

# Motion Near the Earth's Surface

① (a)  $F_g = mg$   
 $= 60(3.72) = 223.2 \text{ N}$

(b)  $F_g = mg$   
 $= 60(10.49) = 629.4 \text{ N}$

(c)  $F_g = mg$   
 $= 60(0.31) = 18.6 \text{ N}$

②

Constant Velocity

$$F_g = mg$$

$$= 2(9.8) = 19.6 \text{ N}$$

$$F_p = \frac{19.6}{4} = 4.9 \text{ N}$$

Accelerate

$$v_i = 0$$

$$v_f = 3 \text{ m/s}$$

$$t = 4.0 \text{ s}$$

$$a = ?$$

$$v_f = v_i + at$$

$$3 = 0 + a(4)$$

$$a = 0.75 \text{ m/s}^2$$

$$F_a = ma = 2(0.75) = 1.5 \text{ N}$$

$$F_{\text{net}} = 4.9 + 1.5 = \underline{6.4 \text{ N}}$$

③

$$v_i = 0$$

$$v_f = ?$$

$$t = 3 \text{ s}$$

$$d = -18 \text{ m}$$

$$d = \left( \frac{v_i + v_f}{2} \right) t$$

$$-18 = \left( \frac{0 + v_f}{2} \right) 3$$

$$v_f = -12 \text{ m/s}$$

$$v_f = v_i + at$$

$$-12 = a(3)$$

$$a = -4 \text{ m/s}^2$$

on earth

$$F_g = mg$$

$$710 = m(9.8)$$

$$m = 72.4 \text{ kg}$$

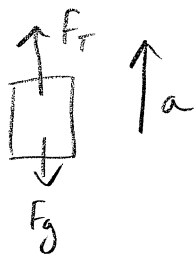
on planet

$$F_g = mg$$

$$= 72.4(4)$$

$$F_g = \underline{290 \text{ N}}$$

4



$$F_{net} = F_T - F_g = ma$$

$$F_T - mg = ma$$

$$F_T - (1 \times 10^3)(9.8) = (1 \times 10^3)(21)$$

$$F_T = \underline{30800 \text{ N}}$$

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(a) (i)



(ii)



(b)  $v_i = ?$

$$v_f = 0$$

$$a = -9.8 \text{ m/s}^2$$

$$d = 5.0 \times 10^3 - 1 \times 10^3 = 4 \times 10^3 \text{ m}$$

$$d = \left( \frac{v_f + v_i}{2} \right) t$$

$$4 \times 10^3 = \left( \frac{v_i}{2} \right) t$$

$$t = \frac{8 \times 10^3}{v_i}$$

$$v_f = v_i + at$$

$$0 = v_i - 9.8 \left( \frac{8 \times 10^3}{v_i} \right)$$

$$\frac{78400}{v_i} = v_i$$

$$78400 = v_i^2$$

$$v_i = \underline{280 \text{ m/s}}$$

(c) Engine on

$$v_i = 0$$

$$v_f = 280 \text{ m/s}$$

$$a = ?$$

$$d = 1 \times 10^3 \text{ m}$$

$$t = ?$$

$$d = \left( \frac{v_i + v_f}{2} \right) t$$

$$1 \times 10^3 = \left( \frac{0 + 280}{2} \right) t$$

$$t = 7.14 \text{ s}$$

$$v_f = v_i + at$$

$$280 = 0 + a(7.14)$$

$$a = \underline{39 \text{ m/s}^2}$$

Engine off

$$a = -9.8 \text{ m/s}^2 \text{ (only force acting is gravity)}$$

5 continued

○ (d)  $F_{net} = F_E - F_g = ma$

$$F_E - mg = ma$$

$$F_E - (1 \times 10^3)(9.8) = (1 \times 10^3)(39)$$

$$F_E = 49000 \text{ N} \quad (4.9 \times 10^4 \text{ N})$$

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$$F_{net} = F_{jump} - F_g = ma$$

$$= F_j - mg = ma$$

$$m = 70 \text{ kg}$$

$$g = 9.8 \text{ m/s}^2$$

$$a = ? \leftarrow$$

$$F_j - 70(9.8) = 70(39.2)$$

$$\underline{F_j = 3430 \text{ N}}$$

pushing

$$d = 0.2 \text{ m}$$

$$v_i = 0$$

$$v_f = ? \leftarrow$$

$$a = ?$$

$$t = ?$$

$$d = \left( \frac{v_i + v_f}{2} \right) t$$

$$0.2 = \left( \frac{0 + 3.96}{2} \right) t$$

$$t = 0.101 \text{ s}$$

$$v_f = v_i + at$$

$$3.96 = 0 + a(.101)$$

$$\leftarrow a = 39.2 \text{ m/s}^2$$

In air

$$d = 0.8 \text{ m}$$

$$v_f = 0$$

$$v_i = ?$$

$$a = -9.8 \text{ m/s}^2$$

$$v_f = v_i + at$$

$$0 = v_i - 9.8t$$

$$t = \frac{v_i}{9.8}$$

$$d = \left( \frac{v_i + v_f}{2} \right) t$$

$$.8 = \left( \frac{v_i}{2} \right) \left( \frac{v_i}{9.8} \right)$$

$$.8 = \frac{v_i^2}{19.6}$$

$$v_i^2 = 15.68$$

$$v_i = 3.96 \text{ m/s}$$

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$$F_{net} = F_T - F_g = ma$$

$$F_T - mg = ma$$

$$(5.6 \times 10^{-4}) - (1 \times 10^{-4})(9.8) = (1 \times 10^{-4})a$$

$$a = -4.2 \text{ m/s}^2$$

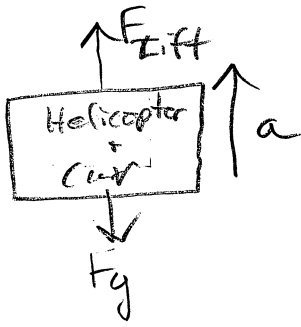
$$(a = 4.2 \text{ m/s}^2 \text{ down})$$

$$m = .1 \text{ g} = 1 \times 10^{-4} \text{ kg}$$

$$F_T = 5.6 \times 10^{-4} \text{ N}$$

$$g = 9.8 \text{ m/s}^2$$

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$$(a) \quad m = 5000 + 2000 = 7000 \text{ kg}$$

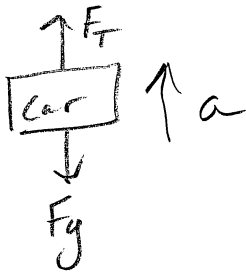
$$F_{\text{net}} = F_{\text{Lift}} - F_g = ma$$

$$F_{\text{Lift}} - mg = ma$$

$$F_{\text{Lift}} - 7000(9.8) = 7000(0.5)$$

$$F_{\text{Lift}} = \underline{72\,100 \text{ N}} \quad (\text{up})$$

(b)



$$m = 2000 \text{ kg}$$

$$F_{\text{net}} = F_T - F_g = ma$$

$$F_T - mg = ma$$

$$F_T - 2000(9.8) = 2000(.5)$$

$$F_T = \underline{20\,600 \text{ N}} \quad (\text{up})$$