YTU Physics Department 2018-2019 Fall Semester	Exam Date: 21/01/ 2019	Exam Duration: 90 min.
FIZ1001 Physics-1 Make-up		

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

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

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

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

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

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

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

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

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

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

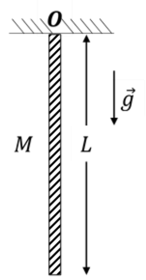
$$\bar{\omega} = \frac{\Delta\theta}{\Delta t};\ \ \omega = \frac{d\theta}{dt};\ \ \bar{\alpha} = \frac{\Delta\omega}{\Delta t}\ ;\ \alpha = \frac{d\omega}{dt}\ ; a_t = \alpha r;\ v = r\omega; S = r\theta;\ \vec{a} = \vec{a}_t + \vec{a}_r$$

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

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

Questions 1-3

Consider a rope of total mass M and length L suspended at rest from a fixed mount (point O). The rope has a linear mass density that varies with height as $\lambda(y) = \lambda_0 \sin(\frac{\pi y}{L})$ where λ_0 is a constant.



1) Determine the constant λ_0.

a) $\frac{\pi m}{L}$ **b)** $\frac{\pi m}{2L}$ **c)** $\frac{3\pi m}{2L}$ **d)** $\frac{3\pi m}{L}$ **e)** $\frac{\pi m}{3L}$

2) What is the tension at the free end (bottom) of the rope?

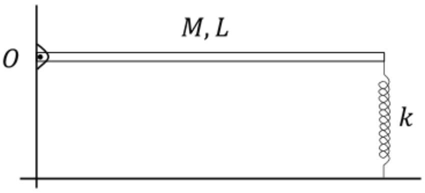
a) Mg **b)** $\frac{3}{2}Mg$ **c)** 0 **d)** $\frac{2}{3}Mg$ **e)** $\frac{1}{2}Mg$

3) Calculate the tension along the rope at $y = L/6$ from the point O.

a) 0.86 Mg **b)** 0.43 Mg **c)** 1.86 Mg **d)** 0.93 Mg **e)** 3.72 Mg

Questions 4-5

A horizontal plank of mass $M = 4\ (kg)$ and length $2\ (m)$ is pivoted at one end. The plank's other end is supported by a spring of force constant $108\ (N/m)$. The plank is displaced by a small angle θ from its horizontal equilibrium position and released. (The moment of inertia of the plank with respect to center of mass is $I_{CM} = \frac{1}{12}ML^2$)



4) Find the amount of compression in the spring at the horizontal equilibrium position.

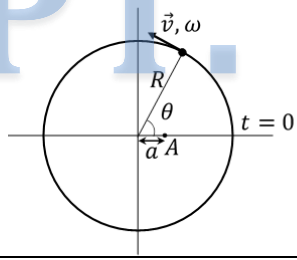
a) $\frac{3}{17}\ (m)$ **b)** $\frac{5}{27}\ (m)$ **c)** $\frac{1}{7}\ (m)$ **d)** $\frac{1}{17}\ (m)$ **e)** $\frac{3}{19}\ (m)$

5) Find the angular frequency with which the plank moves with simple harmonic motion.

a) $7\ (s^{-1})$ **b)** $3\ (s^{-1})$ **c)** $4\ (s^{-1})$ **d)** $9\ (s^{-1})$ **e)** $5\ (s^{-1})$

Questions 6-10

A particle of mass $m = 0.5\ (kg)$ is rotating along a circular path of radius $R = 0.4\ (m)$ with a constant angular velocity $\omega = 20\ (s^{-1})$. Notice the point A at the distance $a = 0.1\ (m)$ from the origin. Answer the following questions for the same time $t = \frac{\pi}{3\omega}\ (s)$.



6) Find the linear momentum of the particle.

a) $2\ (kg\frac{m}{s})$ **b)** $1\ (kg\frac{m}{s})$ **c)** $0.8\ (kg\frac{m}{s})$ **d)** $0.4\ (kg\frac{m}{s})$ **e)** $4\ (kg\frac{m}{s})$

7) Find the total force acting on the particle.

a) $80\ (N)$ **b)** $160\ (N)$ **c)** $40\ (N)$ **d)** $60\ (N)$ **e)** $100\ (N)$

8) Find the total torque acting on the particle relative to the point A.

a) $11\sqrt{3}\ (N.m)$ **b)** $4\sqrt{3}\ (N.m)$ **c)** $10\sqrt{3}\ (N.m)$ **d)** $12\sqrt{3}\ (N.m)$ **e)** $13\sqrt{3}\ (N.m)$

9) Find the angular momentum of the particle relative to the point A.

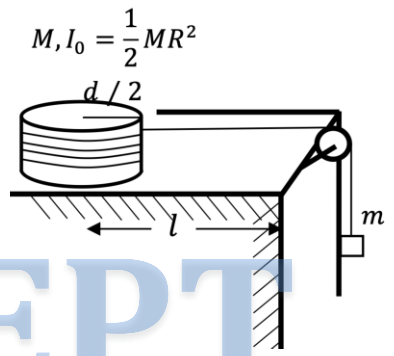
a) $1.4\ (\frac{kgm^2}{s})$ **b)** $1.9\ (\frac{kgm^2}{s})$ **c)** $1.3\ (\frac{kgm^2}{s})$ **d)** $1.7\ (\frac{kgm^2}{s})$ **e)** $1.5\ (\frac{kgm^2}{s})$

10) Find the cosine of the angle between $\vec{v}$ the linear velocity and $\vec{L}$ angular momentum of the particle.

a) $\frac{\sqrt{3}}{2}$ **b)** $\frac{\sqrt{2}}{2}$ **c)** 1 **d)** $\frac{1}{2}$ **e)** 0

Questions 11-15

A solid spool of mass M and radius $d/2$ is released from rest a distance from l from the edge of a table. The spool is connected via a massless, inextensible string to a hanging mass m. The spool slides and rotates freely.



11) What is the acceleration of mass m?

a) $\frac{mg}{2(M+3m)}$ **b)** $\frac{3mg}{M+3m}$ **c)** $\frac{4mg}{M+3m}$ **d)** $\frac{mg}{M+3m}$ **e)** $\frac{3mg}{2M+3m}$

12) What is the acceleration of the center of mass of the spool?

a) $\frac{mg}{2(M+3m)}$ **b)** $\frac{3mg}{M+3m}$ **c)** $\frac{4mg}{M+3m}$ **d)** $\frac{mg}{M+3m}$ **e)** $\frac{3mg}{2M+3m}$

13) What is the angular acceleration of the spool?

a) $\frac{mg}{2d(M+3m)}$ **b)** $\frac{3mg}{d(M+3m)}$ **c)** $\frac{4mg}{d(M+3m)}$ **d)** $\frac{mg}{d(M+3m)}$ **e)** $\frac{3mg}{d(2M+3m)}$

14) How long it takes for the spool to get to the edge of the table?

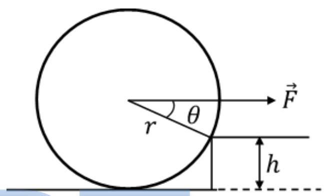
a) $\sqrt{\frac{l(2M+3m)}{3mg}}$ **b)** $\sqrt{\frac{l(M+3m)}{4mg}}$ **c)** $\sqrt{\frac{l(M+3m)}{3mg}}$ **d)** $\sqrt{\frac{l(M+3m)}{mg}}$ **e)** $\sqrt{\frac{2l(M+3m)}{mg}}$

15) What is the velocity of the mass m when the spool's center of mass reaches the edge of the table?

a) $\sqrt{\frac{18l\,mg}{M+3m}}$ **b)** $\sqrt{\frac{18l\,mg}{(2M+3m)}}$ **c)** $\sqrt{\frac{18l\,mg}{3(2M+3m)}}$ **d)** $\sqrt{\frac{18l\,mg}{5(2M+3m)}}$ **e)** $\sqrt{\frac{18l\,mg}{3(M+3m)}}$

Question 16

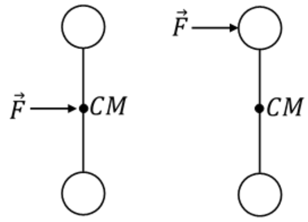
What magnitude of force F applied horizontally at the axle of the wheel is necessary to raise the wheel over an obstacle of height h? Take $h = 0.2\ (m), r = 0.5\ (m)$ as the radius of the wheel and $W = 50\ (N)$ as its weight.



a) $\frac{100}{3}\ (N)$ **b)** $\frac{200}{3}\ (N)$ **c)** $\frac{50}{3}\ (N)$ **d)** $\frac{150}{3}\ (N)$ **e)** $\frac{250}{3}\ (N)$

Questions 17-18

A force $\vec{F}$ is applied to two identical dumbbells, each comprised of two masses separated by a thin rod. The force is applied at the center of mass for the left dumbbell and directly on one of the masses for the right dumbbell. The forces are applied for the same duration of time.



17) Which dumbbell acquires the greatest center of mass velocity?

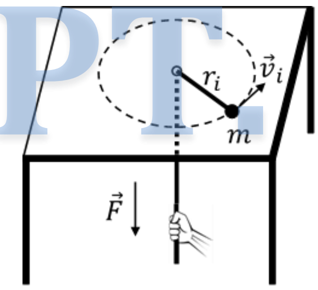
a) Left
b) Right
c) Both have the same
d) The separation between two masses is needed to know
e) None

18) Which dumbbell acquires the greatest kinetic energy from the applied force?

a) Left
b) Right
c) Both have the same
d) We need to know $\vec{F}$
e) None

Questions 19-20

The puck in the figure has a mass of $m = 0.3\ (kg)$. The distance of the puck from the center of rotation is initially 50 (cm), and the puck is sliding with a speed of $v_i = 40\ (cm/s)$. The string is pulled downward 30 (cm) (final state) through the hole in the frictionless table.



19) Find the tension in the string at the final state.

a) 1.5 (N) **b)** 1.6 (N) **c)** 2 (N) **d)** 5 (N) **e)** 7 (N)

20) Find the work done on the puck.

a) 0.124 (J) **b)** 0.128 (J) **c)** 0.120 (J) **d)** 0.122 (J) **e)** 0.126 (J)