YTU Physics Department 2018-2019 Fall Semester	Exam Date: 14/12/ 2018	Exam Duration: 90 min.
FIZ1001 Physics-1 Midterm-2		
Question Sheet	**A A A A A**	

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

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

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

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

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

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

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

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

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

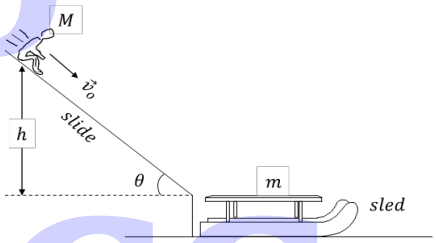
$$W_T = \Delta K\ ;\ U = mgy\ ;\ U = \frac{1}{2}kx^2;\ W_{con} = -\Delta U;\ W = \Delta U + \Delta K;$$

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

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

Questions 1-2

A child $M = 40\ kg$ slides down a frictionless slide, starting from the $h = 0.8\ m$ height with the initial speed $v_0 = 3m/s$ parallel to the slide. The slide has a horizontal angle of $\theta = 53°$. The child leaves the end of the slide and lands on a $m = 8\ kg$ sled at rest. Then, the sled starts sliding on the frictionless ice.



1) At what speed the child leaves the slide?

a) 4 (m/s) **b)** 16 (m/s) **c)** 5 (m/s) **d)** 25 (m/s) **e)** 8 (m/s)

2) At what speed the sled starts sliding on ice just after the child lands on it?

a) $\frac{25}{6}$ (m/s) **b)** $\frac{5}{2}$ (m/s) **c)** $\frac{15}{2}$ (m/s) **d)** $\frac{13}{2}$ (m/s) **e)** $\frac{7}{2}$ (m/s)

Questions 3-4

A force $\vec{F}_1 = 3\hat{j}\,(N)$ is applied to a point whose radius vector $\vec{r}_1 = 2\hat{\imath}\,(m)$, while a force $\vec{F}_2 = 4\hat{\imath}\,(N)$ is applied to the point whose radius vector $\vec{r}_2 = \hat{\jmath}\,(m)$. Both radius vectors are determined relative to the origin.

3) Find the torque of the resultant force.

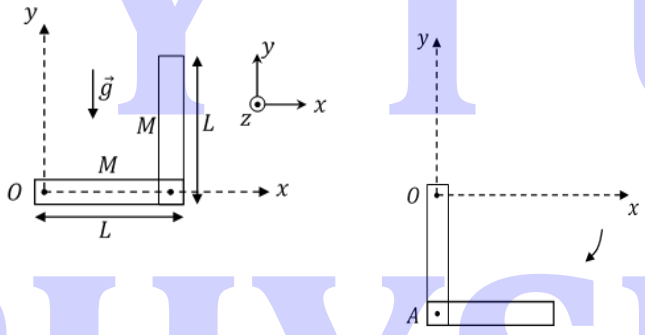
a) $10\,\hat{k}$ **b)** $-10\,\hat{k}$ **c)** $2\,\hat{k}$ **d)** $-2\,\hat{k}$ **e)** $21\,\hat{k}$

4) Find the moment arm of the resultant force.

a) 0.4 (m) **b)** 2 (m) **c)** $-0.4\ (m)$ **d)** $-2\ (m)$ **e)** 4.2 (m)

Questions 5-8

A rigid body has shown if formed two uniform thin rods each of which has mass M and length L. The rigid body is released from the rest and rotates in a vertical plane about an axis through the pivot O without friction. The moment of inertia of a uniform rod with length L and mass M about an axis through its center of mass $I_{cm} = \frac{1}{12}ML^2$.



5) What is the moment of inertia of this rigid body about pivot O?

a) $\frac{1}{3}\,ML^2$ **b)** $\frac{2}{3}\,ML^2$ **c)** $\frac{1}{6}\,ML^2$ **d)** $\frac{5}{3}\,ML^2$ **e)** $\frac{5}{6}\,ML^2$

6) What is the angular acceleration at the instant shown in the figure on the right?

a) $-\frac{9}{10}\frac{g}{L}\,\hat{k}$ **b)** $-\frac{3}{5}\frac{g}{L}\,\hat{k}$ **c)** $\frac{3}{5}\frac{g}{L}\,\hat{k}$ **d)** $-\frac{6}{5}\frac{g}{L}\,\hat{k}$ **e)** $-\frac{3}{10}\frac{g}{L}\,\hat{k}$

7) Find the angular velocity at the instant shown in the figure on the right.

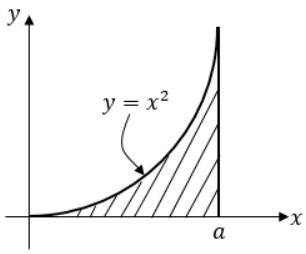
a) $-\sqrt{\frac{9}{10}\frac{g}{L}}\,\hat{k}$ **b)** $-\sqrt{\frac{5}{3}\frac{g}{L}}\,\hat{k}$ **c)** $-\sqrt{\frac{3}{20}\frac{g}{L}}\,\hat{k}$ **d)** $-\sqrt{\frac{12}{5}\frac{g}{L}}\,\hat{k}$ **e)** $\sqrt{\frac{9}{10}\frac{g}{L}}\,\hat{k}$

8) Find the total acceleration of point A at the instant shown in the figure on the right.

a) $-\frac{1}{10}g\,\hat{\imath}+\frac{1}{5}g\hat{\jmath}$ **b)** $-\frac{3}{10}g\,\hat{\imath}+\frac{12}{5}g\hat{\jmath}$ **c)** $-\frac{7}{10}g\,\hat{\imath}+\frac{11}{5}g\hat{\jmath}$ **d)** $-\frac{1}{10}g\,\hat{\imath}+\frac{12}{5}g\hat{\jmath}$ **e)** $-\frac{7}{10}g\,\hat{\imath}+\frac{1}{5}g\hat{\jmath}$

Question 9

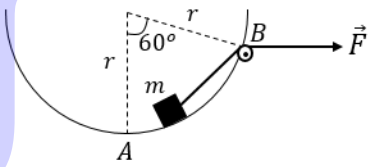
A thin uniform plate has a shape bounded by the lines $x = a$ and $y = x^2$ as shown. Find the x −component of the center of mass of the plate.



a) $\frac{2}{3}a$ **b)** $\frac{1}{3}a$ **c)** $\frac{5}{3}a$ **d)** $\frac{3}{4}a$ **e)** $\frac{3}{5}a$

Questions 10-11

A $m = 10kg$ is pulled in the vertical plane along a frictionless surface in the form of an arc of a circle of radius $r = 10\ m$. A constant horizontal force $F = 200\ N$ is applied as shown in the figure. If the block had started from rest at A, answer the following questions.



10) Which of the followings is the work done by the conservative forces between A and B?

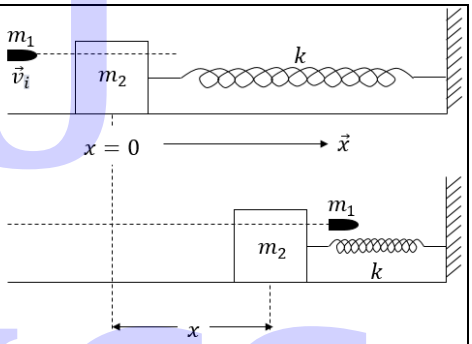
a) $-500\ (J)$ **b)** $-300\ (J)$ **c)** $-1000\ (J)$ **d)** $-860\ (J)$ **e)** $-140\ (J)$

11) Which of the followings is the speed of the block at B?

a) $\sqrt{3}\ (m/s)$ **b)** $10\sqrt{2}\ (m/s)$ **c)** $3\sqrt{10}\ (m/s)$ **d)** $10\ (m/s)$ **e)** $10\sqrt{3}\ (m/s)$

Questions 12-14

$m_1 = 5.0\ g$ bullet moving with an initial horizontal speed of $v_1 = 400\ m/s$ is fired into and passes through a $m_2 = 1.0\ kg$ block. The block, initially at rest on a smooth, horizontal surface, is attached to massless spring with spring constant $k = 900\frac{N}{m}$. The block moves 5.0 cm to the right after the collision.



12) Find the final speed of the bullet after the collision.

a) $30\ (m/s)$ **b)** $200\ (m/s)$ **c)** $100\ (m/s)$ **d)** $50\ (m/s)$ **e)** *none*

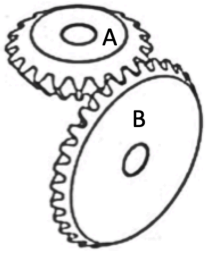
13) Which of the following is the rounded value of the mechanical energy lost in the collision?

a) $373\ (J)$ **b)** $374\ (J)$ **c)** $364\ (J)$ **d)** $375\ (J)$ **e)** $385\ (J)$

14) What is the impulse exerted on the bullet during collision?

a) $1.5\ \hat{\imath}\ (N.s)$ **b)** $2.5\ \hat{\imath}\ (N.s)$ **c)** $-3.5\ \hat{\imath}\ (N.s)$ **d)** $-2.5\ \hat{\imath}\ (N.s)$ **e)** $-1.5\ \hat{\imath}\ (N.s)$

Questions 15-16



Gear A of radius $r_A = 25\ mm$ is in mesh with gear B of radius $r_B = 100\ mm$ as shown. The gear A starts from the rest and has a constant angular acceleration $\alpha_A = 2\ \frac{rad}{s^2}$.

15) Determine the time needed for B to attain an angular velocity $\omega_B = 75\ rad/s$.

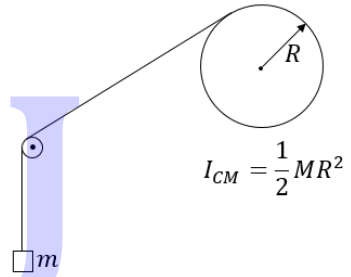
a) 800 (s) **b)** 200 (s) **c)** 150 (s) **d)** 25 (s) **e)** 50 (s)

16) How many revolutions the gear A takes for the gear B to attain an angular velocity $\omega_B = 75\ rad/s$.

a) 11250 (rev) **b)** 2250 (rev) **c)** 22500 (rev) **d)** 3750 (rev) **e)** 37500 (rev)

Questions 17-18

A massless rope is wounded around a pulley, which is a solid disk of mass $M = \frac{3}{5}m$ and radius R. The rope wraps part way around a massless small pulley, and ends at hanging mass m.



17) Find the acceleration of mass m.

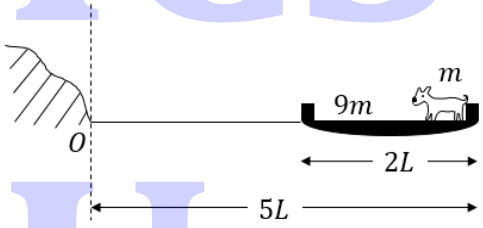
a) $\frac{10}{13}g$ **b)** $\frac{2}{13}g$ **c)** $\frac{5}{13}g$ **d)** $\frac{3}{13}g$ **e)** g

18) Find the torque on the disc.

a) $\frac{10}{13}mgR$ **b)** $\frac{2}{13}mgR$ **c)** $\frac{5}{13}mgR$ **d)** $\frac{3}{13}mg\ R$ **e)** $mg\ R$

Questions 19-20

A dog mass m stands at the back of a perfectly uniform boat mass $9\ m$ and length $2L$. The dog is at the distance of $5L$ from the shore. The boat and the dog are at rest.



19) Find the position of the center of mass relative to the shore.

a) 4.5 L **b)** 4.3 L **c)** 4.1 L **d)** 4.2 L **e)** 4.4 L

20) The dog walks along the boat toward shore and stops at the end of the boat. Assuming no friction, how far the dog is then from the shore.

a) 3.2 L **b)** 3.4 L **c)** 3.6 L **d)** 3.3 L **e)** 3.1 L