UCONN Physics
Unit 5: Pre-Test

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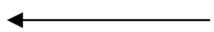
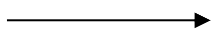
Directions: Avoid writing on this Pre-test to help you study for the actual test.

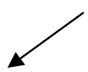
Formula's and Constants, check the formula sheet that will go with this test.

Choose only the BEST answer to each problem. There is only one BEST answer, unless otherwise stated.

1. The horizontal turntable shown below rotates at a constant rate. As viewed from above, a coin on the turntable moves counter-clockwise 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?

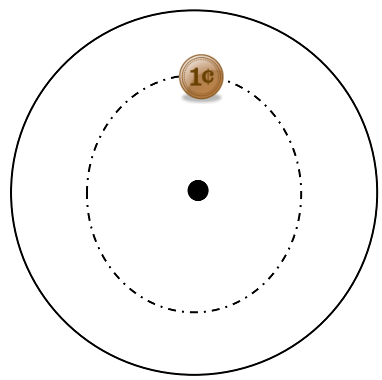
a. 

b. 

c. 

d. 

e. 



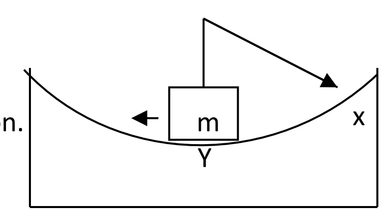
2. Mars has a mass 1/10 that of Earth and a diameter 1/2 that of Earth. The acceleration of a falling body near the surface of Mars is most nearly.

   a. 0.25 m/s^2 b. 0.5 m/s^2 c. 2.0 m/s^2 d. 4.0 m/s^2 e. 25 m/s^2

3. An object weighting 4.0 Newtons swings on the end of a string as a simple pendulum. At the bottom of the swing, the tension in the string is 6.0 Newtons. What is the magnitude of the centripetal acceleration of the object at the bottom of the swing?

   a. 0.0   b. 1/2 "g"   c. "g"   d. 3/2 "g"   e. 5/2 "g"

4. A block of mass "m" slides down a circular ramp of radius "r". The frictional force varies so that the block slides with constant speed "v" from X to Y. Which of the following is true of the block at any point on the path from X to Y?
   a. Its acceleration is zero
   b. The resultant force on the block is zero
   c. The resultant force on the block is constant in magnitude, but varies in direction.
   d. The resultant force on the block varies only in magnitude.
   e. Its change in potential energy is exactly equal to its change in kinetic energy.



5. A car rounds a curve at a steady 50 km/hr. The velocity of the car is:
   a. increasing b. decreasing c. constant d. changing

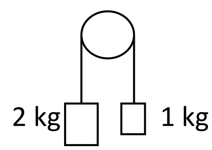
6. If you double the speed of a ball whirling at the end of a string, the tension (Centripetal force in the string:
   a. is unchanged b. is doubled c. is quadrupled d. is cut in half

7. A force of "F" Newtons gives an object with a mass of "M" an acceleration of "A". The same force "F" will give a second object with a mass of 2 "M" an acceleration of:
   a. A/2 b. 2A c. A d. A/4

8. A roller coaster car is on a track that forms a circular loop in the vertical plane. If the car is to just maintain contact with track at the top of the loop, what is the minimum value for its centripetal acceleration at this point?
   a. 2”g” upward b. 1”g” downward c. 1 “g” upward d. 0.5”g” downward

9. Centripetal force is a variation of which one of Newtons 3 laws:
   a. Newton's 1st b. Newton's 2nd c. Newton's 3rd d. It's not from Newton

10. The masses shown in the diagram are hung from a frictionless pulley of negligible mass. The acceleration of the 2.0 kg mass is:
   a. 0.33 m/s^2 b. 0.5 m/s^2 c. 3.3 m/s^2 d. 4.9 m/s^2



11. A person of mass "m" is standing in an elevator of mass "M". The elevator is moving downward, but has an upward acceleration of "a". To an observer fixed on the Earth, the force exerted on the person by the floor of the elevator is:

   a. ("m" + "M") g b. "m"(g+a) c. "m"(g-a) d. "M"(a-g) e. M (a+g)

12. The "T" in the equation for centripetal acceleration means.
   a. the time required to complete one period
   b. the time required to make one revolution
   c. the number of revolutions per unit time
   d. two of the above.

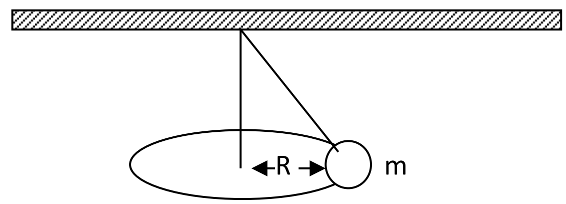
13. Two bodies are moving in circular paths of equal radii. If the speed of the first body is twice that of the second, the ratio of its centripetal acceleration to that of the second is:
   a. 1 to 4 b. 1 to 2 c. 2 to 1 d. 4 to 1

14. Two bodies are moving in circular path a equal speed. The first moves in a circle whose radius is twice as great as that of the second. The ratio of the centripetal acceleration of the first to that of the second is:
   a. 1 to 4 b. 1 to 2 c. 1 to 1 d. 2 to 1

15. Centripetal forces acting in curvilinear motion:
    a. are balanced forces
    b. are unbalanced forces
    c. are not really forces but points of reference.
    d. act in a direction 180 degrees from one another.

16. Car "A" rounds a curve at 20 m/s. Car "B", with twice as much mass, rounds the same curve at 40 m/s. The centripetal force on "B" is:
    a. the same as on "A"
    b. twice that of "A"
    c. four times as much as that of "A"
    d. eight times as much as that of "A"

17. Consider a pendulum bob of mass "M" swinging around in a circle of radius "R". The net force on "M" is pointed:
    a. down
    b. along the string
    c. toward the center of the circle
    d. way from the center of the circle



18. Banked curves serve the primary purpose on highways to:
    a. increase centripetal force
    b. allow water to run off the road better
    c. reduce centripetal force
    d. reduce traction

19. The maximum acceleration a car may undergo with a coefficient of friction of 0.45 is:
    a. 0.45 m/s^2 b. 21.8 m/s^2 c. 4.41 m/s^2 d. unable to be determined

20. An automobile of mass "m" is proceeding around a highway curve of 100-ft radius. The surface of the roadway is horizontal, and the coefficient of friction between the tires and the roadway is 0.50. The maximum speed with which the car can round the curve without slipping is:
    a. 10 ft/sec b. 16 ft/sec c. 32 ft/sec d. 40 ft/sec e. 44 ft/sec

21. An object moving on a plane circular path with constant speed has:
    a. a constant velocity
    b. zero acceleration
    c. a tangential acceleration
    d. an outward radial acceleration
    e. an inward radial acceleration

22. A planet has a time period of a pendulum (equal length of that on earth) to be 4 times as long as found on the earth. What do you know about the gravity on this planet.
    a. same as on earth
    b. 1/4 of that on earth
    c. 4 times that on earth
    d. 16 times that on earth
    e. 1/16 that on earth
    f. I have no clue

23. According to Kepler's second Law, a planet must move fastest when it is ___________ the sun.
a. closest to b. farthest from c. at its average distance from d. at its apogee

24. If the earth is one astronomical unit of distance from the sun and has a period of one year, approximately how far is Jupiter from the sun in astronomical units? Jupiter has a period of 12 years.
a. 2 b. 5 c. 10 d. 15

25. You weigh 526 N on Earth, Planet "X" has twice the mass of Earth and twice the radius of Earth. What is your weight in Newtons on Planet "X"?
a. 53 N b. 263 N c. 526 N d. 1040 N

IN QUESTIONS 26 AND 27, DETERMINE THE VALUE OF GRAVITY AT VARIOUS HEIGHTS ABOVE THE EARTH'S SURFACE.

26. 3200 km above the Earth's surface
a. 4.36 m/s^2 b. 9.8 m/s^2 c. 14.7 m/s^2 d. 22.1 m/s^2

27. 40 km above the Earth's surface:
a. 9.92 m/s^2 b. 9.86 m/s^2 c. 9.74 m/s^2 d. 9.68 m/s^2

28. Consider two objects on a single rotating disk, one at a distance "R" from the center and one at a distance 2 "R" from the center.
a. Both experience the same centripetal acceleration
b. The object nearest the axis experiences the greatest centripetal acceleration
c. The object farthest from the center experiences the greatest centripetal acceleration
d. Depending on the rate of rotation, either object would have the greatest centripetal acceleration.

29. What is the centripetal acceleration of a point on the perimeter of a bicycle wheel of diameter 70 cm when the bike is moving 8 m/s?
a. 91 m/s^2 b. 183 m/s^2 c. 206 m/s^2 d. 266 m/s^2

30. A jet fighter plane and pilot flying 600 m/s experiences at total of 4 "g's" when pulling out of a dive. What is the radius of curvature of the loop in which the plan is flying? (use "g" as 10 m/s^2)
a. 15 m b. 20 m c. 7,000 m d. 9,000 m e. 12,000 m

31. A stone of mass "m" is attached to a strong string and whirled in a vertical cir le of radius "r". At the exact top of the path the tension in the string is 3 times the stone's weight. The stone's speed at this point is given by:
a. $2\sqrt{gr}$ b. $\sqrt{gr}$ c. $4gr$ d. $\sqrt{2gr}$

32. A spaceship is traveling to the moon. At what point is it beyond the pull of the earth's gravity?
a. When it gets above the atmosphere
b. When it is half-way there
c. When it is closer to the moon than it is to the earth
d. It is never beyond the pull of the earth's gravity

33. A spherically symmetric planet has four time the earth's mass an twice its radius. If an object weighs 12 N on the surface of the earth, how much would it weigh on the surface of this planet?
    a. 6 N   b. 12 N   c. 24 N   d. none of these answers

34. As a planet moving in a elliptical orbit moves closer to the sun, its orbital velocity ......
    a. increases   b. decreases   c. remains constant   d. varies randomly

35. All satellites orbiting the earth have the same:
    a. orbital period to average radius ratio
    b. centripetal acceleration
    c. orbital period to average radius squared ratio
    d. orbital period squared to average radius cubed ratio

UCONN Physics
Unit 5: Pre-Test Guide

Copy__________

Directions: Use this Pre-Test Guide as it is intended. It is NOT a tutorial for each problem, it is a guide. You may explore all aspects of each problem, deciding on how the instructor may change or adjust this problem for future tests.

1. D The frictional for comes from the centripetal force (center seeking)

2. D F = force attraction on mars m_1 = Mass of Earth m_2 = Mass of Mars m_{obj} = object
g_2 = gravity on mars r_2 = distance between object and center of mars

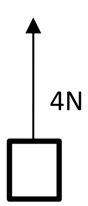
$$F = G\,\frac{m_{obj}\, m_2}{r^2_2} \quad \therefore \quad m_{obj}\, g_2 = G\,\frac{m_{obj}\, m_2}{r^2_2} \quad \therefore \quad g_2 = G\,\frac{m_2}{r^2_2}$$

$$\therefore \quad g_2 = G\,\frac{m_2 = (\,1/10 \;\; m_1\,)}{[r_2 = \;(1/4 \text{ dia of earth})]^2} = G\,\frac{1/10\, m_1}{\frac{1}{4}\, r^2_{earth}} = G\,\frac{4\;\, m_1}{10\;\, r^2_{earth}}$$

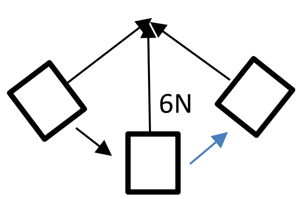
(Tricky) →

$$\therefore \quad g_2 = \frac{4}{10}\, G\,\frac{m_1}{r^2_{earth}} = 0.4 \left[G\,\frac{m_1}{r^2_{earth}} \right] = 0.4 \;\text{x}\; 9.8 \;\text{m/s}^2 = \boxed{3.92 \;\text{m/s}^2}$$

3. B



4N = mg
m = 0.41 kg
(not moving)



F_T = mg + F_{cp}
6N-4N = F_{cp}
2N = F_{cp}

F = m a
2N = 0.41 kg (a)
a = 4.88 m/s^2 ~ ½ g

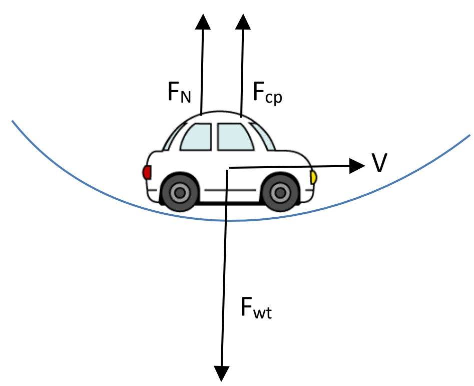
4. C The block moves with a constant speed, therefore the only force is the centripetal force that pushes up on the block perpendicular to the surface (Force Normal) but this force changes in direction as the block slides down the incline.

5. D Velocity is magnitude and direction, even if magnitude doesn't change, the velocity may change if direction changes.

6. C $a_{cp} = \frac{V^2}{r}$ doubling the speed, causes the centripetal acceleration to increase by "4".

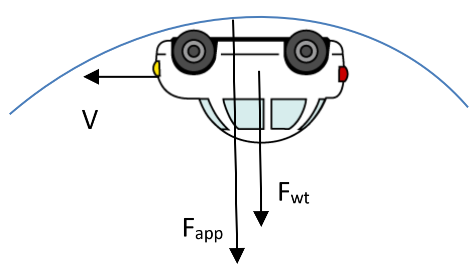
7. A $F_1 = M_1 A_1$ $F_1 = 2M_1 (½ A_1)$

8. B In diagram below, Car at the bottom of track feels (F_N) $F_{app} = F_{cp} + mg$ (F_N)



The ground supports BOTH the Weight of the car and the Force Centripetal

Upside down, the F_{app} will be the difference between the Centripetal force and the weight of the car. If the car was not moving, the track would not produce a force normal in the below situation.



F_{app} (F_N) $= F_{cp} - mg$

If $F_{cp} \geq mg$: Not fall
If $F_{cp} < mg$: Will fall

9. B $F = ma$ or $F = m \frac{V^2}{r}$

10. C Find the "net" force ie. $F = ma$ "F" is the net force.
"m" is the total mass that moves
"a" is the acceleration of the system

11. B If the elevator is moving downward and experiences and upward acceleration, it is slowing down. You'd feel like you weigh more. $F = mg + ma$

12. D "T" always stands for time period. The time to complete one oscillation, or revolution. (two correct choices were A and B)

13. D

First body	Second Body	Ratio
$a_1 = \frac{V^2_1}{r_1}$	$a_2 = \frac{V^2_2}{r_1}$	$\frac{a_1}{a_2} = \frac{4}{1}$

$V_1 = 2 V_2$

14. B

First body	Second body	Ratio
$a_1 = \frac{V^2_1}{r_1}$	$a_2 = \frac{V^2_2}{r_2}$	$\frac{½ a_1}{a_2} = \frac{1}{2}$

$V_1 = V_2$ $r_1 = 2 r_2$

Since radius and acceleration are indirectly related; as the First body has twice the radius as the second body, the centripetal acceleration of the First body is ½ of the second body.

15. B All accelerations are unbalanced in either magnitude and/or direction, otherwise if balanced, acceleration would not exist, as acceleration is defined as a change in velocity.

16. D In the formula $F = \frac{m v^2}{r}$, Force is directly proportional to mass and velocity squared.
If mass is doubled AND velocity is doubled (quadrupled due to being squared) and both are directly proportional to Force, the Force will be 8 times as much: 2x4 = 8

17. C Centripetal Force always points towards the center of the circle

18. A Banking allows the cars weight to help point toward the center of the curve.

19. C $F_{fr} = \mu F_N$ ∴ $ma = \mu mg$ ∴ $a = \mu g$

20. D The Centripetal Force is due to friction between the road and tires.

$$F_{fr} = \frac{m v^2}{r} \qquad \mu F_N = \frac{m v^2}{r} \qquad \mu mg = \frac{m v^2}{r} \qquad \mu g = \frac{v^2}{r}$$

v = 40 ft/sec

21. E Any object moving in a circular path will have an inward centripetal acceleration

22. E Determine the formula for Time Period (T) in a pendulum into the formula. Time period is inversely related to the square root of gravity.

∴ If "T" is 4 x higher on a planet than earth, the gravity must go down, but by how much? 4 times ? no, 16 times.

23. A Check textbook for answer

24. B Use Kepler's 3rd law to answer.

$$\frac{r^3_{Earth}}{T^2_{Earth}} = \frac{r^3_{Jupiter}}{T^2_{Jupiter}} \qquad \frac{(1\ AU)^3}{(1\ yr)^2} = \frac{r^3_{Jupiter}}{(12\ yr)^2}$$

25. B

Earth	Planet X
$526\ N = G \dfrac{m_1 m_2}{r^2_1}$	$F = G \dfrac{2\, m_1 m_2}{(2\, r_1)^2}$
	$F = G \dfrac{2}{4} \dfrac{m_1 m_2}{r^2_1}$

$$F = \tfrac{1}{2}\, G \frac{m_1 m_2}{r^2_1} = \tfrac{1}{2} \times 526\ N = 263\ N$$

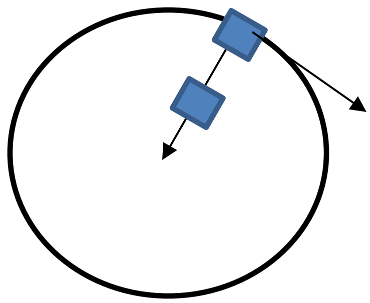
26. A Use the inverse square law, as was applied on worksheet II.

$$\text{Radius } (r) = \frac{6380 \text{ km} + 3200 \text{ km}}{6380 \text{ km}} = 1.5 \qquad F \ \alpha \ \frac{1}{(r^2)} = \frac{1}{(1.5^2)}$$

$$F = ma \ \therefore \ F \ \alpha \ a \ \therefore \ 9.8 \text{ m/s}^2 \ \text{x} \ 1/(1.5^2) = \boxed{4.36 \text{ m/s}^2}$$

27. D Done the same way as problem 26 with 40 km instead of 3200 km

28. C $a_{cp} = \frac{V^2}{r}$



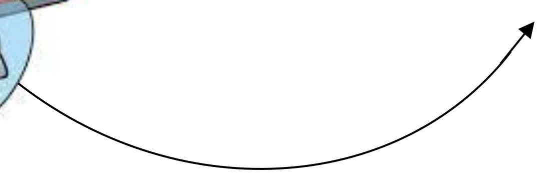
The outside object undergoes a larger linear velocity and having it squared caused the centripetal acceleration to increase despite the increase in radius.

29. B

$a_{cp} = \frac{V^2}{r}$ Radius = ½ diameter

30. E

Pilot feels 1 "g" at the bottom of the loop due their own weight, Plus 3 "g's" added to make the curve upward. Use 3 "g's" to calculate the centripetal acceleration.



$a_{cp} = \frac{V^2}{r}$ $\qquad 30 \text{ m/s}^2 = \frac{(600 \text{ m/s})^2}{r}$ $\qquad$ solve for "r"

31. A Whirling an object in a vertical circle causes the tension in the string to increase at the bottom and reduced at the top of the path. Use the below formula to calculate the apparent force (tension) felt in the string at the top of the path.

$F_{apparent} = F_{cp} - mg$ $3 \times mg = F_{cp} - mg$ $3\,mg + mg = F_{cp}$ $4\,mg = F_{cp}$

$4\,mg = mv^2 / r$ $4\,g = v^2 / r$ $4gr = v^2$ solve for "v"

32. D

33. B

Earth

$$12\text{ N} = G \frac{m_1 m_2}{r^2_1}$$

Planet

$$F = G \frac{4\, m_1\, m_2}{(2r_1)^2}$$

$$F = G \frac{4}{4} \frac{m_1\, m_2}{r_1^2}$$

$$\therefore F = G \frac{m_1\, m_2}{r_1^2}$$

No change is attractive force (same)
increase in mass is offset by increase in radius

34. A Check Kepler's second law in our textbook

35. D Check Kepler's third law in our textbook