

Midterm #1, 141, Q2 Schwartz Name:

From the syllabus: In order to achieve an A: Consistently

- correctly identifies underlying physics concepts,
- sets up problem with good drawing and reasons,
- formulates method to solve problem,
- correctly uses units and
- verifies whether answer makes sense.

An answer alone is worth no credit. Please estimate answers: don't leave them in roots, trig., fractions.

A 50 kg woman runs to the top of a 20 m high hill in 10 seconds.

- What is her average power output?
- After reaching the top she jumps off a 20 m cliff. What's her speed when he reaches the bottom?
- What is the power output from gravity acting on her during the fall? Please state if your calculation is the average power of gravity, or the maximum.



$$a) \bar{P} = \frac{dE}{dt} = \frac{w}{dt}$$

$$W = \Delta E = KE = \frac{1}{2}mv^2 + PE \\ = \frac{1}{2}(50\text{kg})(2\text{m/s})^2 \\ = 100\text{kg}\cdot\text{m}^2/\text{s}^2$$

$$W = 100\text{J} + 10,000\text{J}$$

$$v = \frac{20\text{m}}{10\text{s}} = 2\text{m/s}$$

$$PE = m \cdot g \cdot h \\ = (50\text{kg})(10\text{m/s}^2)(2\text{m}) \\ = 10,000\text{J}$$

$$\bar{P} = \frac{10,100\text{J}}{10\text{s}} = 1,010\text{W}$$

b) Energy - because her potential energy at the top of the hill will be converted to kinetic energy when she jumps off.

$$PEg = m \cdot g \cdot h \\ = (50\text{kg})(10\text{m/s}^2)(20\text{m}) \\ = 10,000\text{J}$$

$$PEg = KE_f \\ 2(10,000\text{J}) = \frac{1}{2}mv^2 \\ \frac{20,000\text{J}}{m} = v^2$$

$$mgh = \frac{1}{2}mv^2 \\ (2gh)^{\frac{1}{2}} = v$$

$$\sqrt{\frac{20,000\text{J}}{50\text{kg}}} = v$$

$$\sqrt{400\text{m}^2/\text{s}^2} = v$$

$$v = 20\text{m/s} \text{ at the bottom of hill.}$$

c)

$$P = \frac{\Delta E}{\Delta t} =$$

$$\frac{20m/s}{10m/s^2} = \frac{10^3 J/s^2}{10^3 J/s^2} (t)$$

$$P = \frac{10,000J}{2s}$$

$$P = 5,000W$$

average power of gravity.

2s = t → how did you get 2 s?
Kinematics ... good.