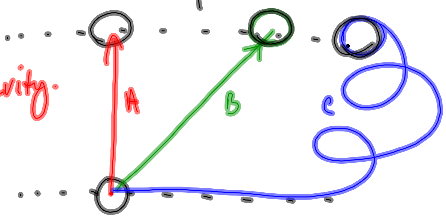
Chapter 7 - Conservation of Energy + Momentum

Conservative force - the path does not matter

example: gravity



All three paths require the same amount of work since the change in gravitational potential energy is the same in each case

Non-Conservative force - the path matters!

example: friction

§7.1 Energy Transformations

Consider a falling rock: ↓

	$E_g = 100\,J$	$E_k = 0\,J$	$E_{total} = 100\,J$
	$E_g = 70\,J$	$E_k = 30\,J$	$E_{total} = 100\,J$
	$E_g = 35\,J$	$E_k = 65\,J$	$E_{total} = 100\,J$
ref level	$E_g = 0\,J$	$E_k = 100\,J$	$E_{total} = 100\,J$

As the rock falls F_g does work which cause the kinetic energy to increase.

As the potential energy decreases, the kinetic energy increases and the total energy stays the same (neglecting air resistance.... a non-conservative force)

This is referred to as the Law of Conservation of Energy

$$E_{total} = E'_{total}$$

(before) (after)

Mechanical →

$$E_g + E_e + E_k = E'_g + E'_e + E'_k$$

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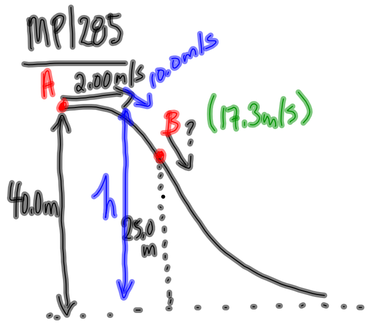


frictionless

a) $V_B = ?$ at 25.0m

b) $h_c = ?$ if $v = 10.0$ m/s

$$E_{total} = E'_{total}$$

A B

$$E_{g_A} + E_{k_A} = E_{g_B} + E_{k_B}$$

$$mgh_A + \frac{1}{2}mv_A^2 = mgh_B + \frac{1}{2}mv_B^2$$

$$(9.81\,m/s^2)(40.0\,m) + \frac{1}{2}(2.00\,m/s)^2 = (9.81\,m/s^2)(25.0\,m) + \frac{1}{2}v_B^2$$

$$392.4\,\frac{m^2}{s^2} + 2.00\,\frac{m^2}{s^2} = 245.25\,\frac{m^2}{s^2} + \frac{1}{2}v_B^2$$

$$149.15\,\frac{m^2}{s^2} = \frac{1}{2}v_B^2$$

$$298.3\,\frac{m^2}{s^2} = v_B^2$$

a) $v_B = 17.3$ m/s

b) $E_{total} = E'_{total}$

A C

$$E_{g_A} + E_{k_A} = E_{g_C} + E_{k_C}$$

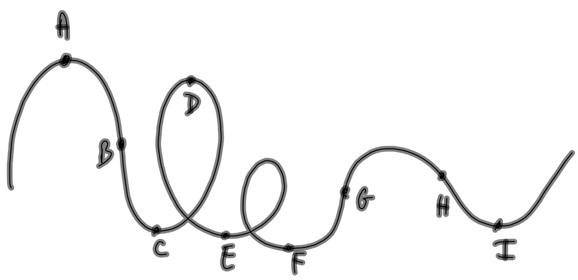
$$mgh_A + \frac{1}{2}mv_A^2 = mgh_C + \frac{1}{2}mv_C^2$$

$$(9.81\,m/s^2)(40.0\,m) + \frac{1}{2}(2.00\,\frac{m}{s})^2 = (9.81\,m/s^2)h_c + \frac{1}{2}(10.0\,m/s)^2$$

$$394.4\,\frac{m^2}{s^2} = (9.81\,m/s^2)h_c + 50.0\,\frac{m^2}{s^2}$$

$$344.4\,\frac{m^2}{s^2} = (9.81\,m/s^2)h_c$$

b) $h_c = 35.1$ m



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