Quiz 5
Name:  
Section:  

This quiz is composed of 1 problem (10 points). Answer all parts.

Problem 1:
a) Define the work done by a constant force \( F \), in the direction of motion of a body, over a distance \( d \) (1pt) (formula)

\[
W = Fd
\]

b) A car with an initial velocity \( v = 26.6 \text{ m/s} \) and mass \( m = 1000 \text{ kg} \), enters a sandbox. (Consider that the engine of the car is turned off right at the moment it touches sand) The sand is exerting a constant force \( F = 1000 \text{ N} \) on the car, on the opposite direction of its motion. The sandbox has a length of \( 1000 \text{ m} \). Calculate the kinetic energy of the car. (2 pts)

\[
K_i = \frac{1}{2}mv_i^2 = \frac{1}{2} (1000 \text{ kg}) (26.6 \text{ m/s})^2 = 1400 \text{ KJ}
\]

c) Where does the car stop with respect to the end of the sandbox (4 pts)

\[
-Fd = W = \Delta K = K_f - K_i = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2
\]

\[
\Rightarrow d = \frac{mv_f^2}{2F} = \frac{(1000 \text{ kg}) (26.6 \text{ m/s})^2}{2 (1000 \text{ N})} = 1400 \text{ m}
\]

d) What is the average power the sandbox outputs, if the car takes 26.6 seconds to stop? (2 pts)

\[
P = \frac{W}{t} = \frac{Fd}{t} = \frac{Fmv_f^2}{2tF} = \frac{(1000 \text{ kg}) (26.6 \text{ m/s})^2}{2 (26.6 \text{ s})} = 10 \text{ kW}
\]
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Problem 1:
a) Define the work done by a constant force $F$, in the direction of motion of a body, over a distance $d$ (1pt) (formula)

\[ W = Fd \]

b) Define the kinetic energy of a body with mass $m$ and velocity $v$. (1pt) (formula)

\[ K = \frac{1}{2} m v^2 \]

c) A water droplet with mass 0.1 gr is at the bottom edge of a cloud, at a height of 500 meters. At an instance it starts falling towards earth. Consider, its initial velocity to be zero.
Calculate the force of gravity on the droplet. (2 pts)

\[ F_{\text{grav}} = mg = (0.1 \text{ g}) \left( \frac{1 \text{ kg}}{1000 \text{ g}} \right) (9.8 \text{ m/s}^2) = 0.001 \text{ mN} \]

d) How much work does gravity do on the droplet? (3 pts)

\[ W_{\text{grav}} = F_{\text{grav}}d = mg(h-0) = (0.1 \text{ g}) \left( \frac{1 \text{ kg}}{1000 \text{ g}} \right) (9.8 \text{ m/s}^2) (500 \text{ m}) = 0.5 \text{ J} \]

\[ d) \text{ What is the speed with which the droplet hits the ground? (Assume the air does not affect the droplet) (3 pts) } \]

\[ W = \Delta K = K_f - K_i = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2 \]

\[ \Rightarrow v = \sqrt{\frac{2W}{m}} = \sqrt{\frac{2 F_{\text{grav}} d}{m}} = \sqrt{\frac{2 mgh}{m}} = \sqrt{2gh} = \sqrt{2(9.8 \text{ m/s}^2)(500 \text{ m})} \]

\[ = 100 \text{ m/s} \]