Conservation of Energy: Falling Problems Part 2

Our goal is to build a *quantitative* understanding of energy!

Problems that Review concepts from previous packet
Part A: Review of formulas for kinetic energy and gravitational potential energy.
Part B: Conservation of energy of somebody sledding down a hill (very similar to the ball rolling down problem.

Similar to Old Problems with a small new element
Part C: Heat Loss in a falling problem.

Problems that Add New Elements, Take you in new directions
Part D: Abstract algebra on the energy equations.
Part E: Energy in a jelly donut [conversion factors]

Part A: Review of formulas for Kinetic and Gravitational Potential Energy

$$KE = \frac{1}{2}mv^2 \qquad GPE = mgh$$

Symbol	Quantity	SI Unit
KE	Kinetic Energy	Joules (J)
m	Mass	Kilograms (kg)
v	velocity	m/s
GPE	Gravitational potential energy	Joules (J)
g	9.8*** m/s^2	m/s^2
h	Height	Meters (m)

*** Free fall acceleration, depends upon planet, but equals 9.8 m/s^2 on earth.

A.1. A dog with a mass of 35 kg is running at 8 m/s. What is its kinetic energy?

Looking For	Formula
Already Know	
Answer in a complete sentence with unit	

A.2. Sonic the hedgehog has a mass of 25 kg and is running at 84 m/s. What is his kinetic energy?

Looking For	Formula
Already Know	
Answer in a complete sentence with unit	

A.3. Sonic then jumps 6 meters into the air. His mass is the same as it was in the last problem. What is his gravitational potential energy?

Looking For	Formula
Already Know	
Answer in a complete sentence with unit	

A.4. An Atlantis ninth grader is on the third floor, which is 15 meters up. He has a mass of 62 kg. What is his gravitational potential energy?

Looking For	Formula
Already Know	
Answer in a complete sentence with unit	

A.5. A car has a speed of 12 m/s and has 43200 Joules of kinetic energy. What is its mass?

Looking For	Formula
Already Know	
Answer in a complete sentence with unit	

A.6. A runner has a mass of 55 kg and has 990 Joules of kinetic energy. What is his speed?

Looking For	Formula
Already Know	
Answer in a complete sentence with unit	

A.7. A car has a mass of 500 kg and has 100,000 Joules of kinetic energy. What is its speed?

Looking For	Formula
Already Know	
Answer in a complete sentence with unit	

A.8. A book with a mass of 8 kg has 235 J of potential energy. What is its height?

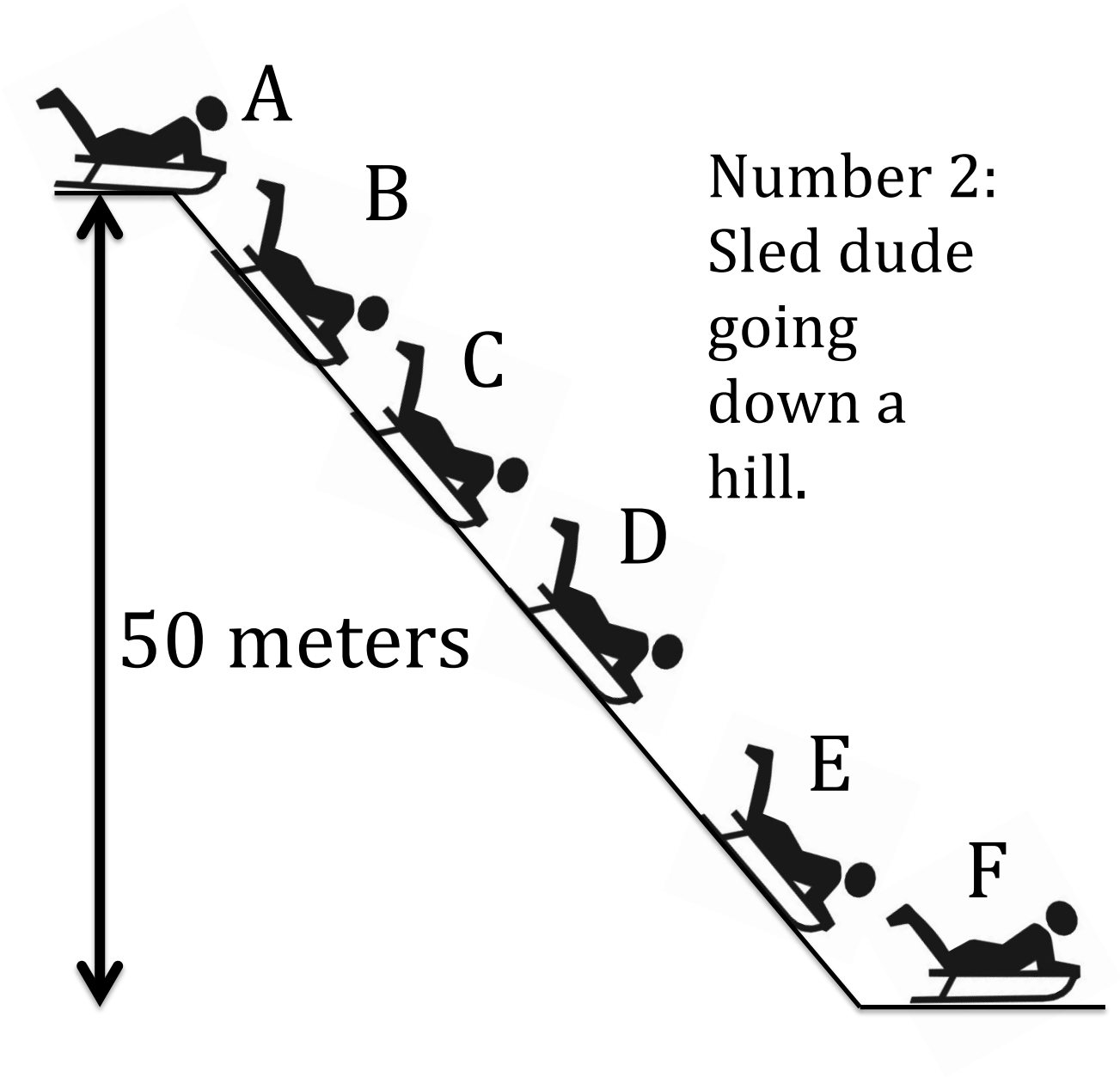
Looking For	Formula
Already Know	
Answer in a complete sentence with unit	

Part B: Conservation of Energy in a Sledding Dude
Rule 1:

Total Energy = KE + GPE
Total Energy is always the same!

Rules 2 and 3:

$$KE = \frac{1}{2}mv^2$$
$$GPE = mgh$$



B.1. Use the rules of fill out the following graph.

Point	KE (J)	GPE (J)	Total Energy (J)
A	0		
B	7,500		
C		23,300	
D	22,000	18,180	
E	33,000		
F		0	

B.2. Pick a point where you have enough information to find the *mass*:
What is the mass of the rider?

Looking For	Formula
Already Know	
Answer in a complete sentence with unit	

B.3. Use the formulas to fill out the following table.
[Hint: If you know how to do part D, do that first. It makes this *much* quicker.]

Point	Speed (m/s)	Height (m)
A		50
B		
C		
D		
E		
F		

B.4. What is the final speed of the sled dude?

B.5. Imagine yourself sledding. Do you ever go that fast?

B.6. In this problem, we assumed that there was no friction or air resistance, which would have taken some of the final. Was this an accurate assumption? How can we tell?

B.7. Create a graph of Kinetic Energy, Gravitational Potential Energy, and Total Energy.

Use a different mark for each quantity:

Quantity	**Mark**	
Kinetic Energy	•	Place Energy in Joules on the Y-axis. Use a scale of 4000 Joules per box. Place Height in meters on the X-Axis. Use a scale of 5 meters per box.
Gravitational Potential Energy	○	
Total Energy	x	

B.8. As the ball moves down the ramp, what happens to Kinetic Energy?

B.9 As the ball moves down the ramp, what happens to Gravitational Potential Energy?

B.10 As the ball moves down the ramp, what happens to Total Energy?

Answers

A.1. 1120 J

A.2. 88200 J

A.3. 1470 J

A.4. 9114 J

A.5. 600 kg

A.6. 6 m/s

A.7. 20 m/s

A.8. 3 meters

B.1.

Point	KE (J)	GPE (J)	Total Energy (J)
A	0	40,180	40,180
B	7,500	32,680	40,180
C	16,880	23,300	40,180
D	22,000	18,180	40,180
E	33,000	7,180	40,180
F	40,180	0	40,180

B.2. 82 kg

B.3.

Point	Speed (m/s)	Height (m)
A	0	50
B	13.5	40.7
C	20.3	29.0

D	23.2	22.6
E	28.4	8.9
F	31.3	0

B.4. 31.3 m/s