Mechanical Energy Worksheet

1. What is:

Kinetic energy's formula	Potential energy's formula	Mechanical energy's formula
$E_k = \frac{1}{2} \cdot m \cdot v^2$	$E_p = m \cdot g \cdot h$	$E_m = E_k + E_p$

2. A quarterback throws a football weighing 200.0 g at a speed of 10.0 km/h at a height of 20.0 m. What is the football's mechanical energy?

$E_m = E_k + E_p$

① E_k

$m = 200.0\,g \rightarrow 0.2\,kg$

$v = 10.0\,km/h \rightarrow 10 \times 1000/3600$

$2.\overline{777}$

$E_k = \frac{1}{2} \cdot m \cdot v^2$

$E_k = \frac{1}{2} \cdot 0.2 \cdot 2.78^2 = 0.7716 \rightarrow$ **0.772 J**

② $E_p = m \cdot g \cdot h$

$E_p = 0.2 \times 9.8 \times 20.0$

$E_p = 39.2 \rightarrow$ **39.2 J**

③ $E_m = E_k + E_p$

$E_m = 0.772 + 39.2$

$E_m = 39.972$

40.0 J

3. A crane carries a metal tube weighing 95.0 kg 90.0 m above ground at a speed of 2.0km/h. What is metal tube's mechanical energy?

① E_k

$m = 95.0\,kg$

$v = 2.0\,km/h \rightarrow 2000/3600 = 0.55\,m/s$

$E_k = \frac{1}{2} \cdot m \cdot v^2$

$E_k = \frac{1}{2} \times 95.0 \times 0.55^2$

$E_k = 14.660 \rightarrow$ **15 J**

② $E_p = m \cdot g \cdot h$

$E_p = 95 \times 9.8 \times 90$

$E_p = 83\,790\,J \rightarrow$ **83800J**

③ $E_m = E_k + E_p$

$E_m = 15 + 83800$

$E_m = 83815 \Rightarrow$ **83800J**

4. A bus weighing 7000.0 kg travels at a speed of 50.0 km/h. It reaches an area that has a lot of hills. One hill is at 10.0 m, the next is at 4.0 m and the last is at 20.0 m high. What is the mechanical energy of the bus when it reaches the top of the third hill?

① E_k

$m = 7000.0\,kg$

$v = 50.0\,km/h \rightarrow 50\,000/3600 = 13.\overline{8}\,m/s$

$E_k = \frac{1}{2} \cdot m \cdot v^2$

$E_k = \frac{1}{2} \times 7000.0 \times 13.8^2$

$E_k = 675\,154\,J$

675 000 J

② $E_p = m \cdot g \cdot h$

$E_p = 7000.0 \times 9.8 \times 20.0$

$E_p = 1\,372\,000\,J$

1 370 000 J

③ $E_m = E_k + E_p$

$E_m = 675\,000 + 1\,370\,000$

$E_m = 2\,045\,000$

2 050 000J

5. A stone weighing 40.0 g is tossed into the air at a speed of 40.0m/s. It reaches a height of 30.0 m. What is the ball's mechanical energy at this height?

① E_k

$m = 40.0g \rightarrow 0.0400\,kg$

$v = 40.0\ m/s$

$E_k = \frac{1}{2} \cdot m \cdot v^2$

$E_k = \frac{1}{2} \times 0.04 \times 40.0^2$

$E_k = 32\ J \rightarrow \boxed{32.0\ J}$

② E_P

$E_P = m \cdot g \cdot h$

$E_p = 0.04 \times 9.8 \times 30.0$

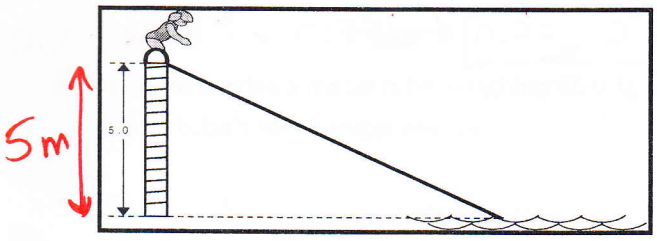
$E_p = 11.76 \rightarrow \boxed{11.8\ J}$

③ $E_m = E_k + E_P$

$E_m = 32.0 + 11.8$

$\boxed{E_m = 43.8\ J}$

6. A camp has a waterslide that is 5.0 meters high. Debra, a 55 kg camper, is sliding down the waterslide from rest as shown below.



How fast will Debra be travelling when she reaches the water? Neglect resistance forces (air and friction).

E_p at top = E_k at bottom

① E_P

$m = 55\ kg$

$E_P = m \times g \cdot h$

$E_p = 55 \times 9.8 \times 5.0$

$E_p = 2695\ J$

keep same #'s til end of problem.

② $E_k = E_P$

$E_k = \frac{1}{2} \cdot m \cdot v^2$

$2695 = \frac{1}{2} \cdot 55 \cdot v^2$

$2695 = 27.5 \times v^2$

$98 = v^2$

$\sqrt{98} = v \rightarrow 9.899$

$\boxed{9.9\ m/s}$