Newton's 3rd Law

① a) northward force of football on toe

b) forward force of ground on shoe

c) upward force of desk on book

d) forward force of gases on jet engines

e) forward push of water on swimmer's hands

② In every action-reaction pair, one force acts on object A, the other acts on object B. In order to be considered "balanced," 2 forces must act on the same object.

③ Forward. The water pushes backward on the hose. To balance this, the firefighter must push forward on the hose.

④ Throw nuts toward the edge of the roof. Each time he throws a nut, the nut pushes backward on him, slowing him down.

⑤ 3.00 N

Newton's 2nd Law

⑥ $v_i = 0$
$v_f = 8$ m/s
$t = 0.15$ s
$a = ?$

$m = 0.7$ kg

$v_f = v_i + at$

$8 = 0 + a(0.15)$

$a = 53.\overline{3}$ m/s^2

$\Sigma F = ma$

$= (0.7)(53.3)$

$\Sigma F = \boxed{37.\overline{3} \text{ N}}$

⑦ total mass = 13.1 + 81.7 = 94.8 kg

$a = \frac{\Sigma F}{m} = \frac{9.78\ N}{94.8\ kg} = \boxed{0.103\ m/s^2}$

⑧ Plane

$a = \frac{\Sigma F}{m} = \frac{37\,000\ N}{31\,000\ kg} = 1.194\ m/s^2$

Pilot

$\Sigma F = ma = (78)(1.194) = \boxed{93.1\ N}$

⑨ $m = 5\ kg$

$\Sigma F = 4.9 \times 10^5\ N$

$a = \frac{\Sigma F}{m} = \frac{4.9 \times 10^5}{5} = 98\,000\ m/s^2$

$v_i = 0$

$v_f = 4 \times 10^3\ m/s$

$v_f = v_i + at$

$4 \times 10^3 = 0 + 98000\,t$

$t = \boxed{0.041\ s}$

⑩ $v_i = 0$

$v_f = 45\ m/s$

$d = 0.44\ m$

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

$45^2 = 0^2 + 2a(0.44)$

$2025 = 0.88a$

$a = 2301\ m/s^2$

$m = 0.058\ kg$

$\Sigma F = ma$

$= (0.058)(2301)$

$\Sigma F = \boxed{133.5\ N}$

(11) $d = 18\ m$
$t = 0.95\ s$
$v_i = 0$
$a = ?$

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

$18 = (0)(0.95) + \frac{1}{2} a (0.95)^2$

$18 = 0.45125\, a$

$a = 39.889\ m/s^2$

$m = 72\ kg$

$\Sigma F = ma$

$= (72)(39.889)$

$\Sigma F = \boxed{2872\ N}$

(13) $v_i = 0$
$v_f = 56\ m/s$
$d = 80\ m$
$a = ?$

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

$56^2 = 0^2 + 2a(80)$

$3136 = 160\, a$

$a = 19.6\ m/s^2$

$m = 13\,300\ kg$

$\Sigma F = ma$

$= (13\,300)(19.6)$

$\Sigma F = \boxed{260\,680\ N}$