

First Name: _____

Last Name: _____

L12 - FQ - Circular Motion (Vertical Systems)

Q1: A bicycle of mass 12kg holds a 60kg passenger. If the bicycle is going to make a vertical loop of diameter 8m, what is the minimum speed the bicycle must be travelling? (3 marks)

$$m = 72 \text{ kg}$$

$$r = 4 \text{ m}$$

At top 0 @ minimum speed

$$\downarrow F_c = \downarrow F_g (+ \nearrow F_N)$$

$$\frac{mv^2}{r} = mg$$

$$\frac{v^2}{(4)} = (9.81)$$

$$v^2 = 39.24$$

$$v = \boxed{6.26 \text{ m/s}}$$

Q2: The same bicycle and passenger can achieve a maximum speed of 8m/s. What is the optimal vertical loop radius they can transverse successfully, without having any normal force contribution?

(3 marks)

$$m = 72 \text{ kg}$$

$$v = 8 \text{ m/s}$$

$$r = ?$$

At top 0

$$\downarrow F_c = \downarrow F_g (+ \nearrow F_N)$$

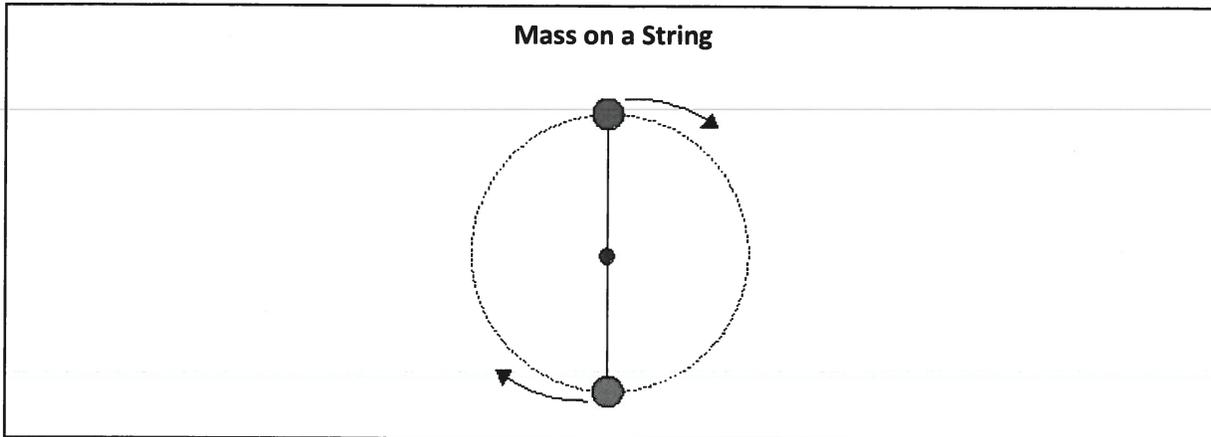
$$\frac{mv^2}{r} = mg$$

$$v^2 = rg$$

$$\frac{v^2}{g} = r$$

$$r = \frac{(8)^2}{9.81} = \boxed{6.52 \text{ m}}$$

Use the following information to answer Q3:



Q3: If a mass on a string is swung in a vertical loop, as depicted above, then the tension in the string will be greatest when the string is

- a. Vertical, and the mass is at the top of the circle.
- (b)** Vertical, and the mass is at the bottom of the circle.
- c. Horizontal, and the mass is on the far left side of the circle.
- d. Horizontal, and the mass is on the far right side of the circle.

Q4: If the mass is 0.018kg and swung at 14m/s in a vertical circle of 80cm radius, what is the tension in the rope when the mass is directly above the center of the circle?

(Record your **three-digit** answer in the Numerical Response boxes below)

4	.	2	3
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$m = 0.018 \text{ kg}$
 $v = 14 \text{ m/s}$
 $r = 0.80 \text{ m}$

At top
 $\downarrow F_c = \downarrow F_g + \downarrow F_N$

\uparrow
 \downarrow
 $+$

$\frac{mv^2}{r} = mg + F_N$
 $\frac{(0.018)(14)^2}{(0.80)} = (0.018)(9.81) + F_N$

$4.41 = 0.17658 + F_N$

$4.23342 = F_N$

$F_N \approx 4.23 \text{ N}$

MARKING:

Beginning	0	-	3.5
Progressing	4	-	5.5
Competent	6	-	7
Exemplary	7.5	-	8