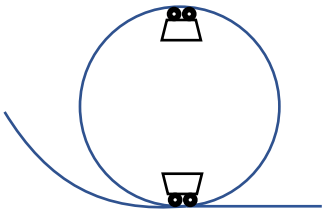
CONCEPT: VERTICAL CENTRIPETAL FORCES

● For Circ. Mo. problems in the *vertical* plane, **mg** pulls obj's downwards, so speed is **[CONSTANT | NOT CONSTANT]**

EXAMPLE**:** You're sitting in a rollercoaster as it goes in a vertical loop of radius 10m**.** Your mass is 70kg**.** At the bottom of the loop, your speed is 30m/s**.** At the top of the loop, your speed is 20m/s**.** Calculate the centripetal acceleration and the normal force from the seat on you when you are at the **a)** bottom of the loop and **b)** top of the loop**.**



CENTRIPETAL FORCES

1) Draw FBD
2) Write $\Sigma F_c = ma_c$
(rewrite $a_C \Rightarrow v^2/R$)
3) Solve

Circ. Motion / Centripetal Forces

$$a_C = \frac{v_T^2}{R} = \frac{4\pi^2 R}{T^2} = 4\pi^2 R f^2$$

$$T = \frac{1}{f} \Leftrightarrow f = \frac{1}{T}$$

$$v_T = \frac{C}{T} = \frac{2\pi R}{T} = 2\pi R f$$

● There are also "rules" to determine signs of Centripetal Forces**:**

- Forces pointing *towards* center are **[+ | – | 0]**
- Forces pointing *away* from center are **[+ | – | 0]**
- Forces pointing perpendicular (**90°**) to the direction to center are **[+ | – | 0]**

PROBLEM: Suppose a 1,800-kg car passes over a bump in a roadway that follows the arc of a circle of radius 20m. What force does the road exert on the car as the car moves over the top of the bump if the car moves at a constant 9 m/s?

A) 10350N
B) 24930N
C) 17640N
D) 16830N

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$$T = \frac{1}{f} \Leftrightarrow f = \frac{1}{T} = \frac{\text{RPM}}{60}$$

$$v_T = \frac{C}{T} = \frac{2\pi R}{T} = 2\pi R f$$