AP physics web review - Gravity

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

_____ 1. A roller coaster, loaded with passengers, has a mass of 2 000 kg; the radius of curvature of the track at the bottom point of the dip is 24 m. If the vehicle has a speed of 18 m/s at this point, what force is exerted on the vehicle by the track? ($g = 9.8$ m/s^2)
   a. 2.3×10^4 N
   b. 4.7×10^4 N
   c. 3.0×10^4 N
   d. 1.0×10^4 N
   e. 5.5×10^4 N

_____ 2. Consider a point on a bicycle tire that is momentarily in contact with the ground as the bicycle rolls across the ground with constant speed. The direction for the acceleration for this point at that moment is:
   a.   upward.
   b.   down toward the ground.
   c.   forward.
   d.   at that moment the acceleration is zero.
   e.   none of the above.

_____ 3. Consider a child who is swinging. As she reaches the lowest point in her swing:
   a.   the tension in the rope is equal to her weight.
   b.   the tension in the rope is equal to her mass times her acceleration.
   c.   her acceleration is downward at 9.8 m/s^2.
   d.   none of the above.
   e.   both choices A and C are valid.

_____ 4. A cylindrical space colony 8 km in diameter and 30 km long has been proposed as living quarters for future space explorers. Such a habitat would have cities, land and lakes on the inside surface and air and clouds in the center. All this would be held in place by the rotation of the cylinder about the long axis. How fast would such a cylinder have to rotate to produce a 1-g gravitational field at the walls of the cylinder?
   a.   0.05 rad/s
   b.   0.10 rad/s
   c.   0.15 rad/s
   d.   0.20 rad/s
   e.   0.25 rad/s

_____ 5. The Earth is 93 million miles (mi) from the Sun and its period of revolution is 1 year = 3.15×10^7 s. What is the acceleration of the Earth in its orbit about the Sun?
   a.   18.6 mi/s^2
   b. 9.3×10^{-3} mi/s^2
   c. 13.6×10^{-6} mi/s^2
   d. 3.7×10^{-6} mi/s^2
   e. 2.9×10^{-6} mi/s^2

_____ 6. An Earth satellite is orbiting at a distance from the Earth's surface equal to one Earth radius (4 000 miles). At this location, the acceleration due to gravity is what factor times the value of g at the Earth's surface?
   a.   There is no acceleration since the satellite is in orbit.
   b.   2
   c.   1/2
   d.   1/4
   e.   4

_____ 7. If a planet has a radius 20% greater than that of the Earth but has the same mass as the Earth, what is the acceleration due to gravity at its surface?
   a.   14 m/s^2
   b.   12 m/s^2
   c.   8.2 m/s^2
   d.   6.8 m/s^2
   e.   5.3 m/s^2

_____ 8. The acceleration due to gravity at the surface of Planet X is 10 m/s^2. What is the acceleration due to gravity at an altitude of 3000 km above the surface of this planet?
   a.   10 m/s^2
   b.   8.0 m/s^2
   c.   4.4 m/s^2
   d.   3.5 m/s^2
   e.   More information is needed.

_____ 9. At an altitude of 4 times the radius of the earth, the acceleration due to gravity is
   a.   g/2.
   b.   g/4.
   c.   g/16.
   d.   g/20.
   e.   not given.

_____ 10. An artificial Earth satellite in an elliptical orbit has its greatest centripetal acceleration when it is at what location?
   a.   nearest the Earth
   b.   farthest from the Earth
   c.   between Earth and Moon
   d.   between Earth and Sun
   e.   nearest the Moon

_____ 11. Of the nine known planets in our solar system, the innermost is Mercury. When compared to the other planets in the system, Mercury has the:
   a.   greatest centripetal acceleration.
   b.   greatest period of revolution.
   c.   smallest angular velocity.
   d.   smallest tangential velocity.
   e.   both choices A and D are valid.

_____ 12. According to Kepler's second law, Halley's Comet circles the Sun in an elliptical path with the Sun at one focus of the ellipse. What is at the other focus of the ellipse?
  a.   nothing
  b.   the Earth
  c.   The comet itself passes through the other focus.
  d.   The tail of the comet stays at the other ellipse.
  e.   the Jupiter

_____ 13. For any object orbiting the Sun, Kepler's Law may be written $T^2 = kr^3$. If T is measured in years and r in units of the Earth's distance from the Sun, then $k = 1$. What, therefore, is the time (in years) for Mars to orbit the Sun if its mean radius from the Sun is 1.5 times the Earth's distance from the Sun?
  a.   1.8 years
  b.   2.8 years
  c.   3.4 years
  d.   4.2 years
  e.   5.0 years

_____ 14. In order for a satellite to be geosynchronous, its orbit must:
  a.   go over the North and South Poles.
  b.   be over the equator.
  c.   be over a single longitude.
  d.   emit television signals.
  e.   none of the above.

_____ 15. Doubling the mean distance from the Sun results in changing the orbital period of revolution by what factor?
  a. $2^{1/2}$
  b.   2
  c. $2^{3/2}$
  d. 2^2
  e. 2^4

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Answer Section

MULTIPLE CHOICE

   1. B
   2. A
   3. D
   4. A
   5. D
   6. D
   7. D
   8. E
   9. E
  10. A
  11. A
  12. A
  13. A
  14. B
  15. C