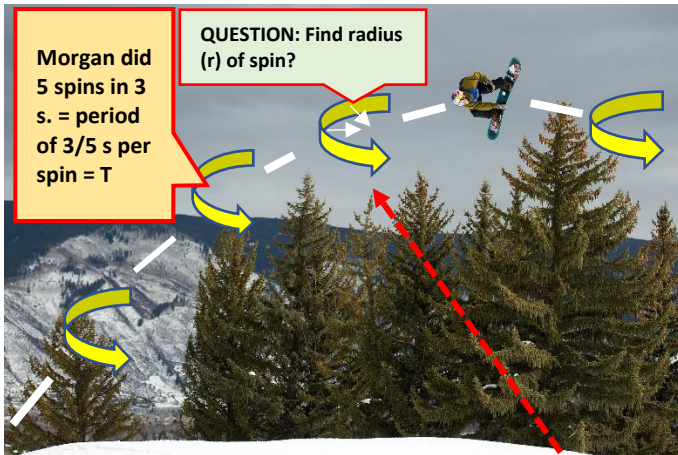


CENTRIPETAL ACCELERATION

Unit 13, Dr. John P.

Cise, Professor of Physics, Austin Com. College, NRG Campus, Austin Tx. jpcise@austincc.edu & New York Times, January 26, 2017, by Matt Higgins. Application dedicated to my HS (Roger Bacon, St. Bernard Ohio) math teacher, Father Lucian

Snowboarders Resist Making Big Air All About the Latest Trick



Morgan did 5 spins in 3 s. = period of 3/5 s per spin = T

QUESTION: Find radius (r) of spin?

INTRODUCTION: A quadruple (5) spins has been done by a snowboarder. The five spins were done over 3 seconds of flight off a jump(see left). The article mentions that 4 g's ($4 \times 32 \text{ ft./s.}^2 = 128 \text{ ft./s.}^2$) of centripetal acceleration were experienced by snowboarder.

QUESTIONS: (a) Find ave. radius of the snowboarder's body while spinning?, (b) Does answer seem reasonable?

HINTS: $a_{\text{CENTRIPETAL}} = V^2/r$, $V = r\omega = r 2\pi f = r 2\pi/T$, thus $a = 4\pi^2 r / T^2$, where T = period (time for one spin or rev.)

ANSWERS: (a) $r = \sim 1.167 \text{ ft.}$ or $\sim 14 \text{ inches.}$

(b) You can see in the picture the snowboarder grabs the snowboard and does indeed reduce his radius (in this case to 14 inches) to decrease his moment of inertia, which causes him to spin more.....

$$I_1 \omega_1 = I_2 \omega_2 \quad \text{Angular momentum conservation}$$

Mark McMorris of Canada hit a backside triple cork 1440 in the men's snowboard slopestyle event at the 2016 Winter X Games last January in Aspen, Colo.

It was a shot across the bow, and the snowboarder Billy Morgan played the part of cannonball, wearing all black while tucking and somersaulting through the air more than 100 feet from a specially constructed jump made of snow at a resort in Livigno, Italy. This was in **April 2015, when Morgan, of Britain, landed a backside quadruple cork 1800, a marvel of physics and rotational forces consisting of four off-axis back flips and (((five spins compressed into three seconds of hang time.)))** Video of [Morgan somersaulting through the air](#) went viral on social media. **No snowboarder had ever landed a(((quadruple)))... (5) flips, and it signaled an escalation in the difficulty of maneuvers leading up to the debut of big air, the newest snowboarding discipline at the Winter Olympics next year.** Within seven months, two more riders — Max Parrot, of Canada, and Marcus Kleveland, of Norway — landed their own versions of a quad cork for cameras. This year, the field includes Kleveland, but not Morgan. If a rider attempts a quad, the trick will be doing so with grace. In [a segment for ESPN's "Sport Science,"](#) the host, John Brenkus, demonstrated how **Parrot's quad flip required approaching a jump at more than 50 miles an hour, and generated(((four g's of centripetal acceleration)))while spinning — equivalent to the most extreme amusement park rides — and resulted in a half-ton of force upon landing. "A bigger spin, say, an 1800, you have to throw it so hard,** and get the grab and hold, that you don't have as much time to put your style, or personal stamp, on the trick," Mike Jankowski, the head coach of the United States snowboarding team, said. "The best riders will stand out having that unique personal stamp on the trick."