

Concept-Development Practice Page

14-1

Satellite Motion

1. Figure A shows "Newton's Mountain," so high that its top is above the drag of the atmosphere. The cannonball is fired and hits the ground as shown.

- a. You draw the path the cannonball might take if it were fired a little bit faster.
- b. Repeat for a still greater speed, but still less than 8 km/s.
- c. Then draw the orbital path it would take if its speed were 8 km/s.
- d. What is the shape of the 8 km/s curve?

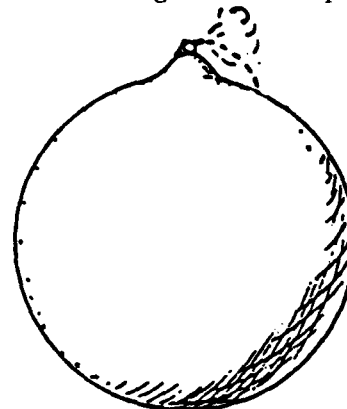


Figure A

- e. What would be the shape of the orbital path if the cannonball were fired at a speed of about 9 km/s?

2. Figure B shows a satellite in circular orbit.

- a. At each of the four positions draw a vector that represents the gravitational *force* exerted on the satellite.
- b. Label the force vectors F .
- c. Then draw at each position a vector to represent the *velocity* of the satellite at that position, and label it V .
- d. Are all four F vectors the same length? Why or why not?

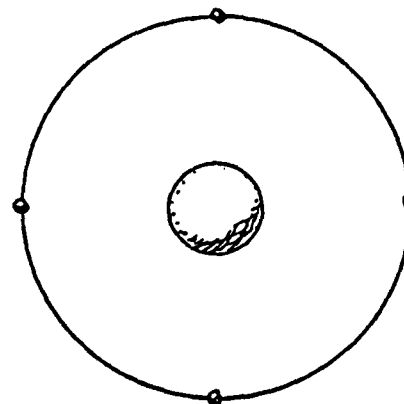


Figure B

- e. Are all four V vectors the same length? Why or why not?

- f. What is the angle between your F and V vectors? _____
- g. Is there any component of F along V ? _____
- h. What does this tell you about the work the force of gravity does on the satellite?

- i. Does the KE of the satellite in Figure B remain constant, or does it vary? _____
- j. Does the PE of the satellite remain constant, or does it vary?

3. Figure C shows a satellite in elliptical orbit.

a. Repeat the procedure you used for the circular orbit, drawing vectors F and V for each position, including proper labeling. Show equal magnitudes with equal lengths, and greater magnitudes with greater lengths, but don't bother making the scale accurate.

b. Are your vectors F all the same magnitude? Why or why not?

c. Are your vectors V all the same magnitude? Why or why not?

d. Is the angle between vectors F and V everywhere the same, or does it vary?

e. Are there places where there is a component of F along V ?

f. Is work done on the satellite when there is a component of F along and in the same direction of V and if so, does this increase or decrease the KE of the satellite?

g. When there is a component of F along and opposite to the direction of V , does this increase or decrease the KE of the satellite?

h. What can you say about the sum $KE + PE$ along the orbit?

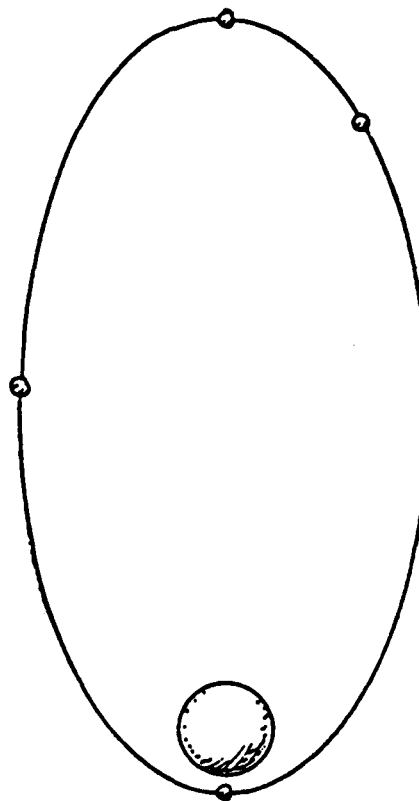


Figure C