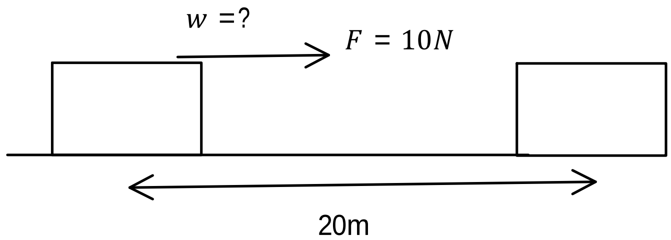
P11 - 6.1 - Work

$What\ is\ the\ work\ done\ on\ an\ Object\ with\ a\ Force\ of$ 10 $N\ over\ a\ distance\ of$ 20 $m.$



$W = Fd$
$W = 10 \times 20$
$W = 200\ Nm$

$\boxed{W = Fd}$

$Work = Force \times Distance$

$1J = 1Nm$ $\quad Joules\ (J)$

$How\ much\ energy\ was\ exerted?$

$W = \Delta E$
$\Delta E = W$
$\Delta E = 200J$

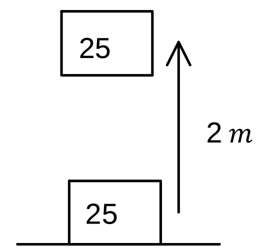
$\boxed{W = \Delta E}$

$What\ is\ the\ work\ done\ lifting\ an\ Object\ with\ a\ Mass\ of$ 25 $kg\ straight\ up\ a\ distance\ of$ 2 $m.$

$W_y = F_y d_y$
$W = mgd$
$W = 25(9.8)(2)$
$W = 490\,J$

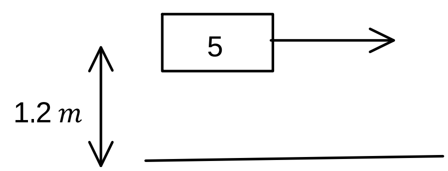
$\boxed{F_y = mg}$

$\boxed{W = mgd}$



$A\ Watermelon\ with\ a\ Mass\ of$ 5 $kg\ is\ carried\ to\ school\ at\ a\ Constant\ Height\ of$ 1.2 $m.$
$How\ much\ Work\ is\ done\ on\ the\ Watermelon.$

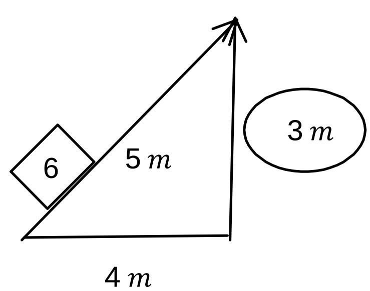
0 J



A 6 $kg\ Case\ is\ carried\ up\ a$ 5 $m\ ramp\ over\ a\ length\ of$ 4 $m. What\ is\ the\ Work\ done\ on\ the\ Case.$

$W = Fd$
$W = mgd$
$W = 6(9.8)(3)$
$W = 176.4\,J$

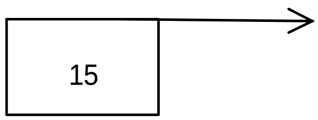
$b = \sqrt{5^2 - 4^2}$
$b = 3$



A 6 $kg\ Case\ is\ carried\ staight\ up$ 3 $m. What\ is\ the\ Work\ done\ on\ the\ Case.$ $\quad W = 176.4\,J$

P11 - 6.2 - Energy

Kinetic Energy, E_k: *Energy due to an objects Motion*

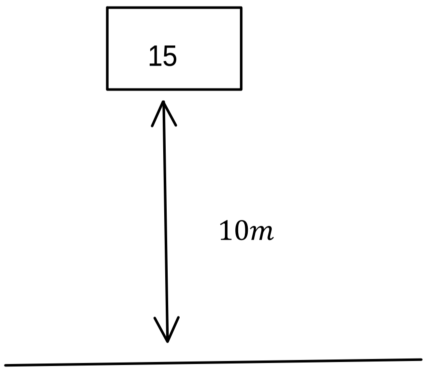


$v = 25\frac{m}{s}$

$E_k = \frac{1}{2}mv^2$
$E_k = \frac{1}{2}(15)(25)^2$
$E_k = 4687.5\,J$

$\boxed{E_k = \frac{1}{2}mv^2}$

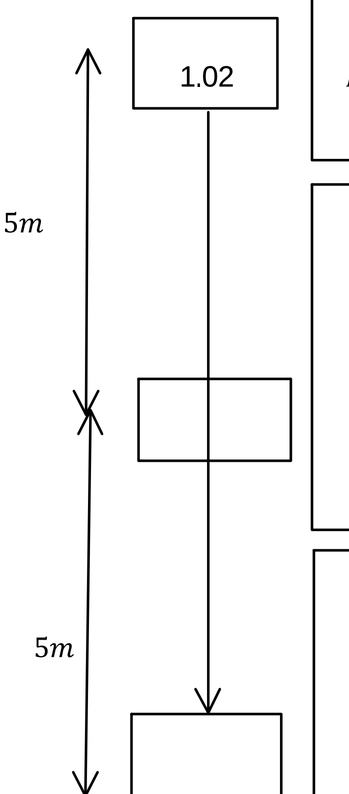
Potential Energy, E_p: *Energy due to an ogjects Height*



$E_p = mgh$
$E_p = 15 \times 9.8 \times 10$
$E_p = 1470\,J$

$\boxed{E_p = mgh}$

Conservation of Energy



$E_t = 100\,J$ $\quad E_k = 0\,J, \text{at rest}$

$E_p = mgh$
$E_p = (1.02)(9.8)(10)$
$E_p = 100\,J$

$\boxed{E_t = E_k + E_p}$

$E_t = 100\,J$

$E_k = \frac{1}{2}mv^2$
$v = \sqrt{\frac{2E_k}{m}}$
$v = \sqrt{\frac{2(50)}{1.02}}$
$v = 9.9\frac{m}{s}$

$E_p = mgh$
$E_p = (1.02)(9.8)(5)$
$E_p = 50\,J$
$\boxed{E_k = 50\,J}$

$E_t = 100\,J$

$E_k = \frac{1}{2}mv^2$
$v = \sqrt{\frac{2E_k}{m}}$
$v = \sqrt{\frac{2(100)}{1.02}}$
$v = 14\frac{m}{s}$

$E_p = mgh$
$E_p = (1.02)(9.8)(0.001)$
$E_p = 0.01\,J$
$\boxed{E_k = 100\,J}$
$E_p = 0\,J, h = 0.001\,m$

Energy – Kinematics Link

$v_f^2 = v_i^2 + 2ad$
$v_f = \sqrt{2ad}$
$v_f = \sqrt{(2)(-9.8)(-10)}$
$v_f = 14\frac{m}{s}$

P11 - 6.3 - Energy Work Mom. Dyn. Kin Link Notes

What is the Final Velocity a box, of Mass 25 kg, *initially at rest, with a Force of* 125 N *a Distance of* $10m$?

$$E = W$$
$$\frac{1}{2}mv^2 = Fd$$
$$v = \sqrt{\frac{2Fd}{m}}$$
$$v = \sqrt{\frac{2(125)(10)}{25}}$$
$$v = 10\frac{m}{s}$$

$$\boxed{E_k = \frac{1}{2}mv^2}$$

$$\boxed{W = Fd}$$

How much Work was done on the Object?

$$W = Fd$$
$$W = 125(10)$$
$$W = 1250\ J$$

What was the Objects Acceleration?

$$v_f^2 = v_i^2 + 2ad$$
$$a = \frac{v_f^2}{2d}$$
$$a = \frac{10^2}{2(10)}$$
$$a = 5\frac{m}{s^2}$$

$$\boxed{v_i = 0}$$

Check your Answer!

$$F = ma$$
$$125 = 25(5)$$
$$125N = 125\ N$$

How long did it take?

$$\Delta d = v_i t + \frac{1}{2}at^2$$
$$t = \sqrt{\frac{2d}{a}}$$
$$t = \sqrt{\frac{(2)(10)}{5}}$$
$$t = 2\ s$$

$$\boxed{OR}$$

$$v_f = v_i + at$$
$$a = \frac{v_f}{t}$$
$$a = \frac{10}{2}$$
$$a = 5$$

What is the Final Momentum of the Box?

$$p = mv$$
$$p = (25)(10)$$
$$p = 250\frac{kgm}{s}$$

$$\boxed{\textit{And around and Around We Go!}}$$

P11 - 6.4 - Law of Conservation Of Energy

Conservation of Energy cannot be created or destroyed

$\boxed{E_p = mgh}$ *Potential Energy: Stored Energy*

$\boxed{E_k = \frac{1}{2}mv^2}$ *Kinetic Energy: Energy due to motion*

The Law of Conservation Of Energy: Energy Must Be Conserved!

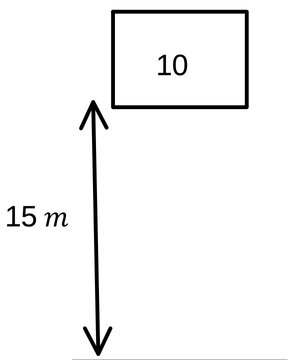
Total Initial Energy = Total Final Energy

$$\boxed{\begin{gathered} E_i = E_f \\ E_{ki} + E_{pi} = E_{kf} + E_{pf} \\ \frac{1}{2}mv_i^2 + mgh_i = \frac{1}{2}mv_f^2 + mgh_f \end{gathered}}$$

$$\Delta E_p + \Delta E_k = 0$$
$$\Delta E_p = -\Delta E_k$$

Total Energy Change equals zero

What is the Potential, Kinetic and Total Energy of 10 *kg object at a height of* 15 *m*?

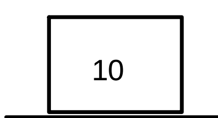


$E_p = mgh$
$E_p = 10(9.8)(15)$
$E_p = 1470\ J$

$E_k = \frac{1}{2}mv^2$
$E_k = \frac{1}{2}(10)(0)^2$
$E_k = 0\ J$

$E_t = E_g + E_k$
$E_t = 1470 + 0$
$E_t = 1470\ J$

What is the Potential, Kinetic and Total Energy of 10 *kg object at a height of* 0 *m*?



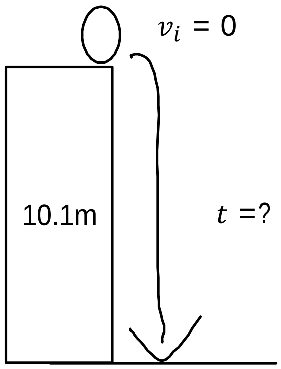
$E_p = mgh$
$E_p = 10(9.8)(0)$
$E_p = 0\ J$

$E_k = \frac{1}{2}mv^2$
$E_k = \frac{1}{2}(10)(0)^2$
$E_k = 0\ J$

$E_t = E_g + E_k$
$E_t = 0 + 0$
$E_t = 0\ J$

P11 - 6.4 - Energy Notes

$What\ is\ the\ Final\ Velocity, and\ Time\ in\ Flight, of\ 5\ kg\ ball\ if\ dropped\ from\ a\ 10.1\ m?$



$$\cancel{E_{ki}} + E_{pi} = E_{kf} + \cancel{E_{pf}}$$

$$\cancel{m}gh_i = \frac{1}{2}\cancel{m}v_f^2$$

$$v_f = \sqrt{2gh}$$

$$v_f = \sqrt{(2)(-9.8)(10.1)}$$

$$v_f = 14.1\frac{m}{s}$$

$$\boxed{Mass\ is\ Irrelevant!}$$

$Work - Kinematics\ Link$

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

$$-10.1 = 0 \times t + \frac{1}{2}(-9.8)t^2$$

$$-10.1 = \frac{1}{2}(-9.8)t^2$$

$$-10.1 = -4.9t^2$$

$$2.06 = t^2$$

$$t = 1.44s$$

$$v_b = v_i + at$$

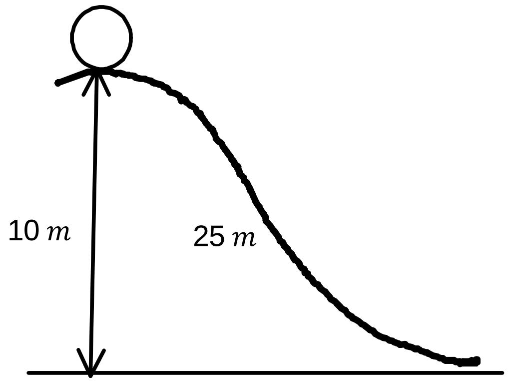
$$v_b = at$$

$$v_b = (-9.8)(1.44)$$

$$v_b = -14.11\frac{m}{s}$$

P11 - 6.5 - Slide Energy Notes

A Ball, initially at Rest, rolls down a $10m$ *high Frictionless Slide over* 25 m. *What is the Final Velocity of the Ball?*



$$\cancel{E_{ki}} + E_{pi} = E_{kf} + \cancel{E_{pf}}$$

$$\cancel{m}gh_i = \frac{1}{2}\cancel{m}v_f^2$$

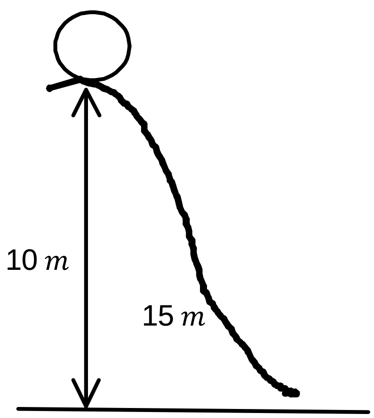
$$v_f = \sqrt{2gh}$$

$$v_f = \sqrt{(2)(-9.8)(10.1)}$$

$$v_f = 14.1\frac{m}{s}$$

$\boxed{\textit{Distance is Irrelevant}}$

A Ball, initially at Rest, rolls down a $10m$ *high Frictionless Slide over* 15 m. *What is the Final Velocity of the Ball?*



$$\cancel{E_{ki}} + E_{pi} = E_{kf} + \cancel{E_{pf}}$$

$$\cancel{m}gh_i = \frac{1}{2}\cancel{m}v_f^2$$

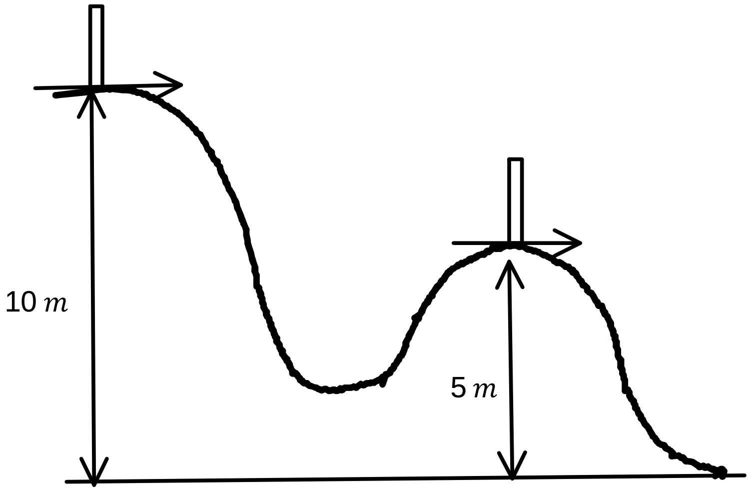
$$v_f = \sqrt{2gh}$$

$$v_f = \sqrt{(2)(-9.8)(10.1)}$$

$$v_f = 14.1\frac{m}{s}$$

P11 - 6.5 - Slide Energy Notes

$A\ 65\ kg\ Skiier, initially\ at\ Rest, travels\ down\ the\ Mountain\ 10\ m\ high\ as\ shown.$
$What\ is\ the\ Velocity\ at\ the\ Second\ Hump?$



$$\cancel{E_{ki}} + E_{pi} = E_{kf} + E_{pf}$$

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

$$v_f = \sqrt{2(gh_i - gh_i)}$$

$$v_f = \sqrt{2((9.8)(10) - (9.8)(5))}$$

$$v_f = 9.98\frac{m}{s}$$

$$\boxed{OR}$$

Initial

$$E_k = 0$$

$$E_p = mgh$$
$$E_p = 65(9.8)(10)$$
$$E_p = 6370\ J$$

$$E_t = E_k + E_i$$
$$E_t = 0 + 6370$$
$$E_t = 6370\ J$$

Final

$$E_k = \frac{1}{2}mv^2$$
$$E_k = \frac{1}{2}(65)v^2$$
$$E_k = 32.5v^2$$

$$E_p = mgh$$
$$E_p = 65(9.8)(5)$$
$$E_k = 3185\ J$$

$$E_t = E_k + E_i$$
$$E_t = 32.5v^2 + 3185$$

$$E_t = E_t$$
$$6370 = 32.5v^2 + 3185$$
$$3185 = 32v^2$$
$$v^2 = 99.5$$
$$v = 9.98\frac{m}{s}$$

P11 - 6.6 - Power Notes

$Power: The\ ability\ to\ do\ Work\ in\ Watts$

$$\boxed{\frac{J}{s} = W}$$

$How\ much\ Power\ if\ 30\ J\ of\ Work\ is\ done\ on\ an\ object\ for\ 5s?$

$$P = \frac{W}{t}$$
$$P = \frac{30}{5}$$
$$P = 6\ W$$

$$\boxed{P = \frac{W}{t}}$$

$How\ much\ Power\ does\ it\ take\ a\ Motor\ to\ Push\ 15\ kg\ object\ from\ rest\ to\ 15\frac{m}{s}\ over\ a\ distance\ 37.5\ m\ in\ 5\ s?$

$$P = \frac{W}{t}$$
$$P = \frac{1687.5}{5}$$
$$P = 337.5\ W$$

$$W = Fd$$
$$W = Fd$$
$$W = 45(37.5)$$
$$W = 1687.5\ J$$

$$F = ma$$
$$F = 15(3)$$
$$F = 45\ N$$

$Acceleration$

$$v_f^2 = v_i^2 + 2ad$$
$$a = \frac{v_f^2}{2d}$$
$$a = \frac{15^2}{2(37.5)}$$
$$a = 3\frac{m}{s}$$

$$v_f = v_i + at$$
$$v_f = at$$
$$a = \frac{v_f}{t}$$
$$a = \frac{15}{5}$$
$$a = 3\frac{m}{s^2}$$

$$d = v_i t + \frac{1}{2}at^2$$
$$a = \frac{2d}{t^2}$$
$$a = \frac{2(37.5)}{5^2}$$
$$a = 3\frac{m}{s}$$

$$\boxed{And\ around\ and\ Around\ We\ Go!}$$

$$\boxed{v_i = 0}$$

$$\boxed{We\ only\ Needed\ 2\ of\ the\ 3\ Variables, v, d, and\ t.}$$

$What\ is\ the\ Efficiency\ of\ the\ Motor\ if\ it\ says\ 500\ W\ on\ the\ side?$

$$E_{ff} = \frac{P_{out}}{P_{in}}$$
$$E_{ff} = \frac{375}{500}$$
$$E_{ff} = 75\%\ Efficient$$

$$\boxed{E_{ff} = \frac{Power\ Out}{Power\ In}}$$

P12 - 6.7 - Work Trig Notes

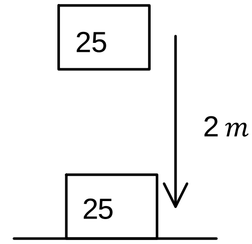
What is the work done dropping an Object with a Mass of 25 *kg a distance of* 2 *m*.

$W_y = F_y d_y$
$W = mgd$
$W = 25(9.8)(-2)$

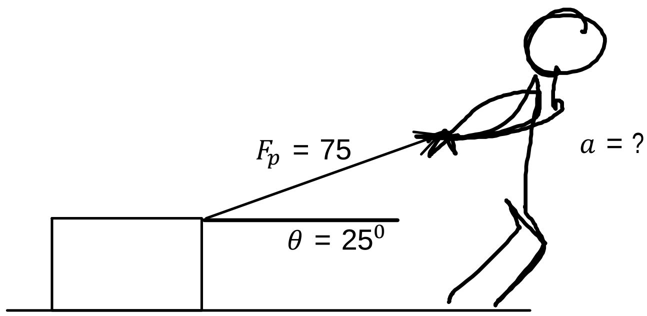
$W = -490\ J$

$\boxed{F_y = mg}$

$\boxed{W = mgd}$



What is the work done on an object with a Force of 75 *N at an angle of* 25^0 *to the horizontal over a distance of* 20 *m*.



$W = F_x d$

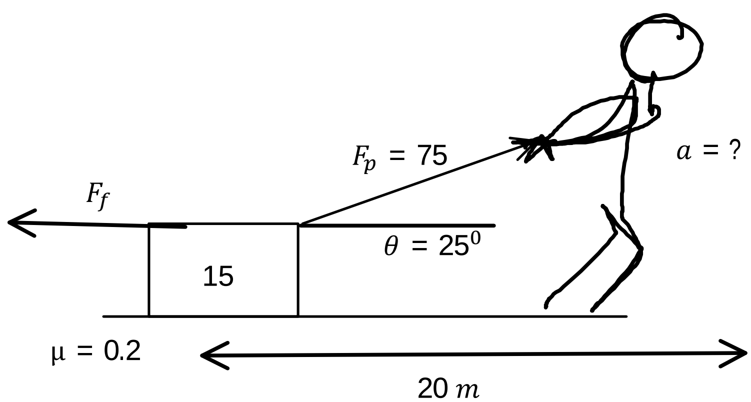
$W = 67.97(20)$

$W = 1359.46\ Nm$

$F_x = F_p \cos\theta$
$F_x = 75\cos 25$

$F_x = 67.97\ N$

What is the Net work done on a 15 *kg object with a Force of* 75 *N and a coefficient of friction* $\mu = 0.2$ *at an angle of* 25^0 *to the horizontal over a distance of* 20 *m*.



$F = ma$
$F_p - F_f = ma$

$67.97 - 29.4 = 15a$
$a = 2.57\ N$

$W = Fd$
$W = mad$

$W = 15(2.57)(20)$

$W = 771.46$

$F_x = F_p \cos\theta$
$F_x = 75\cos 25$
$F_x = 67.97\ N$

$F_g = mg$
$F_g = 15(9.8)$
$F_g = 147\ N$

$F_f = \mu F_n$
$F_f = \mu mg$
$F_f = 0.2(147)$
$F_f = 29.4$