

Energy Conversions

*** For the following questions, assume that $E_p = E_k$ (no energy transformed to heat).

Practice problem:

Kayla stands on the roof of Cochrane High School and drops a 400 g water balloon on the first unsuspecting student to walk by. If the roof of CHS is 12.0 m high, how fast is the water balloon travelling when it hits the poor student?

$$\text{Answer} - E_p = mgh \quad E_p = (0.400)(9.81)(12.0) \quad E_p = 47.01 \text{ J}$$

$$\text{so } E_p = E_k \quad E_k = 0.5mv^2 \quad 47.01 = (0.5)(0.400)(v^2) \quad v = 15.34 \frac{\text{m}}{\text{s}}$$

Practice

1. A chairlift uses 34.5 KJ of energy to get Dylan to the top of a run. If Dylan snowboards down the hill, reaching an overall vertical drop of 50m, how fast is he travelling? (Dylan's mass is 72 kg).

$$\text{Answer} - E_p = E_k \quad E_p = mgh \quad E_p = (72)(9.81)(50) \quad E_p = 35316 \text{ J}$$

$$\text{so } E_k = 0.5mv^2 \quad 35316 = (0.5)(72)(v^2) \quad v = 31.32 \frac{\text{m}}{\text{s}}$$

2. An egg with a mass of 90 g reaches a speed of 5.77 m/s when it hits the ground after rolling off a shelf. How high was the shelf?

$$\text{Answer} - E_k = 0.5mv^2 \quad E_k = (0.5)(0.090)(5.77)^2 \quad E_k = 1.498 \text{ J}$$

$$\text{so } E_p = E_k$$

$$E_p = mgh \quad 1.498 = (0.090)(9.81)(h) \quad h = 1.70 \text{ m}$$

3. Chris and Jeff are pulling a toboggan up a hill. Their combined mass (with the toboggan) is 85.0 kg. The vertical height of the toboggan hill is 45.5 m. If the boys start at the top and toboggan down the hill, how fast will they be travelling right before impact?

$$\text{Answer} - E_p = mgh \quad E_p = (85)(9.81)(45.5) \quad E_p = 37940.175 \text{ J}$$

$$\text{so } E_p = E_k$$

$$E_k = 0.5mv^2 \quad 37940.175 = (0.5)(85)(v^2) \quad v = 29.88 \frac{\text{m}}{\text{s}}$$

4. Shantanu puts his Science textbook (mass = 2.3 kg) on the top shelf of his locker. If the locker shelf is 1.75 m off the ground, how fast would his book be travelling if it was to fall off the shelf?

$$\text{Answer} - E_p = mgh \quad E_p = (2.3)(9.81)(1.75) \quad E_p = 39.48525 \text{ J}$$

$$\text{so } E_p = E_k$$

$$E_k = 0.5mv^2 \quad 39.48525 = (0.5)(2.3)(v^2) \quad v = 5.86 \frac{\text{m}}{\text{s}}$$

5. Maria dives off the high diving board and reaches a speed of 5.1 m/s. If Maria's mass is 48 kg, how high was the diving board off the water?

$$\text{Answer} - E_k = 0.5mv^2 \quad E_k = (0.5)(48)(5.1)^2 \quad E_k = 624.24 \text{ J}$$

$$\text{so } E_p = E_k$$

$$E_p = mgh \quad 624.24 = (48)(9.81)(h) \quad h = 1.33 \text{ m}$$