YTU Physics Department 2019-2020 Fall Semester		Exam Date: 13.01.2020	Exam Duration: 90 min.
FIZ1001 PHYSICS-1 Retake Exam		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.	
Question Sheet	**A A A A A**		
Name Surname			
Student No			
Physics Group No			
Department			
Exam Hall		**Student Signature:**	
Instructor's Name Surname			

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

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

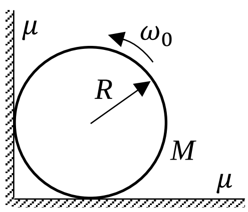
$W = \Delta U + \Delta K$; $U = mgy$; $U = \frac{1}{2}kx^2$; $\vec{F} = \frac{d\vec{p}}{dt}$; $\vec{p} = m\vec{v}$; $\vec{I} = \Delta\vec{p} = \vec{\bar{F}}\Delta t$; $\vec{r}_{cm} = \frac{\sum m_i \vec{r}_i}{\sum m_i}$; $\vec{r}_{cm} = \frac{\int \vec{r} dm}{\int dm}$; $\vec{\bar{\omega}} = \frac{\Delta\vec{\theta}}{\Delta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

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

$K_{rot} = \frac{1}{2}I\omega^2$; $I = \int r^2 dm$; $I = I_{cm} + MD^2$; $P = \vec{\tau}\cdot\vec{\omega}$; $W = \int \vec{\tau}\cdot d\vec{\theta}$; $\vec{L} = \vec{r}\times\vec{p}$; $\vec{L} = I\vec{\omega}$; $\vec{\tau} = \frac{d\vec{L}}{dt}$; $\vec{\bar{\tau}} = \frac{\Delta\vec{L}}{\Delta t}$

$v_{cm} = R\omega$; $x(t) = A\cos(\omega t + \varphi)$; $T = \frac{1}{f}$; $\omega = 2\pi f$

Questions 1-2 As shown in the figure, a homogen cylinder with mass of M and radius R is slowly left to the corner as it rotates around its axis with an angular velocity ω_0. Friction coefficient between the wall and the surface of the cylinder and between the floor and the surface of the cylinder is μ.



1) Find the magnitude of the angular acceleration of the cylinder. $I_{cm} = \frac{1}{2}MR^2$

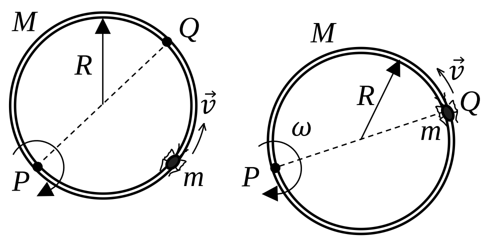
A) $\frac{\mu g(1+\mu)}{2R(1+\mu^2)}$ B) $\frac{2\mu g(1-\mu)}{R(1+\mu^2)}$ C) $\frac{2\mu g(1-\mu)}{R(1-\mu^2)}$ D) $\frac{\mu g(1+\mu)}{2R(1-\mu^2)}$ E) $\frac{2\mu g(1+\mu)}{R(1+\mu^2)}$

2) How many cycles has the cylinder made until it stops?

A) $\frac{R(1+\mu^2)\omega_0{}^2}{8\pi\mu g(1+\mu)}$ B) $\frac{R(1+\mu^2)\omega_0{}^2}{8\pi\mu g(1-\mu)}$ C) $\frac{R(1-\mu^2)\omega_0{}^2}{8\pi\mu g(1+\mu)}$ D) $\frac{R(1-\mu^2)\omega_0{}^2}{16\pi\mu g(1+\mu)}$ E) $\frac{R(1+\mu^2)\omega_0{}^2}{16\pi\mu g(1+\mu)}$

Questions 3-4 A circle with mass M and radius R can rotate freely around point P on the frictionless plane. A bug with mass m runs along the circle with speed $\vec{v}$ with <u>respect to the circle</u> as shown in the figure.

3) Find the angular velocity of the circle when the bug reaches diametrically opposite to the point P (point Q).



A) $\frac{mv}{(M+2m)R}$ B) $\frac{2mv}{(M+3m)R}$ C) $\frac{2mv}{(M+2m)R}$ D) $\frac{2mv}{\left(M+\frac{1}{3}m\right)R}$ E) $\frac{mv}{(M+m)R}$

4) Find the linear velocity of the bug <u>relative to the plane</u> when the bug reaches to the point Q.

A) $\frac{mv}{(M+m)}$ B) $\frac{2mv}{(M+3m)}$ C) $\frac{Mv}{M+2m}$ D) $\frac{2mv}{\left(M+\frac{1}{3}m\right)}$ E) $\frac{2mv}{(M+2m)}$

Questions 5-6-7 The velocity components of a particle with mass m=0.5 (kg) moving in the x-y plane are given by $v_x = 11 + 2t$ (m/s) and $v_y = 5$ (m/s). The particle is at the origin at t=0.

5) At t=1 second, how many meters is the particle far away from the origin?

A) 15 **B)** 12 **C)** 11 **D)** 14 **E)** 13

6) Find the work done by the net force on the particle within the time interval t=0 to t=1 (s) in Joule.

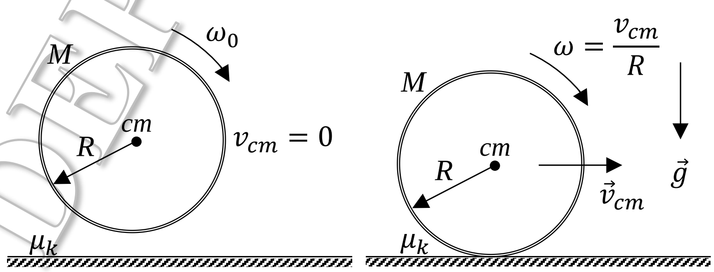
A) 17 **B)** 5 **C)** 12 **D)** 15 **E)** 24

7) Find the tangential acceleration of the particle in t=1 second in unit of (m/s^2)?

A) $\frac{36}{\sqrt{194}}$ **B)** $\frac{26}{\sqrt{194}}$ **C)** $\frac{16}{\sqrt{184}}$ **D)** $\frac{52}{\sqrt{146}}$ **E)** $\frac{6}{\sqrt{184}}$

Questions 8-9 A circle with radius R and mass M is slowly left onto the horizontal frictional ground while rotating at an angular velocity ω_0.

8) How soon does the ball start to <u>roll without sliding</u>?



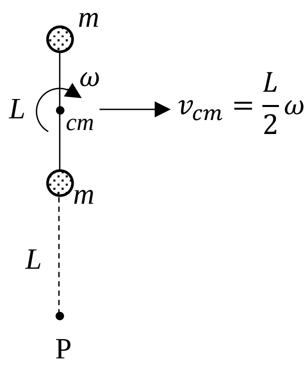
A) $\frac{\omega_0 R}{2\mu_k g}$ **B)** $\frac{4\omega_0 R}{3\mu_k g}$ **C)** $\frac{2\omega_0 R}{5\mu_k g}$ **D)** $\frac{2\omega_0 R}{3\mu_k g}$ **E)** $\frac{3\omega_0 R}{5\mu_k g}$

9) What is the speed of the center of mass when rolling?

A) $\frac{4\omega_0 R}{3}$ **B)** $\frac{2\omega_0 R}{5}$ **C)** $\frac{3\omega_0 R}{5}$ **D)** $\frac{\omega_0 R}{2}$ **E)** $\frac{\omega_0 R}{3}$

Questions 10-11 The two point masses in the figure rotate around the center of mass at an angular velocity ω on the frictionless ground connected to each other by a massles rigid rod with L-length and atthe same time it is being moved by $v_{cm} = \frac{L}{2}\omega$

10) Find the total moment of inertia of the two masses relative to the axis perpendicular to the page plane and passing through point P.



A) $\frac{3}{2}mL^2$ **B)** $\frac{5}{2}mL^2$ **C)** $5mL^2$ **D)** mL^2 **E)** $\frac{7}{2}mL^2$

11) Find the magnitude of the total angular momentum of the masses relative to point P.

A) $3mL^2\omega$ **B)** $\frac{11}{2}mL^2\omega$ **C)** $4mL^2\omega$ **D)** $\frac{13}{2}mL^2\omega$ **E)** $\frac{3}{2}mL^2\omega$

Questions 12-13-14 The position of an object in simple harmonic motion is given by $x(t) = 0.16\cos(\omega t + \varphi)$ (m). If the period of the motion is 32 (s) and its position is x(0)=0.08 (m) at t = 0;

12) Find the angular frequency ω in (rad/s). (Take π=3)

A) $\frac{3}{8}$ **B)** $\frac{1}{32}$ **C)** $\frac{3}{16}$ **D)** $\frac{1}{8}$ **E)** 3

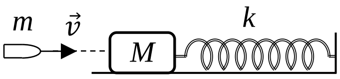
13) Find the phase difference φ in rads.

A) $\frac{1}{6}$ **B)** 2 **C)** $\frac{1}{2}$ **D)** $\frac{1}{4}$ **E)** 1

14) Find the maximum velocity in (m/s).

A) 0.03 **B)** 0.06 **C)** 0.48 **D)** 0.05 **E)** 0.02

Questions 15-16 A bullet with a mass of m=0.05 (kg) and a velocity of v = 200 (m/s) is stuck into a wooden block of M = 0.95 (kg), which is connected to a spring with a constant k = 64 (N/m) standing in a frictionless horizontal plane.



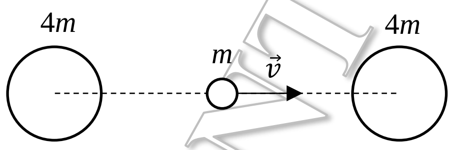
15) Find the angular frequency of the resulting harmonic motion in unit of (rad/s).

A) $16\sqrt{5}$ **B)** $4\sqrt{3}$ **C)** 64 **D)** 8 **E)** 16

16) Find the amplitute of the harmonic motion in meters.

A) $\frac{\sqrt{5}}{8}$ **B)** 1.25 **C)** $\frac{1}{64}$ **D)** $\frac{5}{8}$ **E)** 1.6

Questions 17-18 As shown in the figure, the masses of $4m$ are initially at rest and another mass of m collides with the mass of $4m$ on the right-hand side with a velocity of v=2 (m/s). After this collision, it collides with the other $4m$ mass. Since the collisions are perfectly elastic and head to head;



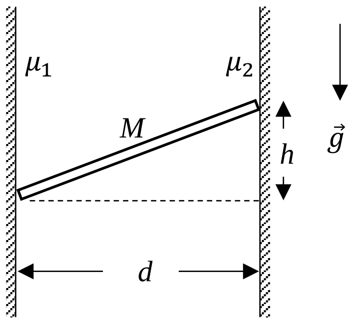
17) Find the velocity of the $4m$ mass at the end of the first collision in (m/s).

A) $\frac{2}{3}$ **B)** $\frac{1}{2}$ **C)** $\frac{3}{5}$ **D)** $\frac{4}{5}$ **E)** $\frac{1}{3}$

18) Find the velocity of the center of mass of the system at the end of the second collision in (m/s).

A) $\frac{3}{7}$ **B)** $\frac{5}{11}$ **C)** $\frac{2}{9}$ **D)** $\frac{3}{8}$ **E)** $\frac{4}{9}$

Questions 19-20 As shown in the figure, a homogen rod with mass M=8 (kg) is in static equilibrium between two parallel frictional walls with a distance of d=2 (m) between them. Since the coefficients of friction between the rods and walls are $\mu_1 = 0.8$ and $\mu_2 = 0.4$;



19) What is the $\frac{f_1}{f_2}$ ratio of the frictional forces acting on the rod?

A) 3 **B)** 4 **C)** 0.5 **D)** 2.5 **E)** 2

20) Find the distance h in meters.

A) 0.5 **B)** 0.4 **C)** 1.5 **D)** 0.25 **E)** 0.3