

ave. = 7.0
 $\sigma = 2.1$

Quiz #6: Dynamics II: Motion Along a Plane

Problem 1 (1.5 points)

A stone is tied to a 0.50-m string and whirled at a constant speed of 4.0 m/s in a vertical circle. Its acceleration at the top of the circle is:

- a) 9.8 m/s², up
- b) 9.8 m/s², down
- c) 8.0 m/s², down
- d) 32 m/s², up
- e) 32 m/s², down

$$a = \frac{v^2}{r} = \frac{(4.0 \text{ m/s})^2}{0.50 \text{ m}} = \underline{32 \text{ m/s}^2}$$

↓ direction is towards center

E

Problem 2 (1.5 points)

A car goes around a curve of radius r at a constant speed v . Then it goes around a curve of radius $2r$ at speed $2v$. What is the centripetal force on the car as it goes around the second curve, compared to the first?

- a) four times as big
- b) twice as big
- c) one-half as big
- d) one-fourth as big
- e) the same

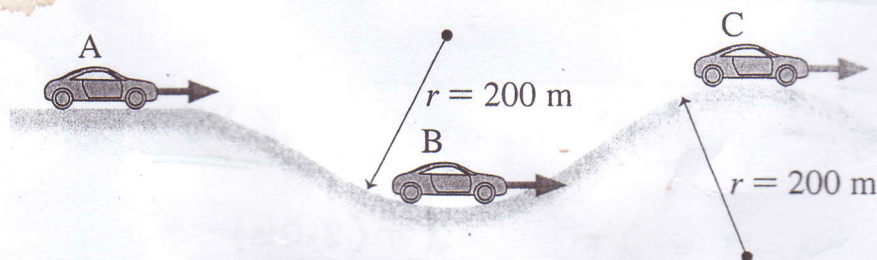
$$a = \frac{v^2}{r} \quad a' = \frac{(2v)^2}{(2r)} = 2 \frac{v^2}{r} = 2a$$

⇒ acceleration doubles so centripetal force doubles

B

Problem 3 (2 points)

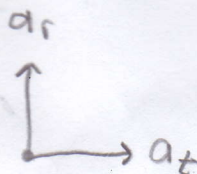
In the figure below, suppose that the car is speeding up as it passes through point B and slowing down as it passes through point C. In what direction does the total acceleration vector point at points B and C? Answer in terms of a quadrant (I, II, III, or IV) and justify your answer.



© 2017 Pearson Education, Inc.

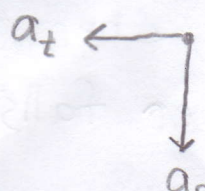
a) Point B:

Quadrant I



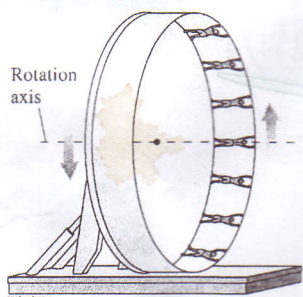
b) Point C:

Quadrant III



Problem 4 (5 points)

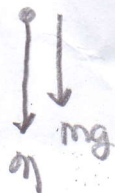
In an amusement park ride called The Roundup, passengers stand inside a 16-m-diameter rotating ring. After the ring has acquired sufficient speed, it tilts into a vertical plane, as shown in the figure below. (a) Suppose the ring rotates once every 4.5 s. If a rider's mass is 55 kg, what is the normal force on the rider at the top of the ride? (b) What is the longest period the ring can have without the riders falling off at the top?



$$\left. \begin{array}{l} r = 8.0\text{m} \\ T = 4.5\text{s} \end{array} \right\} v = \frac{2\pi r}{T} = \frac{2\pi(8.0\text{m})}{4.5\text{s}}$$

$$v = \underline{\underline{11.17\text{m/s}}}$$

(a)



define down as +:

$$\sum F_y = ma_y = mv^2/r$$

$$n + mg = mv^2/r \rightarrow n = m(v^2/r - g)$$

$$n = (55\text{kg}) \left[\frac{(11.17\text{m/s})^2}{8.0\text{m}} - 9.80\text{m/s}^2 \right]$$

$$n = \underline{\underline{319\text{N}}} \rightarrow \boxed{n = 3.2 \times 10^2\text{N}}$$

$$(b) v_{\text{critical}} = \sqrt{rg} = \sqrt{(8.0\text{m})(9.80\text{m/s}^2)} = \underline{\underline{8.85\text{m/s}}}$$

$$v = 2\pi r/T \rightarrow T = \frac{2\pi r}{v} = \frac{2\pi(8.0\text{m})}{8.85\text{m/s}}$$

$$\boxed{T = 5.7\text{s}}$$

↓ if $T > 5.7\text{s}$, then $v < v_{\text{critical}}$ and then $n = 0$ and rider falls off ☹️.

Extra Credit: if $T > 5.7\text{s}$, give