YTU Physics Department 2018-2019 Fall Semester	Exam Date: 03/11/ 2018	Exam Duration: 100 min.
FIZ1001 Physics-1 Midterm-1		
Question Sheet	**A A A A A**	
Name Surname		
Registration No		
Physics Group No		
Department		
Exam Hall		
Lecturer's Name-Surname	**Student Signature**	

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.

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

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

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

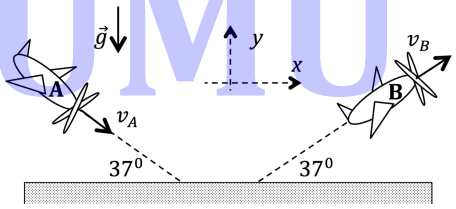
$$a = cons. \Rightarrow\ v = v_0 + at;\ x = x_0 + v_0 t + \frac{1}{2}at^2$$

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

$$W_T = \Delta K;\ U = mgy;\ U = \frac{1}{2}kx^2$$

Questions 1-3

An airplane **A** is landing while another airplane **B** is taking off, both flying in a straight line and making an angle of 37^o with the horizontal as shown in the figure. Plane A has a constant speed of $v_A = 90\ (m/s)$ and plane B has a constant speed of $v_B = 100\ (m/s)$. At time $t = 0$, it is observed that a package P is released from plane B. Ignore the air resistance.
(Notice that the package P has the same velocity of plane B at $t = 0$).



1) As it moves in the air, find the velocity of the package P (in m/s) relative to the ground at $t = 2s$.

a) $\vec{v}_{PG} = 80\hat{\imath} + 40\hat{\jmath}$ **b)** $\vec{v}_{PG} = -80\hat{\imath} + 40\hat{\jmath}$ **c)** $\vec{v}_{PG} = 80\hat{\imath} + 60\hat{\jmath}$ **d)** $\vec{v}_{PG} = 60\hat{\imath} + 40\hat{\jmath}$ **e)** $\vec{v}_{PG} = -60\hat{\imath} + 80\hat{\jmath}$

2) As it moves in the air, find the velocity of the package P (in m/s) relative to the plane B at $t = 2s$.

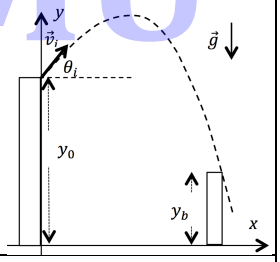
a) $\vec{v}_{PB} = -20\hat{\imath}$ **b)** $\vec{v}_{PB} = -40\hat{\jmath}$ **c)** $\vec{v}_{PB} = -20\hat{\jmath}$ **d)** $\vec{v}_{PB} = 160\hat{\imath} + 100\hat{\jmath}$ **e)** $\vec{v}_{PB} = -40\hat{\imath}$

3) As it moves in the air, find the velocity of the package P (in m/s) relative to the plane A at $t = 2s$.

a) $\vec{v}_{PA} = 152\hat{\imath} - 14\hat{\jmath}$ **b)** $\vec{v}_{PA} = 72\hat{\imath} - 54\hat{\jmath}$ **c)** $\vec{v}_{PA} = 72\hat{\imath} - 14\hat{\jmath}$ **d)** $\vec{v}_{PA} = 8\hat{\imath} + 94\hat{\jmath}$ **e)** $\vec{v}_{PA} = 152\hat{\imath} - 94\hat{\jmath}$

Questions 4-5

A small object is thrown with an initial velocity $\vec{v}_i$ at a horizontal angle of $\theta_i = 53^0$ from a balcony that is $y_0 = 20\ (m)$ high from the ground level. At exactly $t = 2.0\ (s)$ during its flight toward the ground, the object just clears the far end of the roof of a building of $y_b = 8\ (m)$ high as shown in the figure. Ignore the air resistance.



4) Find the magnitude of the initial velocity of the object v_i.

a) 30 (m/s) **b)** 28 (m/s) **c)** 18 (m/s) **d)** 15 (m/s) **e)** 5 (m/s)

5) What is the x coordinate of the far end of the roof?

a) 10 (m) **b)** 25 (m) **c)** 6 (m) **d)** 16 (m) **e)** 15 (m)

Questions 6-7

A car is moving along a straight line, having initial speed of v_0 at $t = 0$. The car experiences a deceleration of $a = -\frac{k}{2v}$ where k is a constant and v is the speed of the car at an instant.

6) Which of the followings is the speed of the car as a function of time?

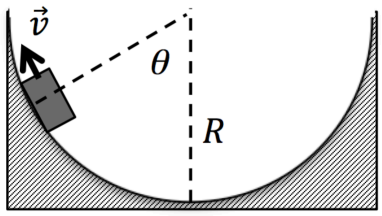
a) $v = v_0 - kt$ **b)** $v = (v_0^2 - kt)^{\frac{1}{2}}$ **c)** $v = (v_0^2 + kt)^{\frac{1}{2}}$ **d)** $v = v_0 + kt$ **e)** $v = kt$

7) How long it takes for the car to stop?

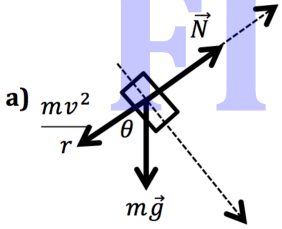
a) $t = \frac{v_0^2}{k}$ **b)** $t = \frac{v_0}{k}$ **c)** $t = kv_0^2$ **d)** $t = kv_0$ **e)** $t = k^2 v_0$

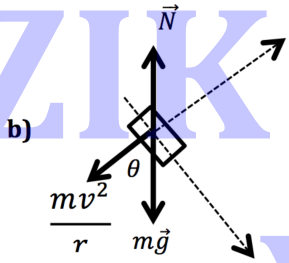
Questions 8-12

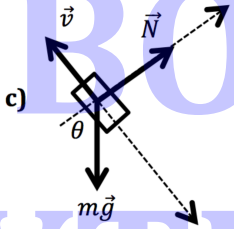
A box of mass $m = 0.1\ (kg)$ can move freely on a frictionless circular track of radius $R = 0.5\ (m)$ as shown in the figure. At a particular moment, the box is in the position shown with $\theta = 37^0$ and upward speed $v = 4.0\ (m/s)$.

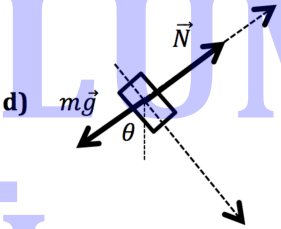


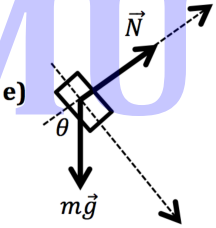
8) Which of the following is the correct the free body diagram of the box for that particular moment for a stationary observer on the ground (inertial observer). **e**

a) 

b) 

c) 

d) 

e) 

9) Which of the following is the correct the equations of motion of the box for that particular moment for a stationary observer on the ground (inertial observer).

a) $mgsin\theta = ma_t$ $\quad N - mgcos\theta = m\frac{v^2}{r}$

b) $mgcos\theta = ma_t$ $\quad N = m\frac{v^2}{r}$

c) $mgsin\theta = m\frac{v^2}{r}$ $\quad N - mgcos\theta = 0$

d) $mgcos\theta = ma_t$ $\quad N - mgsin\theta = m\frac{v^2}{r}$

e) $mg = ma_t$ $\quad mgcos\theta = m\frac{v^2}{r}$

10) What is the radial acceleration a_r for that particular moment?

a) $12(m/s^2)$ **b)** $22(m/s^2)$ **c)** $32(m/s^2)$ **d)** $42(m/s^2)$ **e)** $52(m/s^2)$

11) What is the tangential acceleration a_t for that particular moment?

a) $10(m/s^2)$ **b)** $16(m/s^2)$ **c)** $0.6(m/s^2)$ **d)** $6(m/s^2)$ **e)** $26(m/s^2)$

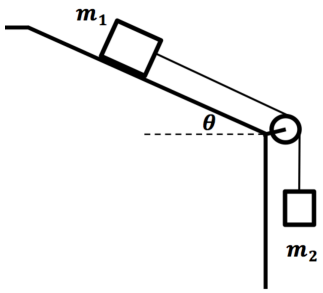
12) What is the magnitude of the normal force acting on the box?

a) $0.4N$ **b)** $14N$ **c)** $40N$ **d)** $24N$ **e)** $4N$

----------USE FOR SCRATCH WORK----------

Questions 13-14

The diagram shows two masses $m_1 = 4.0\ (kg)$ and $m_2 = 1.0\ (kg)$, which are at rest. The pulley is massless and frictionless. Friction is present between the sloped surface and mass m_1, the static friction coefficient $\mu_s = 0.8$. The sloped surface has a horizontal angle of $\theta = 37^0$.



13) What is the static friction force acting on the mass m_1?

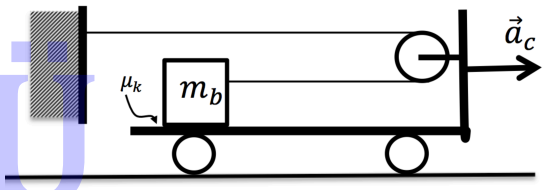
a) 440 (N) **b)** 460(N) **c)** 250 (N) **d)** 240(N) **e)** 540 (N)

14) Now m_2 is increased. What is the minimum value of the mass m_2 for the system to start moving?

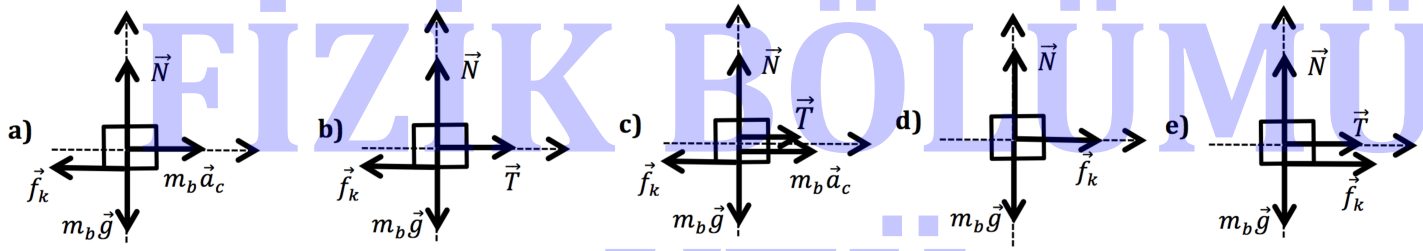
a) 2.0 (kg) **b)** 2.4 (kg) **c)** 3.2 (kg) **d)** 2.8 (kg) **e)** 1.6 (kg)

Questions 15-16

A flat car is given an acceleration $a_C = 2\ (m/s^2)$. A cable is connected to block of mass $m_b = 50.0\ (kg)$ as shown. Neglect the friction between the car wheels and the floor. The pulley is massless. The kinetic friction between the block and the floor of the car is $\mu_k = 0.3$.



15) Which of the following is the correct the free body diagram of the block for a stationary observer on the ground (inertial observer). **b**



16) What is the tension in the cable?

a) 150 (N) **b)** 210 (N) **c)** 280 (N) **d)** 350 (N) **e)** 140 (N)

Questions 17-19

A particle with a mass m moves along the x-axis under the action of a force parallel to the x-axis given by $F(x) = 8Ax^3 + 4Bx\ (N)$ where both A and B are positive constants.

17) Which of the following is the correct dimension of the A and B, respectively?

a) $\frac{[M]}{[T]^2[L]^2}$ and $\frac{[M]}{[T]^2}$ **b)** $\frac{[M]}{[T][L]}$ and $\frac{[M]}{[T]^2}$ **c)** $\frac{[M]}{[T]^2[L]^2}$ and $\frac{[M]}{[T]}$ **d)** $\frac{[M]}{[T]][L]}$ and $\frac{[M]}{[T]}$ **e)** $\frac{[M]}{[T][L]^2}$ and $\frac{[M]^2}{[T]^2}$

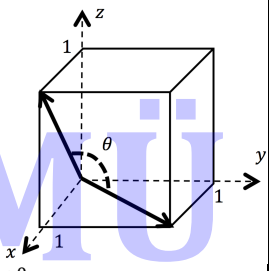
18) Find the work done by $F(x)$ if the object is displaced from $x = 1\ (m)$ to $x = 2(m)$. Assume that $A = 1$ and $B = 1$ in SI unit.

a) 0 (J) **b)** 54 (J) **c)** 48 (J) **d)** 36 (J) **e)** 42(J)

19) If the change of the kinetic energy of the object is 14 (J), what is the work done by the force of friction from $x = 1\ (m)$ to $x = 2(m)$. Assume that $A = 1$ and $B = 1$ in SI unit.

a) $-28\ (J)$ **b)** $-22\ (J)$ **c)** $-34(J)$ **d)** $-15\ (J)$ **e)** $-40\ (J)$

20) Which of the following is the angle between the face diagonals of the unit cube?



a) 30^0 **b)** 60^0 **c)** 90^0 **d)** 45^0 **e)** 120^0

----------USE FOR SCRATCH WORK----------