Solutions

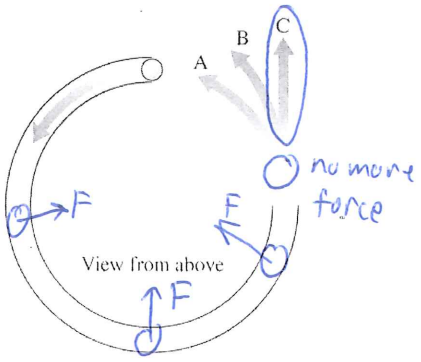
socrative
by MasteryConnect

AP Physics 1 - Test 06 - Circular Motion and Gravity Score: 100 ?

1. A hollow tube lies flat on a table. A ball is shot through the tube. As the ball emerges from the other end, which path does it follow?

(A) A
(B) B
(C) C

Once it leaves the tube, there is no force pointed to the center of the circle



2. A ball at the end of a string is being swung in a horizontal circle. The ball is accelerating because

(A) The speed is changing.
(B) The direction is changing.
(C) The speed and the direction are changing.
(D) The ball is not accelerating.

Velocity changes, but speed does not. This is because velocity relies on direction.

3. A ball at the end of a string is being swung in a horizontal circle. What is the direction of the acceleration of the ball?

(A) Tangent to the circle, in the direction of the ball's motion
(B) Toward the center of the circle

4. A ball at the end of a string is being swung in a horizontal circle. What is the direction of the velocity of the ball?

(A) Tangent to the circle, in the direction of the ball's motion
(B) Toward the center of the circle

5. A ball at the end of a string is being swung in a horizontal circle. What force is producing the centripetal acceleration of the ball?

(A) Gravity
(B) Air resistance
(C) Normal force
(D) Tension in the string

6. A ball at the end of a string is being swung in a horizontal circle. What is the direction of the net force on the ball?

(A) Tangent to the circle

(B) Toward the center of the circle

(C) There is no net force.

7. An ice hockey puck is tied by a string to a stake in the ice. The puck is then swung in a circle. What force is producing the centripetal acceleration of the puck?

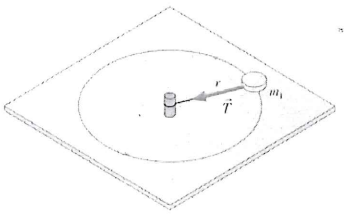
(A) Gravity

(B) Air resistance

(C) Friction

(D) Normal force

(E) Tension in the string



8. Click the image and answer

(A) A

(B) B

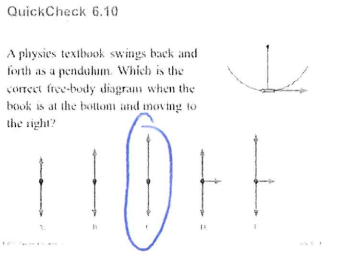
(C) C

(D) D

(E) E

$F_T > F_g$

Center of circle is up so up force is larger than down force.



9. Click the image and answer

(A) A

(B) B

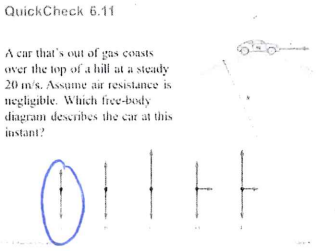
(C) C

(D) D

(E) E

$F_n < F_g$

Center of circle is down so down force is larger than up force.



10. Click the image and answer

(A) A

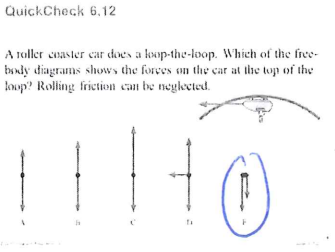
(B) B

(C) C

(D) D

(E) E

Both are down



11. The force of Planet Y on Planet X is ___ the magnitude of $F_{X \text{ on } Y}$.

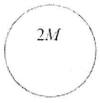
(A) One quarter

(B) One half

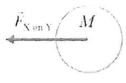
(C) The same as

(D) Twice

Planet X pulls on Planet Y just as hard as Planet Y pulls on Planet X.



Planet X



Planet Y

(E) Four times

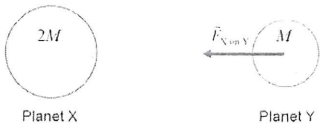
12. The gravitational force between two asteroids is 1,000,000 N. What will the force be if the distance between the asteroids is doubled?

(A) 250,000 N
(B) 500,000 N
(C) 1,000,000 N
(D) 2,000,000 N
(E) 4,000,000 N

Using $F_g = G\frac{m_1 m_2}{r^2}$

$F_g \propto \frac{1}{r^2}$

If you double "r" you one-fourth "F_g"



13. Planet X has free-fall acceleration 8 m/s2 at the surface. Planet Y has twice the mass and twice the radius of planet X. On Planet Y

(A) g = 2 m/s^2
(B) g = 4 m/s^2
(C) g = 8 m/s^2
(D) g = 16 m/s^2
(E) g = 32 m/s^2

$g = G\frac{M}{r^2}$ $\xrightarrow{(2r)^2}$ $\frac{1}{4} = \frac{1}{2}$ of original

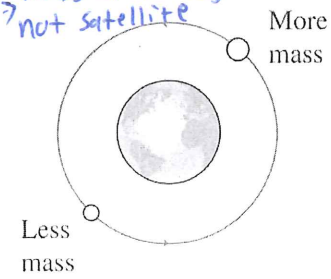
14. Astronauts on the International Space Station are weightless because

(A) There's no gravity in outer space.
(B) The net force on them is zero.
(C) The centrifugal force balances the gravitational force.
(D) g is very small, although not zero.
(E) They are in free fall.

15. Two satellites have circular orbits with the same radius. Which has a higher speed?

(A) The one with more mass.
(B) The one with less mass.
(C) They both have the same velocity.

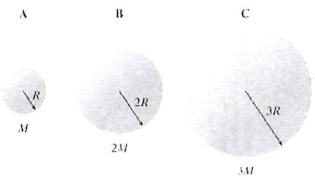
$V_{orbit} = \sqrt{\frac{GM}{r}}$ → mass of Planet, not satellite



16. A 60-kg person stands on each of the following planets. On which planet is his or her weight the greatest?

(A) A
(B) B
(C) C

$g = G\frac{M}{r^2}$



17. In the formula $F = Gm_1m_2/r^2$ the quantity G:

(A) depends on the local value of g

(B) is used only when Earth is one of the two masses

(C) is greatest at the surface of Earth

(D) is a universal constant of nature

(E) is related to the Sun in the same way that g is related to Earth

18. Earth exerts a gravitational force on the Moon, keeping it in its orbit. The reaction to this force, in the sense of Newton's third law, is:

Earth Pull moon ⇒ moon Pull Earth

(A) the centripetal force on the Moon

(B) the nearly circular orbit of the Moon

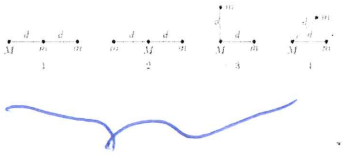
(D) the gravitational force on Earth by the Moon

(D) the tides due to the Moon

(E) the apple hitting Newton on the head.

19. Three particles, two with mass m and one with mass M, might be arranged in any of the four configurations known below. Rank the configurations according to the magnitude of the gravitational force on M, least to greatest.

$F_g = G\frac{Mm}{r^2}$



Look at origin

(A) 1, 2, 3, 4

(B) 2, 1, 3, 4

(C) 2, 1, 4, 3

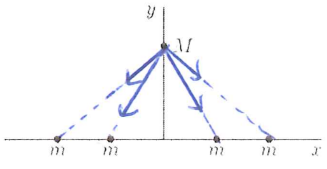
(D) 2, 3, 4, 1

(E) 2, 3, 2, 4

20. Four particles, each with mass m are arranged symmetrically about the origin on the x axis.

A fifth particle, with mass M, is on the y axis. The direction of the gravitational force on M is:

Left cancels with right, leaving the net force down



(A) Up

(B) Down

(C) Left

(D) Right

(E) Stays in Place

21. Let F_1 be the magnitude of the gravitational force exerted on the Sun by Earth and F_2 be the magnitude of the force exerted on Earth by the Sun. Then:

(A) F_1 is much greater than F_2

(B) F_1 is slightly greater than F_2

(C) F_1 is equal to F_2

Newton's 3rd Law

(D) F_1 is slightly less than F_2

(E) F_1 is much less than F_2

22. The mass of an object:

(A) is slightly different at different locations on Earth

(B) is a vector

(C) is independent of the acceleration due to gravity

(D) is the same for all objects of the same size and shape

23. An object at the surface of Earth (at a distance R from the center of Earth) weighs 90 N. Its weight at a distance 3R from the center of Earth is:

(A) 10 N

$F_g = G\frac{m_1 m_2}{r^2}$

$F_g \propto \frac{1}{r^2}$ $(x3)^2$ $\rightarrow \frac{1}{9}$ of original

(B) 30 N

(C) 90 N

(D) 270 N

(E) 810 N

24. The mass of a hypothetical planet is 1/100 that of Earth and its radius is 1/4 that of Earth. If a person weighs 600N on Earth, what would he weigh on this planet?

HINT: According to $F_g = Gm_1m_2/r^2$, $F_g \propto m$ and $F_g \propto 1/r^2$.

(A) 24 N

$F \propto m^{x\frac{1}{100}} \rightarrow F x \frac{1}{100}$ $\rightarrow F x 16/100$

(B) 48 N

(C) 96 N

$F \propto \frac{1}{r^2}$ $x\left(\frac{1}{4}\right)^2$ $\rightarrow F x 16$ $F x 4/25$ of original

(D) 192 N

$600 \times \frac{4}{25} = 96$

(E) 600 N

25. An object is raised from the surface of Earth to a height of two Earth radii above Earth. Then:

(A) its mass increases and its weight remains constant

(B) both its mass and weight remain constant

(C) its mass remains constant and its weight decreases

(D) both its mass and its weight decrease

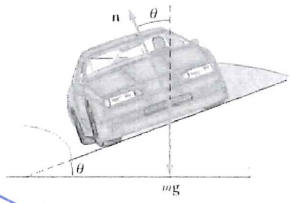
(E) its mass remains constant and its weight increases

26. A car is coming around a corner at a fast speed of 40 m/s.The turn has radius of curvature of 250 m. At what angle would he hope the curve be "banked." Use g=9.8 m/s^2

(A) 30°
(B) 45°
(C) 60°
(D) 22.5°
(E) 33.1°

$\theta = \tan^{-1}\left(\frac{v^2}{gr}\right)$

$= \tan^{-1}\left(\frac{40^2}{(9.8)(200)}\right) = 33.1^\circ$



27. A car goes through an unbanked, *horizontal* turn with a radius of curvature of 150 m. If the car has a coefficience of friction with the road of 0.50, what is the maximum velocity in which a car should travel on this road? Use $g=9.8 m/s^2$

(A) 0
(B) 27.1 m/s
(C) 9.8 m/s
(D) 32 m/s
(E) 22.6 m/s

$v_{max} = \sqrt{\mu_s g r}$

$= \sqrt{(0.5)(9.8)(150)} = 27.1 m/s$

28. A space station rotates to simulate "gravitational forces" with normal forces of astronauts being up against the wall. Suppose the space ship wanted the astronauts to experience a normal force value which was equivalent to their typical gravitational weight. The rotating space ship has a radius of 100 m. What would be the tangent velocity of an astronaut at the edge of this space ship? HINT: we want the centriptal acceleration to simulate the gravitational acceleration.Use $g=9.8 m/s^2$

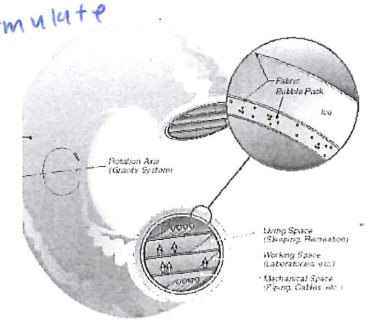
(A) 0
(B) 15.2 m/s
(C) 22.3 m/s
(D) 31.3 m/s
(E) 44.5 m/s

$a_c = \frac{v^2}{r}$ you want to simulate gravity. so $a_c = g$

$v = \sqrt{a_c r}$

$= \sqrt{gr} = \sqrt{(9.8)(100)}$

$= 31.3 m/s$



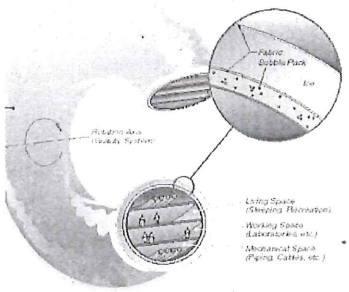
29. A space station rotates to simulate "gravitational forces" with normal forces of astronauts being up against the wall. Suppose the space ship wanted the astronauts to experience a normal force value which was equivalent to their typical gravitational weight. The rotating space ship has a radius of 100 m. How long would it take the ship to make one full rotation?

(A) 30 seconds
(B) 20.1 seconds
(C) 15 seconds
(D) 44.3 seconds
(E) 25.4 seconds

$v = \frac{2\pi r}{T}$ → circumference, → period

$T = \frac{2\pi r}{v}$

$= \frac{2\pi(100)}{(31.3)} = 20.1$



30. What is the term for the net force directed toward the center of an object's circular path?

(A) circular force

(B) centrifugal force

(C) centripetal force

(D) orbital force

31. When calculating the gravitational force between two extended bodies, you should measure the distance

(A) from the closest points on each body.

(B) from the most distant points on each body.

(C) from the center of each body.

(D) from the center of one body to the closest point on the other body.

r = distance from Center to center

32. A car travels in a circle with constant speed. The net force on the car

(A) is zero because the car is not accelerating.

(B) is directed forward, in the direction of travel.

(C) is directed toward the center of the curve.

(D) none of the above

33. The gravitational force between two massive spheres

(A) is always an attraction.

(B) depends on how massive they are.

(C) depends inversely on the square of the distances between them

(D) all of the above

34. A distant moon with a diameter of 1.6×10^7 has a gravitational acceleration of $g=1.2\ m/s^2$ at its surface. What is the mass of this moon?

$\rightarrow r = 0.8 \times 10^7$

(A) 1.15×10^{24} kg

(B) 8.89×10^{24} kg

(C) 3.66×10^{25} kg

(D) 1.05×10^{36} kg

(E) 2.53×10^{23} kg

$$g = G\frac{M}{r^2}$$

$$M = \frac{gr^2}{G} = \frac{(1.2)(0.8\times10^7)^2}{(6.67\times10^{-11})} = 1.15\times10^{24}\ kg$$

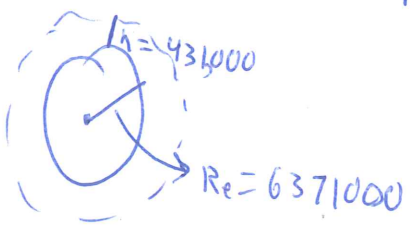
35. How fast does the international space station travel if it is 431 km above the earth's surface? The radius of the Earth is $r_e=6371$ km and the mass of the earth is $m_E=5.972\times10^{24}$

(A) 8023 m/s

(B) 6088 m/s

(C) 7652 m/s

(D) 15 m/s



$r = R + h = 6371000 + 431000$

$r = 6802000\ m$

$$V_{orb} = \sqrt{\frac{GM}{r}} = \sqrt{\frac{(6.67\times10^{-11})(5.972\times10^{24})}{6802000}}$$

$= 7652\ m/s$

(E) 3201 m/s

36. A bug lands on a wheel 0.2 m away from the center of rotation. If the wheel is turning at a rate of 120 rpm, what is the velocity of the bug?

(A) 50 m/s
(B) 13.2 m/s
(C) 1.33 m/s
(D) 2.5 m/s
(E) 5.36 m/s

$f = \frac{120\ \text{rev}}{1\ \text{min}} \left| \frac{2\pi\ \text{rad}}{1\ \text{rev}} \right| \frac{1\ \text{min}}{60\ \text{sec}}$

$V = 2\pi r \cdot f$

$= 4\pi\ \text{rad/sec}$

$= 2\pi(0.2)(4\pi)$

$= 2.5\ \text{m/s}$