Duration: 50 minutes
Show all your work for full/partial credit!
Include the correct units in your final answers for full credit!
Unless otherwise stated, quote your results in SI units!
1.) **Multiple Choice**  
(25 pts.)
For each statement below, circle the correct answer (TRUE or FALSE, no reasoning required).

(a) If a car takes a turn on a road without sliding, the static friction force between tires and road acts as a centripetal force.  
TRUE  FALSE

(b) Since work depends on force and displacement, it is a vector quantity.  
TRUE  FALSE

(c) The normal force is a nonconservative force.  
TRUE  FALSE

(d) The acceleration of an object in simple harmonic motion is largest when the object’s speed is zero.  
TRUE  FALSE

(e) When a tennis ball is thrown at a wall and bounces back with the same speed, the impulse on that ball by the wall is zero.  
TRUE  FALSE

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2.) *Circular Motion* (15 pts.)

Assume the Moon (mass $M_M=7.35\times10^{22} kg$) to be in a circular orbit around Earth (mass $M_E=6\times10^{24} kg$) at a distance of 384000 km. Calculate the period of the Moon's revolution around Earth (in days).
3.) *Mechanical Energy and Nonconservative Work*  
(20 pts.)
A skier starts from the top of a 8 m high hill. With an initial speed of 1.5 m/s he glides down the frictionless slope to the bottom.

(a) What is the skier’s speed at the bottom?

(b) At the bottom, he encounters a rough horizontal ice patch of length 12 m. The kinetic friction coefficient between the rough ice and the skis is 0.25. What is the speed of the skier after passing the ice patch?
4.) *Gravitation and Simple Harmonic Motion* (20 pts.)

Consider a simple pendulum on the Moon’s surface. The Moon’s radius and mass are $R_M=1740\, km$ $M_M=7.35\times10^{22}\, kg$.

(a) Using Newton’s Law of gravitation, calculate the acceleration due to gravity, $g_M$, on the Moon’s surface.

(b) What should be the length of a simple pendulum which has a period of 1s on the Moon’s surface?
5. 2-D Inelastic Collision (20 pts.)
An incoming bowling ball \( (m_1=5\text{kg}, v_{i1}=4\text{m/s due East}) \) collides with a billiard ball \( (m_2=0.8\text{kg}) \) initially at rest. After the collision, the bowling ball is deflected by 6 degrees North of East, with a final speed of 3.7m/s. Calculate the speed and direction of motion (the angle South of East) of the billiard ball after the collision.