

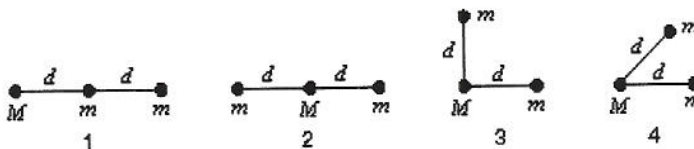
Chap 3

Name: \_\_\_\_\_ Date: \_\_\_\_\_

1. Given the perihelion distance, aphelion distance, and speed at perihelion of a planet, which of the following CANNOT be calculated?
  - A) the mass of the star
  - B) the mass of the planet
  - C) the speed of the planet at aphelion
  - D) the period of orbit
  - E) the semimajor axis of the orbit
  
2. The mass density of a certain planet has spherical symmetry but varies in such a way that the mass inside every spherical surface with center at the center of the planet is proportional to the radius of the surface. If  $r$  is the distance from the center of the planet to a point mass inside the planet, the gravitational force on the mass is:
  - A) not dependent on  $r$
  - B) proportional to  $r^2$
  - C) proportional to  $r$
  - D) proportional to  $1/r$
  - E) proportional to  $1/r^2$
  
3. A rocket ship is coasting toward a planet. Its captain wishes to know the value of  $g$  at the surface of the planet. This may be inferred by:
  - A) measuring the apparent weight of one of the crew
  - B) measuring the apparent weight of an object of known mass in the ship
  - C) measuring the diameter of the planet
  - D) measuring the density of the planet
  - E) observing the ship's acceleration and correcting for the distance from the center of the planet
  
4. A planet is in circular orbit around the Sun. Its distance from the Sun is four times the average distance of Earth from the Sun. The period of this planet, in Earth years, is:
  - A) 4
  - B) 8
  - C) 16
  - D) 64
  - E) 2.52

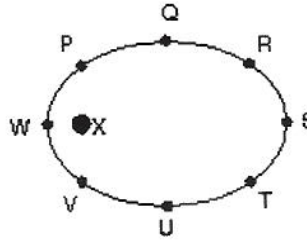
5. If Earth were to rotate only 100 times per year about its axis:
- A) airplanes flying west to east would make better time
  - B) we would fly off Earth's surface
  - C) our apparent weight would slightly increase
  - D) Earth's atmosphere would float into outer space
  - E) our apparent weight would slightly decrease
6. Venus has a mass of about 0.0558 times the mass of Earth and a diameter of about 0.381 times the diameter of Earth. The acceleration of a body falling near the surface of Venus is about:
- A)  $0.21 \text{ m/s}^2$
  - B)  $1.4 \text{ m/s}^2$
  - C)  $2.8 \text{ m/s}^2$
  - D)  $3.8 \text{ m/s}^2$
  - E)  $25 \text{ m/s}^2$
7. An artificial satellite of the Earth releases a bomb. Neglecting air resistance, the bomb will:
- A) strike Earth under the satellite at the instant of release
  - B) strike Earth under the satellite at the instant of impact
  - C) strike Earth ahead of the satellite at the instant of impact
  - D) strike Earth behind the satellite at the instant of impact
  - E) never strikes Earth
8. 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
9. The mass of an object:
- A) is slightly different at different locations on the 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
  - E) can be measured directly and accurately on a spring scale

10. Three particles, two with mass  $m$  and one 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.



- A) 1, 2, 3, 4  
 B) 2, 1, 3, 4  
 C) 2, 1, 4, 3  
 D) 2, 3, 4, 2  
 E) 2, 3, 2, 4
11. Suppose you have a pendulum clock which keeps correct time on Earth (acceleration due to gravity =  $9.8 \text{ m/s}^2$ ). Without changing the clock, you take it to the Moon (acceleration due to gravity =  $1.6 \text{ m/s}^2$ ). For every hour interval (on Earth) the Moon clock will record:
- A)  $(9.8/1.6) \text{ h}$   
 B)  $1 \text{ h}$   
 C)  $\sqrt{9.8/1.6} \text{ h}$   
 D)  $(1.6/9.8) \text{ h}$   
 E)  $\sqrt{1.6/9.8} \text{ h}$
12. A spherical shell has inner radius  $R_1$ , outer radius  $R_2$ , and mass  $M$ , distributed uniformly throughout the shell. The magnitude of the gravitational force exerted on the shell by a point particle of mass  $m$ , located a distance  $d$  from the center, outside the inner radius and inside the outer radius, is:
- A)  $0$   
 B)  $GMm/d^2$   
 C)  $GMm/(R_2^3 - d^3)$   
 D)  $GMm(d^3 - R_1^3)/d^2(R_2^3 - d^3)$   
 E)  $GMm/(d^3 - R_1^3)$

13. A planet travels in an elliptical orbit about a star X as shown. The magnitude of the acceleration of the planet is:



- A) greatest at point Q  
B) greatest at point S  
C) greatest at point U  
D) greatest at point W  
E) the same at all points
14. An artificial satellite of Earth nears the end of its life due to air resistance. While still in orbit:
- A) it moves faster as the orbit lowers  
B) it moves slower as the orbit lowers  
C) it slowly spirals away from Earth  
D) it moves slower in the same orbit but with a decreasing period  
E) it moves faster in the same orbit but with an increasing period
15. 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 the Earth is one of the two masses  
C) is greatest at the surface of the Earth  
D) is a universal constant of nature  
E) is related to the Sun in the same way that  $g$  is related to the Earth