YTU Physics Department 2024-2025 Fall Semester			
FIZ1001 PHYSICS-1 Make up Final exam			
Question Sheet	**AAAAAA**	**29/01/2025 15.00-17.00**	**100 m**

Name		The 9th article of Student Disciplinary Regulations of YÖK Law No.2547 states "**Cheating or helping to cheat or attempt to cheat in exams**" de facto perpetrators take **one or two semesters suspension** penalty. Students are NOT permitted to bring **calculators, mobile phones, smart watches** and/or any other unauthorized **electronic devices** into the exam room.
Surname		
Student No		
Group/Saloon		
Signature		

θ	0^0	30^0	37^0	45^0	53^0	60^0	90^0	
sin	0	1/2	3/5	$\sqrt{2}/2$	4/5	$\sqrt{3}/2$	1	$g = 10\, m/s^2$
cos	1	$\sqrt{3}/2$	4/5	$\sqrt{2}/2$	3/5	1/2	0	$\pi = 3$

$\vec{\bar{v}} = \frac{\Delta \vec{r}}{\Delta t}$; $\vec{\bar{a}} = \frac{\Delta \vec{v}}{\Delta t}$; $\vec{v} = \frac{d\vec{r}}{dt}$; $\vec{a} = \frac{d\vec{v}}{dt}$; $\vec{v} = \vec{v}_0 + \vec{a}t$; $\vec{r} = \vec{r}_0 + \vec{v}_0 t + \frac{1}{2}\vec{a}t^2$; $v^2 = v_0^2 + 2\vec{a}\cdot(\vec{r} - \vec{r}_0)$; $F_r = m\frac{v^2}{r}$; $F_s = -kx$

$f_s \le \mu_s N$; $f_k = \mu_k N$; $P = \vec{F}\cdot\vec{v}$; $W = \Delta K$; $W = \int \vec{F}\cdot d\vec{r}$; $\bar{P} = \frac{\Delta W}{\Delta t}$; $\vec{F}_{con} = -\frac{dU}{dr}\hat{r}$; $W_{con} = -\Delta U$; $W = \Delta U + \Delta K$;

$U = mgy$; $U = \frac{1}{2}kx^2$; $\vec{F} = \frac{d\vec{p}}{dt}$; $\vec{p} = m\vec{v}$; $\vec{I} = \Delta\vec{p} = \vec{\bar{F}}\Delta t$; $\vec{r}_{cm} = \frac{\sum m_i \vec{r}_i}{\sum m_i}$; $\vec{r}_{cm} = \frac{\int \vec{r}\, dm}{\int dm}$; $\vec{\bar{\omega}} = \frac{\Delta\vec{\theta}}{\Delta t}$; $\vec{\bar{\alpha}} = \frac{\Delta\vec{\omega}}{\Delta t}$; $\vec{\omega} = \frac{d\vec{\theta}}{dt}$; $\vec{\alpha} = \frac{d\vec{\omega}}{dt}$;

$\vec{\omega} = \vec{\omega}_0 + \vec{\alpha}t$; $\vec{\theta} = \vec{\theta}_0 + \vec{\omega}_0 t + \frac{1}{2}\vec{\alpha}t^2$; $\omega^2 = \omega_0^2 + 2\alpha(\theta - \theta_0)$; $a_t = r\alpha$; $\vec{\tau} = \vec{r}\times\vec{F}$; $\vec{\tau}_0 = I_0\vec{\alpha}$; $K_{rot} = \frac{1}{2}I\omega^2$; $I = \int r^2 dm$

$I = I_{cm} + MD^2$; $I_{disc=cylinder} = \frac{1}{2}mr^2$; $I_{sphere} = \frac{2}{5}mr^2$; $I_{plate} = \frac{1}{12}m(a^2 + b^2)$; $P = \vec{\tau}\cdot\vec{\omega}$; $W = \int \vec{\tau}\cdot d\vec{\theta}$; $\vec{L} = \vec{r}\times\vec{p}$ $\vec{L} = I\vec{\omega}$

$\vec{\tau} = \frac{d\vec{L}}{dt}$; $\vec{\bar{\tau}} = \frac{\Delta\vec{L}}{\Delta t}$ $v_{cm} = R\omega$; $x(t) = A\cos(\omega t + \varphi)$; $T = \frac{1}{f}$; $\omega = 2\pi f$; $E = \frac{1}{2}kA^2$; $T = 2\pi\sqrt{l/g}$; $T = 2\pi\sqrt{m/k}$; $T = 2\pi\sqrt{I/mgh}$

1) Which of the following/followings can be considered as one of the conservative force types?

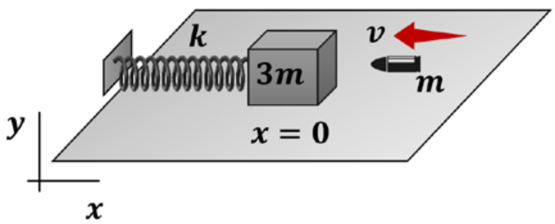
I. Friction force II. Fluid resistance III. Gravitational force IV. Spring force

A) II, III, IV B) III, IV C) III D) I, II, III E) IV

2) Given that "K" is kinetic energy and "p" is linear momentum, which of the following correctly expresses the relationship between linear momentum, mass, and kinetic energy?

A) $p = 2Km$ B) $p = \sqrt{2K}m$ C) $p = \sqrt{2Km}$ D) $p = 2K/m$ E) $p = \sqrt{2K}/m$

Questions 3-6 A massless spring with a spring constant of k is placed on a frictionless horizontal plane, with one end attached to a wall and the other end connected to a block of mass 3m. A bullet of mass m is fired with velocity v and strikes the block, initially at rest at x=0.



3) Since the bullet and block move together immediately after the collision, what is the velocity of the center of mass of the system in terms of unit vectors?

A) $-\frac{2v}{3}\,\hat{\imath}$ B) $-\frac{v}{2}\,\hat{\imath}$ C) $\frac{v}{5}\,\hat{\imath}$ D) $-\frac{v}{4}\,\hat{\imath}$ E) $\frac{3v}{4}\,\hat{\imath}$

4) What is the amplitude of the resulting simple harmonic motion?

A) $\left(\frac{v}{4}\right)\sqrt{\frac{3m}{k}}$ B) $\left(\frac{v}{2}\right)\sqrt{\frac{m}{k}}$ C) $v\sqrt{\frac{m}{k}}$ D) $2v\sqrt{\frac{m}{3k}}$ E) $v\sqrt{\frac{3m}{5k}}$

5) How long does it take for the block to return to its initial position at x=0 for the first time?

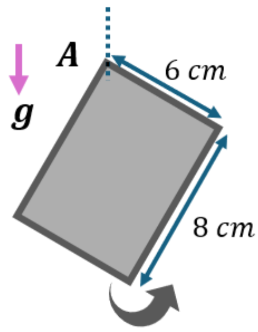
A) $\sqrt{\frac{\pi m}{k}}$ B) $2\pi\sqrt{\frac{m}{k}}$ C) $\pi\sqrt{\frac{m}{k}}$ D) $2\sqrt{\frac{\pi m}{k}}$ E) $\pi\sqrt{\frac{m}{4k}}$

6) What is the maximum acceleration of the block?

A) $\frac{v}{8}\sqrt{\frac{k}{m}}$ B) $2v\sqrt{\frac{k}{m}}$ C) $8v\sqrt{\frac{k}{m}}$ D) $v\sqrt{\frac{k}{8m}}$ E) $v\sqrt{\frac{k}{4m}}$

Questions 7-8 A uniform plate with dimensions $6\ cm \times 8\ cm$ weighs 15 N.

7) When the plate is lifted and held at corner A, it begins to oscillate with a small amplitude. What is the moment of inertia of the plate about point A in the SI unit system?



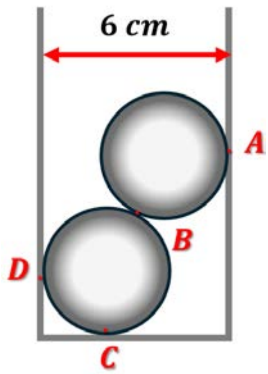
A) 0.01 B) 100 C) 0.05 D) 0.005 E) 10

8) What is the angular frequency of the rectangular plate for small oscillations in the SI unit system?

A) $5\sqrt{6}/2$ B) $5\sqrt{6}/3$ C) $10\sqrt{6}$ D) $5\sqrt{6}$ E) $5\sqrt{6}/6$

Questions 9-11 Two identical marbles with a mass of m and a diameter of 4 cm, are in equilibrium inside a cylindrical container with a radius of 3 cm as shown in the figure. Point B is the contact point between the two marbles.

9) What is the reaction force exerted by the side wall (A) on the upper marble in terms of mg?



A) $\sqrt{3}/3$
B) $3\sqrt{3}$
C) $2\sqrt{3}$
D) $1/\sqrt{2}$
E) $2\sqrt{2}$

10) What is the reaction force between the marbles at the contact point (B) in terms of mg?

A) $\sqrt{2/3}$
B) $\sqrt{3}$
C) $2\sqrt{3}/3$
D) $3\sqrt{1/2}$
E) $2\sqrt{2}$

11) What is the reaction force exerted by the container's bottom (C) on the lower marble in terms of mg?

A) $3/\sqrt{2}$
B) 1
C) 2
D) $\sqrt{3/2}$
E) $1/\sqrt{2}$

Questions 12-14
A stone with a weight of 10N has a position vector given by $\vec{r}(t) = (3t^2 + 25t + 7)\hat{\imath} - 4t^3\hat{\jmath}$ here r is in meters and t is in seconds.
12) What is the velocity vector of the stone 2 seconds after it starts its motion?

A) $37\,\hat{\imath} - 48\,\hat{\jmath}$
B) $37\,\hat{\imath} + 48\,\hat{\jmath}$
C) $33\,\hat{\imath} - 36\,\hat{\jmath}$
D) $37\,\hat{\imath} - 36\,\hat{\jmath}$
E) $31\,\hat{\imath} + 48\,\hat{\jmath}$

13) What is the angular momentum of the stone about its initial position 2 seconds after it starts its motion, in the SI unit system?

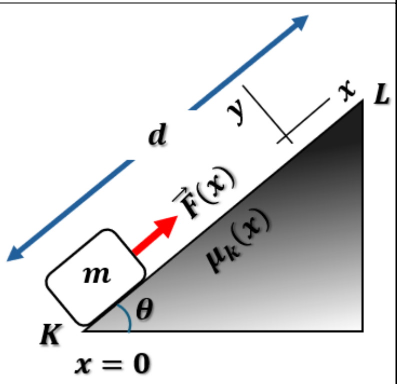
A) $-1792\,\hat{k}$
B)$-3186\,\hat{k}$
C) $4160\,\hat{k}$
D) $-4160\,\hat{k}$
E) $2976\,\hat{k}$

14) What is the average torque acting on the stone in the first two seconds, relative to the point where the motion initially started, in the SI unit system?

A) $-448\,\hat{k}$
B)$-896\,\hat{k}$
C) $1344\,\hat{k}$
D) $-1344\,\hat{k}$
E) $448\,\hat{k}$

Questions 15-17 A mass m moves at a constant speed along the path KL on a rough inclined plane, being pulled by a force F acting parallel to the inclined plane. The coefficient of kinetic friction between the mass and the inclined plane is given as $\mu_k(x) = 0.3x^2 + 0.02$ olarak verilmiştir.
15) What is the work done by the net force acting on the mass m?

A) $3\frac{mgd}{5}$ B) $\frac{mgdsin\theta}{50}$ C) 0 D) $\frac{3mgdsin\theta}{10}$ E) $\frac{mgdsin\theta}{5}$



16) What is the force F(x) acting on the mass m?

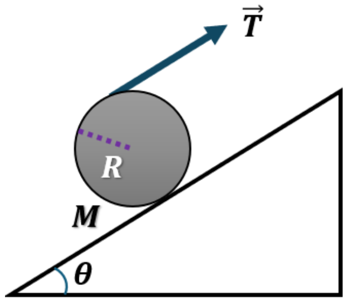
A) $mg(sin\theta + (0.3x^2 + 0.02)cos\theta)$
B) $mg(0.3x^2 + 0.02)$
C) $mgsin\theta(0.3x^2 + 0.02)$

D) $mgcos\theta(0.3x^2 + 0.02)$
E) $mgcos\theta$

17) What is the work done by the force F(x) as the mass m travels the distance d from point K to point L?

A) $mgd(sin\theta + (0.3d^3 + 0.02)cos\theta)$
B) $mgd\left(sin\theta + (0.3d^2 + 0.02)\right)$
C) $mgd(0.3d^2 + 0.02)cos\theta$
D) $mgd(sin\theta + (0.3d^2 + 0.02)cos\theta)$
E) $mgd(sin\theta + (0.1d^2 + 0.02)cos\theta)$

Questions 18-19 A 500 g coil with a radius of 20 cm rolls without slipping along a rough inclined plane at an angle of $\theta = 37^0$ to the horizontal, pulled by a wire wrapped around the coil.



18) What is the tension force on the wire if the coil is in equilibrium?

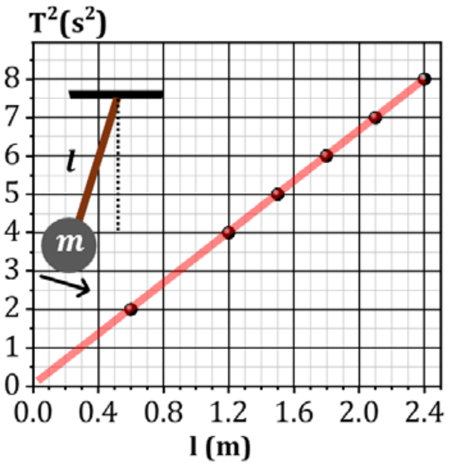
A) 3/2 B) 3 C) 1/2 D) 2/5 E) 2

19) What is the acceleration of the coil in terms of the tension force on the wire if the coil gains a constant acceleration?

A) $\frac{T}{8M} + 2$ B) $\frac{3T}{2M}$ C) $\frac{4T}{3M} - 4$ D) $\frac{6T}{5M}$ E) $\frac{9T}{4M} + 1$

20) LABORATORY QUESTION

In a simple pendulum experiment, the periods for small oscillations of a pendulum with a mass of 5 kg are measured for varying pendulum string lengths, and $T^2 = f(l)$ is observed. Which of the following statements is correct?



A) Assuming $g = 10\ m/s^2$, the relative error is 0.4 %.
B) If the same experiment is performed on Mars, the period values will remain unchanged.
C) Increasing the pendulum's mass m will increase the frequency of oscillations.
D) The length of the pendulum string is directly proportional to the frequency of oscillations.
E) Assuming $g = 9.8\ m/s^2$ the absolute error is $100\ cm/s^2$.