Kuwait University Physics Department

جامعة الكويت
KUWAIT UNIVERSITY

Physics 101

Summer Semester

Final Exam

Monday, August 4, 2025

12:00 – 14:00

Student's Name: ……. Serial Number: ……

Student's Number: ……Section: ……

Choose your Instructor's Name:

Instructors: Drs. Al Dosari, Al Jassar, Al Qattan, Al Smadi, Salameh, Zaman

For Instructors use only

Grades:

#	SP1	SP2	SP3	SP4	SP5	SP6	SP7	LP1	LP2	LP3	Q1	Q2	Q3	Q4	Total
Pts	3	3	3	3	3	3	3	5	5	5	1	1	1	1	40

Important:

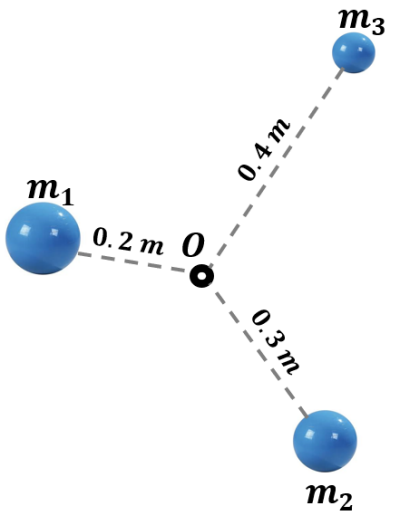
1. Answer all questions and problems (No solution = no points).
2. Full mark = 40 points as arranged in the above table.
3. **Give your final answer in the correct units.**
4. Assume g = 10 m/s^2.
5. Mobiles are **strictly prohibited** during the exam.
6. Programmable calculators, which can store equations, are not allowed.
7. **Cheating incidents will be processed according to the university rules.**

GOOD LUCK

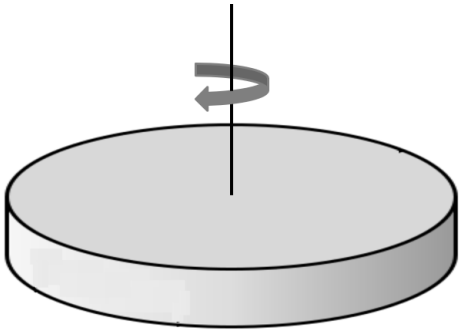
Part I: Short Problems (3 points each)

SP1. A particle moves along the x-axis. Its position is given by $x(t) = t^2 - 6t + 8$, where x is in m and t is in s. **Find the average velocity of the particle during the interval from $t = 1\ s$ to $t = 4\ s$.**

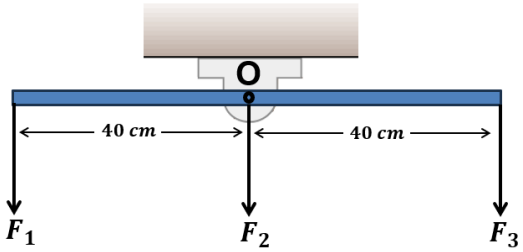
SP2. Three small masses $m_1 = 0.3\ kg$, $m_2 = 0.2\ kg$, and $m_3 = 0.1\ kg$ are rotating about **a vertical axis passing through point O** with an angular speed of $\omega = 40\ rad/s$, as shown. **Find the rotational kinetic energy of the system**.



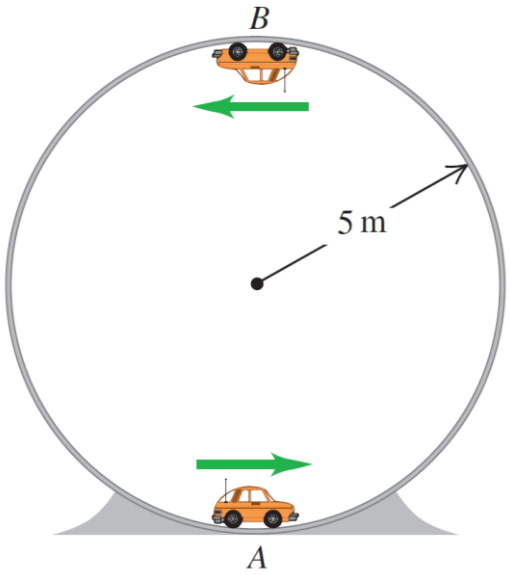
SP3. A solid disk begins rotating with an angular speed of 12 rad/s. It slows down **uniformly** until it stops in 60 s. **How many revolutions does the disk complete during this time?**



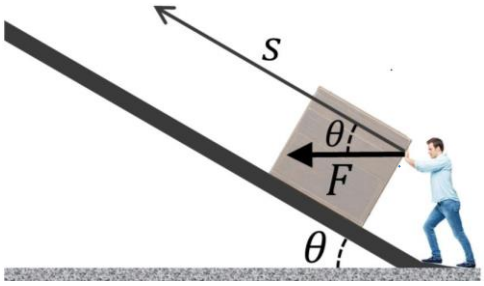
SP4. A uniform, massless rod of length $l = 80\ cm$ is attached to a frictionless pivot at point O and is free to rotate about this point. Three forces $F_1 = 200\ N$, $F_2 = 400\ N$, and $F_3 = 300\ N$ are applied, as shown. As the system starts rotating, **find the magnitude and direction of the initial net torque acting on the rod about the pivot point.**



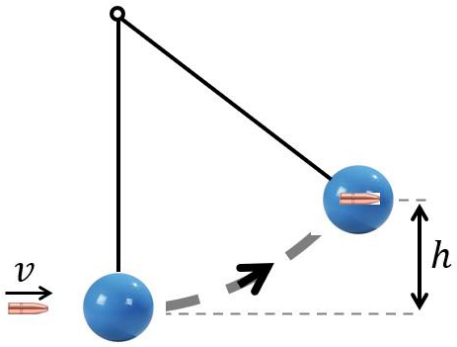
SP5. A 2 kg toy car travels at **constant speed** on the inside of a track that is a **vertical circle** with a radius of $R = 5\ m$, as shown. If the normal force exerted on the car at **point B** is $n = 5.6\ N$, **how much time does it take the car to complete one revolution around the track?**



SP6. A man pushes a box up a **frictionless** incline ($\theta = 40°$) with a constant **horizontal force** of $F = 50\ N$, as shown. If the box moves a distance $s = 3\ m$ at **constant speed**, find the **work done by gravity** on the box.



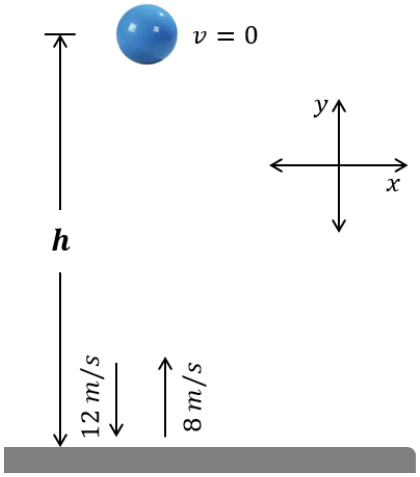
SP7. A bullet of mass $m = 10\ g$ moves at a speed v and makes a **completely inelastic collision** with a stationary ball of mass $M = 0.59\ kg$, which is suspended by a light rope, as shown. After the impact, the ball swings in a vertical circle to a **maximum height** of $h = 20\ cm$. Find the **bullet's speed v before the impact**.



Part II: Long Problems (5 points each)

LP1. A 0.5 kg ball is released **from rest** from a height h above the ground. It strikes the ground with a speed of 12 m/s and rebounds vertically upward with a speed of 8 m/s, as shown. Ignore air resistance.

a) Find the height *h* from which the ball was released.

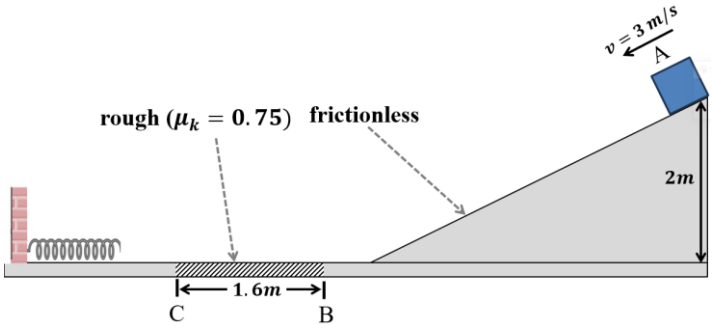


b) Calculate the impulse ($\vec{J}$) exerted by the ground on the ball during the impact, in unit vector notation.

c) If the ball was in contact with the ground for 0.01 s, **find the average net force exerted on the ball by the ground in unit vector notation**.

LP2. A small block of mass $m = 0.4\,Kg$ starts moving **at point A with a speed of 3 m/s**. Its path is frictionless except the region between points B and C, as shown. At the end of the path **a relaxed** spring of force constant $k = 500\ N/m$ is attached to a wall.

a) Find the speed of the block at point B.

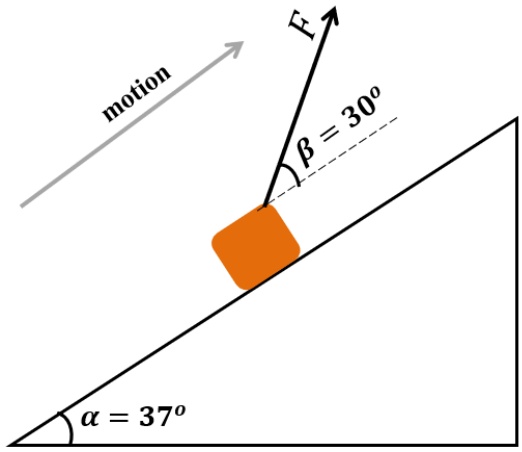


b) Find the speed of the block at point C.

c) Find the maximum compression of the spring.

LP3. A 20 kg block slides up a rough inclined plane ($\mu_k = 0.5$) under the action of a constant force of magnitude $F = 220N$, as shown.

a) Draw the free body diagram of the block.

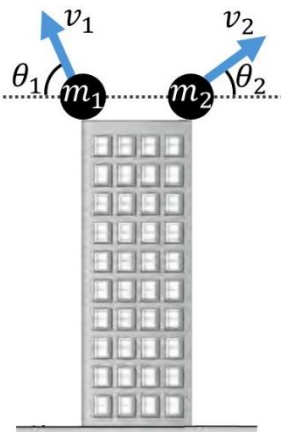


b) Find the magnitude of the friction force acting on the block.

c) Find the acceleration of the block.

Part III: Questions (Choose the correct answer, one point each)

Q1. Two balls with masses m_1 and m_2 are projected from the **same height** at the top of a building, as shown. If both balls **reach the ground with the same speed**, **which of the following is true about their initial projection speeds?** (Ignore air resistance)



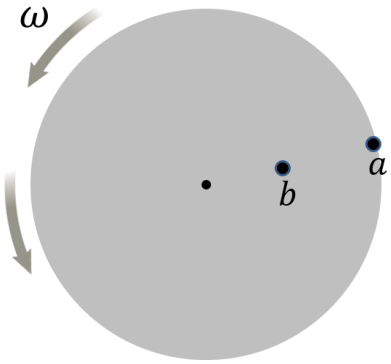
* $v_1 = v_2$
* $v_1 > v_2$
* $v_1 < v_2$
* Cannot tell with the given information

Q2. A small car collides head-on with a large truck. **Which of the following statements correctly describes the magnitude of the average force exerted during the collision?**

* The truck experiences a greater average force.
* The small car experiences a greater average force.
* The small car and the truck experience equal average forces.
* It is impossible to determine without knowing the masses.

Q3. A solid disk rotates about its center with an angular speed ω. Two points (a and b) are marked on its surface as shown. **Which of the following statements is correct?**

* $\omega_a = \omega_b$ and $v_a < v_b$
* $\omega_a = \omega_b$ and $v_a > v_b$
* $\omega_a < \omega_b$ and $v_a = v_b$
* $\omega_a > \omega_b$ and $v_a = v_b$



Q4. The velocity versus time for a particle moving along the x-axis is shown in the figure. **Which of the following statements is correct about its speed?**

* It always increases.
* It always decreases.
* It increases and then decreases.
* It decreases and then increases.