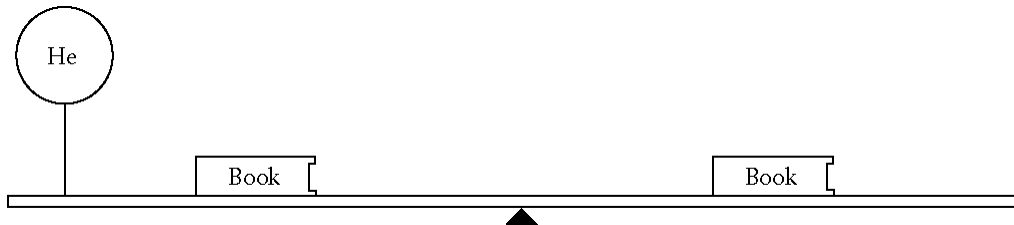# Phys.12- Q2W1- Circular Motion and Gravitation

Problem

1. A new moon is discovered orbiting Neptune with an orbital speed of 9.11×10^3 m/s. Neptune's mass is 1.0×10^{26} kg. What is the radius of the new moon's orbit? What is the orbital period? Assume that the orbit is circular. ($G = 6.673 \times 10^{-11}$ N•m^2/kg^2)

       A- 6.0 x 10^7 m; 3.5 x 10^4 s
       B- 7.0 x 10^7 m; 4.5 x 10^4 s
       C- 8.0 x 10^7 m; 5.5 x 10^4 s
       D- 9.0 x 10^7 m; 6.5 x 10^4 s

2. A 4.2 m board with a mass of 19 kg is pivoted at its center of gravity. A helium balloon attached 0.24 m from the left end of the board produces an upward force of 7.1 N. A 3.5 kg book is placed 0.74 m from the left end of the board, and another book of 1.7 kg is placed 0.77 m from the right end of the board. Find the torque on the board and the direction of rotation.

       A- 13 N.m counterclockwise
       B- 15 N.m counterclockwise
       C- 17 N.m counterclockwise
       D- 19 N.m counterclockwise

3. A boy can raise a rock that weighs 95 N by using a lever and applying a force of 17 N. What is the mechanical advantage of the lever?

       A. 2.6
       B. 3.6
       C. 4.6
       D. 5.6

4. A new planet is discovered orbiting a star with a mass 3.5×10^{31} kg at a distance of 1.2×10^{11} m. Assume that the orbit is circular. What is the orbital speed of the planet? ($G = 6.673 \times 10^{-11}$ N•m^2/kg^2)

       A- 1.4 x 10^5 m/s
       B- 1.4 x 10^5 m/s
       C- 1.4 x 10^5 m/s
       D- 1.4 x 10^5 m/s

5. What is the orbital period of the planet? ($G = 6.673 \times 10^{-11}$ N•m^2/kg^2)

    A- 3.4 x 10^6 s
    B- 4.4 x 10^6 s
    C- 5.4 x 10^6 s
    D- 6.4 x 10^6 s

6. A bucket filled with water has a mass of 33 kg and is attached to a rope wound around a cylinder with a radius of 0.043 m at the top of a well. What torque does the weight of the water and bucket produce on the cylinder? ($g = 9.81$ m/s^2)

    A- 10 N.m
    B- 12 N.m
    C- 14 N.m
    D- 16 N.m

7. How much energy would be required to do 971 J of work with a machine that was 25% efficient?

    A- 0.9 x 10^3 J
    B- 1.9 x 10^3 J
    C- 2.9 x 10^3 J
    D- 3.9 x 10^3 J

8. A 35 kg child moves with uniform circular motion while riding a horse on a carousel. The horse is 3.2 m from the carousel's axis of rotation and has a tangential speed of 2.6 m/s. What is the child's centripetal acceleration?

    A- 1.1 m/s^2
    B- 2.1 m/s^2
    C- 3.1 m/s^2
    D- 4.1 m/s^2

9. A 69.8 kg student sits at a desk 1.75 m away from a 78.9 kg student. What is the magnitude of the gravitational force between the two students? ($G = 6.673 \times 10^{-11}$ N•m^2/kg^2)

    A- 0.20 x 10^{-7} N
    B- 1.20 x 10^{-7} N
    C- 2.20 x 10^{-7} N
    D- 3.20 x 10^{-7} N

10. A satellite in a circular orbit experiences a centripetal acceleration of 8.89 m/s^2. The tangential speed of the satellite is 7.76 × 10^3 m/s. What is the altitude of the satellite? ($r_E = 6.38 \times 10^6$ m)

    A- 290 km
    B- 390 km
    C- 490 km
    D- 590 km

Multiple Choice
Identify the choice that best completes the statement or answers the question.

_____ 11. The degree to which an object attracts other objects is measured by the object's
     a. gravitational mass.
     b. weight.
     c. inertial mass.
     d. gravitational field strength.

_____ 12. When an object is moving with uniform circular motion, the object's tangential speed
     a. is constant.
     b. is directed toward the center of motion.
     c. is perpendicular to the plane of motion.
     d. is circular.

_____ 13. What quantity measures the output force of a machine relative to the input force?
     a. torque
     b. efficiency
     c. mechanical advantage
     d. leverage

_____ 14. A ball is whirled on a string, then the string breaks. What causes the ball to move off in a straight line?
     a. centripetal force
     b. centripetal acceleration
     c. centrifugal force
     d. inertia

_____ 15. What quantity measures the work done by a machine relative to the work done on a machine?
     a. mechanical advantage
     b. efficiency
     c. leverage
     d. torque

_____ 16. Why does an astronaut weigh less on the moon than on Earth?
     a. The astronaut is farther from Earth's center when he or she is on the moon.
     b. The gravitational field strength is less on the moon's surface than on Earth's surface.
     c. The astronaut has less mass on the moon.
     d. The astronaut is continually in free fall because the moon orbits Earth.

_____ 17. Two small masses that are 10.0 cm apart attract each other with a force of 10.0 N. When they are 5.0 cm apart, these masses will attract each other with what force? ($G = 6.673 \times 10^{-11}$ N•m^2/kg^2)
     a. 5.0 N
     b. 20.0 N
     c. 2.5 N
     d. 40.0 N

_____ 18. The equation for the speed of an object in circular orbit is $v_t = \sqrt{G\frac{m}{r}}$. What does *m* represent in this equation?
     a. the mass of the sun
     b. the mass of the orbiting object
     c. the mass of the central object
     d. the mass of Earth

_____ 19. What is the term for the net force directed toward the center of an object's circular path?
     a. centripetal force
     b. circular force
     c. orbital force
     d. centrifugal force

_____ 20. The gravitational force between two masses is 36 N. What is the gravitational force if the distance between them is tripled? ($G = 6.673 \times 10^{-11}$ N•m^2/kg^2)
     a. 27 N
     b. 18 N
     c. 4.0 N
     d. 9.0 N

_____ 21. Where should a force be applied on a lever arm to produce the most torque?
     a. in the middle of the lever arm
     b. farthest from the axis of rotation
     c. It doesn't matter where the force is applied.
     d. closest to the axis of rotation

_____ 22. An object's tendency to resist acceleration is measured by the object's
     a. inertial mass.
     b. gravitational field strength.
     c. weight.
     d. gravitational mass.
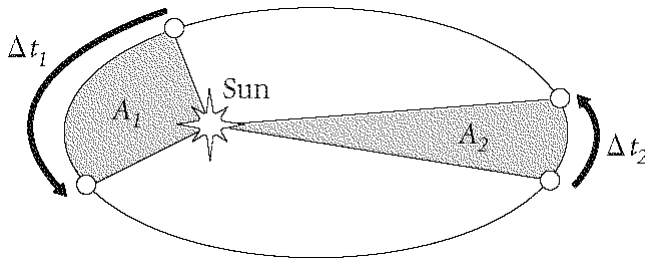
_____ 23. In the figure above, according to Kepler's laws of planetary motion,
     a. $A_1 = A_2$.
     b. if $\Delta t_1 = \Delta t_2$, then the orbit is circular.
     c. if $\Delta t_1 = \Delta t_2$, then $A_1 = A_2$.
     d. $\Delta t_1 > \Delta t_2$.

_____ 24. Tides are caused by
     a. differences in Earth's gravitational field strength at different points on Earth's surface.
     b. fluctuations in the gravitational attraction between Earth and the moon.
     c. differences in the gravitational force of the moon at different points on Earth.
     d. differences in the gravitational force of the sun at different points on Earth.

_____ 25. An iron bar is used to lift a slab of cement. The force applied to lift the slab is 4.0×10^2 N. If the slab weighs 6400 N, what is the mechanical advantage of the bar?
     a. 6000
     b. 1.6
     c. 16
     d. 6.3%

_____ 26. Which of the following can be a centripetal force?
     a. tension
     b. friction
     c. gravity
     d. all of the above

A child rides a bicycle in a circular path with a radius of 2.0 m. The tangential speed of the bicycle is 2.0 m/s. The combined mass of the bicycle and the child is 43 kg.

_____ 27. What kind of force provides the centripetal force on the bicycle?
     a. normal force
     b. gravitational force
     c. friction
     d. air resistance

_____ 28. What is the magnitude of the centripetal force on the bicycle?
     a. 4.0 N
     b. 86 N
     c. 3.7 kN
     d. 43 N

_____ 29. In this text, which of the following symbols represents the constant of universal gravitation?
     a. F_c
     b. G
     c. g
     d. F_g

_____ 30. When an object is moving with uniform circular motion, the centripetal acceleration of the object
     a. is circular.
     b. is directed toward the center of motion.
     c. is perpendicular to the plane of motion.
     d. is zero.

_____ 31. The centripetal force on an object in circular motion is
    a. in the plane of the object's motion and in the same direction as the tangential speed.
    b. perpendicular to the plane of the object's motion.
    c. in the plane of the object's motion and in the direction opposite the tangential speed.
    d. in the plane of the object's motion and perpendicular to the tangential speed.

_____ 32. Newton's law of universal gravitation
    a. can be used to derive Kepler's third law of planetary motion.
    b. can be used to disprove Kepler's laws of planetary motion.
    c. is equivalent to Kepler's first law of planetary motion.
    d. does not apply to Kepler's laws of planetary motion.

_____ 33. How would the speed of Earth's orbit around the sun change if Earth's mass increased by 4 times?
    a. It would decrease by a factor of 2.   c. It would increase by a factor of 4.
    b. The speed would not change.   d. It would increase by a factor of 2.

_____ 34. If the torque required to loosen a nut on a wheel has a magnitude of 40.0 N•m and the force exerted by a mechanic is 133 N, how far from the nut must the mechanic apply the force?
    a. 1.20 m   c. 30.1 cm
    b. 15.0 cm   d. 60.2 cm

_____ 35. Which of the following confirms that gravitational mass and inertial mass are equivalent?
    a. Free-fall acceleration is the same at all points where the gravitational field strength is the same.
    b. An object's weight can change with location, but the object's mass remains constant.
    c. Free-fall acceleration is the same throughout the universe.
    d. Newton's second law is valid throughout the universe.

_____ 36. What is the efficiency of a machine that requires 1.00×10^2 J of input energy to do 35 J of work?
    a. 2.9%   c. 65%
    b. 35%   d. 29%

_____ 37. 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 center of one body to the closest point on the other body.
    c. from the center of each body.
    d. from the most distant points on each body.

_____ 38. A girl pushes a box that has a mass of 450 N up an incline. If the girl exerts a force of 150 N along the incline, what is the mechanical advantage of the incline?
    a. 33%   c. 300
    b. 3.0   d. 0.33

_____ 39. Suppose a doorknob is placed at the center of a door. Compared with a door whose knob is located at the edge, what amount of force must be applied to this door to produce the torque exerted on the other door?
    a. four times as much   c. two times as much
    b. one-half as much   d. one-fourth as much

_____ 40. If you want to open a swinging door with the least amount of force, where should you push on the door?
    a. in the middle   c. close to the hinges
    b. as far from the hinges as possible   d. It does not matter where you push.

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