Class IB$_1$

Physics

Test 2

Friday November 15. 2024

Total: / 35 marks

Name : ANSWERS

Problem 1

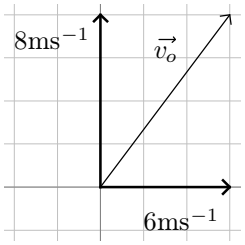


figure 1

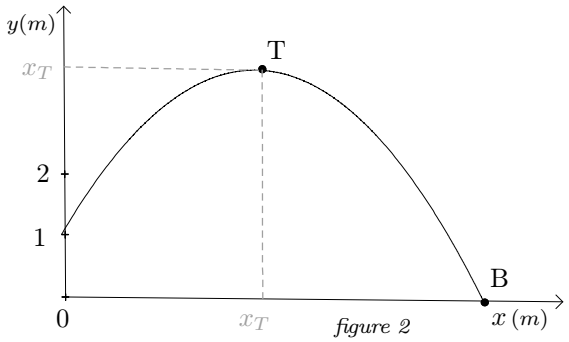


figure 2

For this question you can consider the magnitude of g equal to 10ms^{-2}

At t=0 , a ball is trawn obliquely from from position $x_o = 0$ and $y_0 = 1m$,
with a velocity $\vec{v_o}$ as show in figure 1. figure 2 shos the path of the ball.

1) $v_{ox}=6s^{-1}$ and $v_{oy}=8s^{-1}$

2) The *horizontal* component of the velocity during the travel of the ball is *constant* : $v_x=v_{ox}=6s^{-1}$

3) At the top T: ⊗ the *horizontal* component is $v_x=6s^{-1}$

⊗ the *vertical* component is $v_y=0s^{-1}$

4) The time for reaching the top is the solution of $v_y=0$ whit $v_y=v_{oy}+at = 8-10t$

then we solve $8-10t=0 \Rightarrow$ $t_{top}=0.8\,\text{sec}$.

5) The position of the ball at the top is given by the coordinates x_T and y_T of point T.

where $x_T = v_{ox}\,t_{top} = 6\times 0.8 = 4.8m$

$$y_T = y_0 + v_{ox}\,t_{top} + \frac{1}{2}a t_{top}^2 = 1 + 8\times 0.8 + \frac{1}{2}(-10)\times 0.8^2 = 1 + 6.4 - 3.2 = 4.2m$$

$\Rightarrow$ T: $(4.8m, 4.2m)$

6) The time required to fall from position T is solution of $4.2 = \frac{1}{2}gt^2 \Rightarrow t = \sqrt{\frac{4.2}{5}} = 0.916s$

7) The position of B is (0,d) where d is the horizontal distance move. $d = v_{ox}\times t_{tot}$ =6(0.8+0.916)

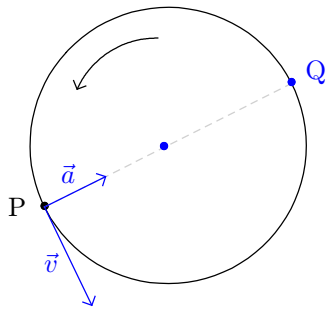
B: $(10.3m\,, 0)$

Problem 2

An object moves in a horizontal circular path with a radius of 0.8 m at a constant speed of 2.5 m/s.

1) The *magnitude* of the object's acceleration $\vec{a}$ is $\boxed{a = \frac{v^2}{r} = 7.82 m s^{-2}}$

2) The *direction* of the object's acceleration $\vec{a}$ when it a a position P is *centripetal*.



3) The *velocity* of the turning object when it is at position P is *tangent* to the circle at P

4) The *angular velocity* of this object is $\boxed{\omega = \frac{v}{r} = \frac{2.5}{0.8} = 3.125 r s^{-1}}$

5) The relation between the *angular velocity* and the angle $\Delta\theta$ moved in a time Δt is $\boxed{\omega = \frac{\Delta\theta}{\Delta t}}$

6) i) The *period* of rotation of this object is $\boxed{T = \frac{2\pi r}{v} = 2.01 s}$

ii) The *time* it will take for this object to complete 7 rotations is $\boxed{7\,T = 14.07 \text{ s}}$

iii) Suppose the object is a P at time $t_0 = 5s$

At time t=8 s, exactly 3 seconds *after* time 5,

it would already has completed of *full rotation* (in $2.01s$) + part of a second rotation.

As the (remaing) time for this part for this second rotation is about *half* of T ($0.99\text{sec} \simeq \frac{T}{2}$),

the object would finally be *very near* to the position Q shown on the picture, opposite to P.