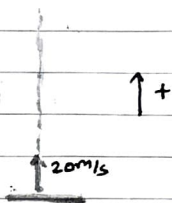


8.01 Exam - I

1. $a = -10$

$$v = 20 - 10t$$

$$y = 20t - 5t^2$$



a) At highest point, $v = 0$

$$10t = 20 \Rightarrow \boxed{t = 2 \text{ sec}}$$

$$y = 20 \cdot 2 - 5 \cdot 4 = 40 - 20 = \underline{\underline{20 \text{ m}}}$$

b) After 2 sec, the first stone is 20 m from the ground.

c) First stone ($t = 3 \text{ s}$)

$$y_1 = 20 \times 3 - 5 \times 9 = 60 - 45 = 15 \text{ m}$$

Second Stone (1 s since thrown)

$$y_2 = v_0 \cdot 1 - 5 \cdot 1^2 = v_0 - 5$$

$$\text{For } y_1 = y_2, \boxed{v_0 = 20 \text{ m/s}}$$

$$2. \quad \vec{r} = 6\hat{x} + (3+4t)\hat{y} - (3+2t-t^2)\hat{z}$$

$$a) \quad \vec{v} = \frac{d\vec{r}}{dt} = 4\hat{y} - (2-2t)\hat{z}$$

$$\text{At } t=+3, \quad \vec{v} = 4\hat{y} - (2-6)\hat{z} = 4\hat{y} + 4\hat{z} \text{ m/s}$$

$$b) \quad \text{speed} = |\vec{v}| = \sqrt{16+16} = 4\sqrt{2} \text{ m/s}$$

$$c) \quad \vec{a} = \frac{d\vec{v}}{dt} = +2\hat{z}, \text{ constant.}$$

$$\text{At } t=3, \quad a = 2 \text{ m/s}^2$$

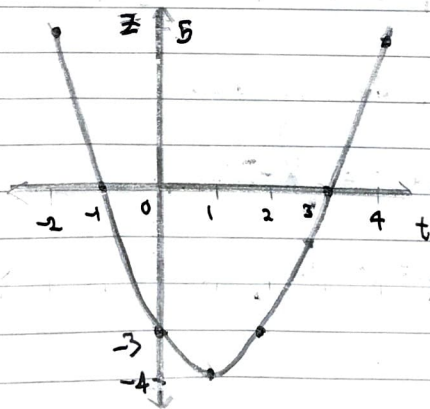
$$\vec{r} = (t^2-2t-3)\hat{z}$$

$$d) \quad \text{stand still, } v=0.$$

$$\frac{d\vec{r}}{dt} = v = (2t-2)\hat{z}$$

The particle is still at $t=1 \text{ sec}$.

e)



3. a) 1st second

$$a = 0$$

$$v = +3$$

$$x = 3t \Rightarrow \boxed{x_1 = 3 \text{ m}}$$

b) $a = \frac{dv}{dt}$ ← slope of tangent

$$a = \frac{0-3}{2-1} = \underline{\underline{-3 \text{ m/s}^2}}$$

c) between 1sec and 3sec

$$a = -3, v_0 = 3, x_0 = 3$$

$$x = 3 + 3t - \frac{1}{2} 3t^2 = 3 \left(1 + t - \frac{t^2}{2} \right)$$

At 3rd second, $t = 2$,

$$x = 3 \left(1 + 2 - 2 \right) = 3 \text{ m.}$$

$$d) \bar{v} = \frac{x_2 - x_0}{3 - 0} = \frac{3 - 0}{3} = 1 \text{ m/s}$$

$$e) \text{ speed} = \frac{\text{distance}}{\text{time}}$$

$$\text{speed} = \frac{x_{01} + x_{12} + x_{23}}{3 - 0} = \frac{3 + 1.5 + 1.5}{3} = \underline{\underline{2 \text{ m/s}}}$$

