CIRCULAR ORBIT

Gravitational force, orbital speed, and orbital radius

Name: ______________________________	Period: ____________	Date: ______________

INVESTIGATION QUESTION **What tangential speed produces a circular orbit at a given radius?**

TIME	SIMULATION	UNIT 2
30 minutes	BuildPhysics > Circular orbit	Force & Translational Dynamics

Learning targets

- Classify orbital paths produced by different initial tangential speeds.
- Find circular speeds at several orbital radii.
- Connect gravity with centripetal acceleration.

Model before you measure

The satellite begins 4.5 m from the central body. The baseline circular speed is approximately 3.0 m/s in the simulation scale.	$F_g = mv^2/r$ $v_c^2 r = \text{constant}$

Important: Gravity toward the central body supplies the centripetal force. Use $g = 9.8$ m/s² only for near-Earth problems; this preset uses its own central gravitational field.

Pre-lab prediction | 4 minutes

1. What happens if the satellite's tangential speed is slightly less than circular speed?

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2. What happens if the speed is slightly greater but still below escape speed?

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3. If orbital radius increases, should circular speed increase or decrease?

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PART A Change tangential speed and classify the path

Setup | 3 minutes

- ☐ Load Circular orbit. Turn on trails and select the satellite.
- ☐ Keep the starting radius at 4.5 m and set $v_x = 0$. Change only the positive tangential v_y.
- ☐ Reset, run long enough to reveal the path, and classify it.
- ☐ Estimate the smallest and largest radius from the grid or radial readout.

Data table | 10 minutes

Initial tangential speed (m/s)	Minimum radius (m)	Maximum radius (m)	Path classification
2.2			
3.0			
3.6			
4.2			
4.5			

Trail sketches | 3 minutes

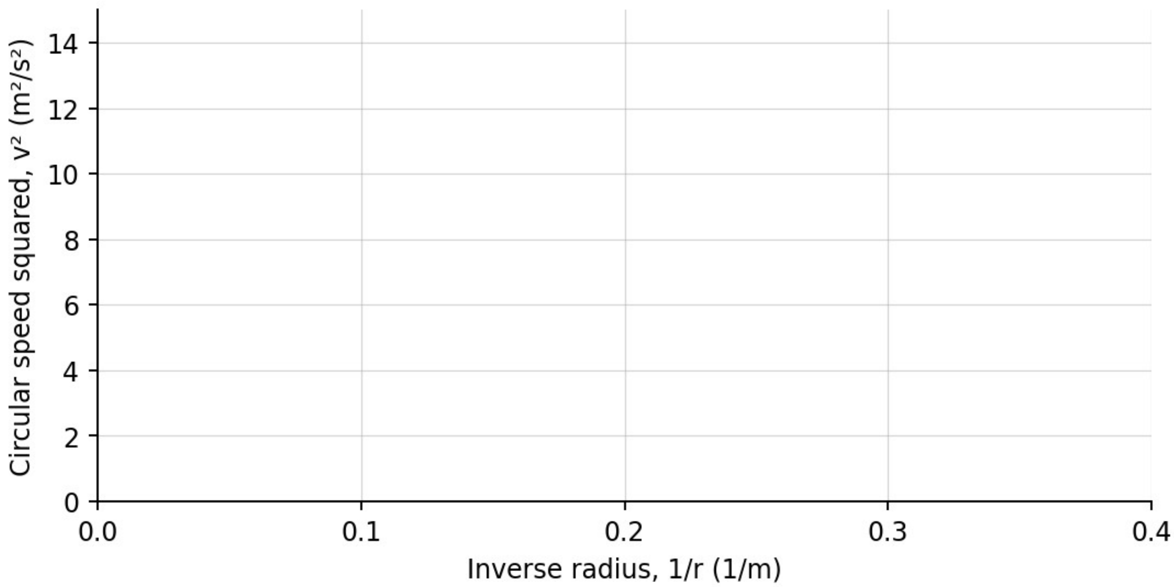
Below circular speed	Circular speed	Above circular speed
Sketch	Sketch	Sketch

PART B Change radius and find circular speed

Radius test | 8 minutes

Procedure: Place the satellite at each radius on the +x side of the central body. Adjust positive v_y until the trail is approximately circular.

Radius r (m)	Circular speed v (m/s)	v^2 (m^2/s^2)	1/r (1/m)	v^2r
3.0				
4.5	3.0			
6.0				
8.0				



4. Plot v^2 versus 1/r. Draw a best-fit line.

Analysis | 6 minutes

5. What path occurred below, at, and above circular speed?

6. What does the slope of the v^2-versus-1/r graph represent for this central body?

7. Why is the satellite accelerating even when its orbital speed is constant?

Claim-Evidence-Reasoning conclusion

Evaluate this statement: “A satellite farther from the central body must move faster to remain in a circular orbit.”

CLAIM	Accept, reject, or revise the statement.
EVIDENCE	Cite at least two measurements or graph features.
REASONING	Connect your evidence to the force model and Newton's laws.

Exit ticket

If the orbital radius doubles around the same central body, by what factor does the circular speed change?