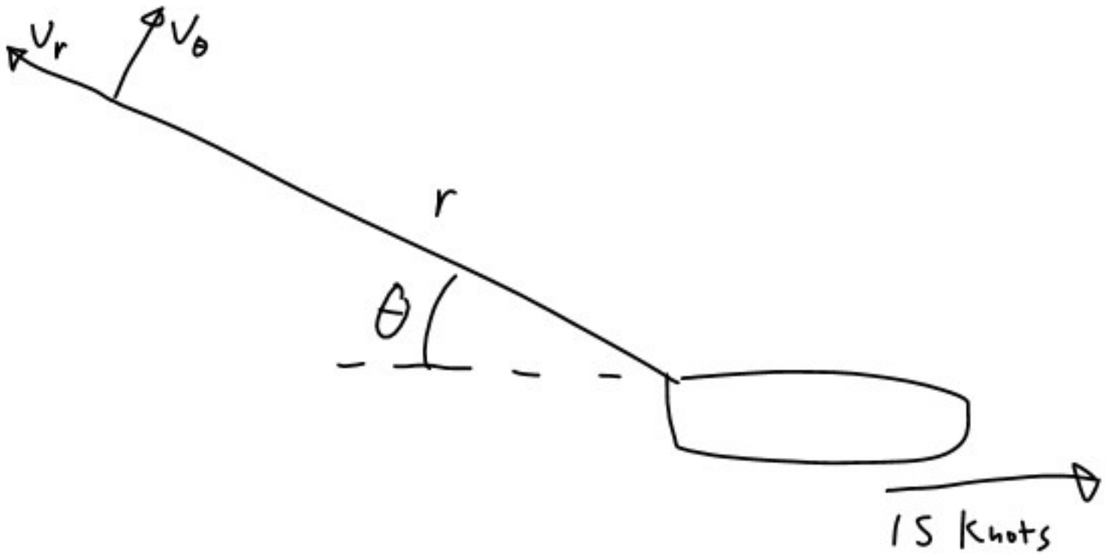
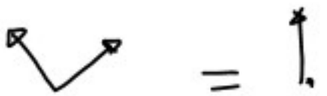
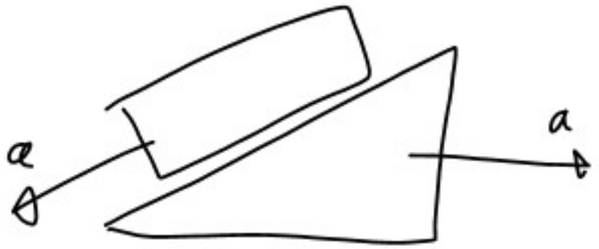
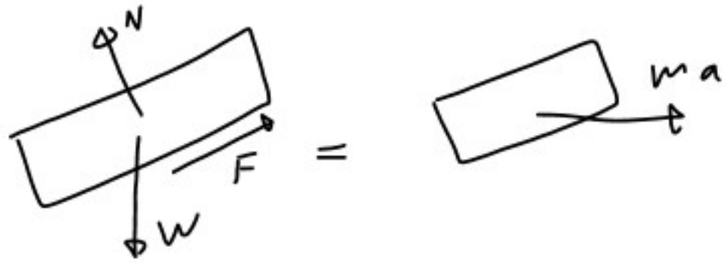
11.164



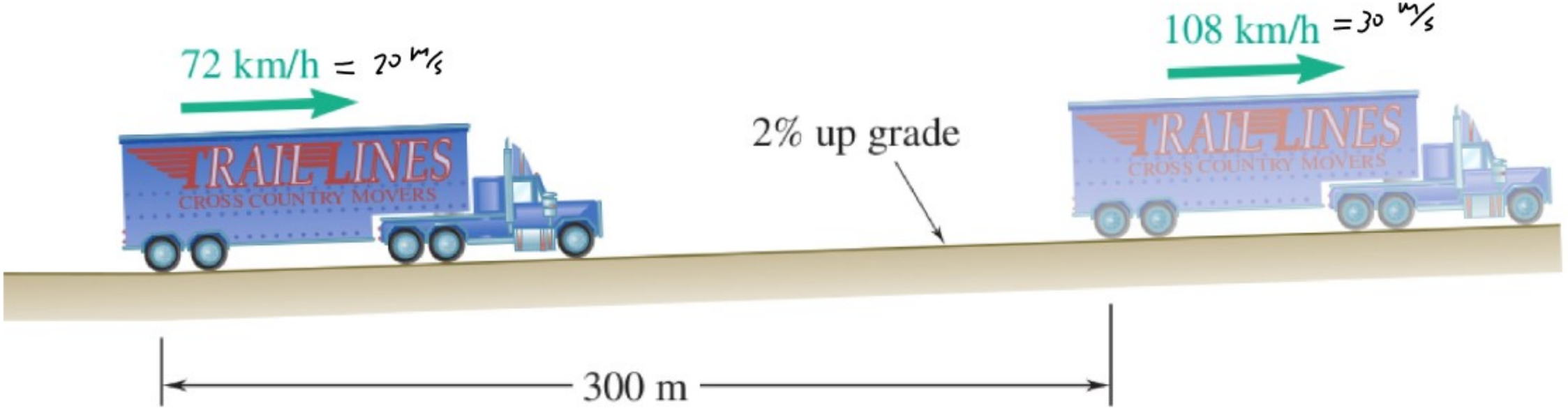


12.22





13.16 A trailer truck enters a 2 percent uphill grade traveling at 72 km/h and reaches a speed of 108 km/h in 300 m. The cab has a mass of 1800 kg and the trailer 5400 kg. Determine (*a*) the average force at the wheels of the cab, (*b*) the average force in the coupling between the cab and the trailer.

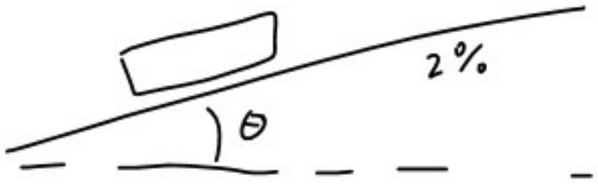


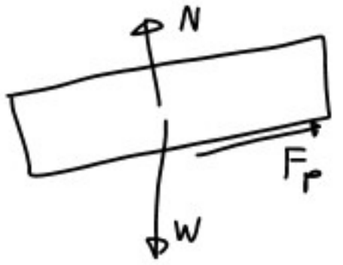
$W = T_2 - T_1$

$T_1 = \frac{1}{2} m v_1^2 = \frac{1}{2} 7200 (20)^2 = 1.44 \times 10^6$

$T_2 = \frac{1}{2} m v_2^2 = \frac{1}{2} 7200 (30)^2 = 3.24 \times 10^6$

$W = 3.24 \times 10^6 - 1.44 \times 10^6 = 1.8 \times 10^6$





$\Sigma F = F_p - W_p$

$F = F_p - 1911$

$\theta = \tan^{-1}(0.02) = 1.146°$

$W_p = W \sin(\theta)$

$= mg \sin(\theta)$

$= 7200 (9.8) \sin(1.146)$

$= 1911$

$1.8 \times 10^6 = (F_p - 1911) 300$

$\frac{1.8 \times 10^6}{300} = F_p - 1911$

$\frac{1.8 \times 10^6}{300} + 1911 = \boxed{F_p = 7411 \ N}$

$W = Fd = (F_p - 1911) 300$

Conservation of energy

$\Delta U_{1\to 2} = W_{y_1} - W_{y_2}$

$= (V_g)_1 - (V_g)_2$

$V_g = W_y$

$\Delta U_{1\to 2} = \frac{GM_m}{r_2} - \frac{GM_m}{r_1}$

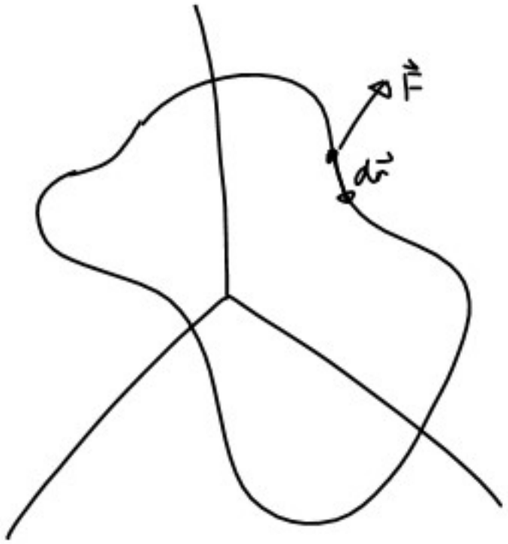
$V_g = \frac{-GM_m}{r} = \frac{-WR^2}{r}$

$\Delta U_{1\to 2} = \frac{1}{2}kx_1^2 - \frac{1}{2}kx_2^2$

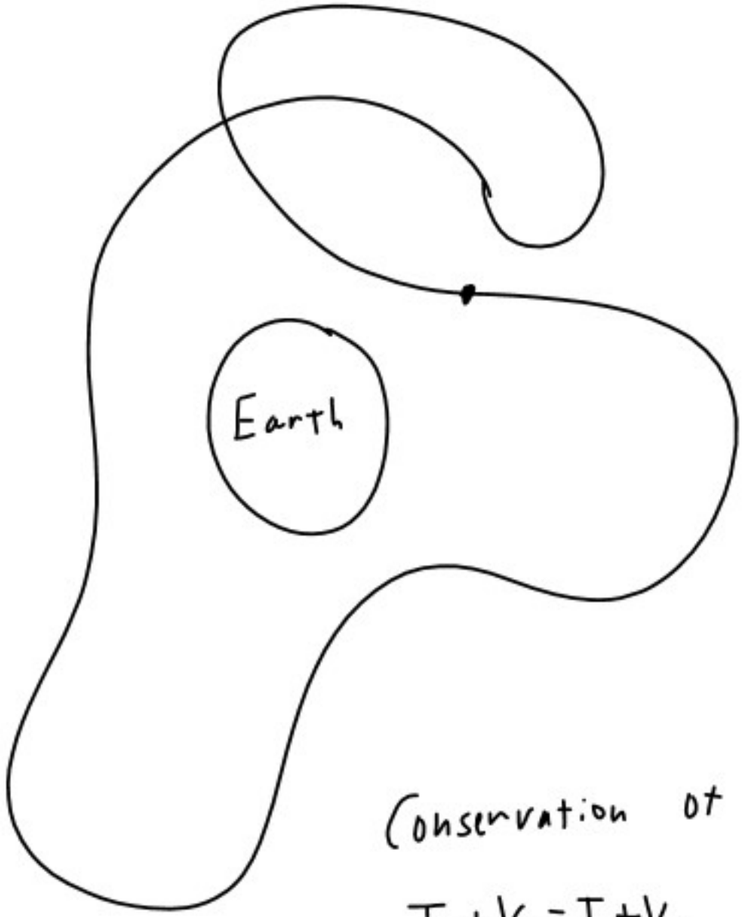
$= (V_e)_1 - (V_e)_2$

$V_e = \frac{1}{2}kx^2$

Conservative Forces



$$\oint F \cdot dr = 0$$



Conservation of energy

$$T_1 + V_1 = T_2 + V_2$$

A 750-g collar can slide along the horizontal rod shown. It is attached to an elastic cord with an undeformed length of 300 mm and a spring constant of 150 N/m. Knowing that the collar is released from rest at A and neglecting friction, determine the speed of the collar (a) at B, (b) at E.