

# Kinematics Review - Key

Note Title

6/13/2016

1.  $v_{avg} = 15.0 \text{ km/hr} = 4.1\bar{6} \text{ m/s}$   
 $t = ?$   
 $d = 35.0 \text{ m}$

$$v_{avg} = \frac{d}{t} \quad t = \frac{d}{v_{avg}} = \frac{35.0}{4.1\bar{6}} = 8.4 \text{ sec}$$

2.  $\vec{v}_i = 0$   
 $\vec{v}_f = 28.8 \text{ km/hr} = 8.0 \text{ m/s}$

$$v_{avg} = \frac{0 + 8}{2} = 4.0 \text{ m/s}$$

3.  $\vec{v}_i = 0$   
 $\vec{v}_f = -15.15 \text{ m/s}$   
 $t = ?$   
 $d = ?$

$$\vec{v}_f = \vec{v}_i + \vec{a}t$$
$$\underline{-15.15} = 0 + \underline{-9.8}t$$

$$1.5459 \text{ s} = t$$

$$t = 1.55 \text{ s}$$

$$\vec{d} = \cancel{v_i}t + \frac{1}{2}\vec{a}t^2$$
$$= \frac{1}{2}(-9.8)(1.5459)^2$$
$$= -11.7 \text{ m}$$

falling down

height = 11.7 m

use this for calculation

$$4. \vec{a} = 13.3 \text{ m/s}^2$$

$$\vec{d} = ?$$

$$t = 5 \text{ s}$$

$$\vec{v}_i = 0$$

$$\vec{d} = \cancel{v_i t} + \frac{1}{2} a t^2$$
$$= \frac{1}{2} (13.3) (5)^2$$

$$= 166.25 \text{ m}$$

$$\vec{d} = 166 \text{ m}$$

$$5. \vec{v}_i = 0$$

$$\vec{v}_f = 22.4 \text{ m/s}$$

$$\vec{a} = 0.60 \text{ m/s}^2$$

$$t = ?$$

$$\vec{d} = ?$$

$$\vec{v}_f = \vec{v}_i + \vec{a}t$$

$$\underline{22.4} = 0 + \underline{(0.60)}t$$

$$37.3 \text{ s} = t$$

$$t = 37.3 \text{ s}$$

$$\vec{d} = \cancel{v_i t} + \frac{1}{2} a t^2$$

$$= \frac{1}{2} (0.60) (37.3)^2$$

$$= 418.13 \text{ m}$$

$$\vec{d} = 418 \text{ m}$$

$$6. \quad \vec{V}_i = 85 \text{ km/hr} \stackrel{\div 3.6}{=} 23.6\bar{1} \text{ m/s}$$

$$\vec{V}_f = 120 \text{ km/hr} \stackrel{\div 3.6}{=} 33.\bar{3} \text{ m/s}$$

$$t = 9.2 \text{ s}$$

$$\vec{a} = ?$$

$$\vec{V}_f = \vec{V}_i + \vec{a}t$$

$$33.\bar{3} = 23.6\bar{1} + \vec{a}(9.2)$$

$$-23.6\bar{1} \quad -23.6\bar{1}$$

$$\frac{9.7\bar{2}}{9.2} = \frac{9.2\vec{a}}{9.2}$$

$$1.06 \text{ m/s}^2 = \vec{a}$$

$$1.06 \text{ m/s}^2 = \vec{a}$$

$$7. \quad t = ?$$

$$\vec{V}_i = 0$$

$$\vec{d} = -92.0 \text{ m}$$

$$\vec{d} = \cancel{V_i}t + \frac{1}{2}at^2$$

$$-92.0 = \frac{1}{2}(-9.8)t^2$$

$$\frac{-92.0}{-4.9} = \frac{-4.9t^2}{-4.9}$$

$$\sqrt{18.776} = \sqrt{t^2}$$

$$4.33 \text{ s} = t$$

$$8. \vec{d} = -13.0 \text{ m}$$

$$\vec{v}_i = -18.8 \text{ m/s}$$

$$\vec{v}_f = ?$$

$$\vec{v}_f^2 = \vec{v}_i^2 + 2\vec{a}\vec{d}$$

$$= (-18.8)^2 + 2(-9.8)(-13.0)$$

$$= 353.44 + 254.8$$

$$\sqrt{\vec{v}_f^2} = \sqrt{608.24}$$

$$\vec{v}_f = 24.663$$

$\vec{v}_f = -24.7 \text{ m/s}$   
moving downward

$$9. \vec{v}_i = 90 \text{ km/hr} \stackrel{\div 3.6}{=} 25 \text{ m/s}$$

$$\vec{v}_f = 0$$

$$t = 12.0 \text{ s}$$

$$\vec{a} = ?$$

$$\vec{v}_f = \vec{v}_i + \vec{a}t$$

$$0 = 25 + \vec{a}(12.0)$$

$$-25 \quad -25$$

$$\frac{-25}{12.0} = \frac{12.0\vec{a}}{12.0}$$

$$-2.08 = \vec{a}$$

$\vec{a} = -2.08 \text{ m/s}^2$

$$10. \vec{v}_i = 60 \text{ km/hr} \stackrel{\div 3.6}{=} 16.6 \text{ m/s}$$

$$\vec{v}_f = 90 \text{ km/hr} \stackrel{\div 3.6}{=} 25 \text{ m/s}$$

$$\vec{a} = 2.03 \text{ m/s}^2$$

$$t = ?$$

$$\vec{d} = ?$$

$$\vec{V}_f = \vec{V}_i + \vec{a}t$$

$$25 = 16.\bar{6} + 2.03t$$

$$\underline{-16.\bar{6}} \quad \underline{-16.\bar{6}}$$

$$\underline{8.\bar{3}} = \underline{2.03t}$$

$$\underline{2.03} \quad \underline{2.03}$$

$$4.105 = t$$

$$t = 4.15$$

$$\vec{d} = \vec{V}_i t + \frac{1}{2} a t^2$$

$$= (16.\bar{6})(4.105) + \frac{1}{2}(2.03)(4.105)^2$$

$$= 85.52 \text{ m}$$

$$\vec{d} = 85.5 \text{ m}$$

$$11. \quad \vec{V}_i = 0$$

$$t = 24.0 \text{ s}$$

$$\vec{V}_f = ?$$

$$\vec{d} = ?$$

$$\vec{V}_f = \vec{V}_i + \vec{a}t$$

$$= 0 + (-9.8)(24.0)$$

$$= -235.2$$

$$V_f = 235 \text{ m/s}$$

speed has  
no direction

$$\vec{d} = \vec{V}_i t + \frac{1}{2} a t^2$$

$$= \frac{1}{2}(-9.8)(24)^2$$

$$= -2822.4 \text{ m}$$

$$\text{height} = 2820 \text{ m}$$

$$12. \quad h_{\max} = 2100 \text{ m}$$

$$\vec{V}_f = ?$$

$$\vec{V}_i = ?$$

$$t = ?$$

$$\vec{V}_f = 0 \text{ m/s}$$

at max height

$$\vec{V}_f^2 = \vec{V}_i^2 + 2\vec{a}\vec{d}$$

$$0 = \vec{V}_i^2 + 2(-9.8)(2100)$$

$$0 = \vec{V}_i^2 - 41,160$$

$$\vec{V}_f = \vec{V}_i + \vec{a}t$$

$$0 = 202.879 + (-9.8)t$$

$$\underline{-202.879} = \underline{-9.8t}$$

$$\underline{-9.8} \quad \underline{-9.8}$$

$$+ 41,160 \quad + 41,160$$

$$\sqrt{41,160} = \sqrt{V_i^2}$$
$$202.819 = V_i$$

$$20.7 \text{ s} = t$$

$$V_i = 203 \text{ m/s}$$

13.  $\vec{V}_i = 2.0 \text{ m/s}$

$$\vec{V}_f = ?$$

$$d = 30.0 \text{ m}$$

$$\vec{V}_f^2 = \vec{V}_i^2 + 2\vec{a}d$$

$$= (2.0)^2 + 2(-9.8)(-30.0)$$

$$= 4 + 588$$

$$\sqrt{\vec{V}_f^2} = \sqrt{592}$$

$$\vec{V}_f = 24.3 \text{ m/s}$$

falling down

$$\vec{V}_f = -24.3 \text{ m/s}$$

14.  $\vec{d}_y = -25.0 \text{ m}$

$$\vec{V}_{ix} = 5.0 \text{ m/s}$$

$$\vec{d}_x = ?$$

$$\vec{V}_{iy} = 0 \text{ (always for$$

Type 1 projectiles)

$$\vec{a}_x = 0 \text{ (always)}$$

$$\vec{d}_y = \vec{V}_{iy}t + \frac{1}{2}\vec{a}_y t^2$$

$$-25.0 = \frac{1}{2}(-9.8)t^2$$

$$-25.0 = -4.9t^2$$

$$-4.9 \quad -4.9$$

$$\sqrt{5.1020} = \sqrt{t^2}$$

$$2.259 = t$$

$$\vec{d}_x = \vec{V}_{ix}t + \frac{1}{2}\vec{a}_x t^2$$

$$= (5.0)(2.259)$$

$$= 11.294 \text{ m}$$

$$\vec{d}_x = 11.3 \text{ m}$$

$$15. \begin{aligned} \vec{d}_y &= -12,000 \text{ m} \\ \vec{v}_{ix} &= 100 \text{ m/s} \\ \vec{d}_x &= ? \end{aligned}$$

$$\begin{aligned} \vec{d}_y &= \vec{v}_{iy}t + \frac{1}{2}\vec{a}_yt^2 \\ -12,000 &= \frac{1}{2}(-9.8)t^2 \\ \frac{-12,000}{-4.9} &= \frac{-4.9t^2}{-4.9} \\ \sqrt{2448.98} &= \sqrt{t^2} \\ 49.487 &= t \end{aligned}$$

$$\begin{aligned} \vec{d}_x &= \vec{v}_{ix}t + \frac{1}{2}\vec{a}_xt^2 \\ &= (100)(49.487) \\ &= 4948.7 \text{ m} \end{aligned}$$

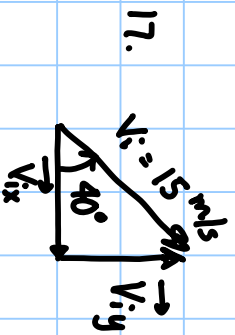
$$\vec{d}_x = 4950 \text{ m}$$

$$16. \begin{aligned} \vec{d}_y &= -15 \text{ m} \\ \vec{d}_x &= 3.0 \text{ m} \\ \vec{v}_{ix} &= ? \end{aligned}$$

$$\begin{aligned} \vec{d}_y &= \vec{v}_{iy}t + \frac{1}{2}\vec{a}_yt^2 \\ -15 &= \frac{1}{2}(-9.8)t^2 \\ \frac{-15}{-4.9} &= \frac{-4.9t^2}{-4.9} \\ \sqrt{3.061} &= \sqrt{t^2} \\ 1.7496 &= t \end{aligned}$$

$$\begin{aligned} \vec{d}_x &= \vec{v}_{ix}t + \frac{1}{2}\vec{a}_xt^2 \\ 3.0 &= \vec{v}_{ix}(1.7496) \\ \frac{3.0}{1.7496} &= \frac{1.7496\vec{v}_{ix}}{1.7496} \\ 1.715 &= \vec{v}_{ix} \end{aligned}$$

$$\vec{v}_{ix} = 1.7 \text{ m/s}$$



$$\vec{v}_{ix} = 15 \cos 40^\circ = 11.491 \text{ m/s}$$

$$\vec{v}_{iy} = 15 \sin 40^\circ = 9.642 \text{ m/s}$$

$$\vec{dx} = ?$$

$$h_{max} = ?$$

$$\vec{dy} = \vec{v}_{iy}t + \frac{1}{2}\vec{a}_y t^2$$

$$0 = (9.642)t + \frac{1}{2}(-9.8)t^2$$

$$-9.642t \quad -9.642t$$

$$\frac{-9.642t}{-4.9t} = \frac{-4.9t^2}{-4.9t}$$

$$1.9677 = t$$

$$\vec{dx} = \vec{v}_{ix}t + \frac{1}{2}\vec{a}_x t^2$$

$$= (11.491)(1.9677)$$

$$= 22.61 \text{ m}$$

$$\vec{dx} = 22.6 \text{ m}$$

$h_{max}$  occurs when  $t = \frac{1}{2}(1.9677) = 0.98385 \text{ s}$

$$\vec{dy} = \vec{v}_{iy}t + \frac{1}{2}\vec{a}_y t^2$$

$$= (9.642)(0.98385) + \frac{1}{2}(-9.8)(0.98385)^2$$

$$= 4.743 \text{ m}$$

$$\vec{dy} = 4.7 \text{ m}$$



