

**Military Training - "Bent Knees" Problem**  
 Calculate the impulse suffered when a 70 kg person lands on firm ground after jumping from a height of 5.0 m. Then find the average force exerted on the person's feet by the ground if he lands and bends his legs and his center of mass moves 50.0 cm.

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

$$v_f^2 = 0 + 2(-9.81)(-5.0)$$

$$v_f = \pm 9.9 \text{ m/s}$$

$$= -9.9 \text{ m/s}$$

$$j = \Delta p$$

$$= (70 \text{ kg})(0 - (-9.9 \text{ m/s}))$$

$$= +693.3 \text{ kg} \cdot \text{m/s}$$

$$j = F \Delta t$$

$$693.3 \text{ kg} \cdot \text{m/s} = F(0.10 \text{ s})$$

$$6933 \text{ N} = F$$

$$v_{\text{ave}} = \frac{v_i + v_f}{2} = \frac{d}{t}$$

$$\frac{9.9 + 0}{2} = \frac{0.5 \text{ m}}{t}$$

$$4.95 \frac{\text{m}}{\text{s}} = \frac{0.5 \text{ m}}{t}$$

$$t = \frac{0.5 \text{ m}}{4.95 \text{ m/s}} = 0.10 \text{ s}$$

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