KINEMATICS REVIEW - SOLUTIONS

1. AVERAGE SPEED IS THE SPEED AVERAGED OVER A TIME SPAN. INSTANTANEOUS SPEED IS THE SPEED AT ANY GIVEN INSTANT IN TIME.

2. VELOCITY IS A VECTOR (MAGNITUDE AND DIRECTION). SPEED IS A SCALAR (MAGNITUDE ONLY)

3. ACCELERATION IS THE RATE OF CHANGE OF VELOCITY.

4. GIVEN

$v_i = 0$

$a = 7.0\ \frac{m}{s^2}$

$t = 10.0\ s$

$v_f = ?$

$v_f = v_i + at$

$= 0 + (7.0)(10.0)$

$= 70.\ \frac{m}{s}$

$\frac{m}{s} \xrightarrow{\times 3.6} \frac{km}{h}$

$= 250\ \frac{km}{h}$

5. GIVEN:

$a = 2.8\ \frac{m}{s^2}$

$v_i = 1.4\ \frac{m}{s}$

$d = 2.5\ m$

$v_f = ?$

$v_f^2 = v_i^2 + 2ad$

$v_f = \sqrt{v_i^2 + 2ad}$

$= \sqrt{(1.4)^2 + 2(2.8)(2.5)}$

$= 4.0\ \frac{m}{s}$

6. GIVEN:

$v_i = 7.58 \times 10^3 \frac{m}{s}$

$a = -78.4 \frac{m}{s^2}$

$v_f = 1.52 \times 10^3 \frac{m}{s}$

$t = ?$

$v_f = v_i + at$

$v_f - v_i = at$

$t = \frac{v_f - v_i}{a}$

$= \frac{(1.52 \times 10^3) - (7.58 \times 10^3)}{-78.4}$

$= 77.3\ s$

7. GIVEN:

$v_i = 80.0 \frac{km}{h} \xrightarrow{\div 3.6} = 22.\overline{2} \frac{m}{s}$

$a = -1.4 \frac{m}{s^2}$

$v_f = 20.0 \frac{km}{h} \xrightarrow{\div 3.6} = 5.\overline{55} \frac{m}{s}$

$d = ?$

$v_f^2 = v_i^2 + 2ad$

$v_f^2 - v_i^2 = 2ad$

$d = \frac{v_f^2 - v_i^2}{2a}$

$= \frac{(5.\overline{55})^2 - (22.\overline{2})}{2(-1.4)}$

$= 165\ m \rightarrow 170\ m$

8. GIVEN:

$d = 5.3\times10^2\ m$

$a = 9.8\ \frac{m}{s^2}$

$v_i = 0$

$t = ?$

$d = v_i t + \frac{1}{2}at^2$ ($v_i = 0$)

$d = \frac{1}{2}at^2$

$t^2 = \frac{2d}{a}$

$t = \sqrt{\frac{2d}{a}}$

$= \sqrt{\frac{2(5.3\times10^2)}{9.8}}$

$= 10.\ s$

9. GIVEN:

$d = 5.0\ cm = 0.050\ m$

$v_i = 0$

$v_f = 0.100\ c = 0.100(3.00\times10^8\ \frac{m}{s}) = 3.00\times10^7\ \frac{m}{s}$

$a = ?$

$v_f^2 = v_i^2 + 2ad$ ($v_i = 0$)

$v_f^2 = 2ad$

$a = \frac{v_f^2}{2d}$

$= \frac{(3.00\times10^7)^2}{2(0.050)}$

$= 9.0\times10^{15}\ \frac{m}{s^2}$

10. GIVEN:

$v_i = 40.0 \frac{m}{s}$

$t = 5.2 s$

$a = 4.90 \frac{m}{s^2}$

$v_f = ?$

$v_f = v_i + at$

$= 40.0 + (4.90)(5.2)$

$= 65 \frac{m}{s}$

11. GIVEN:

$v_i = 80.0 \frac{km}{h} \xrightarrow{\div 3.6} = 22.\bar{2} \frac{m}{s}$

$v_f = 60.0 \frac{km}{h} \xrightarrow{\div 3.6} = 16.\bar{6} \frac{m}{s}$

$a = 2.22 \frac{m}{s^2}$

$d = ?$

$v_f^2 = v_i^2 + 2ad$

$v_f^2 - v_i^2 = 2ad$

$d = \frac{v_f^2 - v_i^2}{2a}$

$= \frac{(16.\bar{6})^2 - (22.\bar{2})^2}{2(2.22)}$

$= 49 m$

12. a) GIVEN:

$v_i = 0.50 \frac{m}{s}$

$d = 56 m$

$a = 2.3 \frac{m}{s^2}$

$v_f = ?$

$$v_f^2 = v_i^2 + 2ad$$

$$v_f = \sqrt{v_i^2 + 2ad}$$

$$= \sqrt{(0.50)^2 + 2(2.3)(56)}$$

$$= 16.06 \frac{m}{s} \qquad 16 \frac{m}{s}$$

b) GIVEN:

$v_i = 0.50 \frac{m}{s}$

$d = 56 m$

$a = 2.3 \frac{m}{s^2}$

$v_f = 16.06 \frac{m}{s}$

$t = ?$

$$v_f = v_i + at$$

$$v_f - v_i = at$$

$$t = \frac{v_f - v_i}{a}$$

$$= \frac{16.06 - 0.50}{2.3}$$

$$= 6.8 s$$

c) GIVEN:

$d = 200.00 m$

$a = 9.8 \frac{m}{s^2}$

$v_i = 0$

$t = ?$

$$d = v_i t + \frac{1}{2}at^2 \quad (v_i = 0)$$

$$d = \frac{1}{2}at^2$$

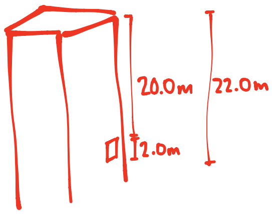
$$t^2 = \frac{2d}{a}$$

$$t = \sqrt{\frac{2d}{a}}$$

$$= \sqrt{\frac{2(200.00)}{9.8}}$$

$$= 6.4 s$$

13.



GIVEN:

$a = 9.8\ \frac{m}{s^2}$

$v_i = 0$

$d = 20.0\ m$

$t = ?$

FIND TIME IT TAKES TO GET TO TOP OF WINDOW (d=20.0m)

$v_i = 0$

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

$d = \frac{1}{2} a t^2$

$t^2 = \frac{2d}{a}$

$t = \sqrt{\frac{2d}{a}}$

$= \sqrt{\frac{2(20.0)}{9.8}}$

$= 2.0 s$

GIVEN:

$a = 9.8\ \frac{m}{s^2}$

$v_i = 0$

$d = 22.0\ m$

$t = ?$

FIND TIME IT TAKES TO GET TO BOTTOM OF WINDOW (d=22.0m)

$v_i = 0$

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

$d = \frac{1}{2} a t^2$

$t^2 = \frac{2d}{a}$

$t = \sqrt{\frac{2d}{a}}$

$$= \sqrt{\frac{2(22.0)}{9.8}}$$

$$= 2.1$$

FIND THE DIFFERENCE BETWEEN THE TWO TIMES, Δt

$$\Delta t = 2.1 - 2.0$$

$$= 0.1 s$$

14. GIVEN:

$v_i = 0$

$a = 6.00 \frac{m}{s^2}$

$t = 10.0 s$

$d = ?$

FIND DISTANCE AT $t = 10.0 s$

$v_i = 0$

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

$$d = \frac{1}{2} a t^2$$

$$= \frac{1}{2}(6.00)(10.0)^2$$

$$= 300. m$$

GIVEN:

$v_i = 0$

$a = 6.00 \frac{m}{s^2}$

$t = 15.0 s$

$d = ?$

FIND DISTANCE AT $t = 15.0 s$

$v_i = 0$

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

$$d = \frac{1}{2} a t^2$$

$$= \frac{1}{2}(6.00)(15.0)^2$$

$$= 675 m$$

FIND THE DISTANCE BETWEEN THE POSITIONS

$$\Delta d = 675 - 300$$

$$= 375 m$$

15. a)

GIVEN:

$v_i = 3.50 \frac{m}{s}$

$v_f = 11.40 \frac{m}{s}$

$t = 4.20 s$

$\bar{v} = ?$

$$\bar{v} = \frac{v_f + v_i}{2}$$

$$= \frac{11.40 + 3.50}{2}$$

$$= 7.45 \frac{m}{s}$$

b)

GIVEN:

$v_i = 3.50 \frac{m}{s}$

$v_f = 11.40 \frac{m}{s}$

$t = 4.20 s$

$\bar{v} = 7.45 \frac{m}{s}$

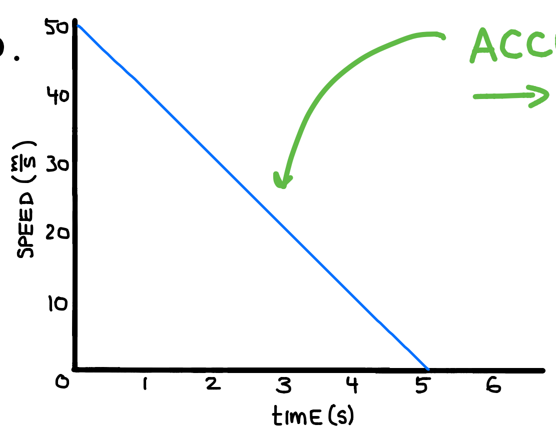
$d = ?$

$$d = \bar{v} t$$

$$= (7.45)(4.20)$$

$$= 31.3 m$$

16.



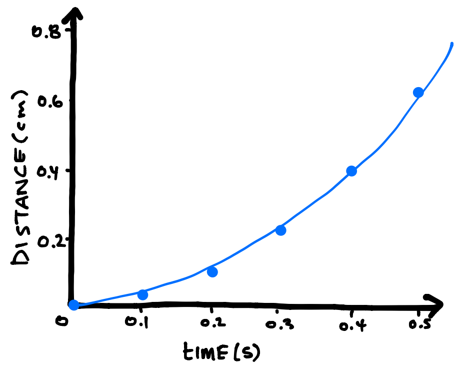
ACCELERATION IS $9.8 \frac{m}{s^2}$ DOWN

⟶ SLOPE OF GRAPH $= -9.8 \frac{m}{s^2}$

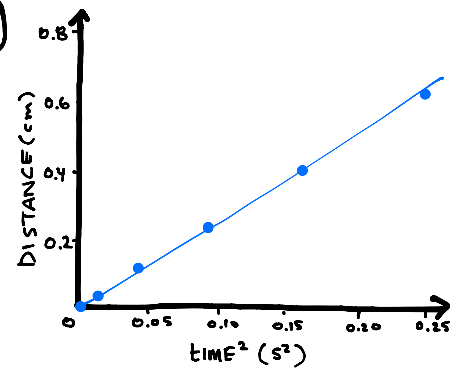
17.

DISTANCE (cm)	0	0.025	0.100	0.225	0.400	0.625
time (s)	0	0.100	0.200	0.300	0.400	0.500
time² (s²)	0	0.0100	0.0400	0.0900	0.160	0.250

a)



b)



c)

$$\text{slope} = \frac{\Delta d}{\Delta t^2} = \frac{0.625 - 0}{0.250 - 0} = 2.50 \frac{m}{s^2}$$

$$d = v_i t + \frac{1}{2}at^2 \quad (v_i = 0)$$

$$d = \frac{1}{2}at^2$$

$$\frac{d}{t^2} = \frac{1}{2}a$$

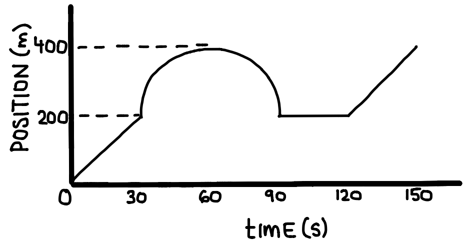
$$a = 2 \times \frac{d}{t^2}$$

$$= 2 \times \text{SLOPE}$$

$$= 2 \times 2.50$$

$$= 5.00 \frac{m}{s^2}$$

18. a)



DISPLACEMENT IS THE CHANGE IN POSITION

400 − 200 = 200m

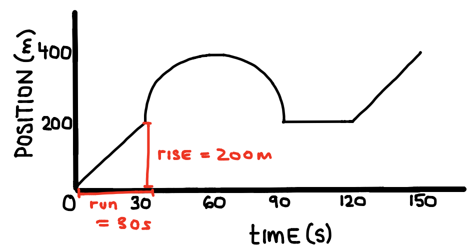
b) 0 - 60s AND 120 - 150s

c) $V = \text{SLOPE} = \frac{\text{rise}}{\text{run}}$

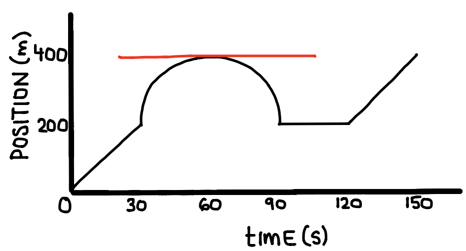
$= \frac{\Delta d}{\Delta t}$

$= \frac{200}{30}$

$= 6.7 \frac{m}{s}$



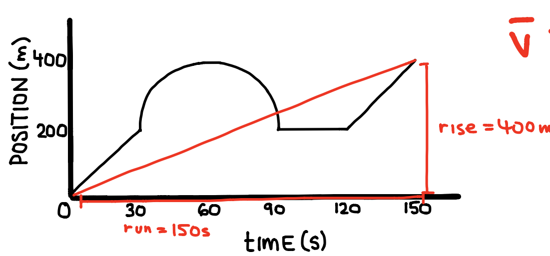
d)



V = SLOPE

= 0

e)



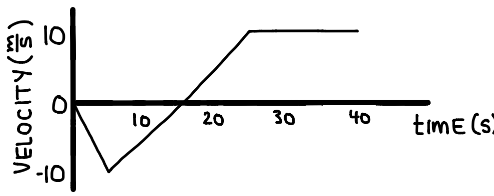
$\bar{v} = \text{SLOPE} = \frac{\text{rise}}{\text{run}}$

$= \frac{\Delta d}{\Delta t}$

$= \frac{400}{150}$

$= 2.7 \frac{m}{s}$

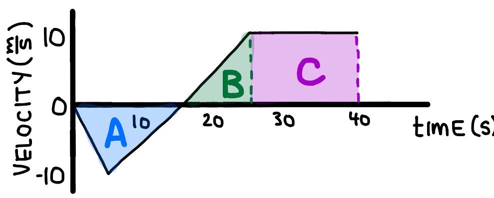
19. a) 15-40s



b) 5-25s

c) UNIFORM MOTION : MOVING IN THE POSITIVE DIRECTION WITH A CONSTANT VELOCITY OF 10 $\frac{m}{s}$.

d)



DISPLACEMENT = AREA

$= -AREA_A + AREA_B + AREA_C$

$= -\frac{1}{2}(15)(10) + \frac{1}{2}(10)(10) + (15)(10)$

$= -75 + 50 + 150$

$= 125\,m$

e) DISTANCE = AREA

$= +AREA_A + AREA_B + AREA_C$

$= +\frac{1}{2}(15)(10) + \frac{1}{2}(10)(10) + (15)(10)$

$= +75 + 50 + 150$

$= 275\ m$

f)

$\bar{v} = \frac{\vec{d}}{t}$

$= \frac{125}{40}$

$= 3.1\ \frac{m}{s}$