effect if the energy of the light falling on it is greater than the work function of the metal. Energy of 300 nm light = $E = h\nu = hc/\lambda$ $= \frac{6.626\times10^{-34} js^{-1}\times3\times10^{8} ms^{-1}}{300\times10^{-9} m} = 6.626 \times 10^{-19} J$ $1.6 \times 10^{-19} J = 1\,eV$ Therefore $6.626 \times 10^{-19} J = 4.14\,eV$ The work function of Li and Mg is less than the energy of light falling on it, so they will show photoelectric effect.
28.	To evaluate wavelength of various H-lines Ritz introduced the following expression, $\bar{v} = \frac{1}{\lambda} = \frac{v}{c} = R\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$ $\frac{v}{cR} = \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$ For Paschen series n_1 =3 n_2 =? On substituting the values: $\left(\frac{2.34\times10^{14}}{3\times10^{8}}\right)\times109,67758.1m^{-1})$ $= \left[\frac{1}{3^2} - \frac{1}{n_2^2}\right]$ Hence n_2 = 4
29.	Due to difference in energy levels, the spectrum is different.
30.	For Lyman series, $n_1 = 1$ in Rydberg formula

	$\upsilon = \frac{1}{\lambda} = R\left[1 - \frac{1}{n_2^2}\right]$ $E = h\upsilon = \frac{hc}{\lambda} = hcR\left[1 - \frac{1}{n_2^2}\right]$ For the line with the lowest energy $n_2 = 2$
31.	We have, $k_1 = \tan 27\theta - \tan \theta$Objective Questions Type [Only one correct answer] $= (\tan 27\theta - \tan 9\theta) + (\tan 9\theta - \tan 3\theta) + (\tan 3\theta - \tan \theta)$ Now, $\tan 3\theta - \tan \theta = \frac{\sin 2\theta}{\cos 3\theta \cos \theta} = \frac{2 \sin \theta}{\cos 3\theta}$ Similarly, $\tan 9\theta - \tan 3\theta = \frac{2 \sin 3\theta}{\cos 9\theta}$ and $\tan 27\theta - \tan 9\theta = \frac{2 \sin 9\theta}{\cos 27\theta}$ $\therefore \quad k_1 = 2\left[\frac{\sin 9\theta}{\cos 27\theta} + \frac{\sin 3\theta}{\cos 9\theta} + \frac{\sin \theta}{\cos 3\theta}\right] = 2k_2$
32.	$\frac{a+c}{b+d} = \frac{\cos x + \cos (x + 2\theta)}{\cos (x + \theta) + \cos (x + 3\theta)}$ $= \frac{2 \cos (x + \theta) \cos \theta}{2 \cos (x + 2\theta) \cos \theta} = \frac{b}{c}$
33.	Given that $\sin (x + 80°) = a$ $\therefore \quad \cos (x + 140°) = \cos \{(x + 80°) + 60°\}$ $= \cos (x + 80°) \cos 60° - \sin (x + 80°) \sin 60°$ $= -\sqrt{(1 - a^2)} \cdot \frac{1}{2} - \frac{a\sqrt{3}}{2} = \frac{-\sqrt{(1 - a^2)} - \sqrt{3}\, a}{2}$ ($\because$ $20° < x < 60°$, $\cos (x + 80°)$ is $-$ ve)
34.	$a = \sin \frac{\pi}{18} \sin \frac{5\pi}{18} \sin \frac{7\pi}{18}$ $= \sin 10° \sin 50° \sin 70°$ $= \frac{1}{2}[2 \sin 70° \sin 10°] \sin 50°$ $= \frac{1}{2}[\cos 60° - \cos 80°] \sin 50°$

35.	$\sin\frac{\pi}{2n} + \cos\frac{\pi}{2n} = \sqrt{2}\sin\left(\frac{\pi}{4}+\frac{\pi}{2n}\right)$ $\Rightarrow \quad \frac{\sqrt{n}}{2} = \sqrt{2}\sin\left(\frac{\pi}{4}+\frac{\pi}{2n}\right)$ So for $n > 1$, $\frac{\sqrt{n}}{2\sqrt{2}} = \sin\left(\frac{\pi}{4}+\frac{\pi}{2n}\right) > \sin\frac{\pi}{4} = \frac{1}{\sqrt{2}}$ or $n > 4$ Since, $\sin\left(\frac{\pi}{4}+\frac{\pi}{2n}\right) < 1$ for all $n > 2$, we get $\frac{\sqrt{n}}{2\sqrt{2}} < 1$ or $n < 8$ So that $4 < n < 8$. By actual verification we find that only $n = 6$ satisfies the given relation.
36.	Given $2\left(\sin\left(\frac{A+B}{2}\right)\cos\left(\frac{A-B}{2}\right) + \sin\left(\frac{C+D}{2}\right)\cos\left(\frac{C-D}{2}\right)\right) = 2\times 2$ $\sin A + \sin B + \sin C + \sin D = 4$ $\Rightarrow \quad \sin A = \sin B = \sin C = \sin D = 1$ $\Rightarrow \quad \angle A = \angle B = \angle C = \angle D = 90^\circ$ Now, $\Sigma \cos\frac{A}{2}\cos\frac{B}{2} = \Sigma\cos 45^\circ\cdot\cos 45^\circ$ $= 6\times\left(\frac{1}{\sqrt{2}}\right)^2 = 3$
37.	Equation first can be written as $x\sin a + y\times 2\sin a\cos a + z\times\sin a(3-4\sin^2 a)$ $= 2\times 2\sin a\cos a\cos 2a$ $\Rightarrow \quad x + 2y\cos a + z(3+4\cos^2 a - 4)$ $= 4\cos a(2\cos^2 a - 1)$ as $\sin a \neq 0$ $\Rightarrow 8\cos^3 a - 4z\cos^2 a - (2y+4)\cos a + (z-x) = 0$ $\Rightarrow \cos^3 a - \left(\frac{z}{2}\right)\cos^2 a - \left(\frac{y+2}{4}\right)\cos a + \left(\frac{z-x}{8}\right) = 0$ Which shows that $\cos a$ is root of the equation $t^3 - \left(\frac{z}{2}\right)t^2 - \left(\frac{y+2}{4}\right)t + \left(\frac{z-x}{8}\right) = 0$ Similarly, from second and third equation we can verify $\cos b$ and $\cos c$ are the roots of the given equation.
38.	$\because a\sec\alpha = d + c\tan\alpha \quad \ldots$(i) and $b\sec\alpha = c - d\tan\alpha \quad \ldots$(ii) Squaring and adding Eqs. (i) and (ii) $(a^2+b^2)\sec^2\alpha = d^2 + c^2\tan^2\alpha + 2dc\tan\alpha$ $+ c^2 + d^2\tan^2\alpha - 2dc\tan\alpha$ $\Rightarrow (a^2+b^2)\sec^2\alpha = c^2(\tan^2\alpha + 1) + d^2(1+\tan^2\alpha)$ $= (c^2+d^2)\sec^2\alpha$ Hence, $a^2+b^2 = c^2+d^2$

39.	$\because \tan 7\frac{1^\circ}{2} = \frac{-1+\sqrt{1+\tan^2 15^\circ}}{\tan 15^\circ}$ $\because \tan 15^\circ = 2-\sqrt{3}$ or $\frac{\sqrt{3}-1}{\sqrt{3}+1}$ $\therefore \quad \tan 7\frac{1^\circ}{2} = \frac{-1+\sqrt{1+\left(\frac{\sqrt{3}-1}{\sqrt{3}+1}\right)^2}}{\left(\frac{\sqrt{3}-1}{\sqrt{3}+1}\right)}$ $= \frac{-1(\sqrt{3}+1)+2\sqrt{2}}{(\sqrt{3}-1)}$
40.	$(1+\cos\pi/8)(1+\cos 3\pi/8)(1+\cos 5\pi/8)(1+\cos 7\pi/8)$ $= 2\cos^2\pi/16 \cdot 2\cos^2 3\pi/16 \cdot 2\cos^2 5\pi/16 \cdot 2\cos^2 7\pi/16$ $= 16(\cos\pi/16\cos 3\pi/16\cos 5\pi/16\cos 7\pi/16)^2$ $= (2\cos 7\pi/16\cos\pi/16)^2(2\cos 5\pi/16\cos 3\pi/16)^2$ $= (\cos\pi/2+\cos 3\pi/8)^2(\cos\pi/2+\cos\pi/8)^2$ $= \cos^2 3\pi/8\cos^2\pi/8$ $= \frac{1}{4}(\cos\pi/2+\cos\pi/4)^2$ $= \frac{1}{8}$
41.	$\because \sin\theta_1+\sin\theta_2+\sin\theta_3 = 3$ Which is possible only when $\sin\theta_1 = \sin\theta_2 = \sin\theta_3 = 1$ $\therefore \quad \theta_1 = \theta_2 = \theta_3 = \frac{\pi}{2}$ $\therefore \quad \cos\theta_1+\cos\theta_2+\cos\theta_3 = 0+0+0 = 0$
42.	$\cos\left(\frac{2\pi}{7}\right)+\cos\left(\frac{4\pi}{7}\right)+\cos\left(\frac{6\pi}{7}\right)$ $= \mathrm{Re}\left\{e^{\frac{2\pi i}{7}}+e^{\frac{4\pi i}{7}}+e^{\frac{6\pi i}{7}}\right\}$ $= \frac{e^{\frac{2\pi i}{7}}+e^{\frac{4\pi i}{7}}+e^{\frac{6\pi i}{7}}+e^{\frac{-2\pi i}{7}}+e^{\frac{-4\pi i}{7}}+e^{\frac{-6\pi i}{7}}}{2}$ $= \frac{-1+\left(1+e^{\frac{2\pi i}{7}}+e^{\frac{4\pi i}{7}}+e^{\frac{6\pi i}{7}}+e^{\frac{-2\pi i}{7}}+e^{\frac{-4\pi i}{7}}+e^{\frac{-6\pi i}{7}}\right)}{2}$ $= \frac{-1+(\text{sum of seven roots of unity})}{2}$ $= \frac{-1+0}{2} = -\frac{1}{2}$

43.	$\alpha \in (\pi, 3\pi/2)$ $\therefore \quad \sin\alpha < 0 \ \ \& \ \cos\alpha < 0, \tan\alpha > 0$ $\sqrt{4\sin^4\alpha + \sin^2 2\alpha} + 4\cos^2\left(\frac{\pi}{4} - \frac{\alpha}{2}\right)$ $= \sqrt{4\sin^2\alpha(\sin^2\alpha + \cos^2\alpha)} + 4\cos^2\left(\frac{\pi}{4} - \frac{\alpha}{2}\right)$ $= -2\sin\alpha + 2\left(1 + \cos\left(\frac{\pi}{2} - \alpha\right)\right)$ $= -2\sin\alpha + 2 + 2\sin\alpha = 2$
44.	$\cos\frac{\pi}{15}\cos\frac{2\pi}{15}\cos\frac{3\pi}{15}\cos\frac{4\pi}{15}\cos\frac{5\pi}{15}\cos\frac{6\pi}{15}\cos\frac{7\pi}{15}$ $= \cos\frac{\pi}{15}\cos\frac{2\pi}{15}\cos\frac{4\pi}{15}\cos\left(\pi - \frac{8\pi}{15}\right)\cos\frac{3\pi}{15}\cos\frac{5\pi}{15}\cos\frac{6\pi}{15}$ $= -\left(\cos\frac{\pi}{15}\cos\frac{2\pi}{15}\cos\frac{4\pi}{15}\cos\frac{8\pi}{15}\right)\cos\frac{\pi}{5}\cos\frac{\pi}{3}\cos\frac{2\pi}{5}$ $= -\left(\frac{\sqrt{5}+1}{4}\right)\left(\frac{1}{2}\right)\left(\frac{\sqrt{5}-1}{4}\right)\left(\cos\left(\frac{\pi}{15}\right)\cos\left(\frac{2\pi}{15}\right)\right.$ $\left.\cos\left(\frac{4\pi}{15}\right)\cos\left(\frac{8\pi}{15}\right)\right)$ $= -\frac{1}{8}\cdot\frac{\sin\left(2^4\cdot\frac{\pi}{15}\right)}{2^4\cdot\sin\left(\frac{\pi}{15}\right)}$ $= -\frac{1}{2^7}\cdot\frac{\sin\left(\pi + \frac{\pi}{15}\right)}{\sin\left(\frac{\pi}{15}\right)}$ $= \frac{1}{2^7}$
45.	$\sin\left(\frac{\pi}{14}\right)\sin\left(\frac{3\pi}{14}\right)\sin\left(\frac{5\pi}{14}\right)$ $= \cos\left(\frac{\pi}{2} - \frac{\pi}{14}\right)\cos\left(\frac{\pi}{2} - \frac{3\pi}{14}\right)\cos\left(\frac{\pi}{2} - \frac{5\pi}{14}\right)$ $= \cos\left(\frac{3\pi}{7}\right)\cos\left(\frac{2\pi}{7}\right)\cos\left(\frac{\pi}{7}\right)$ $= \cos\left(\pi - \frac{4\pi}{7}\right)\cos\left(\frac{2\pi}{7}\right)\cos\left(\frac{\pi}{7}\right)$ $= -\cos\left(\frac{\pi}{7}\right)\cos\left(\frac{2\pi}{7}\right)\cos\left(\frac{4\pi}{7}\right)$ $\therefore \quad \cos\left(\frac{\pi}{7}\right)\cos\frac{2\pi}{7}\cos\left(\frac{10\pi}{7}\right) - \sin\left(\frac{\pi}{14}\right)\sin\left(\frac{3\pi}{14}\right)\sin\left(\frac{5\pi}{14}\right)$

	$$= \cos\left(\frac{\pi}{7}\right)\cos\left(\frac{2\pi}{7}\right)\cos\left(2\pi - \frac{10\pi}{7}\right) + \cos\left(\frac{\pi}{7}\right)\cos\left(\frac{2\pi}{7}\right)\cos\left(\frac{4\pi}{7}\right)$$ $$= 2\cos\left(\frac{\pi}{7}\right)\cos\left(\frac{2\pi}{7}\right)\cos\left(\frac{4\pi}{7}\right)$$ $$= \frac{2\sin\left(\frac{\pi}{7}\right)\cos\left(\frac{\pi}{7}\right)\cos\left(\frac{2\pi}{7}\right)\cos\left(\frac{4\pi}{7}\right)}{\sin\left(\frac{\pi}{7}\right)}$$ $$= \frac{2\sin\left(\frac{2\pi}{7}\right)\cos\left(\frac{2\pi}{7}\right)\cos\left(\frac{4\pi}{7}\right)}{2\sin\left(\frac{\pi}{7}\right)}$$ $$= \frac{2\sin\left(\frac{4\pi}{7}\right)\cos\left(\frac{4\pi}{7}\right)}{2\times 2\sin\left(\frac{\pi}{7}\right)}$$ $$= \frac{\sin\left(\frac{8\pi}{7}\right)}{4\sin\left(\frac{\pi}{7}\right)} = \frac{\sin\left(\pi + \frac{\pi}{7}\right)}{4\sin\left(\frac{\pi}{7}\right)}$$ $$= -\frac{\sin\left(\frac{\pi}{7}\right)}{4\sin\left(\frac{\pi}{7}\right)} = -\frac{1}{4}$$