



Problem 1:

A man walks with 2 m/s to $+x$ direction for 20 minutes, and he stops for 15 minutes to rest. Then he continues his journey to the $-x$ direction for 1800m within 30 minutes.

- What is his net (total) displacement?
- What is the total distance taken by him?
- Find his average velocity for his whole journey.
- Determine his average speed for his whole journey.

Problem 2:

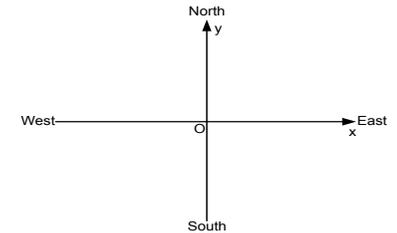
A particle move along the x axis according to the equation $x(t) = 3t^2 - 2t + 3$, where x is in meters and t is in seconds.

- what is the car's position vector at $t = 2\text{s}$?
- what is the car's displacement between $t = 4\text{s}$ and $t = 2\text{s}$?
- what is the car's average velocity between $t = 4\text{s}$ and $t = 2\text{s}$?
- what is the car's velocity as a function of t ?
- what is the car's velocity at $t = 3\text{s}$?
- what is the car's acceleration as a function of t ?
- what is the car's acceleration at $t = 3\text{s}$?

Problem 3:

A car travels 60km due north and then 80km in a direction of 37° north of east. Its trip totally endured as 1h . Find the car's

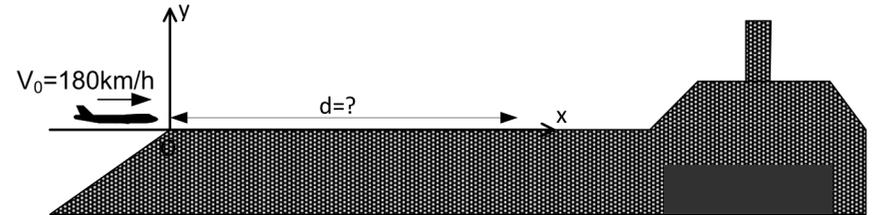
- a) resultant displacement,
- b) average speed,
- c) average velocity.



Problem 4:

A plane lands on an airplane carrier at 180km/h . See the figure.

- a) What is the magnitude of the acceleration if it stops in 4s ?
- b) What is the velocity of the warplane at 2s just after its landing?
- c) How far, in total, does it move until stopping, $d = ?$



Problem 5:

An object moving with uniform acceleration has a velocity of 6 m/s in the *positive x direction* when its *x coordinate* is 3m . If its *x coordinate* 2s later is -5m , what is its acceleration?

Problem 6:

The velocity of a particle moving along the x -axis varies in time according to the expression $v_x = (40 - 5t^2) \text{ m/s}$, where t is in seconds.

- a) Find the average acceleration in the time interval $t=0$ to $t=2.0$ s.
- b) Determine the acceleration at $t=2.0$ s.

Problem 7:

An object is in a “free fall” if the only force acting on it is gravity (no air resistance etc.). All objects in free fall accelerate downwards at the same rate. Generally, we show the acceleration due to gravity as $\vec{g} = -9.8\hat{j} \text{ m/s}^2$.

Using the above information and recalling the following equation, which governs the velocity of a free fall at any time t is given by $\vec{v}_y = \vec{v}_{0y} + \vec{g}t$,

“What are values of the velocity ($\vec{v}_y = ?$), and the acceleration ($\vec{a}_y = ?$) of a stone, which is thrown vertically upward, at the maximum height?”.

Problem 8:

A baseball is hit so that it travels straight upward after being struck by the bat. A fan observes that it takes 3s for the ball to reach its maximum height. Find;

- a) the ball’s initial velocity,
- b) the maximum height it reaches.

Problem 9:

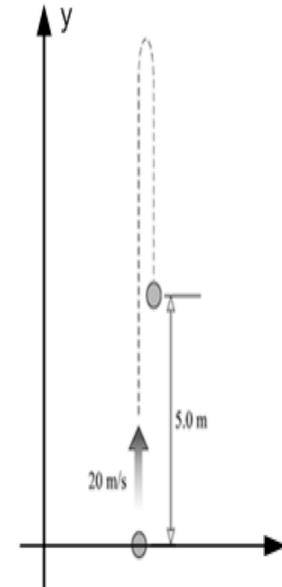
A student throws a set of keys vertically upward to her sorority sister, who is in a window 4m above. The second student catches the keys 1.5s later.

- a) with what initial velocity were the keys thrown?
- b) what was the velocity of the keys just before they were caught?

Problem 10:

A stone was thrown vertically upward from ground level with an initial speed of $v_0 = 20\text{ m/s}$. The ball was caught by the thrower at a height of 5m above the ground on its way back.

- a) Calculate the time of flight for the stone.
- b) Calculate the maximum height reached by the stone.
- c) Calculate the velocity of the stone just before it was caught.
- d) Calculate the average speed of the stone for this flight.
- e) Calculate the average velocity of the stone for this flight.

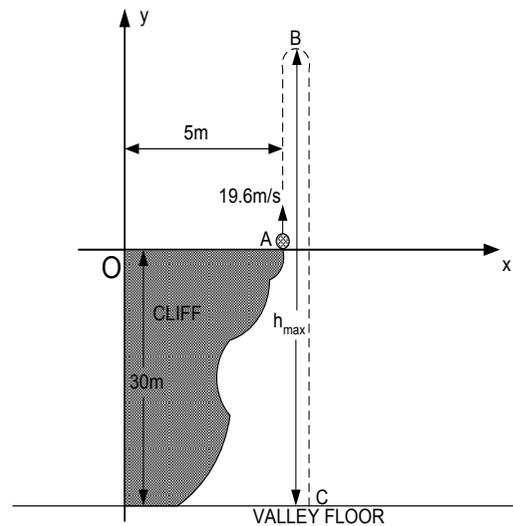


Problem 11:

A particle is standing on a cliff; 30m above the valley floor (see point A). It is observed that the particle is thrown vertically upward at a speed of 19.6m/s.

- a) How long does it take until the particle reaches the maximum height (to point B)?
- b) What is the maximum height of the particle (from the valley floor)?
- c) What is the acceleration of the particle at the maximum height?
- d) Find the speed of the particle after 3s from its throwing.
- e) How long does it take until the particle hits the valley floor (point C) (in short, we ask the time of flight)?

(Ignore all possible frictional effects.)



Problem 12:

A truck covers $40m$ in $8.5s$ while smoothly slowing down to a final speed of 2.8 m/s ,

- a) Find its original speed.
- b) Find its acceleration.

$$\text{Ans: } v = 6.6 \text{ m/s}, \vec{a} = -0.45 \hat{i} \text{ m/s}^2$$

Problem 13:

A car travelling at a constant speed of 45 m/s passes a trooper hidden behind a billboard. One second after the speeding car passes the billboard, the trooper sets out from the billboard to catch it, accelerating at a constant rate of 3 m/s^2 . How long does it take her to overtake the car?

$$\text{Ans: } 1.5t^2 - 45t - 45 = 0, \text{ the positive solution for this equation is } 31s.$$

Problem 14:

A hot air balloon is ascending (rising) vertically at a constant rate of 10 m/s and is $240m$ above the ground when a key is dropped from the balloon at time $t = 0$. Take the direction of motion along the vertical y axis, with positive direction of y upward.

- a) Find the maximum height H from the ground reached by the key.
- b) Find time t at which the key hits the ground.

Problem 15:

A ball is thrown directly downward, with an initial speed of 8 m/s , from a height of 30 m . After what time interval does the ball strike the ground?

Ans: 1.8s

Problem 16:

A stone is thrown straight upward from the edge of the top of a building at an initial speed of 10 m/s . The height of the building is 40 m . How much later must a second stone be dropped from the rest at the same initial height so that the two stones hit the ground at the same time?