Conservation of Energy

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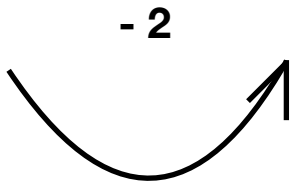
$$E = PE + KE = 10\ J$$

$$5 + 5 = 10$$

$$6 + 4 = 10$$ (KE is converted to PE)

E = PE + KE = 10 J

5 + 5 = 10



3 + 7 = 10 (PE is converted to KE)

Any object at a certain **height (h)** has a potential energy (PE). It does not matter if it is moving or not.

$$\mathbf{PE = m \times g \times h}$$

Any object **moving** at a speed **V** has a kinetic energy (KE). It does not matter how height or low it is.

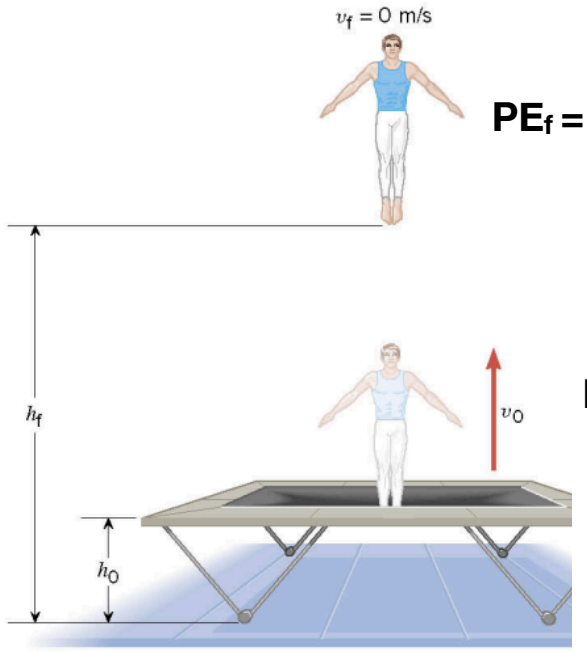
$$\mathbf{KE = 1/2\ m\ V^2}$$

Principle of conservation of energy:

Energy can neither be created nor destroyed, but can only be converted from one form to another.

$$E = KE + PE = \text{constant}$$

KE can converted to PE. PE can be converted to KE.



$PE_f = m \times g \times h_f$ $KE_f = 1/2\ m\ V_f^2 = 0$

total $E_t = KE_f + PE_f$

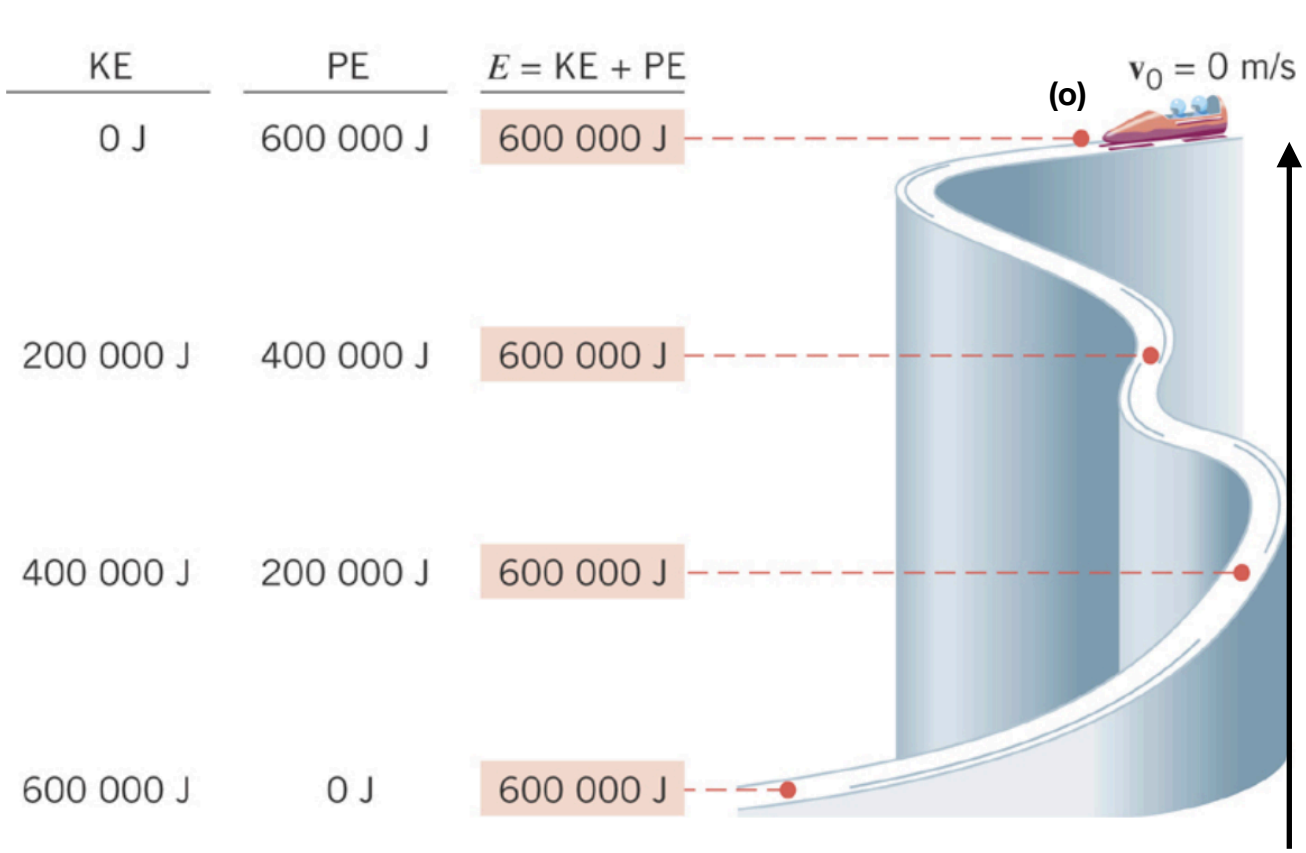
$PE_o = m \times g \times h_o$ $KE_o = 1/2\ m\ V_o^2$

total $E_t = KE_o + PE_o$

The total mechanical energy of an object remains constant

Total energy in the initial position = Total energy in the final position

$$KE_o + PE_o = KE_f + PE_f$$



$KE_o = 1/2\ m\ V_o^2 = 0$ J

$PE_o = m \times g \times h_o$

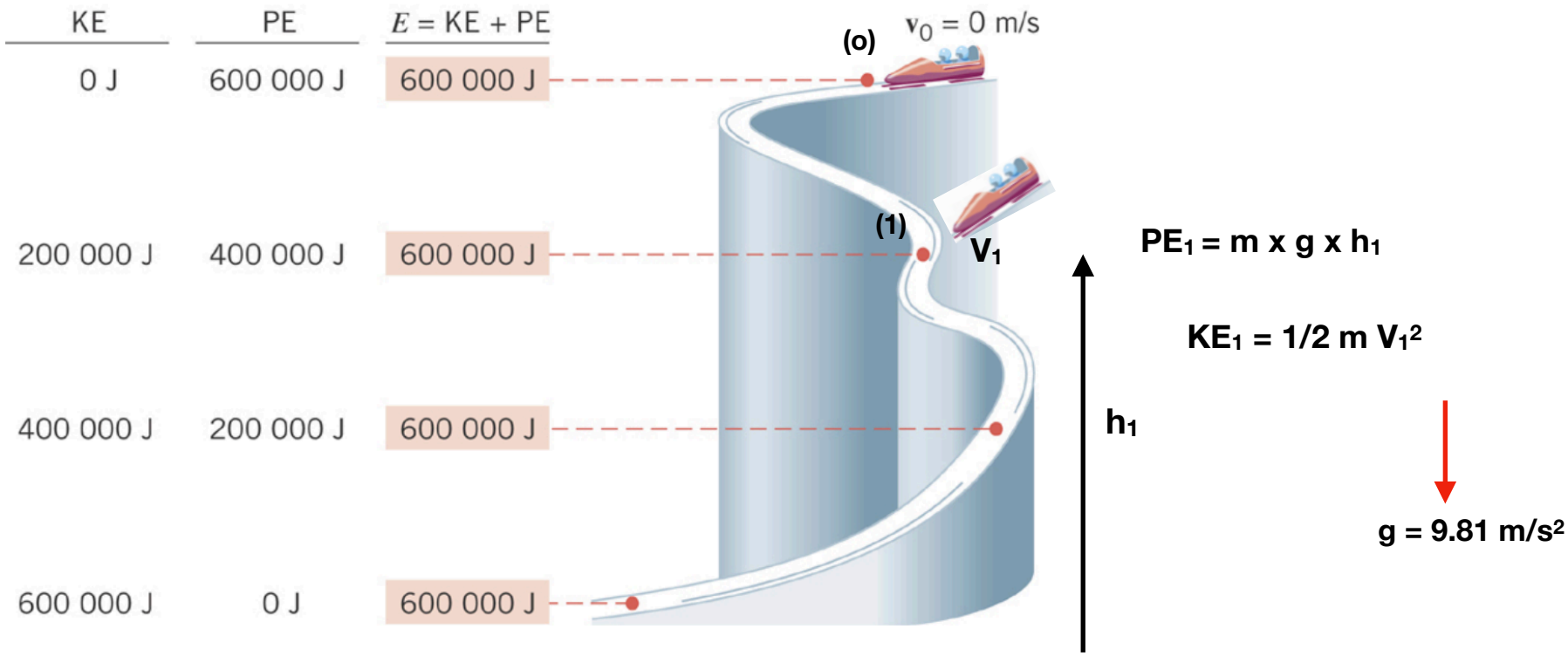
g = 9.81 m/s²

Point (o):

V = 0 m/s, $KE_o = 1/2\ mV^2 = 1/2\ m \times 0 = 0$ J

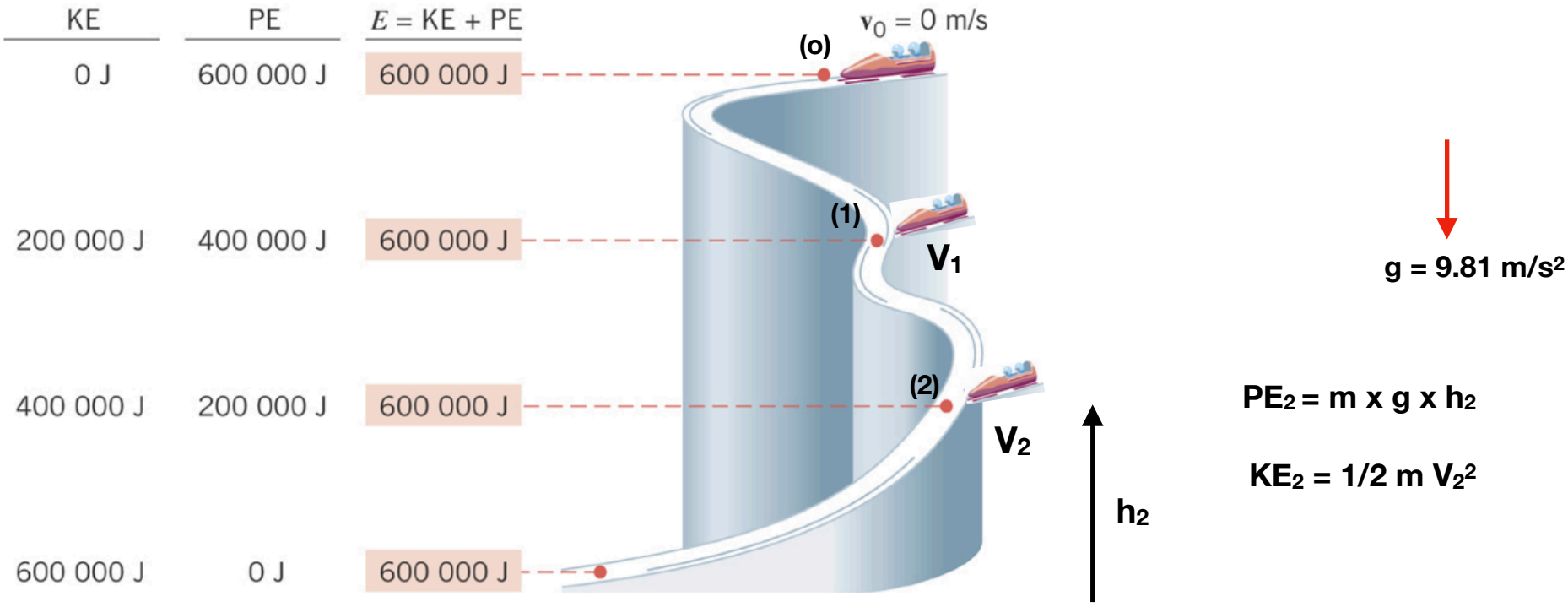
h_o $PE_o = m \times g \times h_o$

$$E = KE_o + PE_o = 0 + PE_o = PE_o$$



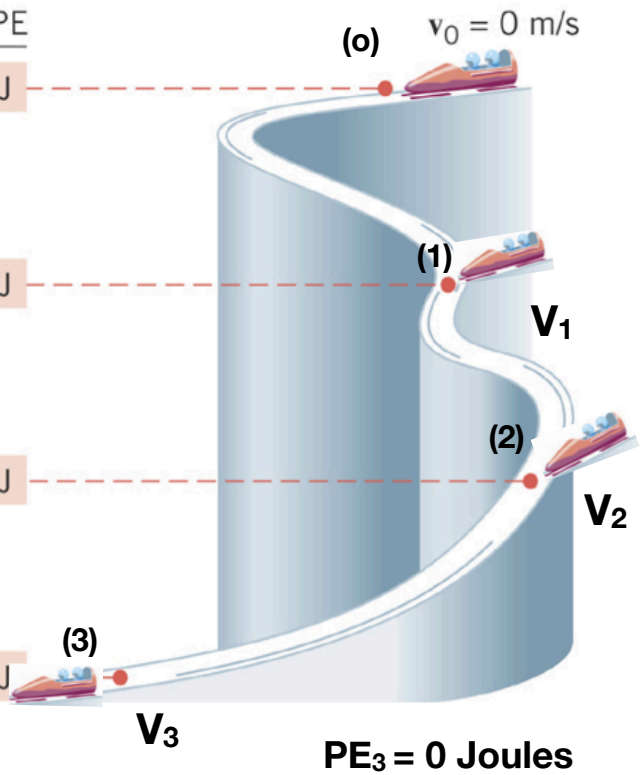
Position (1) : 200 J of PE is converted to KE;

Total E is the same: 600.000 Joules.



Position (2) : PE is converted to KE; Total E is the same: 600.000 Joules.

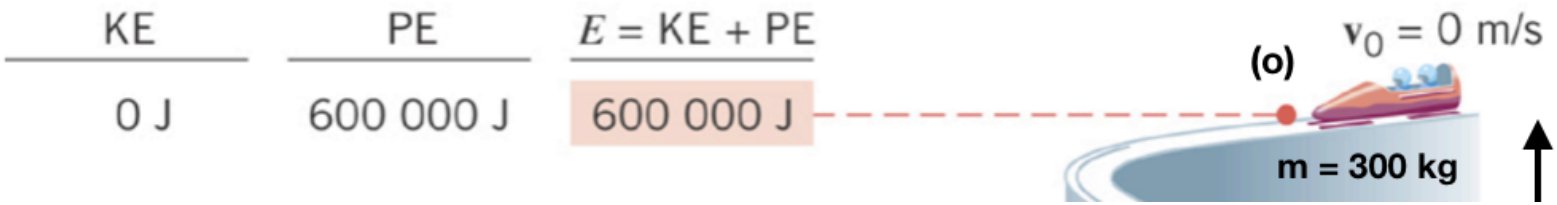
KE	PE	E = KE + PE
0 J	600 000 J	600 000 J
200 000 J	400 000 J	600 000 J
400 000 J	200 000 J	600 000 J
600 000 J	0 J	600 000 J



PE_3 = 0 Joules

$KE_3 = 1/2\ m\ V_3^2$

It is at the surface of the Earth. So, PE = 0 Joules
It is still moving. So there is KE.



Position (o):

KE = 0 Joules because Vo = 0 m/s
PE = 600000 Joules
Mass of sled and people: m = 300 kg.
g = 9.81 m/s^2
How high the sled is above the surface of earth: ho?

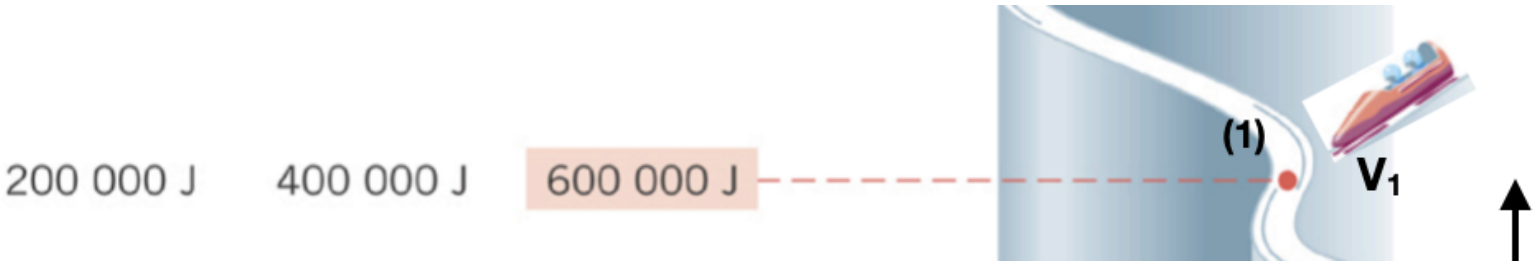
$$PE_o = m \times g \times h_o$$

$$600000 = 300 \times 9.81 \times h_o$$

$$600000 = 2{,}943 \times h_o$$

$$\frac{600000}{2{,}943} = \frac{2{,}943}{2{,}943} \times h_o$$

$$205 \text{ m} = h_o$$



Position (1):

KE = 200000 Joules , V_1 = ?
PE = 400000 Joules , h_1 = ?
Mass of sled and people: m = 300 kg.

$$\mathbf{KE = 1/2\ m\ V^2}$$

$$200000 = 1/2 \times 300 \times V^2$$

$$200000 = 150\ V^2$$

$$\frac{200000}{150} = \frac{150}{150} V^2$$

$$1{,}333.33 = V^2$$

$$\sqrt{1{,}333.33} = \sqrt{V^2}$$

$$36.51 \text{ m/s} = V$$

$$36.51 \text{ m/s} = V_1$$

PE = 400000 Joules, m = 300 kg, g = 9.81 m/s^2

h_1 = ?

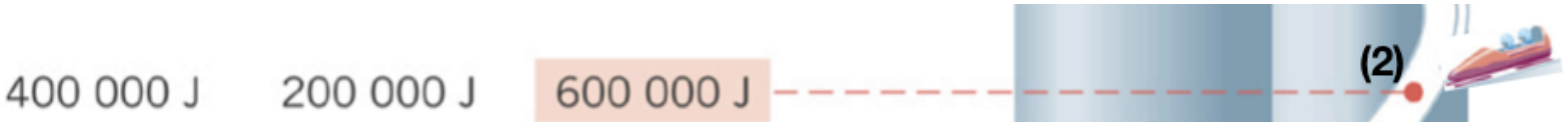
$$\mathbf{PE = m \times g \times h_1}$$

$$400000 = 300 \times 9.81 \times h_1$$

$$400000 = 2{,}943 \times h_1$$

$$\frac{400000}{2{,}943} = \frac{2{,}943}{2{,}943} \times h_1$$

$$135.91 \text{ m} = h_1$$



Position (2):

KE = 400000 Joules , V_2 = ?
PE = 200000 Joules , h_2 = ?
Mass of sled and people: m = 300 kg.
g = 9.81 m/s^2

$$\mathbf{KE = 1/2\ m\ V^2}$$

$$400000 = 1/2 \times 300\ V^2$$

$$400000 = 150\ V^2$$

$$\frac{400000}{150} = \frac{150}{150} V^2$$

$$2{,}666.66 = V^2$$

$$\sqrt{2{,}666.66} = \sqrt{V^2}$$

$$51.63 \text{ m/s} = V$$

$$51.63 \text{ m/s} = V_2$$

PE = 200000 Joules, m = 300 kg, g = 9.81 m/s^2

h_2 = ?

PE = m x g x h_2

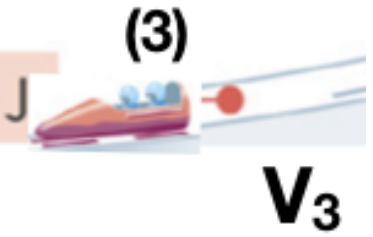
$$200000 = 300 \times 9.81 \times h_2$$

$$200000 = 2{,}943 \times h_2$$

$$\frac{200000}{2{,}943} = \frac{2{,}943}{2{,}943} \times h_2$$

$$67.9 \text{ m} = h_2$$

600 000 J 0 J 600 000 J



Position (3):

KE = 600000 Joules , V_3 = ?

PE = 0 Joules , $h_3 = 0$

Mass of sled and people: **m = 300** kg.

$$\mathbf{KE = 1/2\ m\ V^2}$$

$$600000 = 1/2 \times 300\ V^2$$

$$600000 = 150\ V^2$$

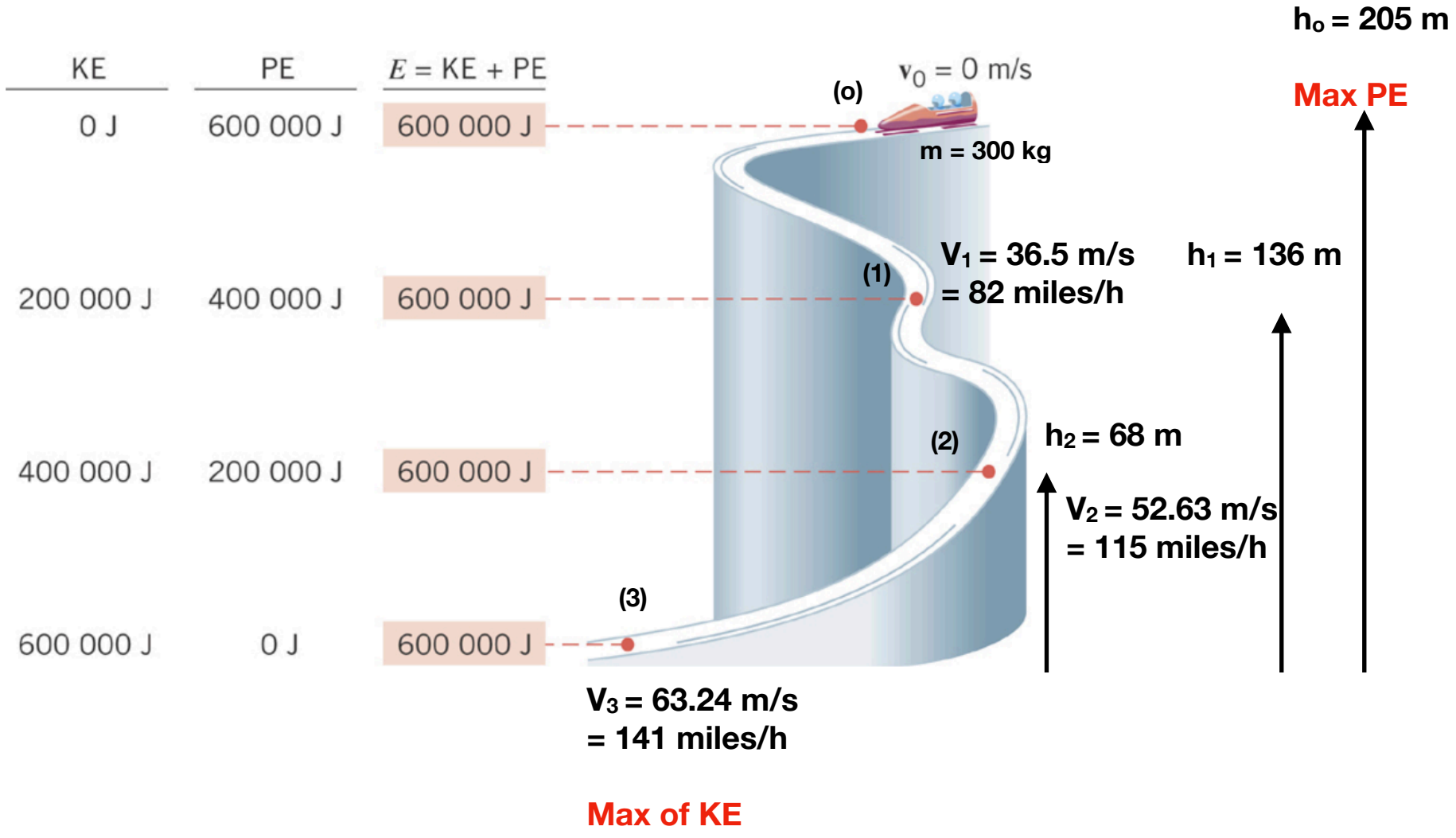
$$\frac{600000}{150} = \frac{150}{150}\ V^2$$

$$4000 = V^2$$

$$\sqrt{4000} = \sqrt{V^2}$$

$$63.24\ \text{m/s} = V$$

$$63.24\ \text{m/s} = V_3$$


h_o = 205 m
Max PE
KE
PE
E = KE + PE
0 J
600 000 J
600 000 J
v_0 = 0 m/s
(o)
m = 300 kg
200 000 J
400 000 J
600 000 J
(1)
V_1 = 36.5 m/s
= 82 miles/h
h_1 = 136 m
400 000 J
200 000 J
600 000 J
(2)
h_2 = 68 m
V_2 = 52.63 m/s
= 115 miles/h
(3)
600 000 J
0 J
600 000 J
V_3 = 63.24 m/s
= 141 miles/h
Max of KE