807 AP Physics Schmidt
Name: _____ Block: __

U5H2

Ch. 9 - Conservation of Momentum 1D and 2D

$\vec{p}_{(i)1} + \vec{p}_{(i)2} + \vec{p}_{(i)3} + \ldots = \vec{p}_{(f)1} + \vec{p}_{(f)2} + \vec{p}_{(f)3} + \ldots$ *If no external forces act on the system*

$p_{(ix)1} + p_{(ix)2} + p_{(ix)3} + \ldots = p_{(fx)1} + p_{(fx)2} + p_{(fx)3} + \ldots$

$p_{(iy)1} + p_{(iy)2} + p_{(iy)3} + \ldots = p_{(fy)1} + p_{(fy)2} + p_{(fy)3} + \ldots$

1. A 30 g dart is shot straight up at 9.0 m/s. At the same instant, a 20g cork ball is dropped from 3.0 m above the dart. What are the speed and direction of the cork ball immediately after it is hit by the dart? Assume the collision is head-on and the dart sticks in the cork. (2.07 m/s)

2. At the center of a 50.0 m diameter circular rink, a 75 kg skater moving north at 2.5 m/s collides with and holds onto a 60 kg skater who had been heading west at 3.5 m/s. (a) How long will it take then to glide to the edge of the rink? (b) Where will they reach it? (Give your answers as an angle north of west.) (11.9 s; 41.7°)

3. Two ice-skaters, with masses of 50 kg and 75 kg, are at the center of a 60 m diameter circular rink. The skaters push off against each other and glide to opposite edges of the rink. If the heavier skater reaches the edge in 20 s, how long does the lighter skater take to reach the edge? (13.3s)

4. A firecracker in a coconut at rest blows the coconut into three pieces. Two pieces of equal mass fly off south and west, perpendicular to each other at 20 m/s. The third piece has twice the mass of the other two. What is the speed and direction of the third one? (14.14 m/s; NE)

5. A red billiard ball is shot east at 2.0 m/s and a blue billiard ball is shot west at 1.0 m/s. After they collide, the blue billiard ball travels north at 1.41 m/s. What are the speed and direction of the red billiard ball after the collision? Give the direction as angle south of east. (1.73 m/s; 54.5°)

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6. In a ballistics test, a 25 g bullet traveling horizontally at 1200 m/s goes through a 30 cm thick 350 kg stationary target and emerges with a speed of 900 m/s. The target is free to slide on a smooth horizontal surface.
   (a) How long is the bullet in the target? Assume that the target was stationary while the bullet was in it. What average force does it exert on the target? (0.29 ms; 25,860N)
   (b) What is the target's speed just as the bullet emerges? (0.021 m/s)

7. A 75 kg shell is fired with an initial speed of 125 m/s at an angle of 55° above the horizontal. Air resistance is negligible. At its highest point, the shell explodes into two fragments, one four times as massive as the other. The heavier fragment lands just below the point of explosion. If the explosion exerts only horizontal forces, how far from the launch point does the lighter fragment land? (4405 m)

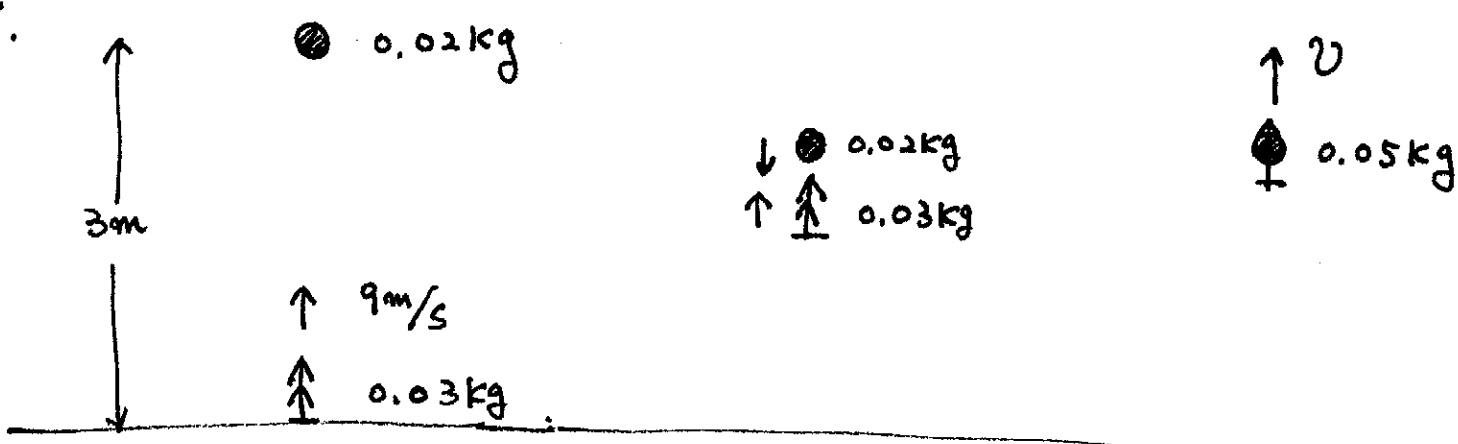
8. A 1500 kg weather rocket accelerates upward at 10 m/s^2. It explodes 2.0 s after takeoff and breaks into two fragments, one twice as massive as the other. The lighter fragment travels straight up and reaches a max height of 530 m. What were the speed and direction of the heavier fragment just after the explosion? (20.5 m/s downward)

9. An object at rest on a flat horizontal surface explodes into two fragments, one seven times as massive as the other. The heavier fragment slides 8.2 m before stopping. How far does the lighter fragment slide? Assume that both fragments have the same coefficient of kinetic friction. (402 m)

Ch9.

LI5 H2.

1.



Before hit

dart.

$y = 9t - \frac{1}{2}(10)t^2$

$= 9t - 5t^2$

ball

$y = 3 - \frac{1}{2}(10)t^2$

$= 3 - 5t^2$

$\therefore 9t - 5t^2 = 3 - 5t^2$

$t = \frac{1}{3}$ sec

dart

$v_d = 9 - 10 \cdot \frac{1}{3}$

$= 5.67$ m/s

ball

$v_b = -10 \cdot \frac{1}{3}$

$= -3.33$ m/s.

Σmv

$= 0.03 \times 5.67$

$- 0.02 \times 3.33$

$= 0.1035$

After hit

Σmv

$0.05 \cdot v$.

$\therefore$ $0.1035 = 0.05v$

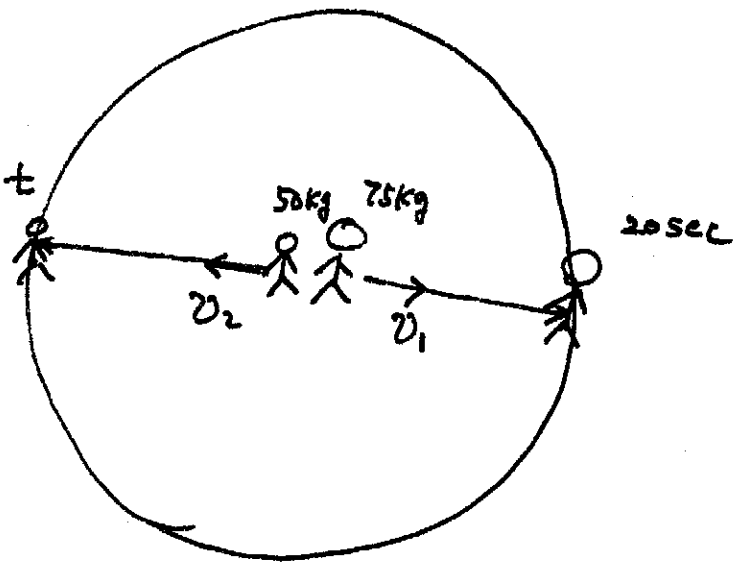
$v = 2.07$ m/s

Ch 9.

U5H2.

60 m

3.



Before.

$\Sigma mv = 0$.

After

$\Sigma mv = 75v_1 - 50v_2$.

$\therefore \; 75v_1 = 50v_2$.

$$v_2 = \frac{75}{50} v_1 = \frac{3}{2} v_1$$

* 75kg

$$x = v_0 t + \frac{1}{2} a t^2 = v_1 t = 30.$$

$$v_1 = \frac{30}{t} = \frac{30}{20} = \frac{3}{2}.$$

$$\therefore v_2 = \frac{9}{4}$$

* 50kg

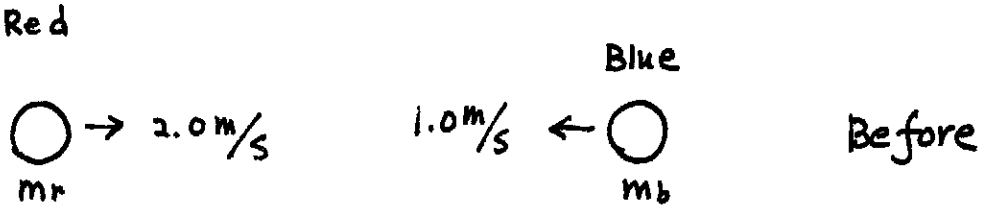
$$x = v_2 t = 30 = \frac{9}{4} \cdot t$$

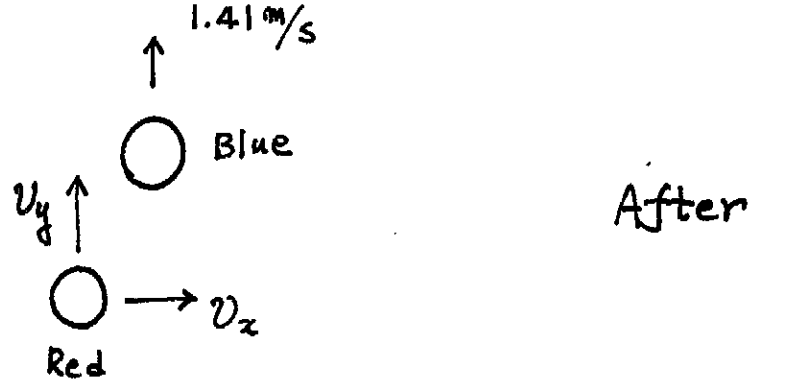
$$t = 13.3 \text{ sec}$$

Ch9

USH2.

5.





Before.

x-direction.

Σmv

$= 2 \cdot m_r - m_b$

After

Σmv

$= m_r \cdot v_x$.

$\therefore 2m_r - m_b = m_r v_x$

$m = m v_x$

$v_x = 1$ m/s

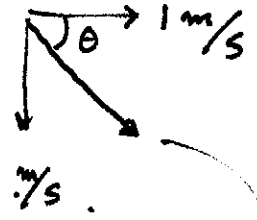
y-direction

$\Sigma mv = m_b \cdot 1.41 + m_r v_y$

$1.41 + v_y = 0$.

$v_y = -1.41$.

$\therefore$



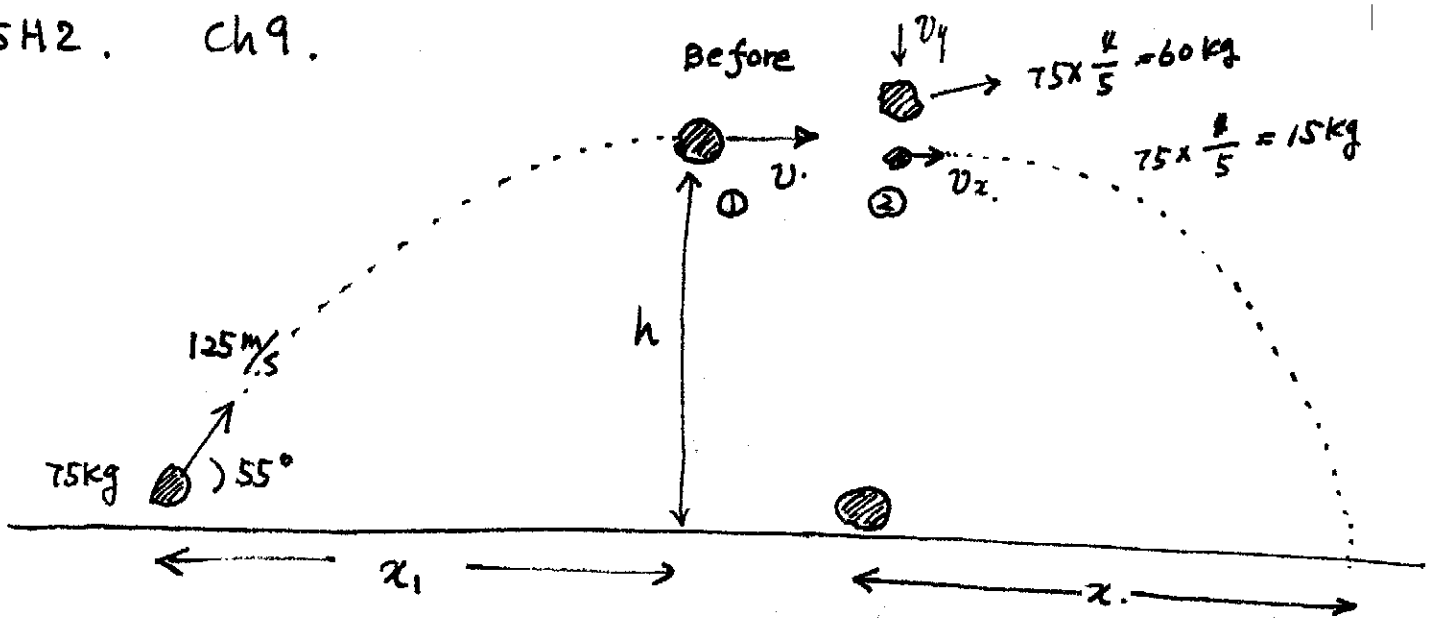
$\therefore \sqrt{1.41^2 + 1^2} = 1.73$ m/s

$\tan\theta = \frac{1.41}{1}$

$\theta = 54.7°$

U5H2. Ch9.

7.



① $\frac{1}{2}\times 75\times 125^2 = \frac{1}{2}\cdot 75\times v^2 + mgh$ X. → h ?

$125\times\cos 55^\circ = v = 71.7$ m/s.

$m\cdot v = 75\times 71.7 = 5377.5$ kg m/s x-direction.

② $15\cdot v_x = 5377.5$

$v_x = 358.5$ m/s

h = ? $\frac{1}{2}\times 75\times 125^2 = \frac{1}{2}\times 75\times 71.7^2 + 75\times 10\times h$.

$10h = 7812.5 - 2570.4$ → $h = 524.21$ m.

$h = \frac{1}{2}\times 10\times t^2 = 524.21$ → $t = 10.24$ sec

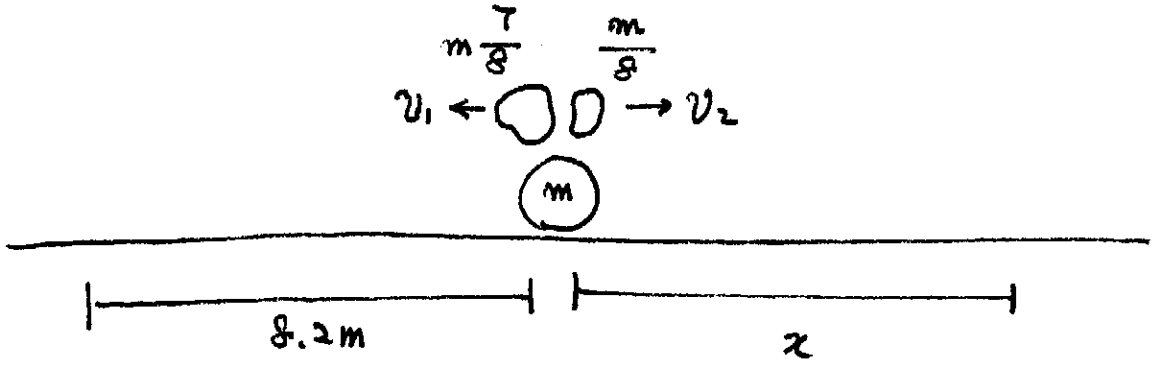
$x = 358.5\times 10.24 = 3670.8$ m

$x_1 = 71.4\times 10.24 = 731.14$ m

4402 m.

Ch9. 练习2.

9.



Before $\quad \Sigma mv = 0.$

After. $\quad \frac{7}{8}m v_1 = \frac{m}{8} v_2$

$$v_2 = 7 v_1$$

$$KE = \frac{1}{2} \times \frac{7}{8} m \times v_1^2 = \frac{7}{16_2} m v_1^2 = \text{Friction} \times 8.2$$

$$= \mu \cdot \frac{7}{8} m \times 10 \times 8.2.$$

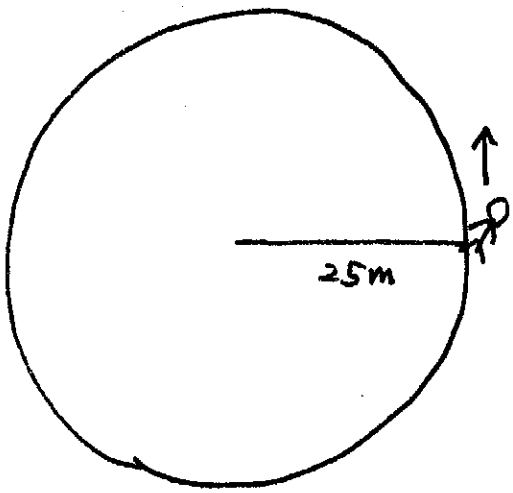
$$\frac{v_1^2}{2 \times 8.2} = \mu.$$

$$\frac{1}{2} \times \frac{m}{8} \times v_2^2 = \mu \cdot \frac{m}{8} \times 10 \times x.$$

$$\frac{1}{2} \times 49 v_1^2 = \frac{v_1^2}{2 \cdot 8.2} \times 10x.$$

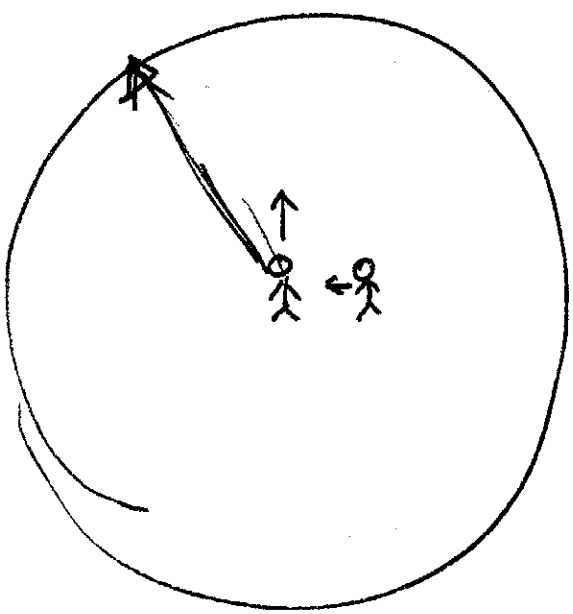
$$x = \frac{2 \cdot 49 \times 8.2}{2 \times 10} = 40 1.8 m.$$

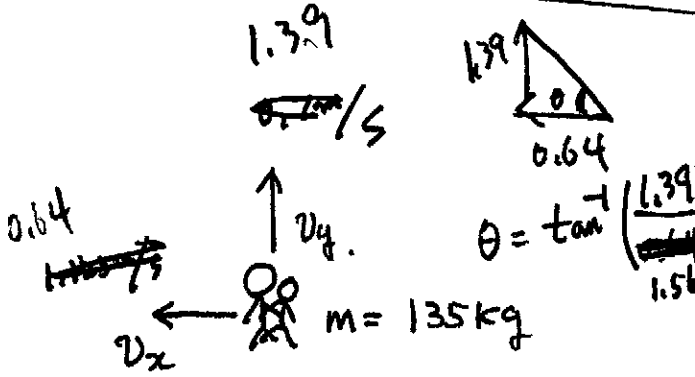
2.



Σmv =

x-dir	y-dir.
-60×3.5	75×2.5
$= -210$	$= 187.5$





Σmv =

x-dir	y- dir.
$-135 \times v_x$	$135 \times v_y = 187.5$
$= -210$	
$v_x = \frac{-210}{135} = 1.56$ m/s	$v_y = 1.39$ m/s

$\text{Speed} = \sqrt{0.64^2 + 1.39^2}$

$= 1.56$ m/s

$= 1.5$ m/s

$= 2$

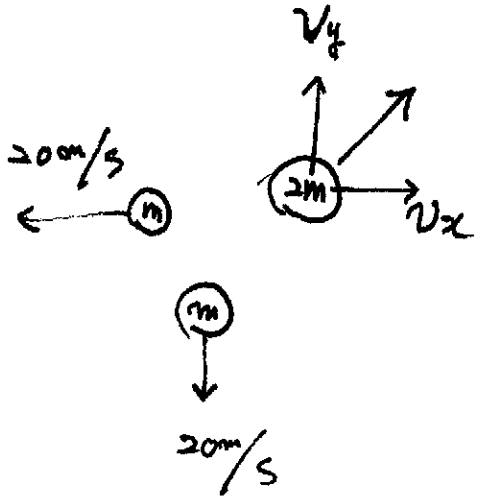
$0.96 \cdot t = 25$

$t = \frac{25}{2.08} = 12$ sec

1.34 sec

4.

$\Sigma mv = 0$.



Σmv .

x-direction

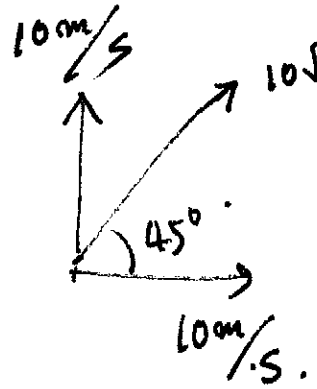
$2m \cdot v_x - m \cdot 20 = 0$

$v_x = 10\ m/s$.

y-direction .

$2m v_y - m \cdot 20 = 0$

$v_y = 10\ m/s$.



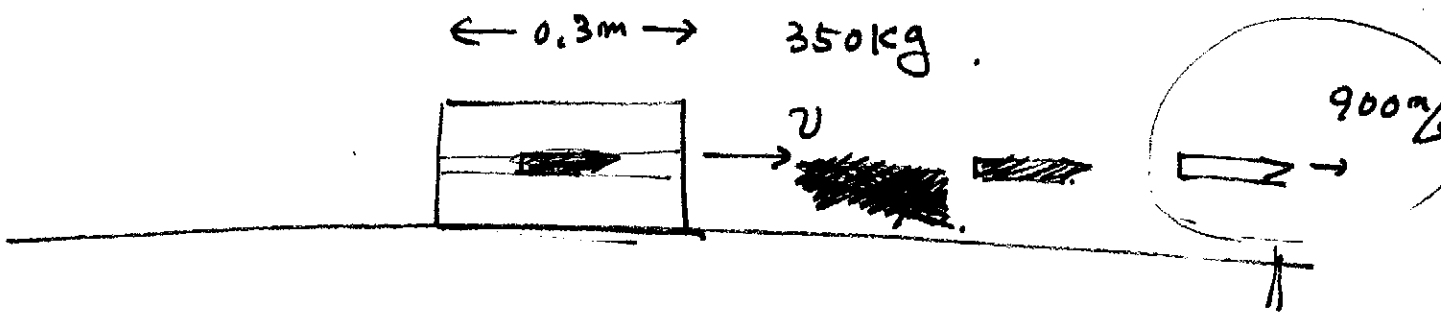
6.

0.025 kg → 1200 m/s

Σmv

$= 0.025 \times 1200$

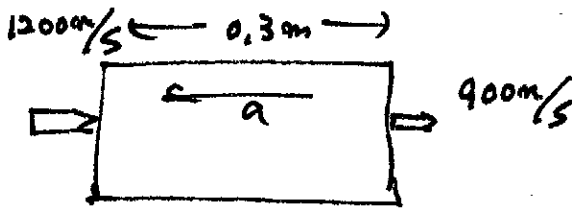
$= 30$



0.025×900

$= 22.5$

$\Delta mv = 22.5 - 30 = -7.5 = F \cdot \Delta t \rightarrow F = \frac{7.5}{0.00029} = 25862N$



$at^2 = at \cdot t$

$x = v_0 t + \frac{1}{2} a t^2$

$0.3 = 1200 \cdot t + \frac{1}{2} \cdot a \cdot t^2$

$v = v_0 + at$

$900 = 1200 + a \cdot t$

$at = -300$

10^{-3}

$0.3 = 1200 \cdot t + \frac{1}{2} (-300) \cdot t$

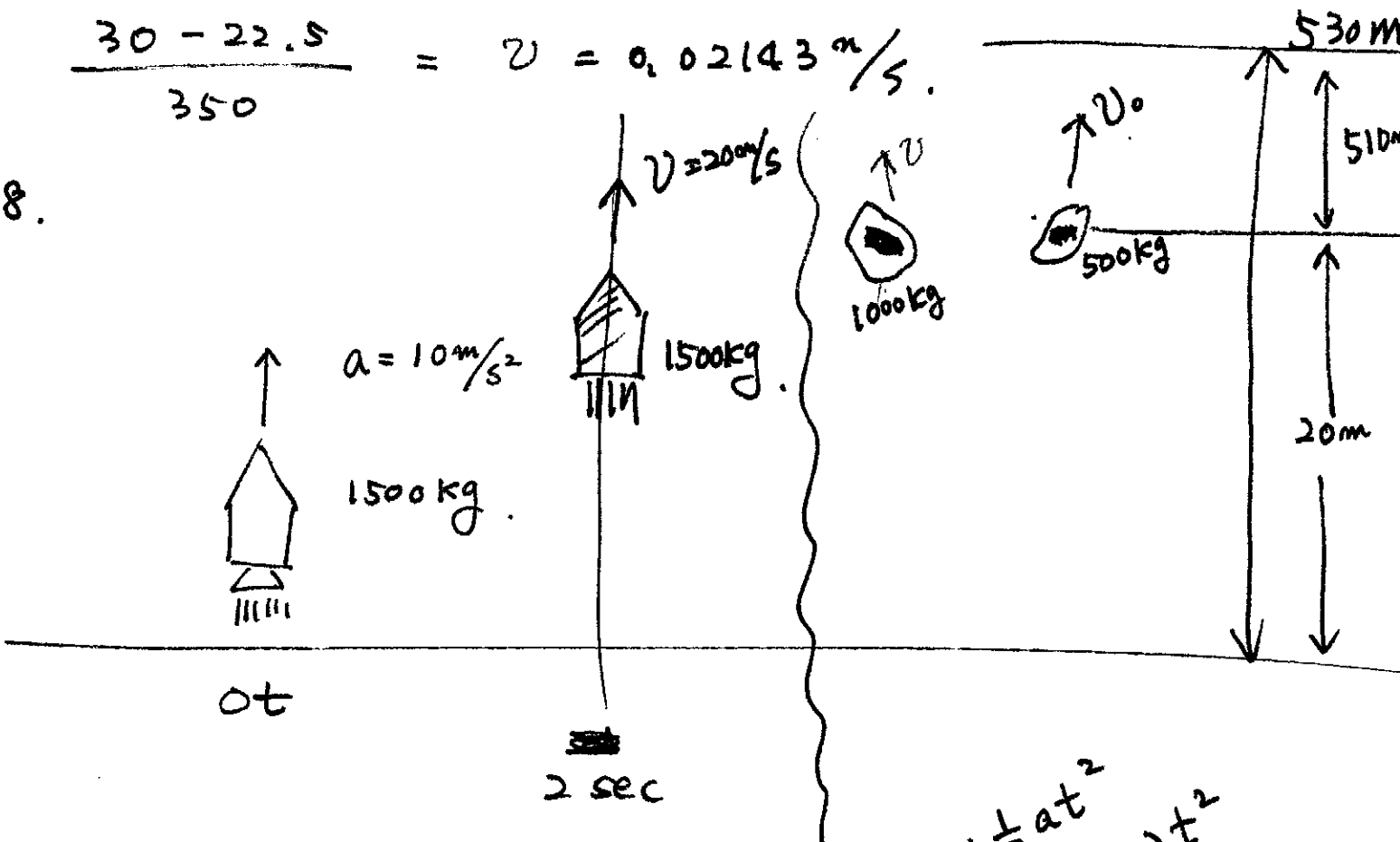
$0.3 = 1200t - 150t = 1050t$

$t = \frac{0.3}{1050} = 0.00029 \text{ sec}$

$30. = 350 \times v + 22.5$

$\frac{30 - 22.5}{350} = v = 0.02143 \text{ m/s}.$

8.



$v = v_0 + at$

$= 0 + 10 \times 2$

$= 20 \text{ m/s}$

$SMV = 20 \times 1500 = 30000$

$x = v_0 t + \frac{1}{2} a t^2$

$= 0 + \frac{1}{2} \times 10 \times 4$

$= 20 \text{ m}$

$x = v_0 t + \frac{1}{2} a t^2$

$510 = v_0 \cdot t + \frac{1}{2}(-10) t^2$

$v = 0 = v_0 + at$

$= v_0 - 10 \cdot t$

$t = \frac{v_0}{10}$

$510 = v_0 \cdot \left(\frac{v_0}{10}\right) - 5 \cdot \frac{v_0^2}{100}$

$v_0 = 101 \text{ m/s}$