YTU Physics Department 2019-2020 Fall Semester		Exam Date: 09.11.2019	Exam Duration: 90 min.
FIZ1001 PHYSICS-1 Midterm Exam 1		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 Signature:**	
Student No			
Physics Group No			
Department			
Exam Hall			
Instructor's Name Surname			

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

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

$$P = \vec{F}\cdot\vec{v} \quad W = \int \vec{F}\cdot d\vec{r} = \Delta K \quad \bar{P} = \frac{\Delta W}{\Delta t}$$

Questions 1-2 For vectors $\vec{a} = \hat{\imath} - 3\hat{\jmath} + 2\hat{k}$ (m) and $\vec{b} = 2\hat{\jmath} - 4\hat{k}$ (m) ;

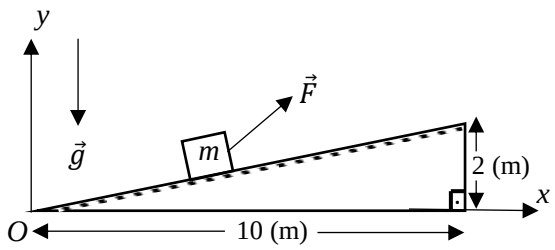
1) If the vectors $\vec{a}$ and $\vec{b}$ form the two sides of a parallelogram, how many square meters is the area of the parallelogram?

A) $\sqrt{84}$ **B)** $\sqrt{14}$ **C)** 7 **D)** $\sqrt{29}$ **E)** $\sqrt{44}$

2) Which of the following is the unit vector perpendicular to both $\vec{a}$ and $\vec{b}$?

A) $\frac{8\hat{\imath}+4\hat{\jmath}+2\hat{k}}{\sqrt{84}}$ **B)** $\frac{6\hat{\imath}+2\hat{\jmath}+4\hat{k}}{\sqrt{14}}$ **C)** $\frac{6\hat{\imath}+2\hat{\jmath}+3\hat{k}}{7}$ **D)** $\frac{4\hat{\imath}+3\hat{\jmath}+2\hat{k}}{\sqrt{29}}$ **E)** $\frac{2\hat{\imath}+8\hat{\jmath}+4\hat{k}}{\sqrt{44}}$

Questions 3-4 As shown in the figure, a block with the mass m=1 (kg) is pulled upwards on the inclined plane by the variable force $\vec{F}(x) = 4\hat{\imath} + x\hat{\jmath}$ (N) where x is in meters.



3) Until the block reaches to point (5,1) from point (0,0) what is the work done by the force $\vec{F}$?

A) 25 (J) **B)** 22.5 (J) **C)** 20 (J) **D)** 15 (J) **E)** 30 (J)

4) When the block reaches point (5,1), the change in its kinetic energy is 10 (J), What is constant friction force in Newtons?

A) $\frac{5}{2\sqrt{26}}$ **B)** $\frac{5}{\sqrt{26}}$ **C)** $\frac{2}{\sqrt{26}}$ **D)** $\frac{1}{2\sqrt{26}}$ **E)** $\frac{1}{\sqrt{26}}$

Questions 5-6-7-8-9-10 At t = 0 moment, the object A begins to move from the origin with the velocity $\vec{v}_{0A} = (\hat{\imath} + 2\hat{\jmath})$ (m/s) and with time-dependent acceleration. $\vec{a}_A = 2t\hat{\imath}$ (m/s^2) it continues its motion.

At the same time, the object B starts to move at a velocity of $\vec{v}_{0B} = \left(\frac{1}{3}\hat{\imath} + 8\hat{\jmath}\right)$ (m/s) from *x*=2 (m), *y*=0 (m) and continues its motion with $\vec{a}_B = 2\hat{\imath} - 4\hat{\jmath}$ (m/s^2) acceleration.

5) Find the velocity vector of object A in (m/s) at any time t.

A) $-\frac{1}{3}\hat{\imath} - 6t\hat{\jmath}$ **B)** $3t^2\hat{\imath} - 2\hat{\jmath}$ **C)** $(1 + t^2)\hat{\imath} + 2\hat{\jmath}$ **D)** $\frac{1}{3}\hat{\imath} - 6t\hat{\jmath}$ **E)** $\frac{1}{3}\hat{\imath} - 2t\hat{\jmath}$

6) Find the position vector of object A in meters at any time t.

A) $\left(t + \frac{t^3}{3}\right)\hat{\imath} + 2t\hat{\jmath}$ **B)** $-\frac{t}{3}\hat{\imath} - 3t^2\hat{\jmath}$ **C)** $(1 + t^3)\hat{\imath} - 2t\hat{\jmath}$ **D)** $\frac{t}{3}\hat{\imath} - 3t^2\hat{\jmath}$ **E)** $\frac{t}{3}\hat{\imath} - t^2\hat{\jmath}$

7) At t=1 (s), find the distance between A and B in meters.

A) 5 **B)** $\sqrt{35}$ **C)** $\sqrt{20}$ **D)** 6 **E)** $\sqrt{26}$

8) At t=1 (s), find the velocity vector of object A relative to object B.

A) $2\hat{\imath} - 4\hat{\jmath}$ (m/s) **B)** $-\frac{2}{3}\hat{\imath} - 3\hat{\jmath}$ (m/s) **C)** $-\hat{\imath} + 2\hat{\jmath}$ (m/s) **D)** $\hat{\imath} + 2\hat{\jmath}$ (m/s) **E)** $-\frac{1}{3}\hat{\imath} - 2\hat{\jmath}$ (m/s)

9) At t=1 (s), find the tangential and centripetal acceleration magnitudes of the object A in (m/s^2), respectively.

A) $\frac{2}{\sqrt{2}}$, $\sqrt{2}$ **B)** 2 , $\sqrt{2}$ **C)** $2\sqrt{2}$, $\sqrt{2}$ **D)** $\sqrt{2}$, 2 **E)** $\sqrt{2}$, $\frac{1}{\sqrt{2}}$

10) After how many seconds do these two objects collide?

A) 1 **B)** 2 **C)** 3 **D)** 4 **E)** 5

Questions 11-12-13 Only two forces affect an object of m=2 (kg) at the same time. The position vector of the object is given by $\vec{r}(t) = 4t\hat{\imath} - 3t^3\hat{\jmath}$ (m). If one of the forces is $\vec{F}_1(t) = 3t^2\hat{\imath} - 4t\hat{\jmath}$ (N);

11) Find the work done by the force $\vec{F}_1$ between t=0 and t=1 (s).

A) 17 (J) **B)** 22 (J) **C)** 34 (J) **D)** 13 (J) **E)** 10 (J)

12) Find the time-dependent expression of the force $\vec{F}_2$ in Newtons.

A) $3t\hat{\imath} - 26t\hat{\jmath}$ **B)** $-3t^2\hat{\imath} - 32t\hat{\jmath}$ **C)** $4t\hat{\imath} + 24t\hat{\jmath}$ **D)** $-30\hat{\imath} + 2t\hat{\jmath}$ **E)** $-t^2\hat{\imath} - 42t\hat{\jmath}$

13) What is the <u>total power</u> consumed at t=1 (s) moment on the object?

A) 240 (W) **B)** 220 (W) **C)** 248 (W) **D)** 156 (W) **E)** 324 (W)

Questions 14-15 A child moving with the velocity $\vec{v}_0 = 10\hat{\imath}$ (m/s) throws a ball <u>relative to him</u> with the velocity $\vec{v}_1 = 12\hat{\imath} + 60\hat{\jmath}$ (m/s) and accelerates with constant acceleration at the same time to keep the ball at the same height.

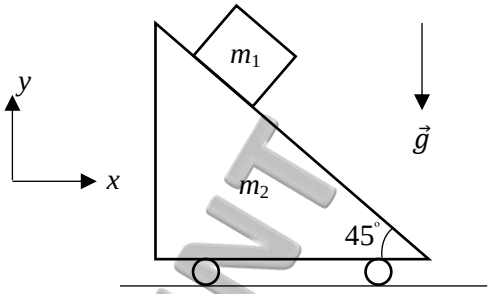
14) Find the time it takes him to catch the ball.

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

15) What must his acceleration be to catch the ball?

A) 4 (m/s^2) **B)** 5 (m/s^2) **C)** 3 (m/s^2) **D)** 2 (m/s^2) **E)** 6 (m/s^2)

Questions 16-17-18 When the system in the figure is released from the rest state, the block with the mass m_1=2 (kg) slides downward on the inclined plane and the inclined plane with the mass m_2=4 (kg) goes to the left. The frictions on the surfaces are ignored.



16) Find the acceleration vector of the block relative to the inclined plane. $\cos(45) = \sin(45) = \frac{\sqrt{2}}{2}$

A) $-2\hat{\imath} - 4\hat{\jmath}$ (m/s^2) **B)** $5\hat{\imath} - 5\hat{\jmath}$ (m/s^2) **C)** $5\hat{\imath} - 4\hat{\jmath}$ (m/s^2) **D)** $3\hat{\imath} - 6\hat{\jmath}$ (m/s^2) **E)** $-8\hat{\imath} - 8\hat{\jmath}$ (m/s^2)

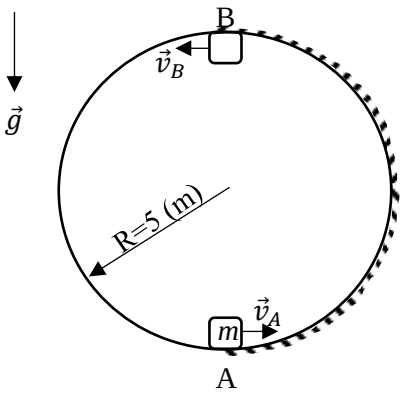
17) Find the acceleration vector of the block relative to the ground.

A) $-3\hat{\imath} + 2\hat{\jmath}$ (m/s^2) **B)** $-1.5\hat{\imath} - 7\hat{\jmath}$ (m/s^2) **C)** $\hat{\imath} - 2\hat{\jmath}$ (m/s^2) **D)** $2.5\hat{\imath} - 5\hat{\jmath}$ (m/s^2) **E)** $3\hat{\imath} - 1.5\hat{\jmath}$ (m/s^2)

18) When the block travels 3 (m) on the inclined plane, find out how many meters the inclined plane travels.

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

Questions 19-20 An object with mass m=2 (kg) moves in a vertical plane on the rail system with radius 5 (m) as shown in the figure. The object passes through point A with the velocity $\vec{v}_A$.



19) If the work done by friction force between A and B is -100 (J), how many joules is the change in the kinetic energy of the object between points A and B?

A) 200 **B)** -300 **C)** -200 **D)** -400 **E)** 300

20) What should the speed of the object be while passing through point A so that the speed at point B is the minimum?

A) $\sqrt{300}$ (m/s) **B)** $\sqrt{200}$ (m/s) **C)** $\sqrt{150}$ (m/s) **D)** $\sqrt{350}$ (m/s) **E)** $\sqrt{250}$ (m/s)