Michael Jackson's Antigravity Claim
US patent 5255452

\[ \theta \approx 40^\circ - 45^\circ \]
\[ m_{MJ} = 60 \text{kg} \]

According to telegraph.co.uk
A UK shoe size: 9
(Europod: 43)
So \( L \approx 295 \text{mm} - 300 \text{mm} \)

Estimate the magnitude of the force that the belt must provide so that Michael does not fall down:

PS: Remember he has two shoes. (But does each shoe have the bolt latch system?)

---

Tight rope walker Nik Wallenda walks over the Niagara Falls & the Grand Canyon. There are 6 sets etc. How does he manage? Why does he hold a long pole while walking? (Lowers his center of gravity, increases his moment of inertia.) We also open our arms while walking on a tight line, like the side of a curb etc.

---

Elastic Properties of Solids

\[ \text{stress} = \text{force per unit area} \quad \text{N/m}^2 = \text{Pascal} \]

- Breaking point
- Elastic limit
- Proportional limit
- Yield strength
- Plastic deformation

\[ \text{strain} = \text{amount of deformation normalized to the size of the object} \]

- \( \text{Young's Modulus} \)

\[ E = \frac{\text{Tensile stress}}{\text{Tensile strain}} = \frac{F/Ai}{\Delta x/L} \]

Note that the force is proportional to the displacement (similar to \( F = -kx \)); Generalized Hooke's Law.

- \( \text{Shear Modulus} \)

\[ \Delta x \rightarrow \text{horizontal distance that the sheared surface moves} \]
\[ \text{tangential force applied on the surface} \]

\[ G = \frac{\text{Shear stress}}{\text{Shear strain}} = \frac{F/A}{\Delta x/h} \]

- \( \text{Bulk Modulus} \)

\[ k = \frac{-\Delta P}{\Delta V/V_i} = \frac{-P}{\text{V}_i} \]

For homogenous isotropic linear materials experiencing elastic deformation, we can relate \( E, G, k \):

\[ \frac{3}{E} = \frac{3}{G} + \frac{1}{k} \]

Ex/When water freezes, it expands about 9%. (come back to this example when discussing buoyancy of ice in water!) What would be the pressure of ice inside an engine block if the water in it froze? \( k = 2.2 \text{GPa} \) (Actually there are many forms of ice & the bulk modulus can be higher. For ex. for ice 4th at -20°C, \( k = 8.9 \text{GPa} \).)

\[ \Delta P = k \cdot \frac{\Delta V}{V_i} = -2.2 \text{GPa} \cdot -0.09 \text{Vig} \approx 180 \text{MPa} \]

\[ \Rightarrow \text{So we get about 1800 atm. Better not forget to add the antifreeze!} \]

---

Gravitation

In Aristotelian physics:
- No motion/without effect without cause.
- Newton's law
- Nature of element "Earth" is to go towards the center of the universe.

- \( \text{Vitruvius}, \text{vol. 7} \) of \( \text{De Architectura} \):

  - Huge stone
  - Tiny piece of gold

Vitruvius's conclusion: gravity depends not on weight, but on the nature of substance.

---

Galileo \( \rightarrow \) Kepler

- "Thought exp. with balls falling from Pisa tower."

Tycho Brahe's data (from 1581 to 1600)

- \( \text{G.Borghi Riccioli} \)

- Launched experiments (1651)

- dist. traveled: 1, 3, 5, 7, 9...

---

phys 102

veo, summer 2013