Kuwait University Physics Department

جامعة الكويت
KUWAIT UNIVERSITY

Physics 101

Fall Semester

Final Exam

Monday, December 29, 2025

3:00 PM – 5:00 PM

Student's Name: ……. Serial Number: ……

Student's Number: ……Section: ……

Choose your Instructor's Name:

Instructors: Drs. Al Dosari, Al Jassar, Al Qattan, Al Smadi, Askar, Demir, 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:

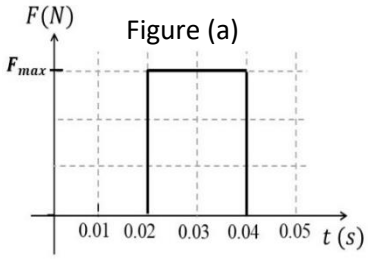
1. Answer all questions and problems (No solution = no points).
2. Full mark = 40 points as arranged in the above table.
3. **Give your final answer in the correct units.**
4. Assume g = 10 m/s^2.
5. Mobiles are **strictly prohibited** during the exam.
6. Programmable calculators, which can store equations,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

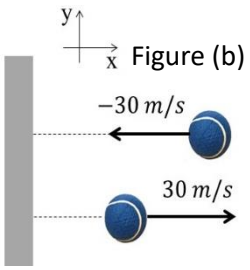
GOOD LUCK

Part I: Short Problems (3 points each)

SP1. A dog runs in a park. Its position vector (in meters) is given by $\vec{r}(t) = (8t + 0.6t^3)\,\hat{\imath} + 2t^2\,\hat{\jmath}$, where t is measured in seconds. **Find the magnitude of the dog's acceleration (in m/s^2) at $t = 2$ s.**

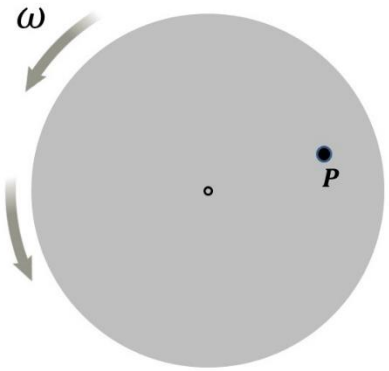
SP2. Figure (a) shows the force–time graph for the collision of a 0.2 kg ball with a vertical wall. The ball moves initially straight toward the wall at **30 m/s** and **rebounds back with the same speed** in the opposite direction, as shown in Figure (b). **Find the maximum contact force F_{max} (in N) during the collision**.



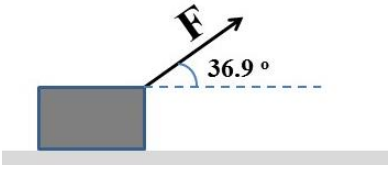


SP3: A 0.5 kg object has a velocity $\vec{v} = \left(6\hat{\imath} - 4\hat{\jmath} + 3\hat{k}\right)\,m/s$ and a position vector $\vec{r} = \left(2\hat{\imath} + 4\hat{\jmath} + 2\hat{k}\right)\,m$. **Find the angular momentum ($\vec{L}$) of the object about the origin in unit vector notation**.

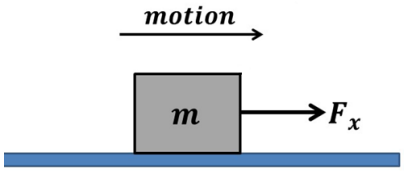
SP4. A disc rotates at a **<u>constant</u> angular speed** of 120 rev/min. **Find the radial (**a_{rad}**) and tangential (**a_{tan}**) components of the acceleration** of point **P** located at 60 cm from the axis of rotation?



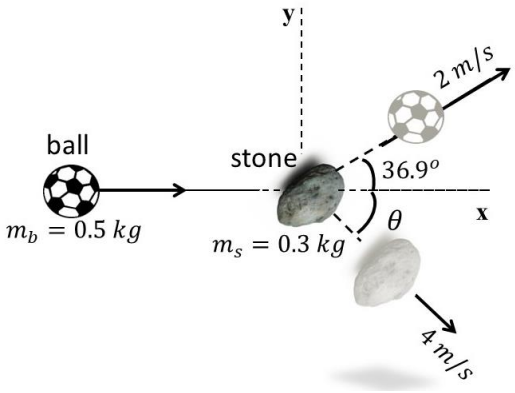
SP.5 A 50 kg box rests on a rough horizontal surface. The **minimum force** required to start moving the box is $|\vec{F}| = 200$ N, applied in the direction shown in the figure. **Calculate the coefficient of static friction (μ_s) between the box and the surface.**



SP6: A box moves to the right on a horizontal **frictionless** surface under the influence of a net force which varies with position according to the relation $F_x = (6x^2 - 2x)$ N, where $\boldsymbol{x}$ is in meters. **Find the total work (in $\boldsymbol{J}$) done on the box as it moves from $\boldsymbol{x = 0}$ to $\boldsymbol{x = 4}$ m.**

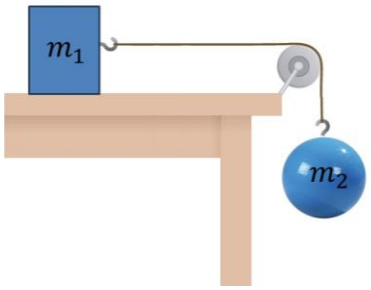


SP7. A ball $(m_b = 0.5\ kg)$ **traveling along the x-axis** collides with a stone $(m_s = 0.3\ kg)$ that **rests** on a frictionless horizontal surface. After the collision, the ball and the stone move as shown in the figure. **Find the angle $\boldsymbol{\theta}$.**



Part II: Long Problems (5 points each)

LP1. A block ($m_1 = 4$ kg) rests on a horizontal **frictionless** surface is connected to a ball ($m_2 = 6$ kg) by a massless rope that passes over a frictionless pulley ($I = 0.05\ kg \cdot m^2$, $R = 0.1\ m$), as shown.



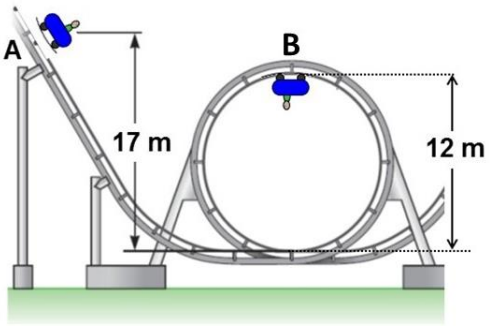
a) If the system is released from rest, find the speed of the ball after it has fallen 0.5 m.

b) Find the angular speed of the pulley at that instant.

c) Find the total kinetic energy <u>of the system</u> at that instant.

LP2. A 150 kg roller coaster car starts from **rest at point A** and slides down the loop-the-loop shown.

a) If the speed of the car at point B is 8 m/s, **find the work done by friction on the car as it moves from A to B.**

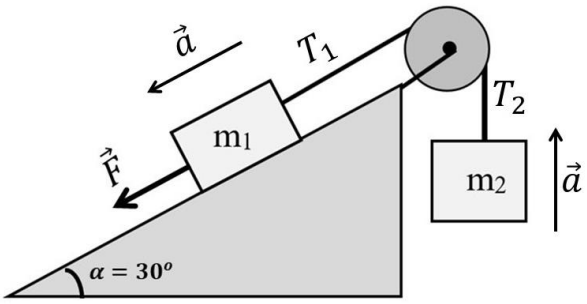


b) Find the normal force exerted on the car at point B?

c) Find the total work done on the car as it moves from A to B.

LP3. Two blocks ($m_1 = 12\ kg$, $m_2 = 6\ kg$) are connected by a light rope that passes over a frictionless pulley of radius $R = 0.1\ m$ and moment of inertia (I). The incline is **frictionless.** A constant force $|\vec{F}| = 40\ N$ acts on block m_1, as shown. The two blocks accelerate in the indicated direction with $|\vec{a}| = 1.2\ m/s^2$.

a) Find the tension T_1 in the segment of the rope attached to mass m_1.



b) Find the tension T_2 in the segment of the rope attached to mass m_2.

c) Find the moment of inertia of the pulley (I).

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

Q1. If $\vec{A}$ and $\vec{B}$ are **nonzero vectors** and $\vec{A} \cdot \vec{B} = 0$, then which of the following **is always true**.

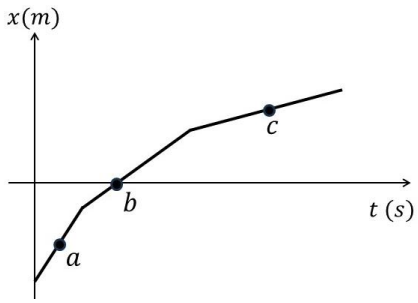
* $\vec{A}$ is parallel to $\vec{B}$.
* $|\vec{A} \times \vec{B}| = |\vec{A}||\vec{B}|$
* $|\vec{A} \times \vec{B}| = 1$
* $|\vec{A} \times \vec{B}| = 0$

Q2. When two objects of different masses collide, **the magnitudes of the impulses they exert on each other are:**

* equal for all collisions
* equal only for elastic collisions
* equal only for inelastic collisions
* always unequal

Q3: The graph shows the position of a particle moving along the x-axis as a function of time. If v_a, v_b, and v_c represent the speeds of the particle at points **a**, **b**, and **c**, respectively, then:

* $v_c > v_b > v_a$
* $v_c > v_a > v_b$
* $v_a > v_c > v_b$
* $v_a > v_b > v_c$



Q4. The angular velocity versus time graph for a point on the rim of a disk rotating about its center is shown. **At which instant of time does the point have the maximum radial acceleration (a_{rad})?**

* t_1 * t_2 * t_3 * t_4