8.32

$h = 100\,m$

$v_i = 0$

mouse, $m = 0.200\,kg$

$$U_i + K_i = U_f + K_f + \Delta E_{int}$$

$$mgh + 0 = 0 + \tfrac{1}{2}mv^2 + F_f x$$

$$F_f = \frac{mgh - \frac{1}{2}mv^2}{x} = \frac{(0.2)(9.8)(100) - \frac{1}{2}(0.2)(8)^2}{100}$$

$$= \cancel{\boxed{1.90\,N}}$$

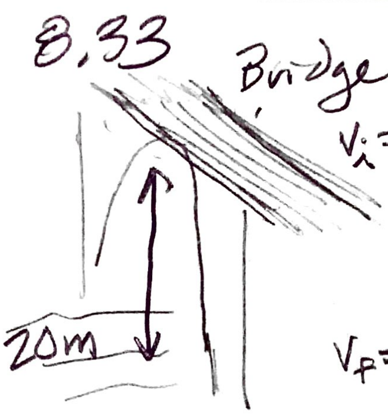
$h = 0$

$v_f = 8.0\,m/s$

This was the force, which is not what the problem asked for. Work done by friction is ΔE_{int}, which is

$$\boxed{\Delta E_{int} = 190\,J}$$

8.33



$v_i = 15.0$ m/s

$v_f = 24.8$ m/s ?

We're asked to show that this result is true, regardless of direction of throw.

The energy analysis is easy:

$$U + K = U + K$$

$$\cancel{m}gh_i + \tfrac{1}{2}\cancel{m}v_i^2 = \cancel{m}gh_f + \tfrac{1}{2}\cancel{m}v_f^2$$

$$\sqrt{\frac{(9.8)(20) + \frac{1}{2}(15)^2 - (9.8)(0)}{1/2}} = v_f$$

$$\boxed{24.3 \text{ m/s}} = v_f$$

The $v_i = 15.0$ m/s is a speed – its direction (up, down, straight out from bridge, or at an angle) doesn't affect its final speed.

An interesting exercise is to do a kinematics analysis of this situation, & perform a vector-based calculation to determine the speed that way.

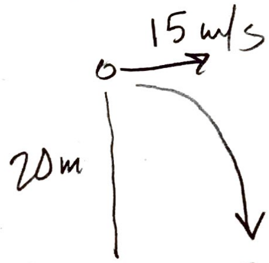
One example: $v_i = 15$ m/s straight up
$\Delta x = x_f - x_i = 0 - 20$ m
$v_f = ?$

$$v_f^2 = v_i^2 + 2a\Delta x$$

$$v_f = \sqrt{15^2 + 2(-9.8)(-20)}$$

$$\boxed{= 24.8 \text{ m/s}}$$

Another example:



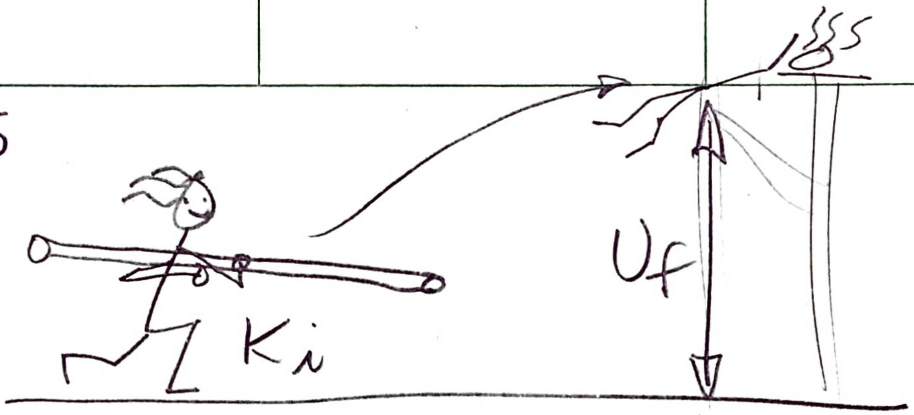
Vert: $v_f^2 = v_i^2 + 2a\Delta x$

$v_f = \sqrt{0 + 2(-9.8)(-20)} = -19.8 \text{ m/s } \hat{j}$

$v_x = 15$ m/s

$v^2 = v_x^2 + v_y^2$, so $v = \sqrt{15^2 + 19.8^2} = \boxed{24.8 \text{ m/s}}$

8.35



$$K_i + U_i = K_f + U_f$$

$$\tfrac{1}{2}mv^2 + 0 = 0 + mgh$$

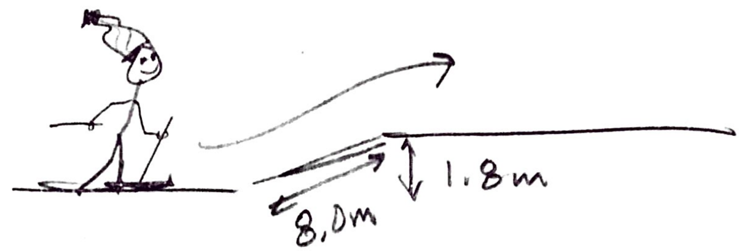
← assumes no K at top of arc, which isn't quite true!

$$\tfrac{1}{2}\cancel{m}v^2 = \cancel{m}gh$$

$$v = \sqrt{2gh} = \sqrt{2 \cdot 9.8 \cdot 4.8\,m}$$

$$= \boxed{9.70 \ m/s}$$

8.38



$m = 100\,kg$
$v = 8.0\,m/s$
$\Delta h = 1.8\,m$

a) Assuming no friction, when skier coasts up the hill...

$$K_i + U_i = K_f + U_f$$
$$\cancel{\tfrac{1}{2}}\cancel{m}v_i^2 + 0 = \cancel{\tfrac{1}{2}}\cancel{m}v_f^2 + \cancel{2}\cancel{m}gh$$
$$v_f = \sqrt{v_i^2 - 2gh}$$
$$= \sqrt{8^2 - 2 \cdot 9.8 \cdot 1.8}$$
$$= \boxed{5.36\,m/s}$$

b) If an 80N frictional force acts over the 8.0m distance of the slope...

$$K_i + U_i = K_f + U_f + \Delta E_{int}$$
$$\tfrac{1}{2}mv^2 + 0 = \tfrac{1}{2}mv_f^2 + mgh + F_f x$$
$$\tfrac{1}{2}(100)(8)^2 = \tfrac{1}{2}(100)v_f^2 + (100)(9.8)(1.8) + (80)(8)$$
$$3200 = 50v_f^2 + 1764 + 640$$
$$v_f = \boxed{3.99\,m/s}$$