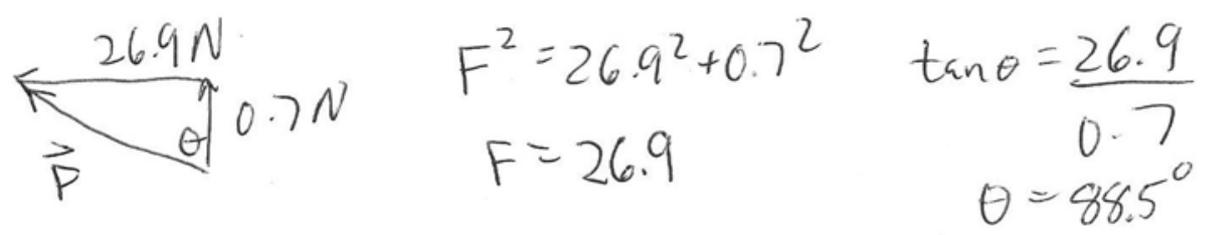


	A	B	C	D	Total
$N-S$	0	-35	38.3	-2.6	0.7 N
$E-W$	20	0	-32.1	-14.8	-26.9 N



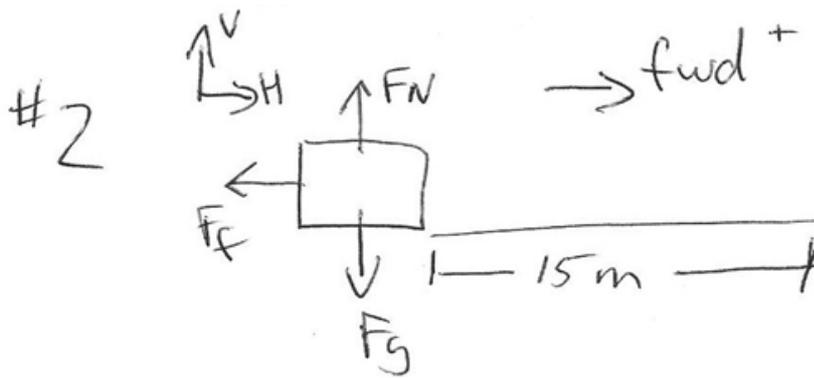
$$\therefore \vec{F}_{NET} = 26.9\text{ N} [N 88.5^\circ W]$$

or

$$[W 1.5^\circ N]$$

$$a = \frac{F}{m} = \frac{26.9\text{ N} [W 1.5^\circ N]}{15\text{ kg}}$$

$$= 1.79 \frac{\text{m}}{\text{s}^2} [W 1.5^\circ N]$$



Vertically

$$F_{NET} = 0$$

$$F_{NET} = F_N - F_g$$

$$\therefore 0 = F_N - F_g$$

$$\begin{aligned} \text{so } F_N &= F_g \\ &= (1000)(9.8) \\ &= 98000 \text{ N} \end{aligned}$$

$$\begin{aligned} (1000)(9.8) &= \\ (1000)(-20.8) &= -\mu(98000) \end{aligned}$$

$$\mu = 0.212$$

Note: Don't need m!

$$F_N = mg$$

$$\therefore \mu mg = -\mu mg$$

$$a = -\mu g$$

(as in question 10, too)

Horizontally

$$F_{NET} = ma$$

$$F_{NET} = -F_f$$

$$\therefore ma = -\mu F_N$$

Need a

$$d = 15 \text{ m}$$

$$v_i = 25 \frac{\text{m}}{\text{s}} \quad \left( 90 \frac{\text{km}}{\text{h}} \right)$$

$$v_f = 0$$

$$a = ?$$

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

$$= \frac{0 - 25^2}{2(15)}$$

$$= -20.8 \frac{\text{m}}{\text{s}^2}$$

#3

**Fuel**

$m = 22 \text{ kg}$   
 $v_i = 500 \frac{\text{m}}{\text{s}}$   
 $v_f = -8000 \frac{\text{m}}{\text{s}}$   
 $t = 8.5 \text{ s}$   
 $a = ?$   
 $F = ?$

**Rocket**

$M = 2.5 \times 10^3 \text{ kg}$   
 $v_i = 500 \frac{\text{m}}{\text{s}}$   
 $v_f = ?$   
 $t = 8.5 \text{ s}$   
 $a = ?$   
 $F = ?$

$a = \frac{v_f - v_i}{t}$   
 $= \frac{-8000 - 500}{8.5}$   
 $= -1000 \frac{\text{m}}{\text{s}^2}$

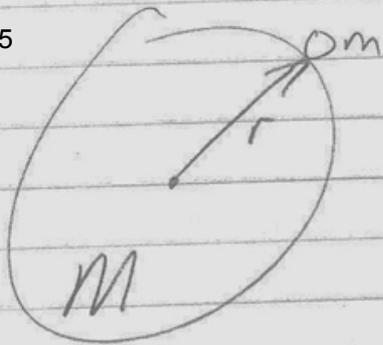
$F = ma$   
 $\therefore F = 22(-1000)$   
 $= -22000 \text{ N}$

$a = \frac{F}{m}$   
 $= \frac{22000 \text{ N}}{2500 \text{ kg}}$   
 $= 8.8 \frac{\text{m}}{\text{s}^2}$

$v_f = v_i + at$   
 $= 500 + (8.8)(8.5)$   
 $= 574.8 \frac{\text{m}}{\text{s}}$

#4 Action-reaction forces are never on the same object. In this case, the action force is on the box and the reaction force is on the person. These forces never cancel since they are on different objects. The harder the mover pushes the box, the more it will accelerate and the more it will push back on HIM.

#5



$$F_g = mg$$

$$F_g = \frac{GMm}{r^2}$$

$$\therefore r/g = \frac{GMm}{r^2}$$

$$g = \frac{GM}{r^2}$$

$$r^2 = \frac{GM}{g}$$

$$= \sqrt{\frac{(6.67 \times 10^{-11})(7.8 \times 10^{24})}{6.8}}$$

$$= 8.75 \times 10^6 \text{ m}$$

$$M = 7.8 \times 10^{24} \text{ kg}$$

$$r = ?$$

$$g = 6.8 \frac{\text{m}}{\text{s}^2}$$

#6

Since  $F_g \propto m_1$ , then if  $m_1$  is  $\times 3$ , then  $F$  is  $\times 3$

Since  $F_g \propto m_2$ , then if  $m_2 \times \frac{1}{2}$ , then  $F$  is  $\times \frac{1}{2}$

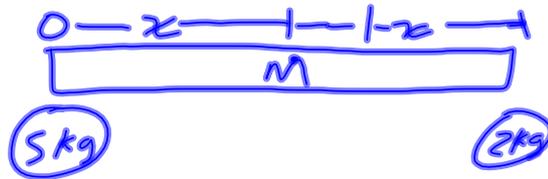
Since  $F_g \propto \frac{1}{r^2}$ , if  $r \times 2$ , then  $F \times \frac{1}{4}$

$$\text{Since } F_g = \frac{Gm_1m_2}{r^2}$$

$\therefore$  Since  $F_{g1} = 3.5 \times 10^{-8} \text{ N}$  then

$$F_{g2} = 3.5 \times 10^{-8} \times 3 \times \frac{1}{2} \times \frac{1}{4}$$

$$= 1.31 \times 10^{-8} \text{ N}$$



#7

$$F_5 = \frac{G(5)M}{x^2} \quad F_2 = \frac{G(2)M}{(1-x)^2}$$

$$F_5 = \frac{1}{3} F_2$$

$$\frac{\cancel{G}(5)M}{x^2} = \frac{1}{3} \frac{\cancel{G}(2)M}{(1-x)^2}$$

$$\frac{5}{x^2} = \frac{2}{3(1-x)^2}$$

$$5(3)(1-x)^2 = 2x^2$$

$$15(1-x)^2 = 2x^2$$

$$15(1-x)(1-x) = 2x^2$$

$$15(1-x-x+x^2) = 2x^2$$

$$15(1-2x+x^2) = 2x^2$$

$$15 - 30x + 15x^2 = 2x^2$$

$$13x^2 - 30x + 15 = 0$$

$$x = \frac{30 \pm \sqrt{(-30)^2 - 4(13)(15)}}{2(13)}$$

$$= \frac{30 \pm \sqrt{900 - 780}}{26}$$

$$= \frac{30 \pm 10.95}{26}$$

$$= \frac{30 + 10.95}{26} \text{ or } \frac{30 - 10.95}{26}$$

$$= 1.575 \text{ m or } 0.73 \text{ m}$$

#8

Vertical

a)  $F_{NET} = 0$

b)  $F_{NET} = F_N + 22.5 - F_g$   
 $\therefore 0 = F_N + 22.5 - (18)(9.8)$   
 $F_N = 176.4 - 22.5$   
 $= 153.9 \text{ N}$

c)  $F_f = \mu F_N$   
 $= (0.25)(153.9)$   
 $= 38.5 \text{ N}$

d) Horizontal

$F_{NET} = ma$

a)  $F_{NET} = 39.0 - F_f$   
 $= 39.0 - 38.5$   
 $= 0.5 \text{ N}$

c)  $\therefore ma = 0.5$   
 $a = \frac{0.5}{18}$   
 $= 0.028 \frac{\text{m}}{\text{s}^2}$

#9

$v_i = 2.2 \frac{m}{s}$   
 $v_f = 1.4 \frac{m}{s}$   
 $d = x$   
 $a = -2.744 \frac{m}{s^2}$

Vertical

$$F_N - F_g = 0$$

$$F_N = mg$$

$$= (18)(9.8)$$

$$= 176.4$$

Horizontal

$$F_{NET} = ma$$

$$F_{NET} = -F_f$$

$$\therefore ma = -\mu F_N$$

$$18a = -(0.28)(176.4)$$

$$a = -2.744 \frac{m}{s^2}$$

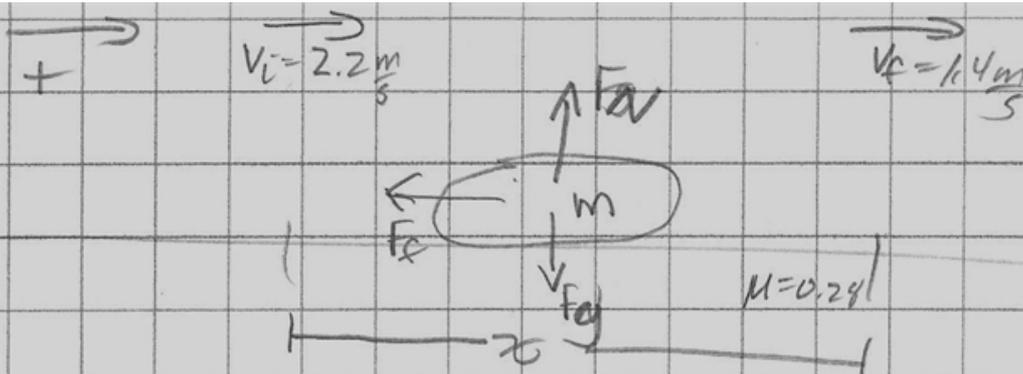
$$d = \frac{v_f^2 - v_i^2}{2a}$$

$$= \frac{1.4^2 - 2.2^2}{2(-2.744)}$$

$$= \frac{-2.88}{-5.488}$$

$$= 0.525 \text{ m}$$

#10

Vert.

$$F_{\text{NET}} = 0$$

$$F_{\text{NET}} = F_N - F_g$$

$$\therefore F_N = F_g$$

$$= mg$$

$$\boxed{F_N = 9.8m}$$

$$\therefore F_f = \mu F_N$$

$$= (0.28)(9.8m)$$

$$= 2.744m$$

Note

$$-F_f = ma$$

$$\therefore -\mu mg = ma$$

$$\boxed{a = -\mu g}$$

Hori.

$$F_{\text{NET}} = ma$$

$$F_{\text{NET}} = -F_f$$

$$= -2.744m$$

$$\therefore -2.744m = ma$$

(m's cancel!)

$$\therefore a = -2.744 \frac{m}{s^2}$$

and  $v_f = 1.4 \frac{m}{s}$   
 $v_i = 2.2 \frac{m}{s}$

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

$$= \frac{1.4^2 - 2.2^2}{2(-2.744)}$$

$$= 0.525 \text{ m}$$