నమస్తే తెలంగాణ
నిపుణ II
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పోటీపరీక్షల ప్రత్యేకం
ఆదివారం 1 అక్టోబర్ 2023

పంచమేశ్వర్ ప్రాజెక్టును మహాంకాళి నదిపై ఏ దేశాల మధ్య నిర్మిస్తున్నారు?
భారత్, నేపాల్

దేశంలో అతి తక్కువ వర్షపాతం పొందే ప్రాంతం ఏది?
జైసల్మీర్

దేశంలో అత్యంత వేడిగా ఉండే ప్రాంతం ?
రాజస్థాన్‌లోని బార్మేర్ (50 డిగ్రీ సెంటీగ్రేడ్)

ప్రపంచంలో అత్యధిక ఉష్ణోగ్రతలు ఎక్కడ నమోదయ్యాయి?
లిబియాలోని అల్ అజీజియా (58 డిగ్రీ సెంటీగ్రేడ్)

The acceleration of a body has the direction of

Motion in a Straight Line

నిన్నటి తరువాయి

- A body is projected vertically upwards reaches a point P in its path at a height h after time t1 and reaches the ground in t2 seconds from that point. Then
  a) Height of the point P is $h = \frac{1}{2} g t_1 t_2$
  b) Initial velocity $= \frac{g}{2}(t_1 + t_2)$
  c) Maximum height of the body $H = \frac{g}{8}(t_1 + t_2)^2$

Rocket Problem:

- A rocket is projected up with resultant acceleration a. Its fuel is burnt in "t" seconds. The maximum height reaches by the rocket is $H = \frac{1}{2}at^2\left[1 + \frac{a}{g}\right]$

- **Water drops falling at regular intervals:** The water drops fall at regular intervals of time from height 'h'. The first drop touches the ground at the instant the nth drop begins to fall then
  a) The time taken by the first drop to touch the ground $(t) = \sqrt{\frac{2h}{g}}$.
  b) The time interval between each drop $= \frac{t}{n-1}$

Juggler Problem:

- A Juggler throws balls in air in such a manner that when a ball is in its maximum height he throws another ball. If he throws n balls in t seconds then maximum height reached by the ball $= \frac{gt^2}{2n^2}$.

- If two stones are thrown up in the same direction with same velocity 'u' with a time gap of Δt sec, the time after which they meet $(t) = \frac{u}{g} + \frac{\Delta t}{2}$

- (a) If two stones are thrown up in the same direction with same velocity u with a time gap of Δt sec, the time after which they meet after the thrown of first stone is t = u/g - Δt/2 . The height from the ground at which they meet is $X = \left(\frac{4u^2 - g^2t^2}{8g}\right)$ meters.
  (b) The time after which they meet after the thrown of second stone is $t = \frac{v}{g} - \frac{\Delta t}{2}$.

Oblique projectile :

- If a body is projected with a certain initial velocity 'u' (where θ≠ 900) with the horizontal. Thus it is called an Oblique Projectile, the trajectory of a projectiles is a parabola at any instant of time the velocity can be resolved in the two rectangular components.

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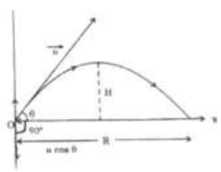
- Let u cos θ is and u sin θ are the horizontal and vertical components of velocities respectively. The horizontal components of velocity remains constant through out the journey where as it vertical component of velocity changes with time due to earth gravitational field.



At the point striking the ground:

- The horizontal component of velocity = u cosθ
- The vertical component of velocity = -u sin θ
- The velocity of projection = Th striking velocity of the projectile
- The angle of projection = The striking angle of the projectile
- The angle between velocity and acceleration = 90 – θ
- If angle of projection is 'θ' then angle of deviation is 2θ.
- The time of flight $= T = (t_a + t_d)$
  $= \frac{u \sin\theta}{g} + \frac{u \sin\theta}{g} = \frac{2u \sin\theta}{g}$
  The maximum height of the projectile $= H = \frac{u^2 \sin^2\theta}{g}$
  a) If $\theta = 90^0$ then $H = \frac{u^2}{2g}$
  b) If u and g are constant then $\frac{H_1}{H_2} = \frac{\sin^2\theta_1}{\sin^2\theta_2}$
  c) The relation between H and T is given by $T = \sqrt{\frac{8H}{g}}$.

➢ Range of projectile $= R = \frac{u^2 \sin 2\theta}{g}$
  a) If $\theta = 45^0$ Then $R = \frac{u^2}{g}$ (max)
  b) Range is same for angles of projection θ and (90⁰ - θ) with same initial velocity.
  c) The relation between R and H_{max} is given by $4H = R\tan\theta$. If $\theta = 45^0$ Then R = 4H
  d) The relation between R and T is $R = gT^2/2 \tan\theta$ If $\theta = 45^0$
  $T = \sqrt{2R/g}$

Worked Numericals :

- A train travels one station to another at a speed of 40 km/hour and returns to the first station at a speed of 60 km/hour. Calculate the average speed and average velocity of the train.

Sol: Let s (km) be the distance between two stations.

$$\text{Average speed} = \frac{\text{(Total distance)}}{\text{(Toatal time)}}$$

$$= \frac{s+s}{\frac{s}{v_1}+\frac{s}{v_2}} = \frac{s+s}{\frac{s}{40}+\frac{s}{60}} = \frac{2 \times 40 \times 60}{40+60}$$
= 40 km/hour

$$\therefore \text{Average velocity} = \frac{\text{Total displacement}}{\text{Toatal time}} = \frac{0}{t_1 + t_2} = 0.$$

- A particle experience constant acceleration for 6 seconds after starting from rest. If it travels a distance s 1 in the first 2sec , s2 in the next 2 seconds , find the ratio of s1 : s2 : s3 ?

Sol : From $s = ut + \frac{1}{2}at^2$
$= 0 \times 2 + \frac{1}{2}a2^2 = 2a$
$s_1 + s_2$ = distance travelled in 4 seconds $= 0 + 4 + a\,4^2 = 8a$
$\therefore s_2 = 8a - 2a = 6a$
$s_1 + s_2 + s_3$ = distance travelled in 6 sec
$= 0 \times 6 \frac{1}{2}a6^2 = 18a$
$\therefore s_3 = 18a - 8a = 10a$
From the above :
$s_1 : s_2 : s_3 = 1 : 3 : 5$.

- A tennis ball is dropped on to the floor from a height of 4.00 m. It rebounds to a height of 3.00 m. If the ball was in contact with the floor for 0.010 sec, what was its average acceleration during contact ?

Sol : If v1 and v2 are initial and final velocities of ball, then change in velocity of the ball in time
Δt = v2 - v1
Average acceleration
$$a = \frac{v_2 - v_1}{\Delta t} = \frac{\sqrt{2yh_2} + \sqrt{2yh_1}}{0.010}$$
$$\frac{\sqrt{2 \times 9.8 \times 3} + \sqrt{2 \times 9.8 \times 4}}{0.010} = 1652\ m/s^2.$$

- It a splash is heard 4.23 seconds after a stone is dropped into a well 78.4 m deep then find the velocity of sound in air ,

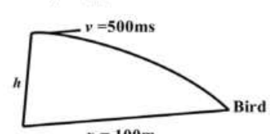
Sol : Let t sec be time taken by the stone to reach the surface of water.
By the relation, $s = ut + \frac{1}{2}at^2$,
$78.4 = 0 + \frac{1}{2} \times 9.8 \times t^2$ or,
$t^2 = \frac{78.4}{4.2} = 16$;
or , t = 4 sec.
The time taken by sound to reach the surface of the water = 4.23 – 4 = 0.23 s.
If v is the velocity of sound,
$V = \frac{s}{t} = \frac{78.4}{0.23} = 340.9$.

- A freely falling body covers in the last two seconds is twice that of covered in first four seconds. Find time of fall.

Sol: Distance travelled in last 2 seconds $= \frac{g(4t-4)}{2}$
Distance travelled in first four seconds $= \frac{1}{2} \times g \times (4)^2$ .....(2)
according the problem, $\frac{g(4t-4)}{2}$
$= 2 \times \frac{1}{2} \times g \times (4)^2$
∴ t = 9S.

- A boy aims a gun at a bird from a point at a distance of 100m, If a gun can impart a velocity of 500 m/s, to the bullet, at what height above the bird must he aim his gun in order to hit it? g = 10 m/s²

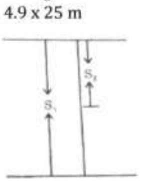
Sol: Let h be the required height. The time of travel of the bullet
$t = \frac{x}{v} = \frac{100}{500} = 0.2$ sec



And $h = \frac{1}{2}gt^2$
$= \frac{1}{2} \times 10 \times 0.2 \times 0.2$
= 5 x 0.04 meters
= 5 x 0.04 x 100 cm = 20cm.

- An object falls freely from rest for 5 seconds. Find the distance travelled in the last 2 seconds. (g= 9.8 ms-2)

Sol : For a freely falling body u = 0, a = + 9.8 m/sec²
Distance travelled in 5 seconds
$(S_1) = ut + \frac{1}{2}at^2$
= 4.9 x 25 m



Distance travelled in
1st 3 seconds $(S_2) = ut + \frac{1}{2}at^2$
$= (0)(3) + \frac{1}{2} \times 9.8 \times 9$
= 4.9 x 9 m.
∴ Distance travelled in last 2 seconds
$(S) = S_1 - S_2 = 16 \times 4.9 = 78.4$ m.

- A grass hoper can jump a maximum horizontal distance of 0.2m. If he spends negligible time on ground with what speed can be travel along the road?

Sol: The maximum horizontal range
$R_{max} = \frac{u^2}{g}$
$\therefore 0.2 = \frac{u^2}{9.8}$ or, $u^2 = 0.2 \times 9.8 = 1.96$
Or, u = 1.4 m/s.
The horizontal component of velocity of the grasshopper along the road is
$U\cos\theta = 1.4 \times \cos 45^0$
$= 1.4 \times \frac{1}{\sqrt{2}}$
= 1 m/s.

Try These

- **A body falling under gravity moves with uniform**
  1) Speed 2) Velocity
  3) Momentum
  4) Acceleration
- **A bomb is released by horizontal flying aeroplane. The trajectory of the bomb is a**
  1) Straight line 2) Parabola
  3) hyperbola 4) Circle
- **The acceleration of a body has the direction of**
  1) Displacement
  2) Change in velocity
  3) Velocity
  4) both (1) and (2)

- **Starting from rest if the displacement of a body s ∝ t² the body has**
  1) Uniform Velocity
  2) Uniform acceleration
  3) Both (1) and (2)
  4) Neither (1) and (2)
- **If a body traverses equal displacements in equal intervals of time, the body has**
  1) Variable Velocity
  2) Uniform acceleration
  3) Zero acceleration
  4) Both (1) and (2)
- **State true or false:** A car can have eastward velocity while experiencing westward acceleration
  1) True 2) False
  3) It may True 4) None

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