Object	Speed (m/s)	Height (m)	Mass (kg)	P.E.(J)	K.E. (J)	T.M.E.(J)
Rock	0	0	0.5	0	0	0
Large Boulder	0	12	2,000	235200	0	235,200
Cheetah	24	1.5	60	882	17,280	18,162
Space Shuttle	300	20,000	40,000	7840000000	1,800,000,000	9,640,000,000
Submarine	40	100	2,500	2450000	2,000,000	4,450,000
Runner	2	1	75	735	150	885
Fly	10	3	0.004	0.1176	0.200	0.318

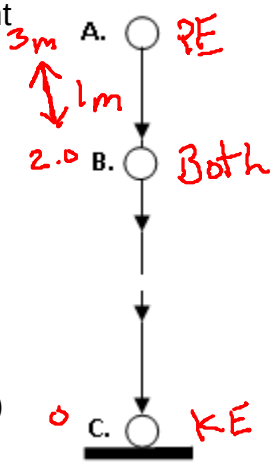
Object	Speed (m/s)	Height (m)	Mass (kg)	P.E.(J)	K.E. (J)	T.M.E.(J)
Lead Block	12.65	7.14	50	3,500	4,000	7,500
Car	14	0.41	1,800	7,200	176400	183,600
Unknown	1,000	0	0.8	0	400,000	400,000
Truck	7.42	0.11	6,400	7,200	176,400	183,600
Laundry Bag	19.08	10	7.14	700	1,300	2,000
Unknown	3.04	3	100	2940	463.3	3,403

Work & Energy

Intro to Energy Conservation

$$PE = mgh \qquad KE = \frac{1}{2}mv^2 \qquad TME = PE + KE$$

In the diagram below, a 0.5 kg ball is dropped from rest from a height of 3.0m at point "A" as shown in the diagram to the right. The ball is 2.0m high at point "B".



1. Calculate the potential energy at points A – C and enter the values in the table below.

   $PE_A = mgh_A = (0.5)(9.8)(3.0) = 14.7$ J

   $PE_B = (.5)(9.8)(2.0) = 9.8$ J

   $PE_C = 0$

2. Using Kinematics, find the velocity at point B (after the ball has fallen 1.0 meter) and point C (after the ball has fallen 3 meters).

Vi = 0
Vf = ?
d = -1.0
a = -9.8

$v_f^2 = v_i^2 + 2 \cdot a \cdot d$
$v_f^2 = 0 + 2 \cdot (-9.8) \cdot (-1.0) = 19.6$
$v_f = \sqrt{19.6} = 4.43 \frac{m}{s}$

$v_f^2 = v_i^2 + 2 \cdot a \cdot d$
$v_f^2 = 0 + 2 \cdot (-9.8) \cdot (-3.0) = 58.8$
$v_f = \sqrt{58.8} = 7.67 \frac{m}{s}$

3. Using the balls velocities from part 2, find the Kinetic Energy of the ball at points A - C

$KE_A = 0$

$KE_B \qquad KE = \frac{1}{2}mv^2 = \frac{1}{2}(0.5)(4.43)^2 = 4.9 \cdot J$

$KE_C \qquad KE = \frac{1}{2}(.5)(7.67)^2 = 14.7 \cdot J$

Position	Speed (m/s)	Height (m)	Mass (kg)	P.E.(J)	K.E. (J)	T.M.E.(J)
Point A	0	3.0	0.5	14.7	0	14.7
Point B	4.43	2.0	0.5	9.8	4.9	14.7
Point C	7.67	0.0	0.5	0	14.7	14.7

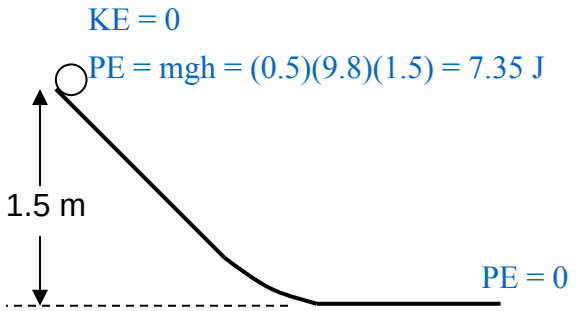
4. What do you notice about the total mechanical energy at points A – C?

The TME stays constant - By the Law of Conservation of Energy

Work & Energy

Conservation of Energy Worksheet

1. A marble (.5 kg) is released (down a ramp) from rest 1.5 m above floor level. Find the marble's speed at the bottom of the ramp.

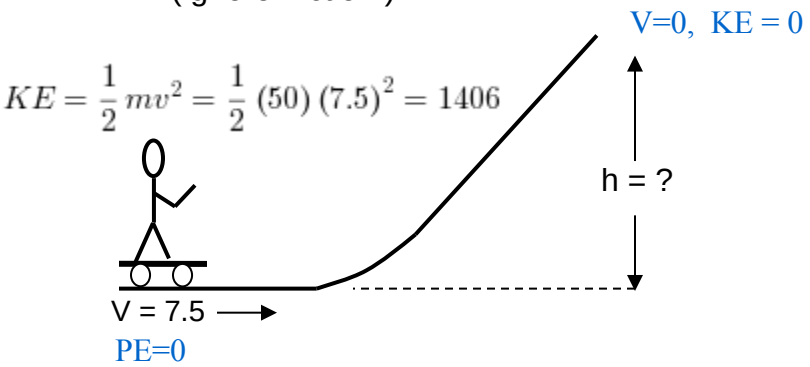


	Top of Ramp	Bottom of Ramp
PE	7.35	0
KE	0	7.35
TOTAL	7.35	7.35

Show all calculations here

$$KE = \frac{1}{2}mv^2$$
$$7.35 = \frac{1}{2}(0.5)v^2$$
$$7.35 = 0.25v^2$$
$$v^2 = \frac{7.35}{0.25} = 29.4$$
$$v = \sqrt{29.4} = 5.42 \cdot \frac{m}{s}$$

2. A 50 kg skateboarder is coasting at a speed of 7.5 m/s along a flat surface. He continues at that speed as he approaches the hill. How high up the hill can he coast before he stops? (Ignore friction.)



Show all calculations here

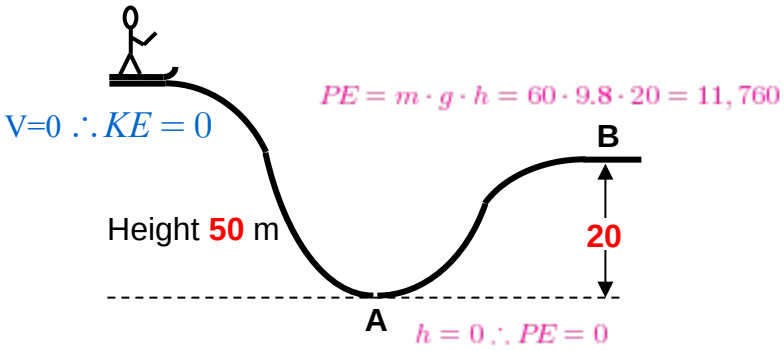
$$PE = m \cdot g \cdot h$$
$$1406 = (50)(9.8)h$$
$$1406 = 490 \cdot h$$
$$h = \frac{1406}{490} = 2.87 \cdot m$$

	Bottom of hill	Top of hill
PE =	0	1406
KE =	1406	0
TOTAL =	1406	1406

Work & Energy

3. A skier rests on top of a 50m hill. The skier's mass if 60 kg. Ignoring friction, calculate the skier's speed at points A and B.

$PE = m \cdot g \cdot h = 60 \cdot 9.8 \cdot 50 = 29,400 \cdot J$



Show all calculations here

$KE = \frac{1}{2}mv^2$ $\quad \frac{1}{2}m = \frac{60}{2} = 30$

Velocity @ A

$29400 = 30v^2$

$v^2 = \frac{2940}{30} = 980$

$v = \sqrt{980} = 31.3 \cdot \frac{m}{s}$

Velocity @ B

$17640 = 30v^2$

$v^2 = \frac{17640}{30} = 588$

$v = \sqrt{588} = 24.2 \cdot \frac{m}{s}$

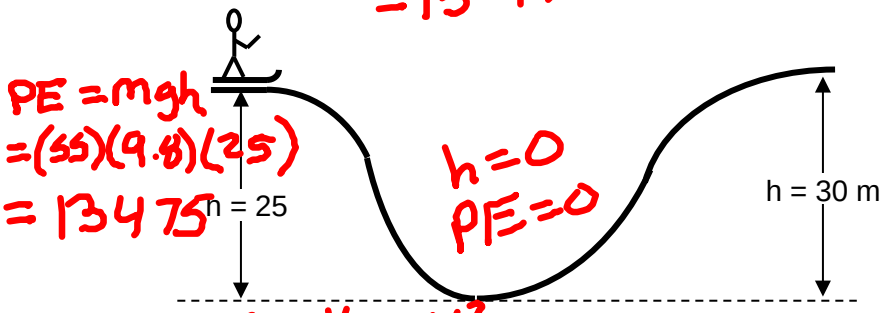
$v = \sqrt{\frac{17640}{30}} = 24.4 \cdot \frac{m}{s}$

	Top of Hill	Point A	Point B
KE	0	29,400	29400-11760 =17640
PE	29,400	0	11,760
TOTAL	29,400	29,400	29,400

4. A 55 kg skier is moving 7.5 m/s at the top of a 25 m hill. Complete the energy table below and determine his speed at the bottom of the hill. **SHOW ALL WORK.**

$KE = \frac{1}{2}mV^2 = \frac{1}{2}(55)(7.5) = 1547$

V = **7.5 m/s**



	Top of hill	Bottom of hill
PE	13,475	0
KE	1547	15,022
TOTAL	15,022	15,022

$KE = \frac{1}{2}mV^2$

$15,022 = \frac{1}{2}(55)V^2$

$V^2 = 15,022 / 27.5 = 546$ $\quad \therefore V = \sqrt{546}$

$V = 23.4$ m/s

5. Does he have enough energy to get to the top of the 30m hill in front of him? Support your answer with calculations.

PE @ 30m $PE = mgh = (55)(9.8)30 = 16,170$ J

NO $16,170 > TME$