PHYS 1901 – Physics 1A (Advanced)
Mechanics module

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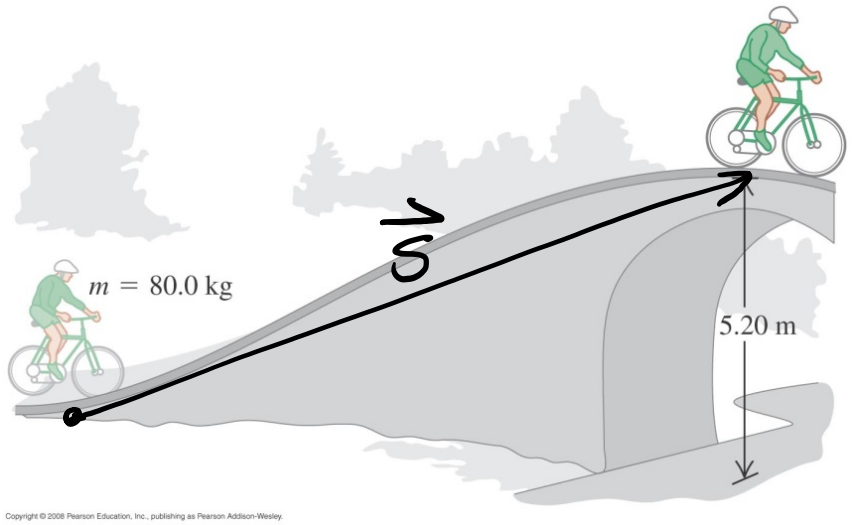
Problem 6.73



Speed at base: 5.00 m/s Speed at top: 1.50 m/s

Ignore any inefficiencies (e.g. energy lost to heat)

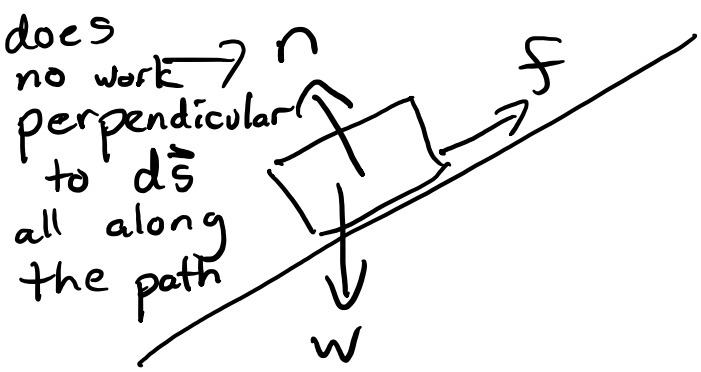
a) What is the total work done on you and your bike?

b) How much work have you done?

a) $W_{total} = \Delta K = K_f - K_i = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$

$= -910\ J$

b) $W_{total} = -910\ J = \cancel{W_n}^{\,0} + W_g + W_f$



$W_g = \vec{w} \cdot \vec{s} = -(80.0\,kg)(9.8\,m/s^2)(5.20\,m)$

$= -4077\ J$

$W_f = 3167\ J$

Chapter

7

Potential Energy and Energy Conservation

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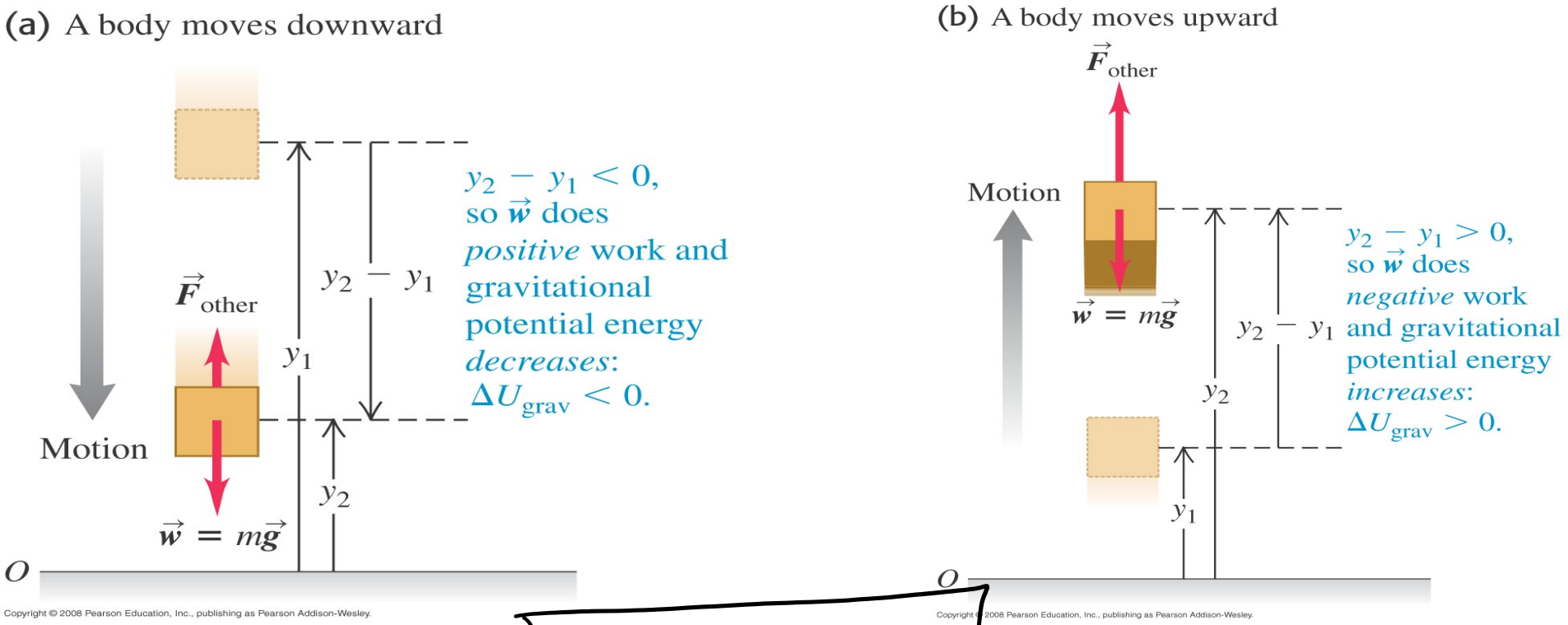
Gravitational Potential Energy



$W_g > 0$

Potential energy is being used

$\Delta U_g + W_g = 0$

$W_g < 0$

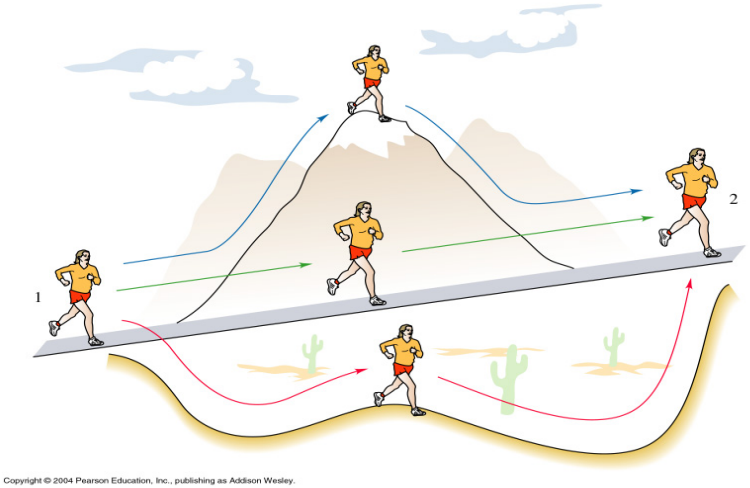
Energy is being stored as potential energy

Potential Energy

So, the energy extracted by gravity is somehow stored in the gravitational field.

Using conservation of energy, we can define the change in **gravitational potential energy** to be

As well as putting energy into the gravitational field, we can extract it; the force is **conservative**



The change in gravitational potential is the same for each.

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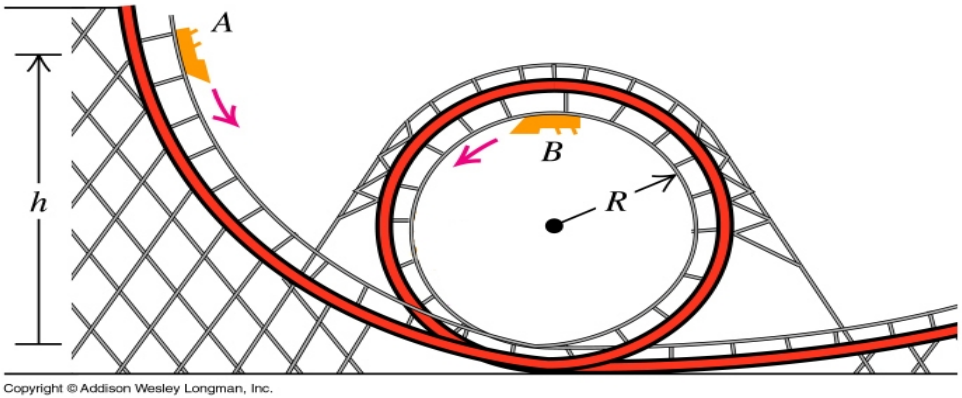
Conservative forces

- Energy depends only on the difference between the initial and final states
- Independent of the path
- Reversible
- If start point and end point are the same, then the work done is zero
- Can define a potential energy function

Conservative forces allow energy storage!

Example



A cart at rest is released from a height h and slides down a friction less track. It encounters a loop of radius R.

What is its velocity at the top of the loop? (Assume the cart is fixed to the track).

What happens if we consider friction?

Initial: A
Final: B

$$W_g = -\Delta U_g$$
$$= -mg\Delta h$$
$$= -mg(h_B - h_A)$$
$$= -mg(2R - h)$$
$$= mg(h - 2R)$$

$$\Delta U = mg\Delta h$$

W-E theorem

$$\Delta K = W_g$$
$$K_B - K_A = W_g = mg(h-2R)$$

$$\frac{1}{2}mv_B^2 = mg(h-2R)$$
$$v_B = \sqrt{2g(h-2R)}$$
(left)