1. Five planets make circular orbits around a star which is much more massive than any of them. The mass and orbital radius of each satellite is given. Which satellite has the longest period?

   A) Mass: ¡ *M*
   Radius: *R*

   B) Mass: *M*
   Radius: ¡ *R*

   C) Mass: *M*
   Radius: *R*

   D) Mass: 2*M*
   Radius: *R*

   E) Mass: *M*
   Radius: 2*R*

2. A satellite is orbiting around the Earth at a radius of 2*R* from its center. What is the magnitude of the velocity it is traveling at?

   A) $\sqrt{\frac{GM}{2R}}$

   B) $\frac{GM}{2R}$

   C) $\frac{2GR}{M}$

   D) $9.8\,\text{m/s}$

   E) $\frac{G}{R}$

3. The Earth exerts the necessary centripetal force on an orbiting satellite to keep it moving in a circle at constant speed. Which of the following statements best explains why the speed of the satellite does not change even though there is a net force exerted on it?

   A) The satellite is in dynamic equilibrium.

   B) The acceleration on the satellite is zero.

   C) The centripetal force is in the direction of the velocity of the satellite.

   D) The centripetal force is equivalent to the reaction force caused from the satellite.

   E) The centripetal force is perpendicular to the velocity of the satellite.

4. A satellite in orbit around the Earth has a period of one hour. An identical satellite is placed in an orbit having a radius which is nine times larger than the first satellite. What is the period of the second satellite?

   A) 0.004 hr

   B) $\frac{1}{3}$ hr

   C) 3 hr

   D) 9 hr

   E) 27 hr

5. A satellite orbits the Earth in at a distance of 1 Earth radius from the surface. Its velocity is *v*. If the satellite moves and enters a new orbit at 3 Earth radii from the Earth's surface, its new velocity will be

   A) $\frac{v}{2}$

   B) $v\sqrt{3}$

   C) $v\sqrt{2}$

   D) $\frac{v}{\sqrt{3}}$

   E) $\frac{v}{\sqrt{2}}$

6. If the radius of a satellite's orbit is doubled, it's kinetic energy will

   A) be doubled.

   B) be halved.

   C) decrease by a factor of 4.

   D) increase by a factor of 4.

   E) remain the same.

7. A moon orbits a planet in a circular orbit of radius *R*. If the mass of the planet is *M*, what is the period of the moon's revolution?

A) $\pi\sqrt{\frac{R^3}{GM}}$

B) $\pi\sqrt{\frac{R^2}{GM}}$

C) $2\sqrt{\frac{R^2}{GM}}$

D) $2\pi\sqrt{\frac{R^3}{GM}}$

E) $\frac{\pi}{2}\sqrt{\frac{R^3}{GM}}$

Base your answers to questions **8** and **9** on the following.

An astronomical unit (AU) is defined as the mean distance at which the Earth orbits the Sun.

8. If the planet *P* orbits at a mean distance of 6 AU, a year on *P* is most nearly

A) 3 Earth years.

B) 6 Earth years.

C) 15 Earth years.

D) 39 Earth years.

E) 216 Earth years.

9. The planet Krypton orbits a star 2 times more massive than the Sun. It takes 27 Earth years to circle this star. The radius of Krypton's orbit is most nearly

A) 5 AU

B) 9 AU

C) 18 AU

D) 27 AU

E) 44 AU

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10. A satellite moves in a circular orbit around a planet at a constant speed. Which of the following must be true?

I. The net force on the satellite is always radially inward.
II. The net work done on the satellite in the interval of half an orbit zero.
III. The angular momentum of the satellite is constant.

A) I only

B) III only

C) I and III, only

D) II and III, only

E) I, II, and III

11. The Moon, mass *m*, orbits the Earth, mass *M*, in a circular orbit with radius *r*. What is the kinetic energy of the Moon in its orbit?

A) $\frac{GMm}{2r}$

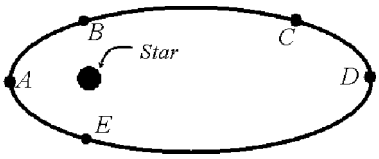
B) $\frac{GMm}{4r}$

C) $\frac{GMm}{r}$

D) $\frac{GMm}{r^2}$

E) $\frac{GMm}{4r^2}$

Base your answers to questions **12** and **13** on the picture below, which represents a planet that moves in an elliptical orbit with a star as one focus as shown above.




12. At which point does the planet have the greatest potential energy?

    A) *A*

    B) *B*

    C) *C*

    D) *D*

    E) *E*

13. At which two points does the planet have the same velocity?

    A) *A* and *E*

    B) *A* and *D*

    C) *B* and *C*

    D) *B* and *E*

    E) *C* and *D*

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14. The square of the period of an orbit is proportional to the cube of the semimajor axis of the orbit. This statement is best known as

    A) Kepler's First Law

    B) Kepler's Second Law

    C) Kepler's Third Law

    D) Conservation of angular momentum

    E) None of the above

15. Planets sweep out equal areas in equal times. This statement is best known as

    A) Kepler's First Law

    B) Kepler's Second Law

    C) Kepler's Third Law

    D) Conservation of angular momentum

    E) None of the above

16. The planets orbit in elliptical paths with the sun at one focus of the ellipse. This statement is best known as

    A) Kepler's First Law

    B) Kepler's Second Law

    C) Kepler's Third Law

    D) Conservation of angular momentum

    E) None of the above

17. What is the total energy of a satellite of mass *m* that orbits a planet of mass *M* in an elliptical orbit with semi-major axis *a*?

    A) $-GMm/2a$

    B) $-GMm/a$

    C) $GMm/4a$

    D) $GMm/2a$

    E) $GMm/a$

18. A planet orbits around a star which is not at the center of its orbit. The shape of the orbit is most likely

    A) circular

    B) parabolic

    C) elliptical

    D) hyperbolic

    E) spherical

**Answer Key**
**Gravitational Force MC Questions [Mar 28, 2011]**

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

Name _____ Class _____ Date _____

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