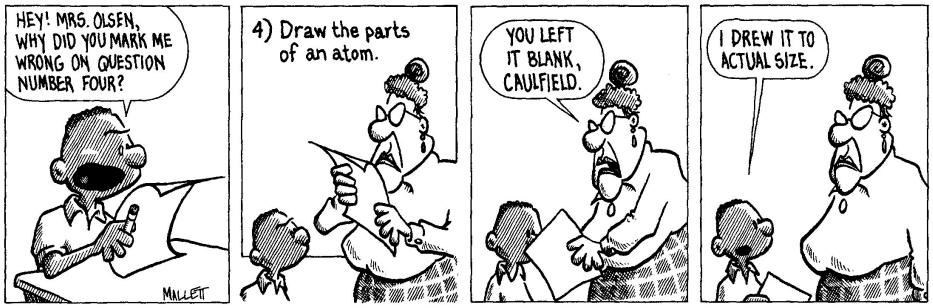
November 28, 2016 Physics 131 Prof. E. F. Redish

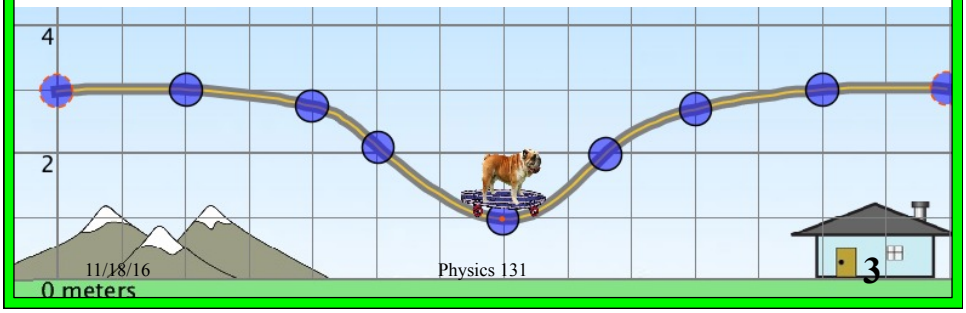
- **Theme Music:** Blondie
  Atomic
- **Cartoon:** Jef Mallett
  Frazz



11/30/15 Physics 131 1

A bulldog on a skateboard is sitting at the bottom of a 2 m dip. What is their total mechanical energy? The bulldog and skateboard combined have a mass of 20 kg. Friction and air drag can be ignored. Note the scale.

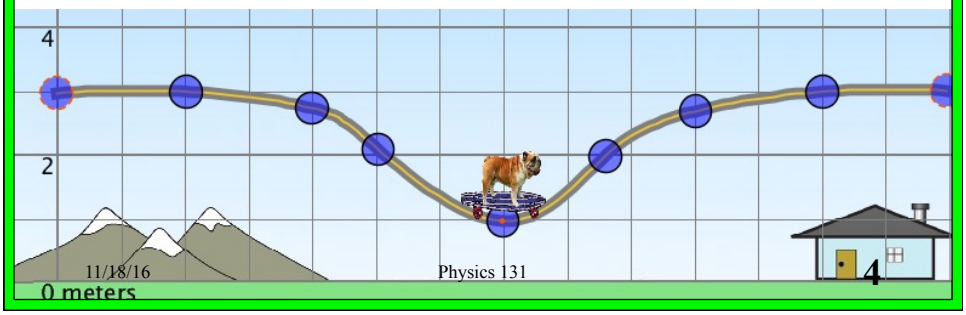
1. Zero (37%)
2. About 400 Joules (29%)
3. **About 200 Joules (32%)**
4. You can't tell from the information given.



11/18/16 Physics 131 3

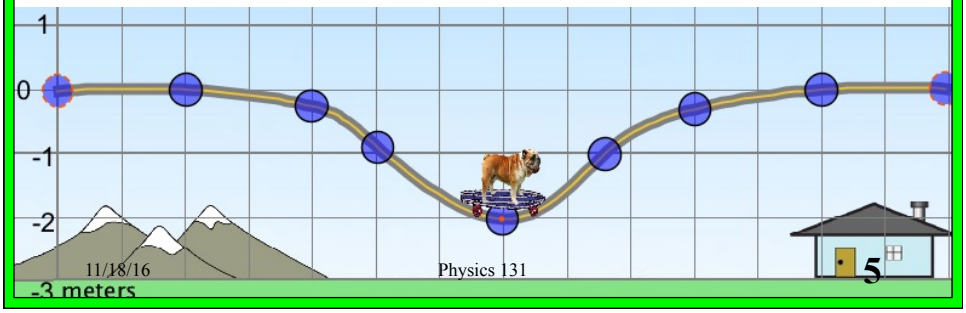
A bulldog on a skateboard is sitting at the bottom of a 2 m dip. How much KE do you have to give them so they will roll out of the dip? The bulldog and skateboard combined have a mass of 20 kg. Friction and air drag can be ignored. Note the scale.

1. None (3%)
2. **About 400 Joules (74%)**
3. About 600 Joules (22%)
4. You can't tell from the information given. (2%)



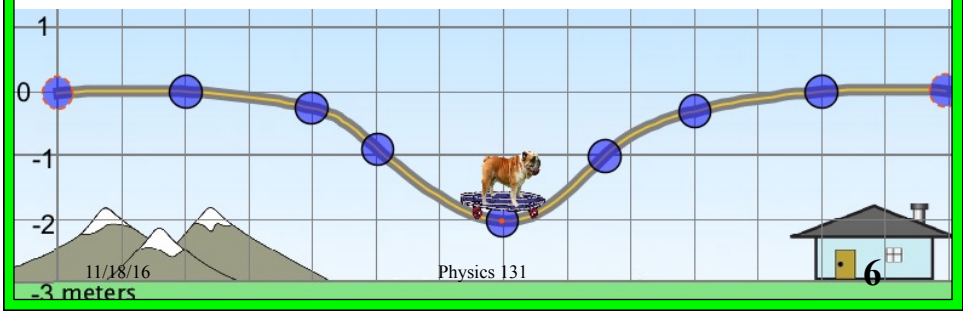
A bulldog on a skateboard is sitting at the bottom of a 2 m dip. What is their total mechanical energy? The bulldog and skateboard combined have a mass of 20 kg. Friction and air drag can be ignored. Note the scale.

1. Zero (28%)
2. About 400 Joules (36%)
3. **About -400 Joules (36%)**
4. You can't tell from the information given.



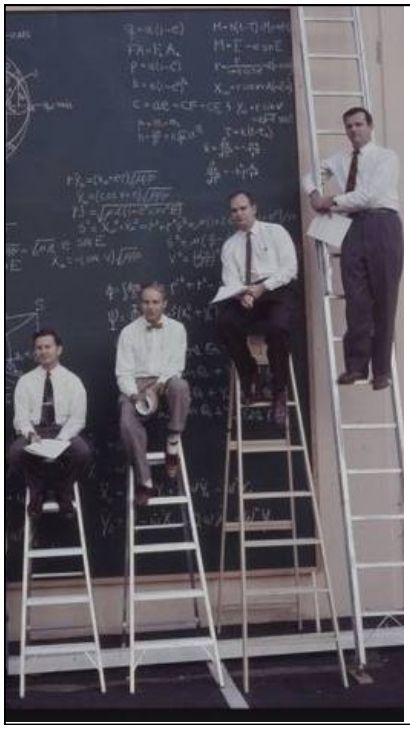
A bulldog on a skateboard is sitting at the bottom of a 2 m dip. How much KE do you have to give them so they will roll out of the dip? The bulldog and skateboard combined have a mass of 20 kg. Friction and air drag can be ignored. Note the scale.

1. None (5%)
2. **About 400 Joules (76%)**
3. About 600 Joules (20%)
4. You can't tell from the information given.



In question 3, one of the choices was that the total mechanical energy of the bulldog was negative. Is this possible?

A. No. Total mechanical energy must be positive. (40%)
B. No. Total mechanical energy could be negative, but not in this case. (14%)
C. **Yes. Because the potential energy can be negative. (38%)**
D. Yes. But only when the kinetic energy is zero. (8%)
E. It cannot be determined for this example.



The Equation of the Day

Force from potential energy

$$F = -\frac{dU}{dx}$$

$$\vec{F} = -\vec{\nabla} U$$

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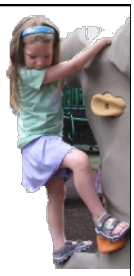
Physics 131

Foothold ideas: Conservation of Mechanical Energy



- Mechanical energy
  - The mechanical energy of a system of objects is conserved if resistive forces can be ignored.

$$\Delta(KE + PE) = 0$$

$$KE_{initial} + PE_{initial} = KE_{final} + PE_{final}$$

This is why we define the PE with a negative sign.

- Thermal energy
  - Resistive forces transform coherent energy of motion (energy associated with a net momentum) into *thermal energy* (energy associated with internal chaotic motions and no net momentum)

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Foothold ideas: Energies between charge clusters

- Atoms and molecules are made up of charges.
- The potential energy between two charges is

$$U_{12}^{elec} = \frac{k_C Q_1 Q_2}{r_{12}}$$

No vectors!

- The potential energy between many charges is

$$U_{12\ldots N}^{elec} = \sum_{i<j=1}^{N} \frac{k_C Q_i Q_j}{r_{ij}}$$

Just add up all pairs!

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