ENERGY IN A LOOP

Speed, gravitational potential energy, and maintaining contact

Name: ____________________________	Period: ____________	Date: ______________

INVESTIGATION QUESTION **How do release height and position in the loop affect speed and contact force?**

TIME	SIMULATION	UNIT 3
30 minutes	BuildPhysics > Energy in a loop	Work, Energy & Power

Learning targets

- Track energy at the bottom, side, and top of a vertical loop.
- Use energy conservation to predict speed changes.
- Determine the release condition needed to complete the loop.

Model before you measure

The car moves on a frictionless track. At the top, gravity and the normal force can both point toward the loop center.	$E_{mech} = K + U_g$ Top: $mg + F_N = mv_{top}^2/r$

Important: Use $g = 9.8\ m/s^2$. A car remains in contact only while the track can exert a nonnegative normal force.

Pre-lab prediction | 4 minutes

1. Where should the car's speed be greatest: bottom, side, or top?

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2. At the top, what condition corresponds to the car being just barely in contact?

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3. Predict how increasing release height changes speed at the top.

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PART A Compare energy at four loop locations

Setup | 3 minutes

- ☐ Load Energy in a loop. Keep friction off and turn on system energy totals.
- ☐ Graph speed, kinetic energy, gravitational potential energy, and normal force.
- ☐ Run and pause near the loop bottom, right side, top, and left side.
- ☐ Record the car's height, speed, energies, and normal force at each position.

Data table | 10 minutes

Location	Height (m)	Speed (m/s)	Kinetic energy (J)	Gravitational PE (J)	Normal force (N)
Bottom					
Right side					
Top					
Left side					

Position comparison | 3 minutes

4. Rank the four locations from greatest to least speed and explain using energy.

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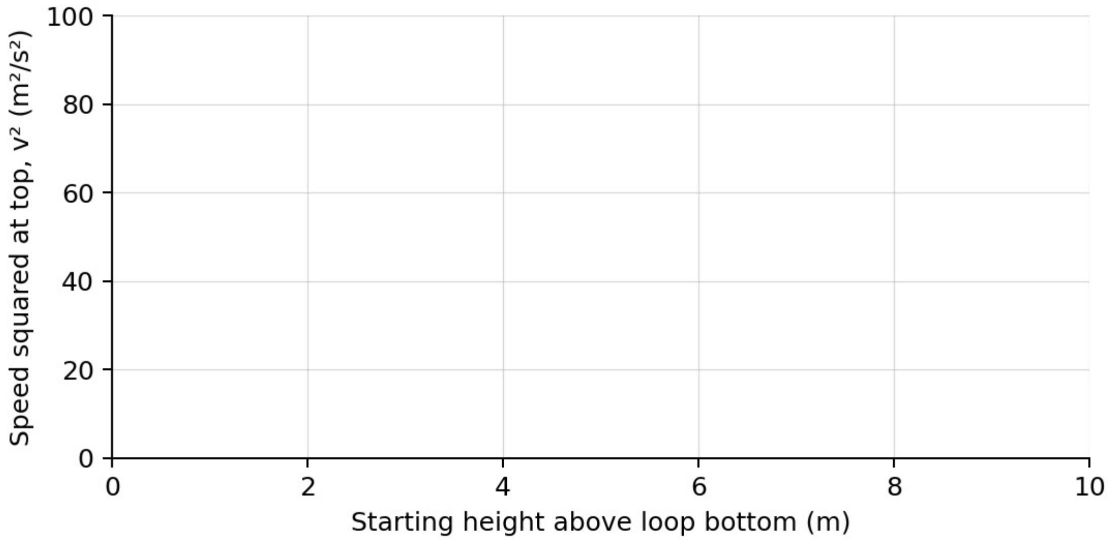
PART B Change release height and test loop completion

Release-height test | 8 minutes

Procedure: Move the car to several starting heights on the approach, release from rest, and record whether it remains on the track through the top.

Trial	Starting height (m)	Completes loop?	Top speed (m/s)	Top normal force (N)
1				
2				
3				
4				



5. Plot top speed squared versus starting height for successful trials. Draw a best-fit line.

Analysis | 6 minutes

6. What did the slope of your graph represent?

7. Why was speed greatest at the bottom and least at the top?

8. What happened to the top normal force as release height was reduced?

9. Explain why a car can have nonzero speed at the top but still lose contact.

Claim-Evidence-Reasoning conclusion

Evaluate this claim: Any car that reaches the top of the loop will necessarily remain in contact with the track.

CLAIM	Accept, reject, or revise the statement.
EVIDENCE	Cite at least two measured trials or graph features.
REASONING	Connect your evidence to the energy model and controlled variables.

Exit ticket

At the top of a loop of radius r, write the minimum-speed condition for just maintaining contact.