Worksheet: Centripetal Force

Q1: A Formula One race car is traveling at 89.0 m/s along a straight track enters a turn on the race track with radius of curvature of 200.0 m. What centripetal acceleration must the car have to stay on the track?

Question Video

A $31.3\ \text{m/s}^2$

B $34.6\ \text{m/s}^2$

C $39.6\ \text{m/s}^2$

D $47.9\ \text{m/s}^2$

E $44.0\ \text{m/s}^2$

Q2: A fairground ride spins its occupants inside a flying saucer-shaped container. If the horizontal circular path the riders follow has an 8.00-meter radius, at how many revolutions per minute are the riders subjected to a centripetal acceleration equal to that of gravity?

Question Video

A 9.81 rpm

B 10.6 rpm

C 12.5 rpm

D 11.7 rpm

E 13.0 rpm

Q3: A geosynchronous satellite orbits Earth at a distance of 4.225×10^8 m and has a period of 1 day, taking a day as 864×10^2 s. What is the centripetal acceleration of the satellite?

A 0.250 m/s

B 0.223 m/s

C 0.213 m/s

D 0.205 m/s

E 0.236 m/s

Q4: A particle travels in a circle of radius 10 m, moving at a constant speed of 20 m/s. What is the magnitude of the particle's centripetal acceleration?

A $5\ \text{m/s}^2$

B $20\ \text{m/s}^2$

C $30\ \text{m/s}^2$

D $40\ \text{m/s}^2$

E $10\ \text{m/s}^2$

Q5: A wind turbine has blades 85 m in length. The tip of a blade has a mass of 2.7 kg. The blades rotate at a steady 0.67 rev/s. What is the magnitude of the centripetal force on the tip of a blade?

A 3.7 kN

B 0.10 kN

C 4.1 kN

D 0.97 kN

E 2.5 kN

Q6: What is the magnitude of the acceleration of Venus toward the Sun, assuming a circular orbit with a radius of 1.082×10^{11} m, and an orbital period of 0.6152 years? (Use a value of exactly 365 for the number of days in a year.)

A 1.023×10^{-2} m/s^2

B 1.119×10^{-2} m/s^2

C 1.538×10^{-2} m/s^2

D 9.812×10^{-3} m/s^2

E 1.135×10^{-2} m/s^2

Q7: In a particle accelerator, a proton moves along a circular path of 5.55 km radius at a speed of 6.05×10^6 m/s. The mass of a proton is 1.67×10^{-27} kg.

- What is the magnitude of the centripetal acceleration of the proton?

A 5.60×10^9 m/s^2

B 3.60×10^9 m/s^2

C 8.60×10^9 m/s^2

D 9.60×10^9 m/s^2

E 6.60×10^9 m/s^2

- What is the magnitude of the centripetal force on the proton?

A 3.10×10^{-17} N

B 2.10×10^{-17} N

C 4.10×10^{-17} N

D 5.10×10^{-17} N

E 1.10×10^{-17} N

Q8: The Sun orbits the Milky Way galaxy once each 2.600×10^8 years, with a roughly circular orbit averaging a radius of 3.00×10^4 light-years.

- Calculate the centripetal acceleration of the Sun in its galactic orbit.

A 1.66×10^{-10} m/s^2

B 1.20×10^{-10} m/s^2

C 4.28×10^{-11} m/s^2

D 8.03×10^{-11} m/s^2

E 7.26×10^{-10} m/s^2

- Calculate the average speed of the Sun in its galactic orbit.

A 2.17×10^{5} m/s

B 1.88×10^{5} m/s

C 1.55×10^{5} m/s

D 1.63×10^{5} m/s

E 1.95×10^{5} m/s

Q9: A particle's centripetal acceleration $a_C = 4.0\ \text{m/s}^2$ at the instant $t = 0$ s. The particle is executing uniform circular motion about an axis, at a distance of 5.0 m from the axis. What is the particle's velocity at $t = 10$ s?

A $(-1.0\mathbf{i} - 5.1\mathbf{j})$ m/s

B $(-2.2\mathbf{i} - 3.9\mathbf{j})$ m/s

C $(-6.0\mathbf{i} - 2.4\mathbf{j})$ m/s

D $(-2.8\mathbf{i} - 6.3\mathbf{j})$ m/s

E $(-3.3\mathbf{i} - 1.9\mathbf{j})$ m/s

Q10: A football player throws a football so that it rotates at 6.8 rev/s. The football has a radius of 8.0 cm at the middle of its axis of rotation. What is the centripetal acceleration of the laces on the edge of the football along its axis of rotation?

A $150\ \text{m/s}^2$

B $87\ \text{m/s}^2$

C $140\ \text{m/s}^2$

D $110\ \text{m/s}^2$

E $98\ \text{m/s}^2$

Q11: A large centrifuge has an arm with a length of 12.7 m. At the end of the centrifuge arm hangs a cage on a pivot.

What angular velocity of the centrifuge will produce a centripetal acceleration of 8.50*g* on the cage?

A 0.820 rad/s

B 6.62 rad/s

C 2.56 rad/s

D 4.65 rad/s

E 1.70 rad/s

At what angle below the horizontal will the cage hang at when the cage experiences a centripetal acceleration of 8.50*g*?

A 4.31°

B 9.50°

C 6.71°

D 7.21°

E 5.81°

Q12: At takeoff, a commercial jet has a speed of 60.0 m/s. Its tires have a diameter of 0.850 m.

- At how many revolutions per minute are the tires rotating?

A 0.974×10^3 rpm

B 1.09×10^3 rpm

C 1.35×10^3 rpm

D 1.36×10^3 rpm

E 1.04×10^3 rpm

- What is the centripetal acceleration at theedge of the tire?

A 7.62×10^3 m/s^2

B 9.50×10^3 m/s^2

C 8.47×10^3 m/s^2

D 9.63×10^3 m/s^2

E 6.96×10^3 m/s^2

- With what force must a determined 1.00×10^{-15} kg bacterium cling to the rim?

A 8.47×10^{-13} N

B 8.47×10^{-5} N

C 8.47×10^{-12} N

D 8.47×10^{-18} N

E 8.47×10^{-15} N

- What is the ratio of this force to thebacterium's weight?

A 712

B 517

C 864

D 1 104

E 435

Q13: A car that has a mass of 900.0 kg drives along a circular unbanked curve at a constant speed of 25.000 m/s. The radius of the curve is 500.0 m.

What magnitude force acts on the car to maintain its speed and direction as it follows the curve?

A 3 354 N

B 2 025 N

C 975.0 N

D 1 125 N

E 750.0 N

What is the minimum possible value for the coefficient of static friction between the car's tires and the road surface?

A 0.9341

B 0.8724

C 0.2552

D 0.1276

E 0.4362

Q14: A car moving at a steady 96.8 km/h travels around a circular curve of radius 182.9 m on a flat country road. What must the minimum coefficient of static friction be to keep the car from slipping as it travels around the curve?

A 0.232

B 0.355

C 0.412

D 0.533

E 0.122

Q15: A bobsled can travel along a curved path despite there being negligible friction between the bobsled and the ice that it slides over. In order for the bobsled to turn, the surface that it slides along must be banked so that the bobsled slides toward the center of curvature of the path followed. What speed should a bobsled be launched at so that it follows a circular curved path of radius 100.0 m that is banked at an angle of 31.0°?

A 24.3 m/s

B 33.6 m/s

C 29.0 m/s

D 22.5 m/s

E 36.9 m/s

Q16: Calculate the angular velocity of an electron in the second excited state in a hydrogen atom. Use a value of 2.12×10^{-10} m for the orbit's radius, and model the orbit as circular. Assume that the proton is stationary and the centripetal force on the electron is supplied by Coulomb attraction.

A 5.15×10^{15} rad/m

B 2.05×10^{15} rad/m

C 1.42×10^{15} rad/m

D 2.96×10^{15} rad/m

E 1.62×10^{15} rad/m

Q17: A proton moves with a speed of 5.000×10^{6} m/s counterclockwise along a circular trajectory of radius 0.175 m. The trajectory of the proton is confined to the xy-plane. At the instant $t = 0.00$ s, the proton's position vector is $0.175\mathbf{i}$ m. What is the proton's position vector at the instant $t = 2.00 \times 10^{-7}$ s?

A $(0.0750\mathbf{i} + 0.0320\mathbf{j})$ m

B $(0.0850\mathbf{i} - 0.107\mathbf{j})$ m

C $(0.111\mathbf{i} - 0.129\mathbf{j})$ m

D $(0.147\mathbf{i} - 0.0950\mathbf{j})$ m

E $(-0.0180\mathbf{i} + 0.112\mathbf{j})$ m

Q18: A jet is flying at 134.1 m/s along a straight line and makes a turn along a circular path that is level with the ground. What must the radius of the circle be to produce a centripetal acceleration of 9.80 m/s^2 on the pilot and jet toward the center of the circular trajectory?

A 2.69 km

B 3.26 km

C 1.83 km

D 1.44 km

E 1.96 km