Key

nysics

Date _____

Test #3 Review

Circles & Gravity

1) A ball attached to a string is whirled around in a horizontal circle having a radius *r*. If the radius of the circle is changed to *4r* and the same centripetal force is applied by the string, the new speed of the ball is which of the following?

A) One-quarter the original speed
B) The same as the original speed
C) One-half the original speed
D) Twice the original speed
E) Four times the original speed

don't know if T stays same

$V = 2\pi r$

$F = \frac{mv^2}{r} = \frac{(1)(1)(4)}{(1)}$

$v = \sqrt{\frac{Fr}{m}} = \sqrt{\frac{(1)(4)}{(1)}} = 2$

2) Mars has a mass 1/10 that of Earth and a diameter 1/2 that of Earth. The acceleration of a falling body near the surface of Mars is most nearly

A) 25 m/s^2
B) 0.5 m/s^2
C) 4 m/s^2
D) 2 m/s^2
E) 0.25 m/s^2

$g = \frac{Gm}{r^2} = \frac{(1)(\frac{1}{10})}{(\frac{1}{2})^2} = \frac{4}{10}$ of Earth

3) If Spacecraft X has twice the mass of Spacecraft Y, then true statements about X and Y include which of the following?

I. On Earth, X experiences twice the gravitational force that Y experiences. $F_g = mg$
II. On the Moon, X has twice the weight of Y. $F_g = mg$
III. When both are in the same circular orbit, X has twice the centripetal acceleration of Y. $a_c = \frac{v^2}{r}$

A) II and III only
B) I, II, and III
C) I only
D) I and II only
E) III only

4) A new planet is discovered that has twice the Earth's mass and twice the Earth's radius. On the surface of this new planet, a person who weighs 500 N on Earth would experience a gravitational force of

A) 2000 N
B) 1000 N
C) 500 N
D) 250 N
E) 125 N

① $g = \frac{Gm}{r^2} = \frac{(1)(2)}{(2)^2} = \frac{1}{2}g$

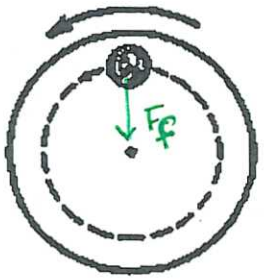
② $F_g = mg = (1)(\frac{1}{2})$

5) If F_1 is the magnitude of the force exerted by the Earth on a satellite in orbit about the Earth and F_2 is the magnitude of the force exerted by the satellite on the Earth, then which of the following is true?

N3L - equal + opposite

A) F_1 is equal to F_2.
B) F_2 is slightly greater than F_1.
C) F_1 is much greater than F_2.
D) F_2 is much greater than F_1.
E) F_1 is slightly greater than F_2.

6) The horizontal turntable shown below rotates at a constant rate.



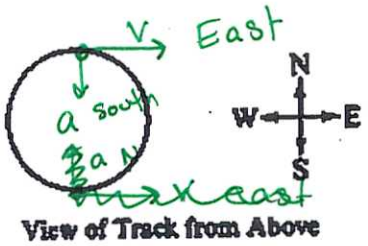
View from Above

As viewed from above, a coin on the turntable moves counterclockwise in a circle as shown. Which of the following vectors best represents the direction of the frictional force exerted on the coin by the turntable when the coin is in the position shown?

F_c points in

A) ↓
B) ↙
C) →
D) ↑
E) ←

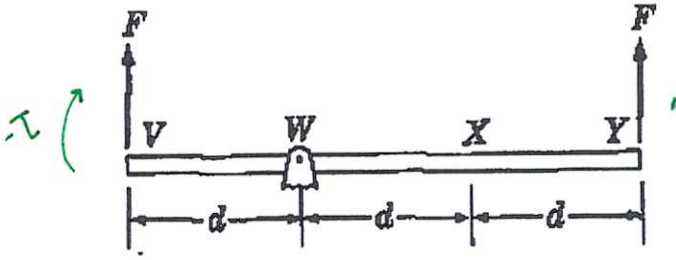
7) A racing car is moving around the circular track of radius 300 meters shown below.



At the instant when the car's velocity is directed due east, its acceleration is directed due south and has a magnitude of 3 meters per second squared. When viewed from above, the car is moving

A) clockwise at 30 m/s
B) ~~counterclockwise~~ at 10 m/s
C) ~~counterclockwise~~ at 30 m/s
D) ~~with constant velocity~~
E) clockwise at 10 m/s

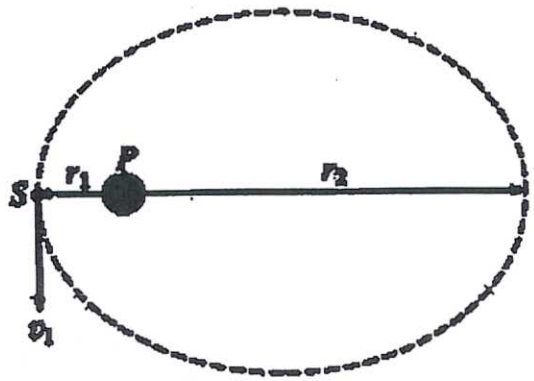
8) A massless rigid rod of length $3d$ is pivoted at a fixed point W, and two forces each of magnitude F are applied vertically upward as shown below.



A third vertical force of magnitude F may be applied, either upward or downward, at one of the labeled points. With the proper choice of direction at each point, the rod can be in equilibrium if the third force of magnitude F is applied at point

A) Y only
B) V or Y only
C) V, ~~W~~, or X
D) ~~W~~ only
E) V or X only

9) A satellite S is in an elliptical orbit around a planet P, as shown below, with r_1 and r_2 being the closest and farthest distances, respectively, from the center of the planet.



If the satellite has a speed v_1 at its closest distance, what is its speed at its farthest distance?

A) $(r_2 - r_1)v_1$
B) $\sqrt{(r_1/r_2)}v_1$
C) $\sqrt{(r_2/r_1)}v_1$
D) $v_1(r_2 - r_1)/(r_1 + r_2)$
E) $\frac{1}{2}(r_1 + r_2)v_1$

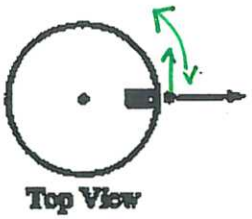
10) A person weighing 800 newtons on Earth travels to another planet with twice the mass and twice the radius of Earth. The person's weight on this other planet is most nearly

A) $800\sqrt{2}$ N
B) 400 N
C) $800/\sqrt{2}$ N
D) 1600 N
E) 800 N

11) An object weighing 4 newtons swings on the end of string as a simple pendulum. At the bottom of the swing, the tension in the string is 6 newtons. What is the magnitude of the centripetal acceleration of the object at the bottom of the swing?

A) 0
B) 2.5g
C) 1.5g
D) g
E) 0.5g

12) A compressed spring mounted on a disk can project a small ball. When the disk is not rotating, as shown in the top view below, the ball moves radially outward.



The disk then rotates in a counterclockwise direction as seen from above, and the ball is projected outward at the instant the disk is in the position shown above. Which of the following best shows the subsequent path of the ball relative to the ground?

A)


B)


C)


D)


E)


↑v circle v launch

→ V launch

13) A child has a toy tied to the end of a string and whirls the toy at constant speed in a horizontal circular path of radius R. The toy completes each revolution of its motion in a time period T. What is the magnitude of the acceleration of the toy?

A) $2\pi g$
B) $\pi R/T$
C) zero
D) $4\pi^2 R/T^2$
E) g

$a_c = \frac{v^2}{r} = \frac{\left(\frac{2\pi r}{T}\right)^2}{r}$

$= \frac{4\pi^2 r^{\not 2}}{T^2 \, r^{\not 2}}$

14) A newly discovered planet has twice the mass of the Earth, but the acceleration due to gravity on the new planet's surface is exactly the same as the acceleration due to gravity on the Earth's surface. The radius of the new planet in terms of the radius R of Earth is

A) $2R$
B) $\frac{1}{2}R$
C) $\sqrt{2}R$
D) $\sqrt{2}/2\,R$
E) $4R$

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

$r = \sqrt{\frac{Gm}{g}} = \sqrt{\frac{(1)(2)}{(1)}} = \sqrt{2}\,R$

15) When a person stands on a rotating merry-go-round, the frictional force exerted on the person by the merry-go-round is

N3L

A) opposite in direction to the frictional force exerted on the merry-go-round by the person.
B) directed away from the center of the merry-go-round.
C) zero if the rate of rotation is constant.
D) independent of the person's mass.
E) greater in magnitude than the frictional force exerted on the merry-go-round by the person.

F_f

μmg or $\frac{mv^2}{r}$ both ha...

16) Each of five satellites makes a circular orbit about an object that is much more massive than any of the the satellites. The mass and orbital radius of each satellite are given below. Which satellite has the greatest speed?

A) mass = $\frac{1}{2}$M; radius = R
B) mass = M; radius = $\frac{1}{2}$R
C) mass = M; radius = 2R
D) mass = M; radius = R
E) mass = 2M; radius = R

$F_g = F_c$

$m_{planet}\frac{Gm}{r^2} = \frac{mv^2}{r}$

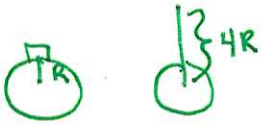
$v = \sqrt{\frac{Gm}{r}}$

↑r ↓v
↓r ↑v

Mobject Cmass

17) An object has weight W when it is on the surface of a planet of radius R. What will be the gravitational force on the object after it has been moved to a distance of $4R$ from the center of the planet?

A) $4\,W$
B) $16\,W$
C) $1/4\,W$
D) $1/16\,W$
E) W



quadruple

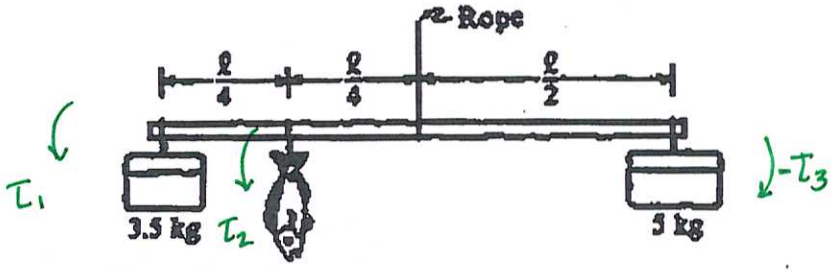
$F_g = \frac{Gmm}{r^2}$

$= \frac{1 \cdot 1 \cdot 1}{(4^2)} = \frac{1}{16}$

18) A car initially travels north and then turns to the left along a circular curve. This causes the package on the seat of the car to slide toward the right side of the car. Which of the following is true of the net force on the package while it is sliding?

A) There is not enough force directed toward the center of the circle to keep the package from sliding.
B) There is not enough force tangential to the car's path to keep the package from sliding.
C) The force is directed north. F points in
D) There is not enough force directed north to keep the package from sliding.
E) The force is directed away from the center of the circle.

19) To weigh a fish a person hangs a tackle box of mass 3.5 kilograms and a cooler of mass 5 kilograms from the ends of a uniform rigid pole that is suspended by a rope attached to its center, as shown below.



$\Sigma \tau = 0 Nm$

$\tau_1 + \tau_2 = \tau_3$

$mr + mr = mr$

$(3.5)(\frac{\ell}{2}) + m(\frac{\ell}{4}) = (5)(\frac{\ell}{2})$

$1.75 + \frac{m}{4} = 2.5$

$\frac{m}{4} = .75$

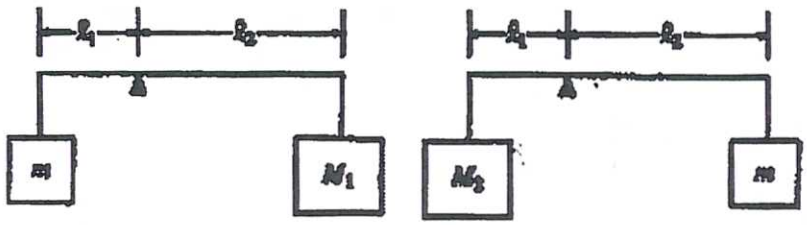
$m = 4(.75)$

$m = 3$

The system balances when the fish hangs at a point 1/4 of the rod's length from the tackle box. What is the mass of the fish?

A) 3 kg B) 6.5 kg C) 6 kg D) 1.5 kg E) 2 kg

20) A rod of negligible mass is pivoted at a point that is off-center, so that length ℓ_1 is different from length ℓ_2. The figures below show two cases in which masses are suspended from the ends of the rod.



Left: $m\ell_1 = M_1\ell_2$

$\ell_1 = \frac{M_1\ell_2}{m}$ solve for ℓ_1 + plug in

Right: $M_2\ell_1 = m\ell_2$

$M_2(\frac{M_1\ell_2}{m}) = m\ell_2$ ℓ_2 cancels

$M_2M_1 = m^2$

$m = \sqrt{M_2M_1}$

In each case the unknown mass m is balanced by a known mass, M_1 or M_2, so that the rod remains horizontal. What is the value of m in terms of the known masses?

A) $M_1 + M_2$
B) $(M_1M_2)/2$
C) $\sqrt{M_1M_2}$
D) M_1M_2
E) $(M_1 + M_2)/2$

1)	2)	3)	4)	5)	6)	7)	8)	9)	10)	11)	12)	13)	14)	15)	16)	17)	18)	19)	20)
D	C	D	D	A	A	A	E	B	B	E	E	D	C	A	B	D	A	A	C