Physics 41 PSet 7

Matthew Phonchay Vilaysack

TOTAL POINTS

8.5 / 20

QUESTION 1

1 Problem 1 2 / 5

- **0 pts** Correct

✓ **- 1 pts** **a) Incorrect conservation of energy equation (leading to the wrong answer). $$I = I_0 + \frac{2mg\sin(\theta)}{k}$$. Or wrong answer.**

- **1 pts** b) Incorrect change in mechanical energy equation, or work done by friction equation including sign error (leading to the wrong answer). $$ I_0 + \frac{2mg(\sin\theta - \mu\cos(\theta))}{k} $$

✓ **- 1 pts** **c) $$\mu = \frac{1}{3}\tan(\theta) $$ not given or answer supplied was not simplified**

✓ **- 1 pts** **d) Wrong answer, and/or didn't simplify completely. $$E_{diss} = \frac{(mg\sin(\theta))^2}{2k}$$**

- **0.5 pts** d) sign error.

- **5 pts** No work.

- **0 pts** c) included upper and lower bound. Only lower was required! Nice job.

QUESTION 2

2 Problem 2 5 / 5

✓ **- 0 pts** **Correct**

- **2 pts** **a)** Did not determine $$W = m_B gl - \mu_km_Agl$$

- **1 pts** **a)** Incorrect signs assigned to the energy terms.

- **1 pts** **a)** Did not find velocity from energy, $$mv^2/2 = W)$$

- **3 pts** **a)** Incorrect process/answer or insufficient work; $$v=\sqrt{2\frac{(m_B-\mu_km_A)gl}{m_A+m_B}}=2.9$$m/s

- **1 pts** **a)** Incorrect algebra/numerical answer

- **2 pts** **b)** Incorrect process/answer or insufficient work; $$W_{loss}=8.8$$kJ

- **0.5 pts** incorrect/missing units

QUESTION 3

3 Problem 3 1.5 / 5

- **0 pts** Correct

- **1 pts** No sketch in part a

- **1 pts** Incorrect $$v_0=\sqrt{2gh(\mu_k\cot\theta+1)}$$ for part b

✓ **- 0.5 pts** **Incorrect $$v_{f1}=\sqrt{v_0^2-2gh(\mu_k\cot\theta+1)}$$ for part c**

✓ **- 1 pts** **Incorrect $$d=\frac{h}{\tan\theta}+v_{f1}\cos\theta\cdot\frac{v_{f1}\sin\theta+\sqrt{(v_{f1}\sin\theta)^2+2gh}}{g}$$ for part d**

✓ **- 0.5 pts** **Incorrect $$\vec{v}_{f2}=v_{f1}\cos\theta\hat{i}-\sqrt{(v_{f1}\sin\theta)^2+2gh}\hat{j}$$ for part d**

- **0.5 pts** Assumed block is launched horizontally (rather than at the angle $$\theta$$) in part d

✓ **- 1 pts** **Incorrect answer/no explanation for part e**

- **5 pts** No answer

- **0.5 pts** Sign error

✓ **- 0.5 pts** **Algebra mistake**

1. where'd g go?

2. very fair :)

QUESTION 4

4 Problem 4 0 / 5

- **0 pts** Correct

✓ **- 1 pts** **Incorrect units/dimensions for (a) (Note: using units here is okay because of typo in problem statement)**

✓ **- 1 pts** **(b) Incorrect work**

✓ **- 0.5 pts** **(c) Didn't account for gravity**

✓ **- 0.5 pts** **(c) Didn't use integration to solve**

✓ **- 1 pts** **(c) Incorrect value of b**

✓ **- 1 pts** **(d) Incorrect force**

- 0.5 pts Including units in c or d

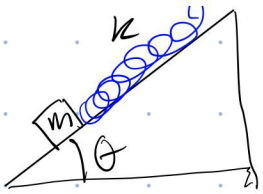
- 5 pts Did not submit

- 0.5 pts (c) sign error

- 0.5 pts (d) sign error

Problem 1)

$L_0 = k$



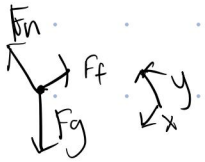
a) $kx = mg\sin\theta$

$x = \frac{mg\sin\theta}{k}$

↑ stretch length.

so $L_0 + \frac{mg\sin\theta}{k} = L_{max}$

$-\Delta U = W$



$F_f = \mu \cdot F_n = \mu \cdot mg\cos\theta$

$F_x = mg\sin\theta$

$F_y = mg\cos\theta$

(b) $W_{grav} - W_{spr} - W_{fr} = \Delta K = 0.$

$mgx\sin\theta - \int_0^{L_{max}} kx\,dx - \mu mg\cos\theta L_{max} = 0.$

$mg(L_{max})\sin\theta - \frac{k(L_{max})^2}{2} - \mu mg L_{max}\cos\theta = 0$

$mg\sin\theta - \mu mg\cos\theta = \frac{k}{2}(L_{max})$

$$L_{max} = \frac{2mg(\sin\theta - \mu\cos\theta)}{k}$$

(c) $$\frac{mg\sin\theta - \frac{k}{2}(L_{max})}{mg\cos\theta} = \mu$$

d) approaches 0.

$mg\sin\theta - \frac{kL_{max}}{2} - \mu mg\cos\theta = 0$

$mg\sin\theta - \frac{kL_{max}}{2} = 0$

so $mg\cos\theta$ J is dissipated in the form.

1 Problem 1 2 / 5

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✓ **- 1 pts** **d) Wrong answer, and/or didn't simplify completely. $$E_{diss} = \frac{(mg\sin(\theta))^2}{2k}$$**

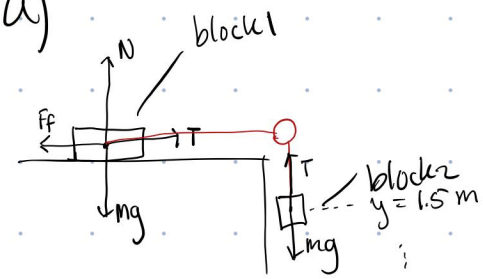
- **0.5 pts** d) sign error.

- **5 pts** No work.

- **0 pts** c) included upper and lower bound. Only lower was required! Nice job.

Problem 2

a)



Want: speed of block 2 after $y_i \to y_f$.

Work Energy Theorem:

$W_{total,1} = W_{T_1} + W_f = \cancel{T} - \mu_k m_1 g l = \frac{1}{2} m_1 v^2$ (i = length = Δx; T = 0)

$-\frac{1}{2}(m_1 + m_2)v^2 = m_2 g \cdot L - \mu_k m g L$

$W_{total,2} = W_{grav} + W_{T_2} = m_2 g \cdot l + \cancel{T} = \frac{1}{2} m_2 v^2$

tension is an internal force, so $W_T = 0$ on the whole system.

$\Delta KE = W_{total}$

$\frac{1}{2} m_1 v^2 + \frac{1}{2} m_2 v^2 = W_{grav} + W_{fr}$

$\frac{1}{2}(m_1 + m_2)v^2 = mg \cdot \Delta x - \mu_k mg \Delta x$

where Δx = displacement.

$\pm\frac{1}{2}(6+8)v^2 = 88.2\,J - 29.4\,J$

$7v^2 = 58.8\,J$

$v = 2.898\ m/s$

Δx – displacement.

7 | 7
88 | 12
29.4
58.8

Block 1

mass: 8 kg

$F_{fr} = \mu_k mg = .25 mg = 2kg \cdot g = 19.6N$

$W_{fr} = \mu_k mg \Delta x = 19.6N \cdot (1.5m) = 29.4J$

Block 2

mass: 6 kg

$y_i = 1.5m$

$y_f = 0m$

$F_g = mg$

$W_{grav} = mg\Delta x = (6kg)(9.8m/s^2)(1.5\,m)$

$= 88.2\,J$

b) $W_{drag} = mgh = 60\,kg \cdot 9.8\,m/s^2 \cdot 1.5m = 8800\,J$ lost.

If V is constant, then KE is constant, however all PE is being lost by the person and so it is dissipated.

2 Problem 2 5 / 5

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- 2 pts **a)** Did not determine $$W = m_B gl - \mu_km_Agl$$

- 1 pts **a)** Incorrect signs assigned to the energy terms.

- 1 pts **a)** Did not find velocity from energy, $$mv^2/2 = W)$$

- 3 pts **a)** Incorrect process/answer or insufficient work; $$v=\sqrt{2\frac{(m_B-\mu_km_A)gl}{m_A+m_B}}=2.9$$m/s

- 1 pts **a)** Incorrect algebra/numerical answer

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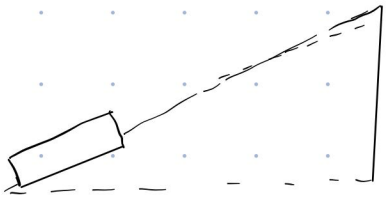
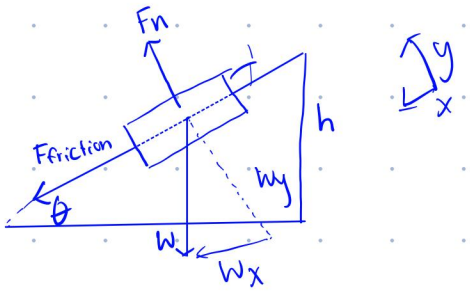
Problem 3

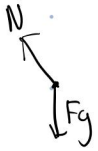
a)





FBD:

b)



$h = \sin(\theta) \times X$

$\frac{h}{\sin\theta} = X$

$W_{fr} = -\mu_k mg\cos\theta \cdot x - mg\sin\theta$

$W = F \cdot d$

x = length of incline

$W_{net} =$

$\Delta KE = W_{total}$

$\frac{1}{2}mv_i^2 + U = -mgx\sin\theta - \mu_k mgx\cos\theta$

$v_i^2 = 2\left(-x\sin\theta - \mu_k x\cos\theta\right)$ (1)

$v_i = \sqrt{2(-x\sin\theta - \mu_k x\cos\theta}$

where $x = \frac{h}{\sin\theta}$.

c) ☐ I will not be doing this.

d) ☐ I will not be doing this.

e) ☐ I will not be doing this (2)

3 Problem 3 1.5 / 5

- **0 pts** Correct
- **1 pts** No sketch in part a
- **1 pts** Incorrect $$v_0=\sqrt{2gh(\mu_k\cot\theta+1)}$$ for part b
- ✓ **- 0.5 pts** **Incorrect $$v_{f1}=\sqrt{v_0^2-2gh(\mu_k\cot\theta+1)}$$ for part c**
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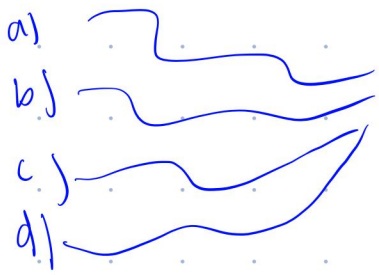
Problem 4



I will respectfully not do this problem.

11

0

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