YTU Physics Department 2018-2019 Fall Semester	Exam Date: 04/01/ 2019	Exam Duration: 90 min.
FIZ1001 Physics-1 Final		

Question Sheet	**AAAAA**
Name Surname	
Registration No	
Physics Group No	
Department	
Exam Hall	
Lecturer's Name-Surname	

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 unauthorised electronic devices into the exam room.

Student Signature	

$g = 10\ (m/s^2)$ $\quad \pi = 3$

θ	0^0	30^0	37^0	45^0	53^0	60^0	90^0
Sin	0	0.5	0.6	$0.7=\frac{\sqrt{2}}{2}$	0.8	$0.86=\frac{\sqrt{3}}{2}$	1
Cos	1	$0.86=\frac{\sqrt{3}}{2}$	0.8	$0.7=\frac{\sqrt{2}}{2}$	0.6	0.5	0

$$I = I_{CM} + Md^2;\quad \vec{\tau} = \vec{r}x\vec{F};\ W = \int \tau\, d\theta;\ K_{rot} = \tfrac{1}{2}I\omega^2;\ K_{roll} = \tfrac{1}{2}I_{CM}\omega^2 + \tfrac{1}{2}mv_{CM}^2$$

$$\vec{L} = \vec{r}x\vec{P};\ \vec{\tau} = \frac{d\vec{L}}{dt};L = I\omega;\ \sum \vec{L}_i = \sum \vec{L}_f;\ \vec{J} = \Delta\vec{L} = \int \vec{\tau}dt = \vec{\tau}_{ave}\Delta t$$

$$x(t) = A\cos(\omega t + \phi);T = \frac{1}{f} = \frac{2\pi}{\omega};\ a(t) = \omega^2 x(t);\alpha(t) = \omega^2\theta(t)$$

$$\omega = \sqrt{\frac{k}{m}};\omega = \sqrt{\frac{g}{l}}\ ;\ \omega = \sqrt{\frac{\kappa}{I}};E = U(t) + K(t) = U_{max} = K_{max}$$

$$\vec{v}_{ave} = \frac{\Delta\vec{r}}{\Delta t};\ \vec{v} = \frac{d\vec{r}}{dt};\ \vec{a}_{ave} = \frac{\Delta\vec{v}}{\Delta t}\ ;\ \vec{a} = \frac{d\vec{v}}{dt}\ ;a_t = \frac{dv}{dt};a_r = \frac{v^2}{r}$$

$$a = cons. \Rightarrow\ v = v_0 + at\ ;\ x = x_0 + v_0 t + \tfrac{1}{2}at^2$$

$$\sum \vec{F} = m\vec{a}\ ;f = -kx;\ \tau = -\kappa\theta;\ f_k = \mu_k N\ ;\ f_s \le \mu_s N\ ;\quad W = \int \vec{F}.d\vec{l}\ \ ;K = \frac{1}{2}\, mv^2$$

$$W_T = \Delta K\ ;\ U = mgy\ \ ;\ U = \frac{1}{2}kx^2;\ W_{con} = -\Delta U;\ W = \Delta U + \Delta K$$

$$P = \frac{dW}{dt} = \vec{F}.\vec{v}\ ;\ \vec{F} = \frac{d\vec{P}}{dt};\ \vec{P} = m\vec{v}\ ;\ \sum \vec{P}_i = \sum \vec{P}_f\ ;\ \vec{I} = \Delta\vec{P} = \int \vec{F}dt = \vec{F}_{ave}\Delta t$$

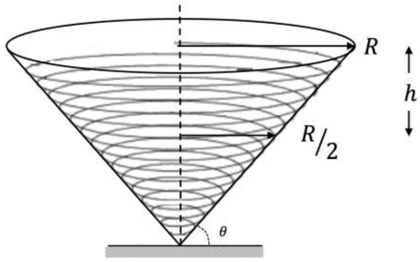
$$\overline{\omega} = \frac{\Delta\theta}{\Delta t};\ \omega = \frac{d\theta}{dt};\ \overline{\alpha} = \frac{\Delta\omega}{\Delta t}\ ;\ \alpha = \frac{d\omega}{dt}\ ;a_t = \alpha r;\ v = r\omega;S = r\theta;\ \vec{a} = \vec{a}_t + \vec{a}_r$$

$$\alpha = cons. \Rightarrow\ \omega = \omega_0 + \alpha t\ ;\ \theta = \theta_0 + \omega_0 t + \tfrac{1}{2}\alpha t^2;$$

$$\vec{r}_{CM} = \frac{\sum m_i\vec{r}_i}{\sum m_i};\ x_{CM} = \frac{\int xdm}{\int dm};\ I = \sum m_i r_i^2;\ I = \int r^2\, dm$$

Questions 1-3

A particle of mass m is thrown into a conical bowl with an angular speed ω_0 for the rotation about the symmetry axis of the cone. It rotates about the symmetry axis of the cone while translationally moving downward to the bottom of the cone. Initially, the particle is at radius R away from the symmetry axis of the cone.



1) Find the angular speed of the particle when it is at radius $R/2$.

a) $2\omega_0$ b) ω_0 c) $4\omega_0$ d) $\frac{1}{2}\omega_0$ e) $8\omega_0$

2) How much the particle descents from initial (R) to the final state ($R/2$).

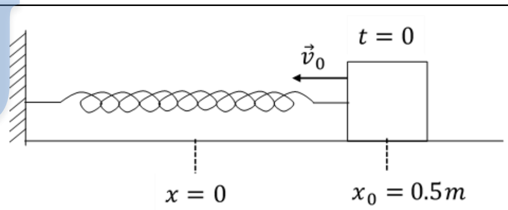
a) $\frac{3\omega_0^2R^2}{2g}$ b) $\frac{2\omega_0^2R^2}{g}$ c) $\frac{\omega_0^2R^2}{2g}$ d) $\frac{\omega_0^2R^2}{g}$ e) $\frac{\omega_0^2R^2}{4g}$

3) What is the normal force acting on the particle when it is at radius $R/2$.

a) $\frac{4mR\omega_0^2}{\sin\theta}$ b) $\frac{32mR\omega_0^2}{\sin\theta}$ c) $\frac{mR\omega_0^2}{\sin\theta}$ d) $\frac{16mR\omega_0^2}{\sin\theta}$ e) $\frac{8mR\omega_0^2}{\sin\theta}$

Questions 4-7

A horizontal spring and mass system has an angular frequency $\omega = 3\pi (rad/s)$. At $t = 0$, the block is at $x_0 = 0.5\ m$ and given an initial velocity $\vec{v}_0 = -4.5\hat{\imath}\ (m/s)$.



4) What is the phase constant (initial phase angle) of the system?

a) $\frac{\pi}{4}$ **b)** 0 **c)** $\frac{\pi}{3}$ **d)** $\frac{\pi}{6}$ **e)** $\frac{\pi}{2}$

5) What is the amplitude of the motion?

a) $\frac{2}{\sqrt{2}}\ (m)$ **b)** $\frac{1}{2}\ (m)$ **c)** $\frac{3}{2}\ (m)$ **d)** $\frac{1}{\sqrt{2}}\ (m)$ **e)** $2\ (m)$

6) What is the maximum velocity and maximum acceleration of the mass, respectively, in SI unit?

a) $\frac{9}{2}\,;\ \frac{81}{2}$ **b)** $\frac{9}{\sqrt{2}}\,;\ \frac{81}{\sqrt{2}}$ **c)** $\frac{3}{2}\,;\ \frac{9}{2}$ **d)** $\frac{3}{\sqrt{2}}\,;\ \frac{9}{\sqrt{2}}$ **e)** $\frac{7}{2}\,;\ \frac{49}{2}$

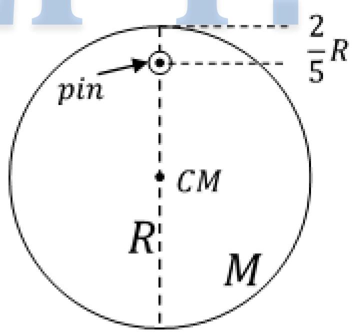
7) What is the energy of the spring-mass system at any instant? Take $k = 500\ N/m$.

a) $\frac{125}{\sqrt{2}}\ (J)$ **b)** $125\ (J)$ **c)** $\frac{125}{2}\ (J)$ **d)** $\frac{250}{\sqrt{2}}\ (J)$ **e)** $\frac{500}{\sqrt{2}}\ (J)$

Question 8

A disc of radius R and mass M has a small hole drilled through it at a distance of $\frac{2}{5}R$ from its edge. The disc is hung from the wall by means of a pin through the hole and used as a pendulum. It is displaced from its equilibrium position for a small angle of θ. What is the angular frequency of the disc for a small angle of θ?

$I_{cm} = \frac{1}{2}MR^2$

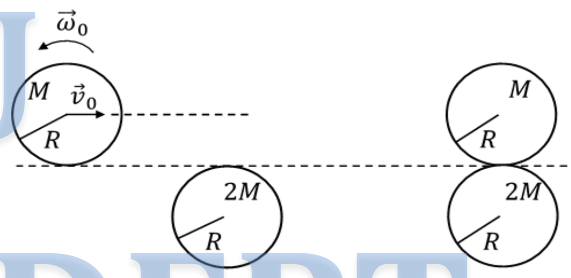


a) $\sqrt{\frac{30}{33}\frac{g}{R}}$ **b)** $\sqrt{\frac{20}{43}\frac{g}{R}}$ **c)** $\sqrt{\frac{20}{33}\frac{g}{R}}$ **d)** $\sqrt{\frac{33}{43}\frac{g}{R}}$ **e)** $\sqrt{\frac{30}{43}\frac{g}{R}}$

Questions 9-12

A uniform disc of mass M and radius R moves toward another uniform disc of mass $2M$ and radius R, on the frictionless table. The center of mass of the first disc has an initial velocity v_0 and rotates with an angular velocity ω_0 as indicated, while the second disc is initially stationary. When the first disc contacts the second (a "glancing" collision), they instantly stick to each other and move as a single object.

$I_{cm} = \frac{1}{2}MR^2$



9) What is the new center of mass after the collision relative to the contact point of the discs?

a) $\frac{1}{3}R$ **b)** $-\frac{2}{3}R$ **c)** $-\frac{1}{3}R$ **d)** R **e)** $\frac{2}{3}R$

10) What is the velocity of the new center of the mass of the combined system after the collision?

a) $\frac{1}{3}v_0$ **b)** $\frac{1}{3}R\omega_0$ **c)** $\frac{2}{3}v_0$ **d)** $\frac{2}{3}R\omega_0$ **e)** $R\omega_0$

11) What is the moment of inertia of the combined system about the new center of the mass?

a) $\frac{3}{2}MR^2$ **b)** $\frac{43}{9}MR^2$ **c)** $\frac{43}{18}MR^2$ **d)** $\frac{25}{6}MR^2$ **e)** $\frac{65}{18}MR^2$

12) What is the angular velocity of the combined system after the collision?

a) $\frac{3}{25}\omega_0 + \frac{8}{25}\frac{v_0}{R}$ **b)** $-\frac{5}{43}\omega_0$ **c)** $\frac{3}{43}\omega_0 + \frac{8}{43}\frac{v_0}{R}$ **d)** $\frac{11}{43}\omega_0$ **e)** $\frac{3}{25}\omega_0 - \frac{8}{25}\frac{v_0}{R}$

Question 13

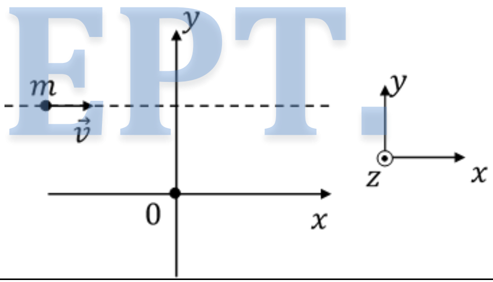
Three different cylinders (A, B and C) of the same size but different masses ($m_A > m_B > m_C$) roll down an incline starting from rest from the same position and at the same time.

13) Which cylinder reaches the bottom first?

a) A **b)** B **c)** C **d)** all the same **e)** not enough information is given

Question 14

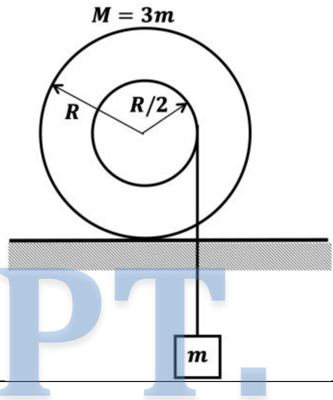
In the figure, the particle is moving in the $x-y$ plane along $+x$ direction with a constant velocity, the angular momentum about the origin,



a) decreases then increases
b) increases then decreases
c) is constant
d) is zero because this is not a circular motion
e) none of these

Questions 15-17

A spool of mass $M = 3m$ with weightless string wound on it rests on a rough horizontal surface. Its moment of inertia relative to its own axis is $I_{cm} = MR^2$,where R is the outside radius of the spool. The radius of the wound string layer is equal to $R/2$. The other end of the string is vertically fixed to a block of mass m as shown in the figure. The system is released from rest.



15) Find the angular acceleration of the spool.

a) $\frac{1}{17}\frac{g}{R}$ **b)** $\frac{1}{15}\frac{g}{R}$ **c)** $\frac{1}{13}\frac{g}{R}$ **d)** $\frac{1}{12}\frac{g}{R}$ **e)** $\frac{2}{25}\frac{g}{R}$

16) Find the tension on the string.

a) $\frac{12}{15}mg$ **b)** $\frac{24}{25}mg$ **c)** $\frac{23}{24}mg$ **d)** $\frac{12}{13}mg$ **e)** $\frac{12}{17}mg$

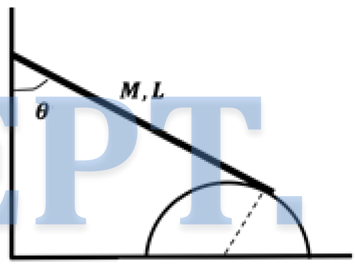
17) What is the angular velocity of the spool after the mass fall downs the distance of $h = 4R$?

a) $\sqrt{\frac{32}{17}\frac{g}{R}}$ **b)** $\sqrt{\frac{32}{13}\frac{g}{R}}$ **c)** $\sqrt{\frac{32}{24}\frac{g}{R}}$ **d)** $\sqrt{\frac{32}{15}\frac{g}{R}}$ **e)** $\sqrt{\frac{32}{25}\frac{g}{R}}$

Question 18

A uniform plank of mass M and length L leans against a wall at one end and rests on a circular support at the other end. Assume that there is friction between the plank and the wall also between the plank and the circular support. Note that the plank hits the circular support tangentially. The plank does not move.

$\theta = 53^0, M = 1(kg), L = 2(m)$



18) Find the normal force from the cylinder acting on the plank.

a) $2(N)$ **b)** $8(N)$ **c)** $3(N)$ **d)** $4(N)$ **e)** $6(N)$

Questions 19-20

The position of $0.5\ kg$ particle is given as $\vec{r}(t) = (1 + 40t)\hat{\imath} + (20t - 5t^2)\hat{\jmath}\ (m)$, t is in second. Answer the following questions in SI unit.

19) Find the torque $\vec{\tau}$ acting on the object at time $t = 2s$ with respect to the origin.

a) $405\hat{k}$ **b)** $405\hat{\jmath} - 810\hat{k}$ **c)** $-405\hat{k}$ **d)** $-810\hat{k}$ **e)** $810\hat{k}$

20) Find the angular momentum $\vec{L}$ of the object at time $t = 2s$ with respect to the origin.

a) $-400\hat{k}$ **b)** $400\hat{\jmath} - 800\hat{k}$ **c)** $400\hat{k}$ **d)** $800\hat{k}$ **e)** $-800\hat{k}$