

Physics 101

Spring Semester

Final Exam

Tuesday, May 20, 2025

05:00 PM – 7:00 PM

Student's Name: Serial Number:

Student's Number:Section:

Choose your Instructor's Name:

Instructors: Drs. Al Dosari, Alkurtass, Al Qattan, Al Refai, 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
	3	3	3	3	3	3	3	5	5	5	1	1	1	1	40
Pts															

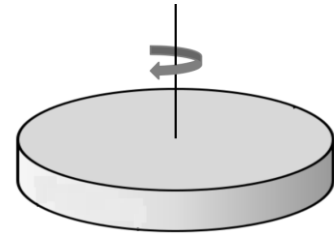
Important:

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 $g = 10 \text{ m/s}^2$.
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.**

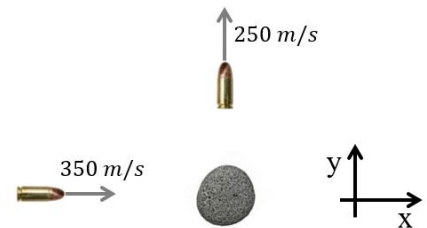
GOOD LUCK

Part I: Short Problems (3 points each)

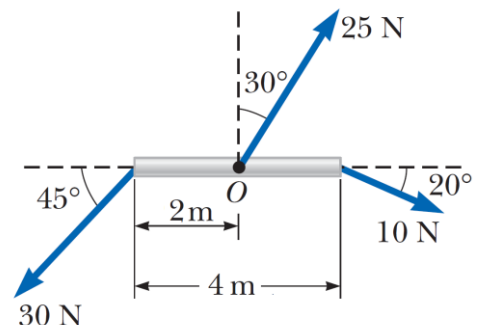
SP1. A wheel starts rotating from **rest** with a constant angular acceleration of 4 rad/s^2 . **Find the number of revolutions of the wheel during the first 5 seconds.**



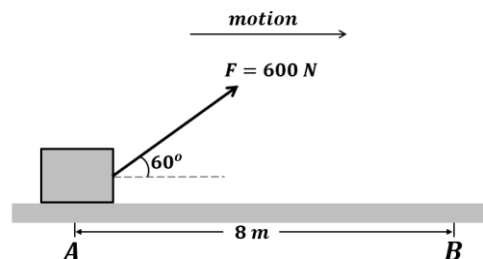
SP2. A 0.1 kg stone **rests** on a frictionless **surface in the xy-plane**. A bullet of mass 6 g , traveling along the x-axis at 350 m/s , strikes the stone and rebounds **horizontally at a right angle** to its original direction with a speed of 250 m/s , as shown. **Find the velocity of the stone after it is struck in unit vector notation.**



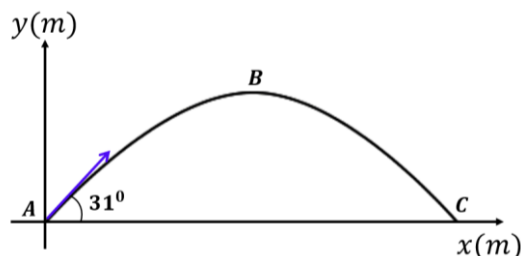
SP3. Calculate the **net torque (magnitude and direction)** on the beam shown in the figure about an axis through point **O** perpendicular to the page. The beam and the three forces lie in **the plane of the page**.



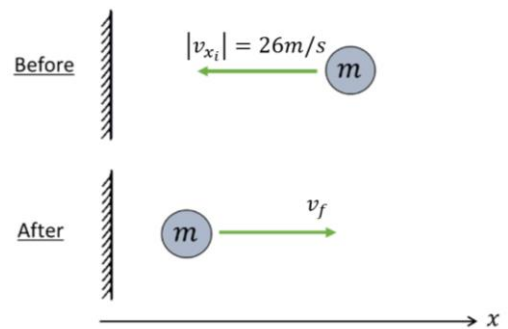
SP4. A force ($F = 600\text{N}$) is applied to a block moving with constant velocity on a **rough** horizontal surface, as shown. **Find the work done by the frictional force** on the block as it moves from point A to point B.



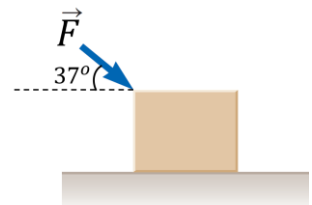
SP5. A stone is projected from the ground at point A and reaches point C after 1.44 seconds. If the speed of the stone at its **maximum height** (point B) is 12 m/s, **find its velocity at point C** (just before it hits the ground) **in unit vector notation**.



SP6. A ball of mass $m = 0.34 \text{ kg}$ is thrown against a brick wall and rebounds **horizontally**, as shown. The **time of contact** between the ball and the wall is 0.01 s and the magnitude of the **average force** exerted on the ball during the impact is 1600 N . **Find the final velocity of the ball.**



SP7. A block of mass $m = 12 \text{ kg}$ is pushed by a force $F = 150 \text{ N}$ on a horizontal **rough surface**, as shown. The coefficient of kinetic friction between the block and the surface is $\mu_k = 0.5$. **Find the acceleration of the block.**



Part II: Long Problems (5 points each)

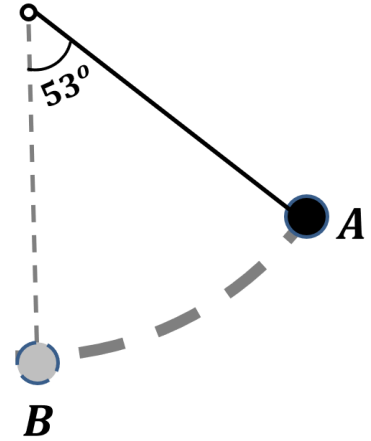
LP1. A 4 kg stone is moving in the $xy - \text{plane}$, its position vector as a function of time is given by

$$\vec{r}(t) = [(14 + 16t)\hat{i} - (3t)\hat{j}]m, \text{ where } t \text{ is measured in seconds.}$$

- a) **Find the linear momentum of the stone in unit vector notation.**
- b) **Find the net force exerted on the stone.**
- c) At a later time, the stone explodes into two fragments of equal mass. If the velocity of the first fragment immediately after the explosion is $\vec{v}_1 = [13\hat{i} - 5\hat{j}]m/s$, **find the velocity of the second fragment just after the explosion in unit vector notation.**

LP2. A light rope of length 2 m is suspended from the ceiling, and a 4 kg ball is attached to its lower end, forming a **simple pendulum**, as shown. The ball is **released from rest** at point A.

a) Find the tension in the rope at point A.

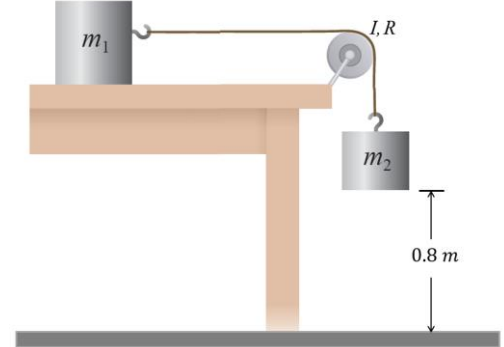


b) Find the speed of the ball at point B.

c) Find the work done by tension on the ball as it moves from point A to point B.

LP3. Two boxes ($m_1 = 12\text{ kg}$, $m_2 = 18\text{ kg}$) are attached by a light rope that passes over a pulley ($I = 5\text{ kg} \cdot \text{m}^2$, $R = 0.4\text{ m}$), as shown. **The tabletop is rough.** The system is released from **rest** when m_2 is 0.8 m above the ground. Just before m_2 hits the ground, its speed is 2 m/s .

- a) Find the angular speed (ω_f) of the pulley just before m_2 hits the ground.



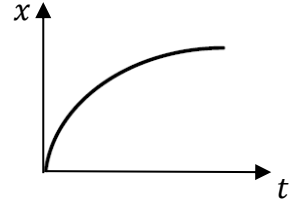
- b) Find the coefficient of kinetic friction (μ_k) between the tabletop and m_1 .

- c) Find the total work done on m_1 during this motion.

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

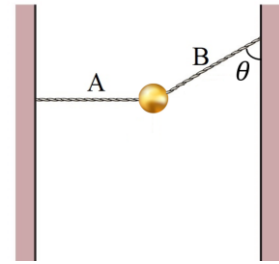
Q1. The graph of position versus time for a car is given below. What can you say about **the speed of the car** over the shown period of time?

- * it speeds up all the time.
- * it slows down all the time.
- * it moves at a constant speed.
- * it sometimes speeds up and sometimes slows down.



Q2: A ball of mass m is **held** in place by light steel cables. Cable B makes an angle θ with the wall, as shown. **The tension in cable A equals**

- * mg
- * $mg \sin \theta$
- * $mg \cos \theta$
- * $mg \tan \theta$



Q3: Two **identical balls** are dropped from the **same height**. **Ball A** lands on a **hard surface** and bounces back, while **Ball B** lands on a **soft surface** and comes to rest without bouncing. **Which ball experiences the greater impulse (\vec{J}) during the collision with the surface?**

- * Ball A.
- * Ball B.
- * Both balls experience the same impulse.
- * Neither ball experiences impulse.

Q4. A block of mass m slides along a track, as shown. The track is frictionless except for the lower section, which is rough. The block comes to a stop over a distance D due to friction. If the block is replaced by another block of mass M (where $M > m$), the stopping distance D will

- * increase
- * decrease
- * stay the same

