

WORK, ENERGY, GPE, CENTRIPETAL ACCELERATION, ORBITS AND
GRAVITATIONAL FORCE
Review Booklet

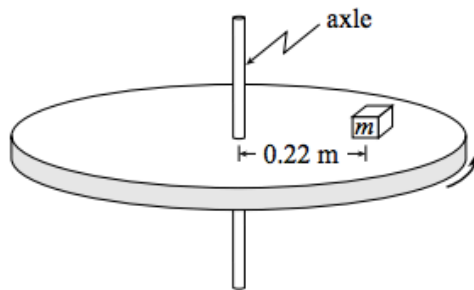
1.

A car completes a horizontal circle of radius r in time T . The same car then completes a larger horizontal circle of radius $2r$ in twice the time, $2T$. What is the ratio of the centripetal acceleration a_c for the car in the second circle to that in the first circle a_{c2}/a_{c1} ?

- A. $1/4$
- B. $1/2$
- C. $2/1$
- D. $4/1$

2.

An object of mass m is on a horizontal rotating platform. The mass is located 0.22 m from the axle and makes one revolution every 0.74 s .

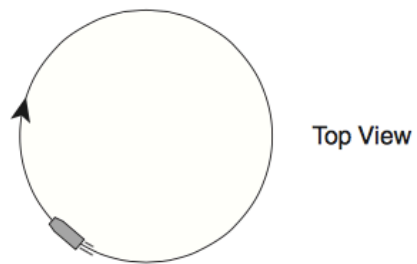


The friction force needed to keep the mass from sliding is 13 N . What is the object's mass?

- A. 0.82 kg
- B. 1.3 kg
- C. 2.7 kg
- D. 5.2 kg

3.

An object is in uniform horizontal circular motion.

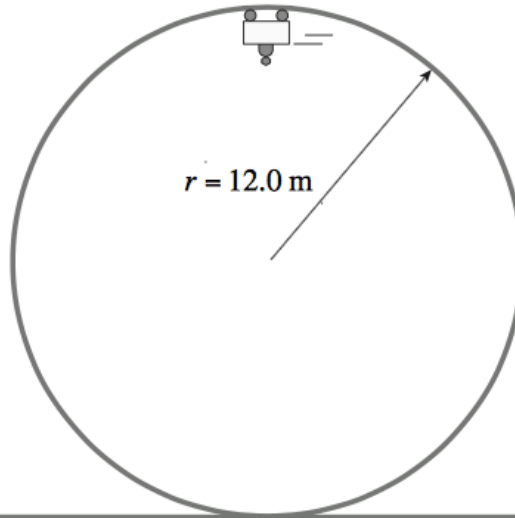


Which of the following shows the correct direction for the velocity, centripetal acceleration, and centripetal force on the object at the point shown?

	DIRECTION OF THE VELOCITY	DIRECTION OF THE CENTRIPETAL ACCELERATION	DIRECTION OF THE CENTRIPETAL FORCE
A.			
B.			
C.			
D.			

4.

A roller coaster car carrying a 75.0 kg man has a speed of 11.0 m/s at the top of a circular loop.



What is the normal force acting on the man at the top of the loop?

- A. 0.0 N
- B. 21 N
- C. 735 N
- D. 756 N

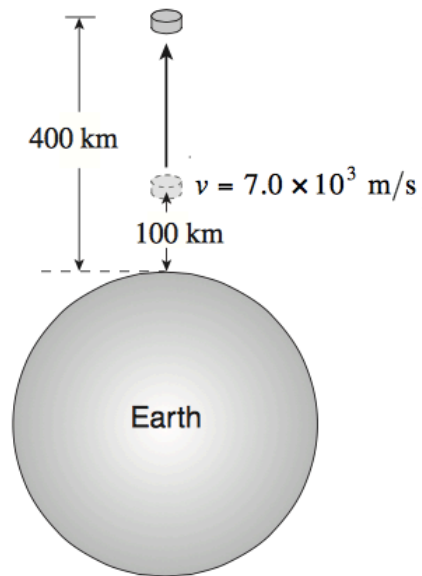
5.

Objects dropped near the surface of the moon fall with one sixth the acceleration of objects dropped near the surface of the earth. Which of the following is the correct value for the gravitational field strength at the moon's surface?

- A. 0.0027 N/kg
- B. 0.27 N/kg
- C. 1.6 N/kg
- D. 9.8 N/kg

6.

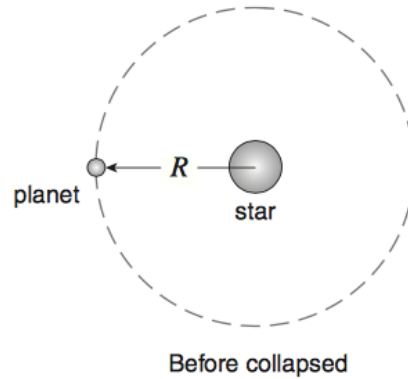
An unpowered 1600 kg object has an upward velocity of 7.0×10^3 m/s at an altitude of 100 km above the earth. The object reaches a maximum altitude of 400 km.



What is the heat energy generated during the object's increase in altitude from 100 km to 400 km?

7.

A planet is in an orbit of radius R around a star. The star collapses to $\frac{1}{10}$ of its original volume while maintaining all of its mass.

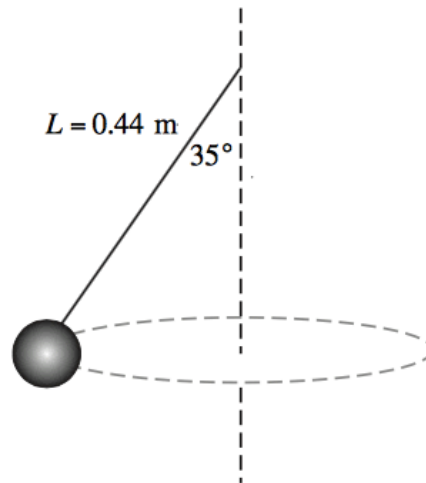


What happens to the centripetal acceleration, a_c , of the planet due to the collapse of the star?

- A. reduced to $\frac{1}{100}$ original a_c
- B. reduced to $\frac{1}{10}$ original a_c
- C. remains unchanged
- D. increased to $10 \times$ original a_c

8.
(5 marks)

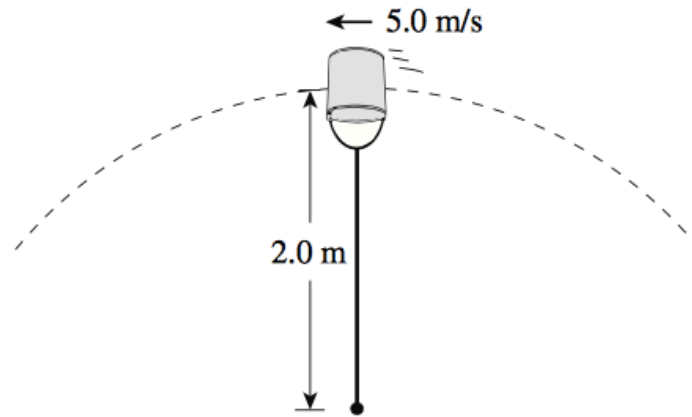
A blue ball is swung in a horizontal circle and completes a single rotation in 1.2 s.
The 0.44 m long cord makes an angle of 35° with the vertical during the ball's motion as shown.



What is the centripetal acceleration of the ball?

9.

A 4.0 kg bucket of paint tied to a rope is being swung in a vertical circle with a radius of 2.0 m. The speed of the bucket at the top of its swing is 5.0 m/s.



What is the tension in the rope at this point?

- A. 11 N
 - B. 39 N
 - C. 50 N
 - D. 89 N
-

10.

Two objects of unequal mass are dropped from the same height near the surface of the earth. Which of the following is the same for both objects just before they hit the surface? (Ignore friction.)

- A. velocity
- B. net force
- C. momentum
- D. kinetic energy

11.

What is the gravitational field strength on the surface of a moon with a mass of 3.7×10^{21} kg and a radius of 8.4×10^5 m ?

- A. 0.35 N/kg
- B. 9.8 N/kg
- C. 540 N/kg
- D. 2.9×10^5 N/kg

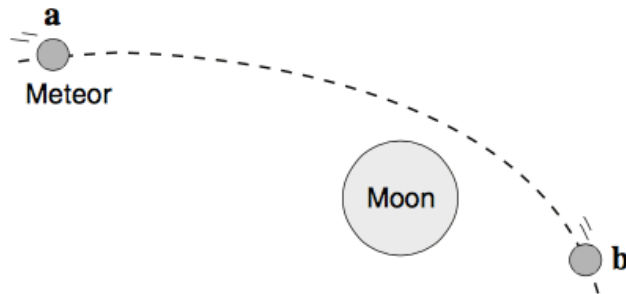
12.

What is the speed required to maintain a stable orbit around a planet of mass 2.5×10^{27} kg at a radius (from the centre of the planet) of 8.5×10^7 m ?

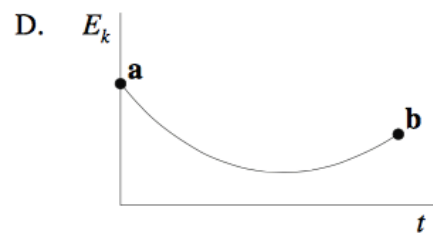
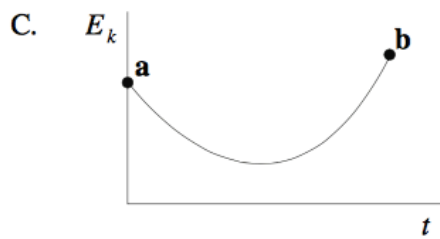
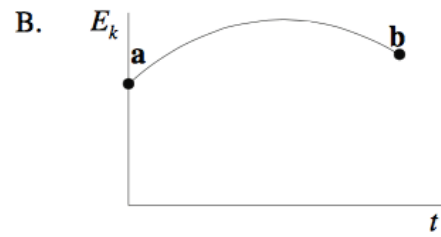
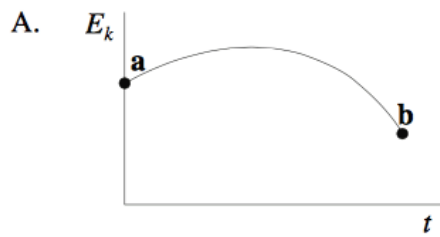
- A. 23 m/s
- B. 3.3×10^4 m/s
- C. 4.4×10^4 m/s
- D. 9.8×10^8 m/s

13.

A meteor passes by a moon as shown below.



Which E_k versus time graph best shows how the kinetic energy of the meteor changes from position **a** to position **b**?



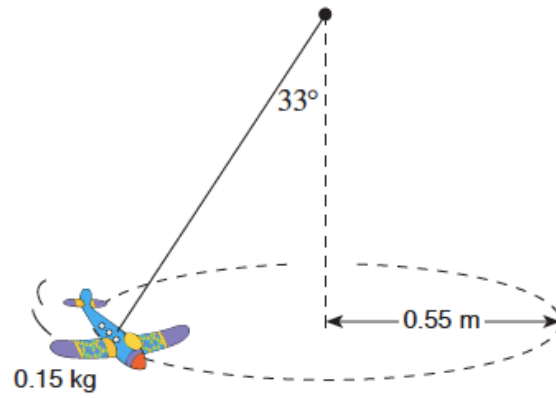
14.

A 5.0×10^4 kg moonlet travels in a circular path around a planet. The moonlet's orbital radius is 2.5×10^7 m and the orbital period is 3.7×10^5 s. What is the mass of the planet?

- A. 1.1×10^8 kg
- B. 6.8×10^{22} kg
- C. 3.4×10^{27} kg
- D. 2.5×10^{28} kg

15.

A 0.15 kg toy airplane is suspended as shown. It travels in a horizontal circle at a constant speed.

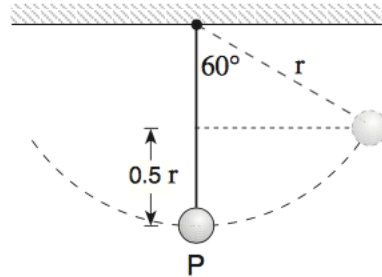


What is the period of the motion of this airplane?

- A. 0.84 s
- B. 1.6 s
- C. 1.8 s
- D. 2.0 s

16.

A small object of mass m is suspended from a fixed point by a light cord.

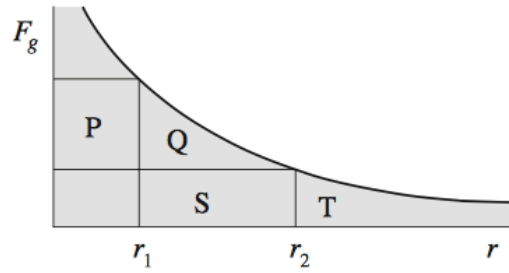


The object is raised to an angle of 60° and released from rest. The object moves in an arc of a circle as shown. When the object passes through its lowest position at point P , what is the tension in the cord in terms of the object's weight (mg)?

- A. $0.5 mg$
- B. $1.0 mg$
- C. $1.5 mg$
- D. $2.0 mg$

17.

The graph shows the gravitational force between the earth and an object as a function of the distance of separation, r , from the centre of the earth.



As the object is moved from r_1 to r_2 , what is the work done?

- A. Q
- B. Q+S
- C. P+Q
- D. Q+S+T

18.

A 200 kg object is released from rest at an altitude of 1.0×10^7 m. What is its impact speed with the earth? Assume no air resistance.

A. 7.0×10^3 m/s

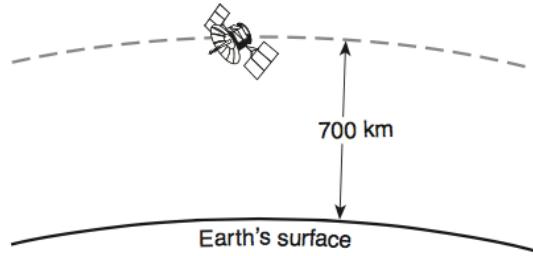
B. 8.7×10^3 m/s

C. 1.1×10^4 m/s

D. 1.4×10^4 m/s

19.

A 4.20×10^4 kg satellite orbits the earth at an altitude of 700 km (7.00×10^5 m).



a) What is the satellite's orbital speed at this altitude?

(4 marks)

b) What is the satellite's total energy at this altitude?

(3 marks)