



Dept. of Physics

PCS 211 – Fall 2021

Tutorial Report Cover Page

Group's Students Info

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Tutorial Number : ____ 4 _____

Tutorial Date : ____ October 26th, 2021 _____

Tutorial TA Name : _____ Matt Bielecki _____

1. .

$$1) \frac{1}{2}mv_{1i}^2 + \frac{1}{2}mv_{2i}^2 + \frac{1}{2}kx_i^2 = \frac{1}{2}mv_{1f}^2 + \frac{1}{2}mv_{2f}^2 + \frac{1}{2}kx_f^2$$

$$\downarrow \quad \quad \quad 0 + 0 + \frac{1}{2}kx_i^2 = \frac{1}{2}mv_{1f}^2 + \frac{1}{2}mv_{2f}^2 + 0$$

[zero because velocity and no spring isn't compressed]

conservation of momentum

$$m_1v_{1i} + m_2v_{2i} = m_1v_{1f} + m_2v_{2f}$$

$$\downarrow \quad \quad \quad 0 + 0$$

$$0 = m_1v_{1f} + m_2v_{2f}$$

$$v_{1f} = \frac{m_2}{m_1} v_{2f}$$

sub into above equation

$$\frac{1}{2}kx_i^2 = \frac{1}{2}m_1 \left(\frac{m_2}{m_1} v_{2f} \right)^2 + \frac{1}{2}m_2 v_{2f}^2$$

$$v_{2f} = \sqrt{\frac{k(x_i)^2}{m_2 \left(1 + \frac{m_2}{m_1} \right)}}$$

$$= \sqrt{\frac{200(0.1)^2}{2 \left(1 + \frac{2}{1} \right)}}$$

$$= 0.577 \text{ m/s}$$

$$v_{1f} = \frac{m_2}{m_1} v_{2f}$$

$$v_{1f} = \frac{2}{1} (0.577)$$

$$= 1.15 \text{ m/s}$$

2.

2. G: for work 1: $\theta = 0^\circ$
 for work 2: $\theta = 62^\circ$

A: $W_1 = \Delta E_{K1} = m E_{Kf} - E_{K0}$
 $W_1 = (F \cos \theta) s$

S: $W_1 = (F \cos \theta) s = \Delta E_{K1}$ $\cos 0^\circ = 1$
 ↓ percent given

Fractional increase: $\frac{\Delta E_{K1}}{E_{K0}} = \frac{(F \cos \theta) s}{E_{K0}} = 0.38$

$F_s = 0.38 E_{K0}$ ①

$W_2 = (F \cos 62^\circ) s = \Delta E_{K2}$

Fractional increase: $\frac{\Delta E_{K2}}{E_{K0}} = \frac{(F \cos 62^\circ) s}{E_{K0}}$ ~~≈ 0.178~~

② $= \frac{F_s}{E_{K0}} \cos 62^\circ$

sub eq'n 1 into 2

$= \frac{0.38 E_{K0} \cos 62^\circ}{E_{K0}}$

$= 0.38 \cos 62^\circ$ 2 sig digits

≈ 0.178 ✓

∴ It would increase by 18% or 17.8%.

3a) OAC

work along OA + AC

$$F_g = 4g = 39.24 \text{ N}$$

$$F_g(OA) \cos 90 + F_g(AC) \cos 180$$

$$= 39.24 \text{ N}(5 \text{ m})(0) + 39.24 \text{ N}(5 \text{ m})(-1)$$

$$= -196.2 \text{ J}$$

3b) OB + BC

$$= F_g(OB) \cos 180 + F_g(BC) \cos 90$$

$$= -196.2 \text{ J}$$

3c) OC

$$\theta = 180 - \tan^{-1}\left(\frac{5}{5}\right)$$

$$= 185$$

$$= F_g(OC) \cos 135$$

$$= 39.24(5\sqrt{2} \text{ m})\left(-\frac{1}{\sqrt{2}}\right)$$

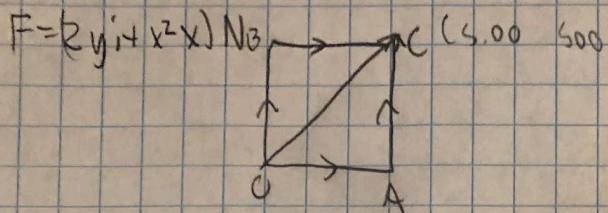
$$= -196.2 \text{ J}$$

The answers are
the same because
gravity is conservative

3.

4. .

4



a) $W = F \cos \theta \Delta r$

$$W_{net} = (W_1 + W_2) \cdot (5 - 5)$$

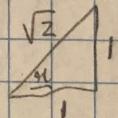
$$\begin{aligned} W_{net} &= (2y)(5)(\cos 0) + x^2(5)(\cos 90) \\ &= 10y \hat{i} + 5x^2 \hat{j} \end{aligned}$$

b) $W_{net} = W_1 + W_2$
 $= 2y(b)(\cos 0) + x^2(s)(\cos 90)$
 $= 10y \hat{i} + 5x^2 \hat{j}$

c) $W_{net} = W_1$

$$\begin{aligned} &= F \cos \theta \Delta r \\ &= (2y \hat{i} + x^2 \hat{j}) (k y_B u_B) (5\sqrt{2}) = 5\sqrt{2} \\ &= (2y \hat{i} + x^2 \hat{j}) \left(\frac{1}{\sqrt{2}}\right) (5\sqrt{2}) \end{aligned}$$

$$= 10y \hat{i} + 5x^2 \hat{j}$$



d) yes the force is conservative because regardless of the path taken from point O → C, I keep getting the same work value

5.

5. Power = $FV\cos\theta$ or $\frac{F\cos\theta \Delta d}{t}$ Velocity is constant
 $\therefore F \Delta d > 0$

$m_{\text{Total}} = 65\text{kg}(4)$ $\Delta d = 140\text{m}$ $t = 2\text{minutes} \left(\frac{60\text{s}}{1\text{min}}\right) = 120\text{s}$

Diagram showing forces: F_T (tension) at an angle θ to the horizontal, F_g (gravity) vertically downwards, and velocity along the horizontal. $\therefore \theta = 0^\circ$

$F_{\text{Tension}} = F_{\text{gravity}}$
 $F_T = mg$
 $F_T = 9.81(65\text{kg})(4)$
 $F_T = 2550.6\text{N}$

Power = $\frac{2550.6\text{N} \cos 0^\circ (140\text{m})}{120\text{s}}$
 $\boxed{\text{Power} = 2975.7 \text{ watts}}$