SHM-UNO: Educational Card Game Documentation

# 1. Introduction

SHM-UNO is an educational adaptation of the classic UNO card game designed to teach and reinforce the principles of Simple Harmonic Motion (SHM). The game integrates key physics concepts into familiar UNO mechanics, making learning interactive, engaging, and enjoyable.

# 2. Learning Objectives

Through playing SHM-UNO, students will be able to:

- Explain Simple Harmonic Motion (SHM).  
- Use the displacement equation: y(t) = A sin(ωt).  
- Use velocity and acceleration equations as functions of displacement or time.  
- Calculate kinetic energy (KE) and potential energy (PE) in SHM.  
- Relate amplitude with energy (KE, PE, and TME).  
- Analyze displacement-time, velocity-time, acceleration-time, and energy-time graphs.  
- Use the period equation for SHM and pendulum systems.

# 3. Deck Structure (54 Cards)

The SHM-UNO deck consists of 54 cards, divided into four colors representing SHM quantities, action cards, and wild cards.

## 3.1 Colors and Meanings

🔴 Red = Displacement  
🔵 Blue = Velocity  
🟢 Green = Acceleration  
🟡 Yellow = Energy

## 3.2 Number/Quantity Cards (40 total)

Each color has 5 unique values, with 2 copies each:  
  
Red (Displacement): +A, +A/2, 0, –A/2, –A  
Blue (Velocity): +v\_max, 0, –v\_max, +v\_half, –v\_half  
Green (Acceleration): +a\_max, 0, –a\_max, +a\_half, –a\_half  
Yellow (Energy): KE=0, KE max, PE=0, PE max, TME constant

## 3.3 Action Cards (10 total)

- 2× Period Reset (Skip): Next player is skipped unless they recall the SHM period equation.  
- 2× Oscillation Reversal (Reverse): Reverses play order.  
- 2× Amplitude Boost (+2): Next player draws 2 cards unless they explain the amplitude–energy relationship.  
- 2× Graph Challenge: Next player must identify a graph type (displacement-time, velocity-time, etc.).  
- 2× Formula Check: Ask an opponent to recall displacement, velocity, or acceleration equations.

## 3.4 Wild Cards (4 total)

- 2× Energy Exchange (Wild): Player chooses the next color/quantity.  
- 2× Resonance (Wild +4): Next player draws 4 cards unless they solve a mini SHM problem.

# 4. Gameplay Rules

1. Setup: Each player is dealt 7 cards. Place one card face up to start the pile. Remaining cards form the draw pile.  
2. Turn Order: On your turn, play a card that matches the top card by color (quantity type) or value (state).  
3. If You Cannot Play: Draw 1 card from the draw pile. If playable, put it down. Otherwise, keep it.  
4. Action & Wild Cards: Follow the physics challenge written on the card. Correct answers avoid penalties.  
5. UNO Rule: When you have one card left, shout 'SHM!' Failure results in drawing 2 cards.  
6. Winning: First to discard all cards wins, but must also correctly explain the meaning of their final card.

# 5. SHM Learning Rule

Whenever a player places a card, they must state its SHM meaning. Example:  
Playing 'Displacement = +A': The player says, 'At +A, displacement is maximum, velocity = 0, acceleration is maximum negative.'

# 6. Example Challenges

- Period Reset (Skip): State the period equation for a simple pendulum.  
- Amplitude Boost (+2): Explain how doubling amplitude affects energy (Energy ∝ A²).  
- Graph Challenge: Identify the point where velocity = 0 on a displacement-time graph.  
- Resonance (Wild +4): Solve: If A = 0.2 m, ω = 10 rad/s, what is v\_max? (Answer: 2.0 m/s).

# 7. Mapping to Learning Outcomes

- Explain SHM through constant card interpretation.  
- Use SHM equations when responding to formula checks.  
- Link displacement, velocity, and acceleration through card plays.  
- Relate KE, PE, and TME using Energy cards.  
- Connect amplitude with energy using Amplitude Boost.  
- Interpret graphs using Graph Challenge cards.  
- Apply SHM and pendulum period equations via Period Reset.

# 8. Conclusion

SHM-UNO transforms learning physics into an interactive game experience. By embedding SHM concepts into UNO gameplay, students practice problem-solving, interpret equations, and reinforce conceptual understanding while enjoying a competitive activity.