Vertical Circular Motion with a Surface

IB PHYSICS | CIRCULAR MOTION

IB Physics Data Booklet

Sub-topic 6.1 – Circular motion

$$v = \omega r$$

$$a = \frac{v^2}{r} = \frac{4\pi^2 r}{T^2}$$

$$F = \frac{mv^2}{r} = m\omega^2 r$$

v – linear velocity (m s^{-1})

ω – angular velocity (rad s^{-1})

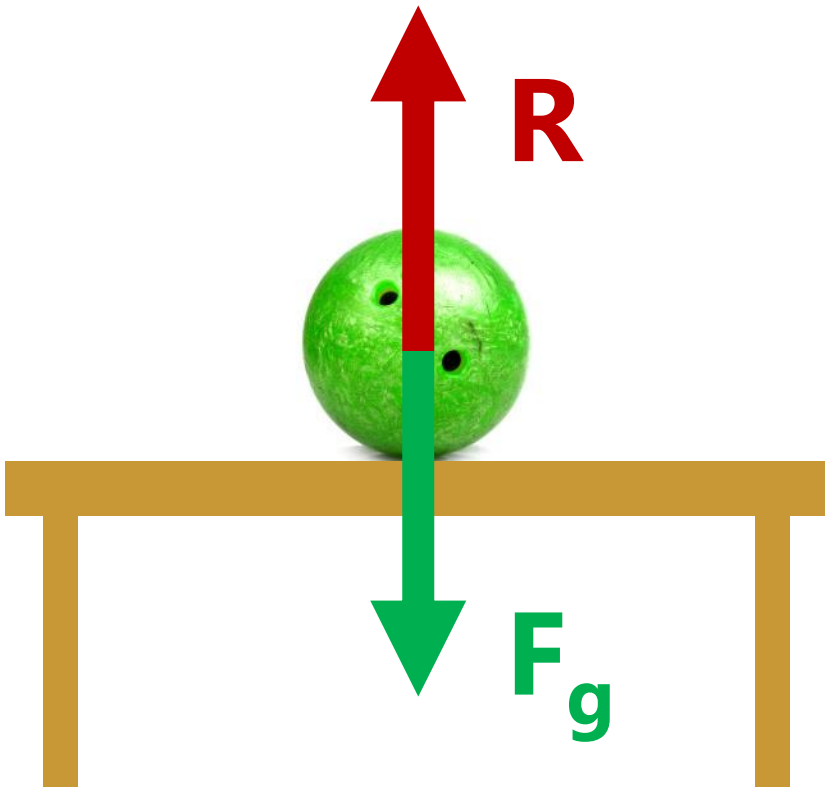
r – radius (m)

T – period (s)

a – centripetal acceleration (m s^{-2})

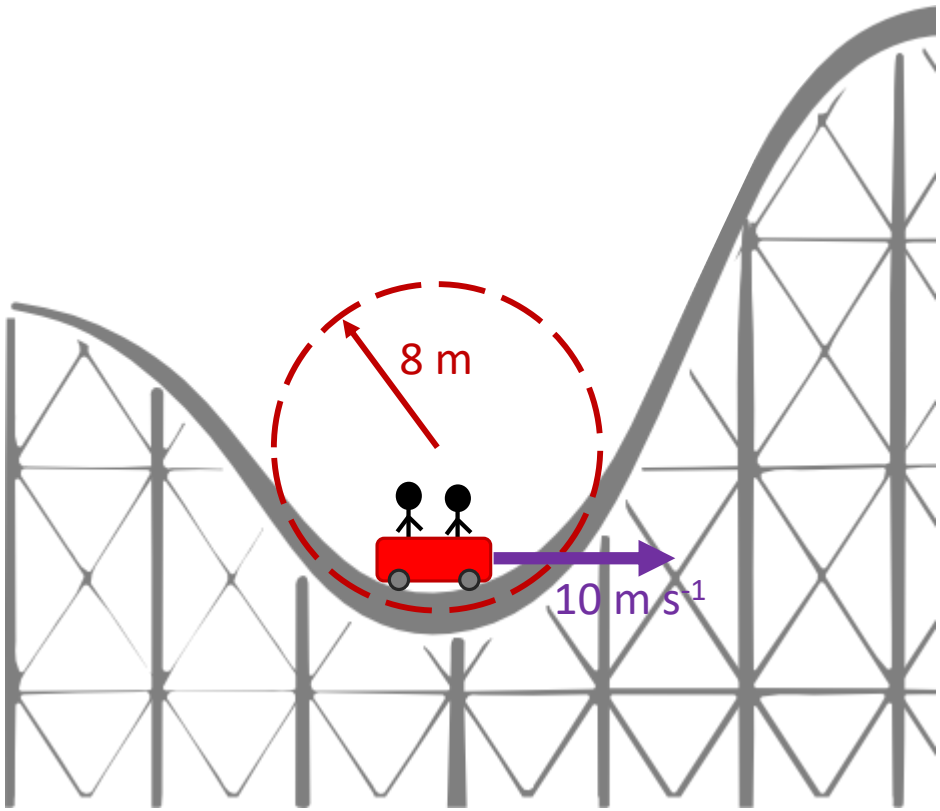
F – centripetal force (N)

Remember Normal Reaction Force?



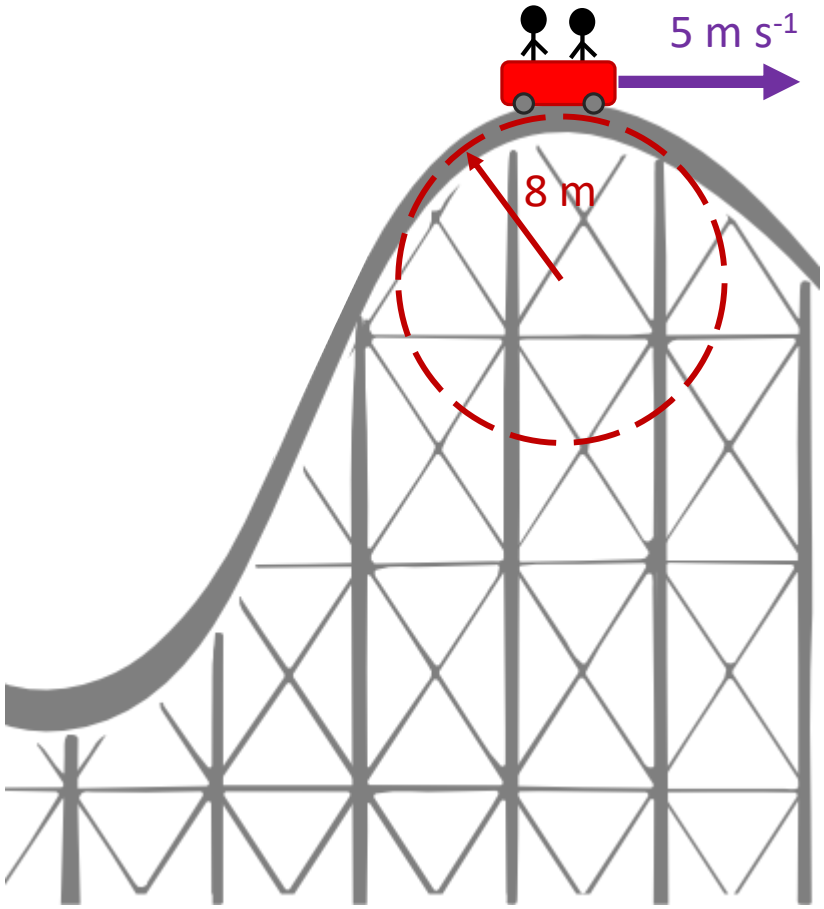
*Always perpendicular to the surface applying the force

Roller Coaster | Bottom



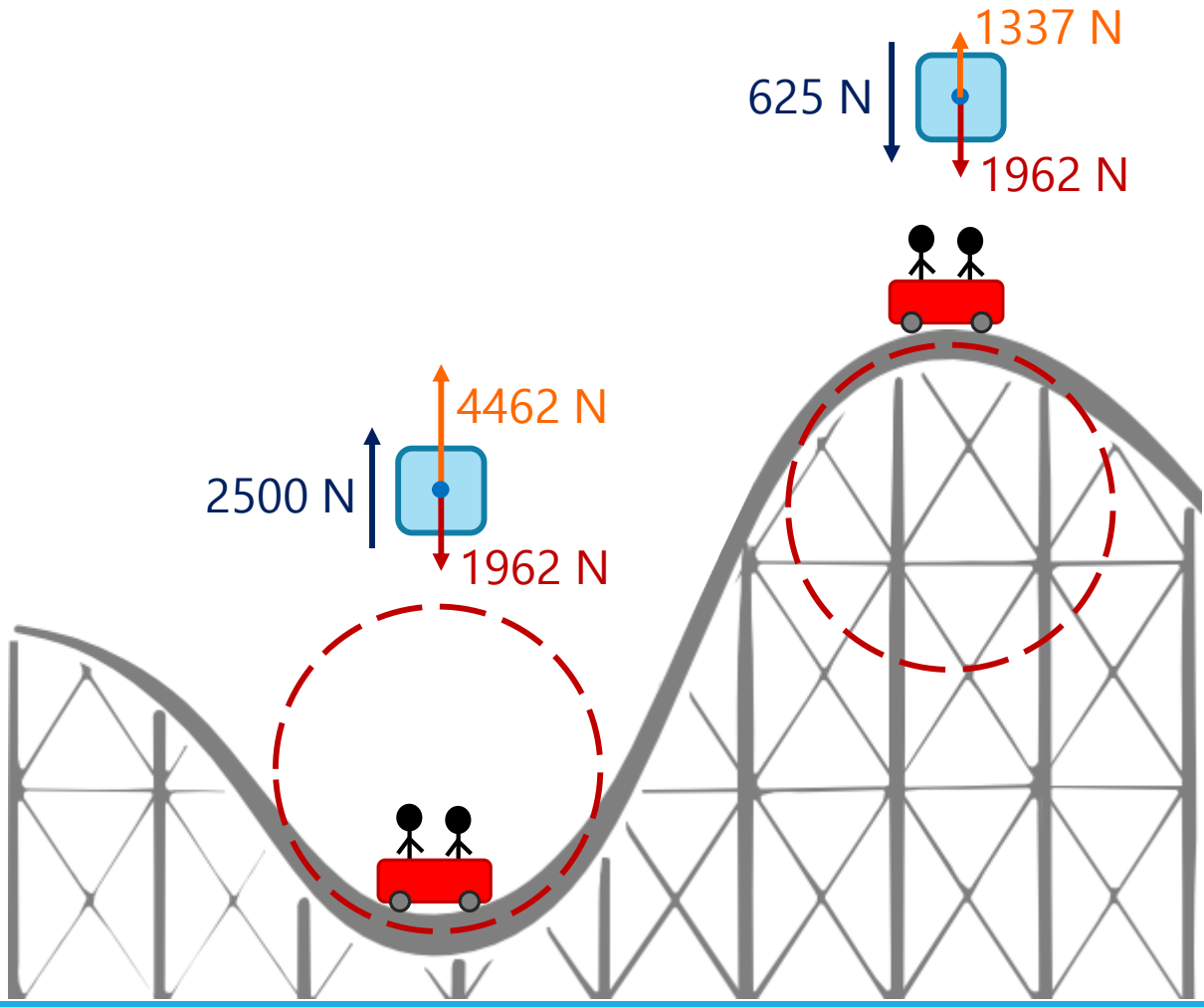
m	200 kg
v	10 m s^{-1}
r	8 m
F_c	
F_{net}	
F_g	
R	

Roller Coaster | Top

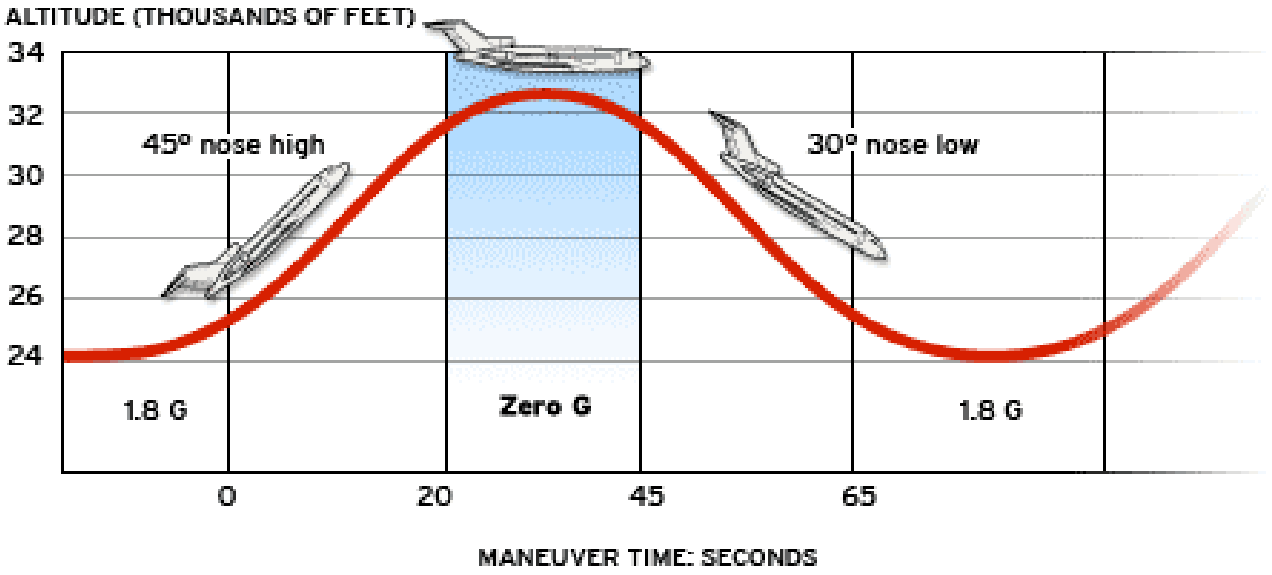


m	200 kg
v_t	5 m s^{-1}
r	8 m
F_c	
F_{net}	
F_g	
R	

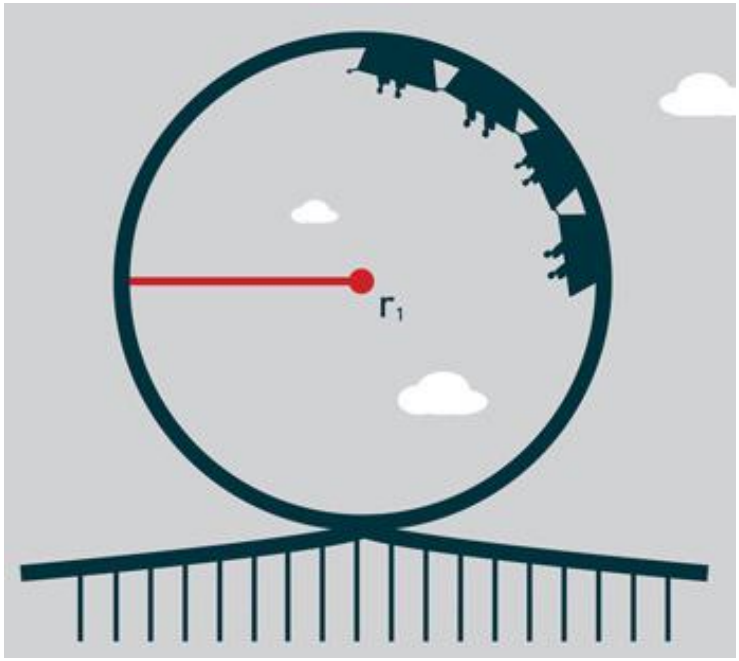
Perceived Weight



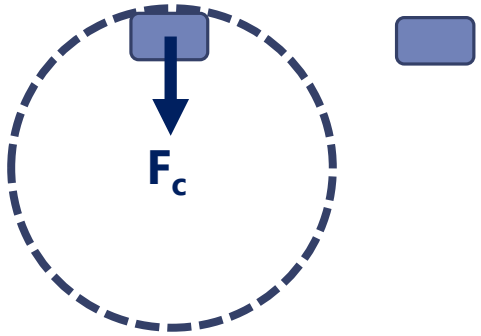
The ultimate “weightless” experience



Loop the Loop!



The velocity needs to be fast enough that the R is greater than 0 N



Minimum velocity required =

Lesson Takeaways

- ❑ I can compare the forces on an object at different positions in vertical circular motion
- ❑ I can determine the magnitude and direction of the forces needed for the overall centripetal force
- ❑ I can qualitatively describe how normal reaction force changes in a vertical circle
- ❑ I can describe the experience of “weightlessness” in terms of normal reaction force