Name: _____ Class: _____ Date: _____ ID: A

Preliminary Quiz 5: Rotational Forces and Gravitation

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____ 1. A blue sphere and a red sphere with the same diameter are released from rest at the top of a ramp. The red sphere takes a longer time to reach the bottom of the ramp. The spheres are then rolled off a horizontal table at the same time with the same speed and fall freely to the floor. Which sphere reaches the floor first?

a. The red sphere
b. The blue sphere
c. The sphere with greater mass
d. Neither; the spheres reach the floor at the same time.

$F = ma$

____ 2. What is the acceleration due to gravity at a location where a 15kg mass weighs 45Newtons.

a. $675 m/s^2$ b. $9.81 m/s^2$ c. $3.00 m/s^2$ d. $0.333 m/s^2$

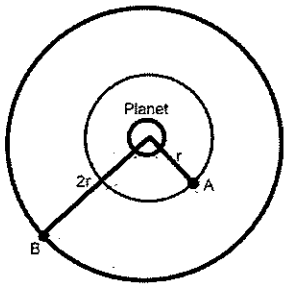
$\frac{F}{m} = a \quad \frac{45}{15} = 3$

____ 3. A 2.0kg object is falling near earths surface. What is the magnitude of Earth's gravitational force that the earth exerts on the object.

a. 20N b. 2.0N c. 0.20N d. 0.0N

$2 \cdot 9.8 = 20$

____ 4.



$F = \frac{GMm}{r^2}$ ↖ $2^2 = \frac{1}{4}$

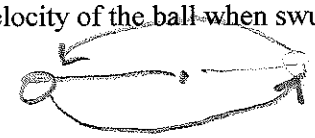
Compared to the magnitude of the gravitational force of attraction between satellite A and the planet, the magnitude of the gravitational force of attraction between satellite B and the planet is

a. half as great
b. twice as great
c. 1/4 as great
d. 4 times as great

____ 5. Bobby is holding a string (length L) that is hooked to the end of a weight (m). Bobby is having to pull with a force of F while swinging the ball in a horizontal circle. In terms of the variables provided, which of the following would accurately describe the constant velocity of the ball when swung around a circle horizontally.

a. $\sqrt{\frac{F_c r}{m}} = v$

b. $\sqrt{m\omega r} = \text{velocity}$



c. $m\omega r = \text{velocity}$

d. $ma_c r = \text{velocity}$

$\frac{mv_t^2}{r} = F_c$

$\sqrt{\frac{rF_c}{m}} = v_t$

____ 6. Which of the following best describes the acceleration of an object traveling in a circle at constant speed.
a. The acceleration is constant do to the constant speed.
b. The angular acceleration is constant but the acceleration centripetal is pulling inward
c. The angular acceleration is constant but the acceleration centripetal is pushing outward.
d. It is impossible to travel in a circle and have constant velocity because the direction is also a component that is changing. .

$10 \cdot 20 = \sqrt{200} = 14.1$

____ 7. A 1500kg car is traveling over a hill with a 20m radius. What is the minimum velocity for the car to experience zero force normal ~~or for~~ the car to become airborne.
a. 10m/s b. 14m/s c. 14m/s d. 20m/s

$mg = \frac{mv^2}{r}$ $\sqrt{gr} = v$

____ 8. A 3000kg truck is following behind the 1500kg car as it travels over the hill of 20m radius. How will the trucks Force normal be different then the car's?
a. The will be the same. The mass is not a determining factor.
b. The truck will need to go twice as fast to equal zero force normal.
c. The truck would need to go 1/2 the speed to accomplish zero force normal.
d. The truck would need to go 4 times faster to achieve the same zero force normal.

____ 9. Bill is walking across a rickety wooden bridge over a creek. Bill is afraid the bridge is going to break, which of the following is true?
a. If he stands a little ways on the bridge and it holds, it will likely hold as he walks across due to his force being constant.
b. If he makes it half way cross he is likely to make it the rest of the way due to his constant gravitational torque
c. If he stands a little ways on the bridge and it holds, it will likely hold as he walks across due to maximum constant net torque.
d. If he makes it half way cross he is likely to make it the rest of the way due bridge holding his maximum torque.

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Short Answer

10. A 300kg bumper car travels around the end of a track in a 10m radius at 9.0m/s.
Calculate the following

$V_t = \omega r$ $V_t = \frac{\theta r}{t}$

a. Angular velocity: $\frac{\Delta\theta}{\Delta t} = \omega$ ⌓ = 180° or π radians $\frac{V_t}{r} = \omega$ $\frac{9.0}{10} = 0.9\frac{\theta}{s}$

b. angular acceleration:: Zero, assume constant

c. centripetal acceleration: $\frac{V_t^2}{r} = a_c$ $\frac{9^2}{10} = \frac{81}{10} = 8.1\ m/s^2$

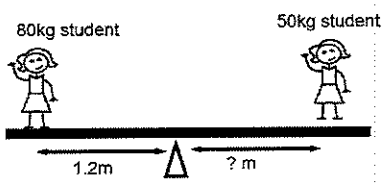
d. Centripetal force: $\frac{mV_t^2}{r} = F_c$ $\frac{300 \cdot 9^2}{10} = 2430.\ N$

e. Force of friction $F_f = F_c$ 2430N

f. Frequency and period or rotation. $\omega^2 r = a_c$ $\frac{\theta^2}{t^2} r = a$ $\frac{2\pi^2}{t^2} = a_c$

$\sqrt{\frac{4\cdot\pi^2}{8.1}} = 2.2\ sec$ freq = $\frac{1}{2.2}$ $\sqrt{\frac{4\pi^2}{a_c}} = T$

11.



Calculate the distance needed for the two students to balance on the teeter totter.

$F_t = F_t$

$F_r = F_r$

$mg \cdot r = mgr \rightarrow \frac{m_1 g r}{m_2} = r$

$\frac{80 \cdot 1.2}{50} = 1.92m$

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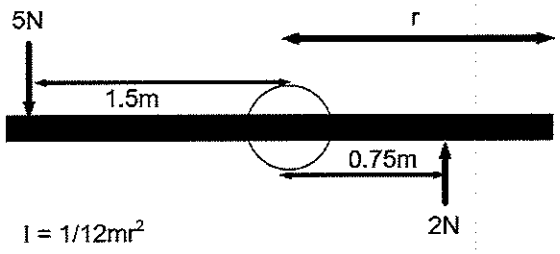
12.



A solid wood door with a mass of 50kg is attached to a hinge in the middle and 2 forces are applied. The rod has a total length of 3.5m long.

a. Calculate the torque of each force. $5 \cdot 1.5 = 7.5\ N \cdot m$ $2 \cdot .75 = 1.5\ N \cdot m$

b. What is the net torque on the rod? $7.5 + 1.5 = 9.0\ N \cdot m$

c. What is the moment of inertia of the rod? $\frac{1}{12} \cdot 50 \cdot 1.75^2 = 12.7$

d. What is the angular acceleration of the rod? $\Sigma T = I\alpha$ $\frac{\Sigma T}{I} = \alpha$ $\frac{9.0}{12.7} = 0.70\ rad/s^2$

e. How long would it take the rod to make 5 revolutions? $5 \cdot 2\pi = 10\pi$

$\theta = \theta_0 + \omega t + \frac{1}{2}\alpha t^2$

$10\pi = 0 + 0 + \frac{1}{2}(.7)t^2$

$t = 9.47\ sec$