PHYS 101: General Physics 1 KOÇ UNIVERSITY Fall Semester 2010

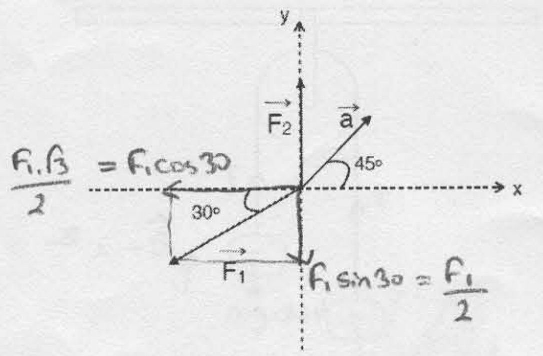
College of Sciences

Section 1 Quiz 3 21 October 2010

Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

Name: Student ID: Signature:

A particle of mass $m = \sqrt{2}$ kg is accelerated at 1 m/s^2 in the direction shown by $\vec{a}$, over a frictionless horizontal surface. The acceleration is caused by three horizontal forces, only two of which are shown: $\vec{F_1}$ of magnitude $2\sqrt{3}$ N and $\vec{F_2}$ of magnitude $\sqrt{3}$ N. What is the third force $\vec{F_3}$ in unit-vector notation?

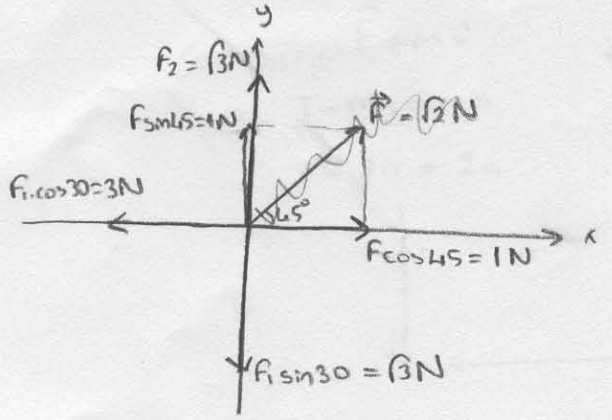


$\vec{F} = m.\vec{a}$

$F = \sqrt{2}.1$

$\vec{F} = \sqrt{2}\,\hat{a}$ N

↓ total force



$\vec{F_1} + \vec{F_2} + \vec{F_3} = \vec{F}$

$\vec{F_3} = \vec{F} - \vec{F_1} - \vec{F_2}$

$\boxed{\vec{F_3} = (4\hat{x} + 1\hat{y})\ \text{N}}$

PHYS 101: General Physics 1 **KOÇ UNIVERSITY** **Fall Semester 2010**

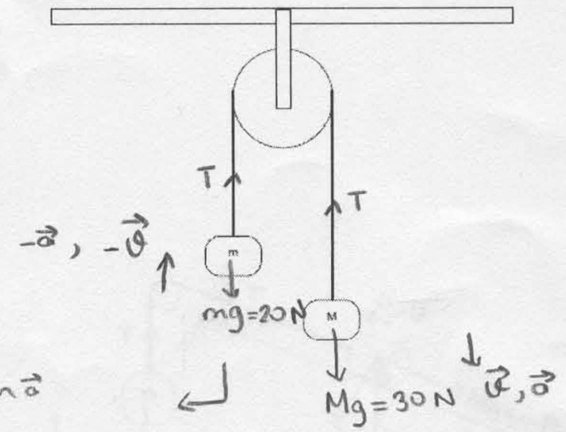
College of Sciences

Section 2 **Quiz 3** **21 October 2010**

Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

Name: **Student ID:** **Signature:**

Two particles of mass $m = 2$ kg and $M = 3$ kg are hung vertically over a frictionless pulley of negligible mass as shown in the figure. Determine the magnitude of acceleration of the two particles and the tension in the massless cord. (Take $g = 10$ m/s^2.)



$\vec{F} = m\vec{a}$

$T - mg = ma$

$T - 20 = 2a$

$\vec{F} = m\vec{a}$

$Mg - T = M.a$

$30 - T = 3a$

$T = 20 + 2a$

$T = 30 - 3a$

$a = 2\,m/s^2$

$T = 24N$

PHYS 101: General Physics 1 **KOÇ UNIVERSITY** **Fall Semester 2010**

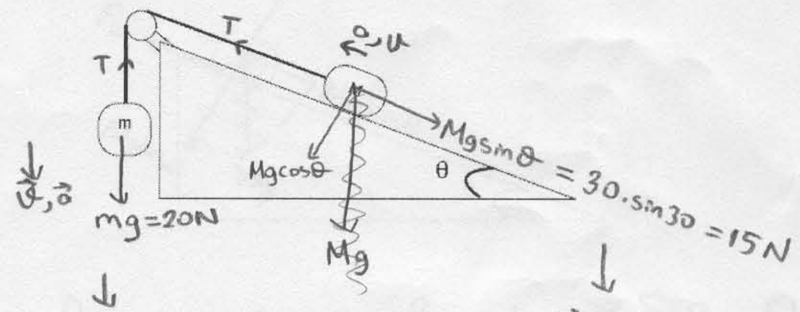
College of Sciences

Section 3 **Quiz 3** **21 October 2010**

Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

Name: **Student ID:** **Signature:**

Two particles of mass $m = 2$ kg and $M = 3$ kg are attached by a massless cord that passes over a frictionless pulley of negligible mass as shown in the figure. The particle of mass M lies on a frictionless incline of angle $\theta = 30$ degrees. Determine the magnitude of the acceleration of the two particles and the tension in the cord. (Take $g = 10\ \mathrm{m/s^2}$.)



$\vec{F} = m\vec{a}$

$mg - T = 2.a$

$20 - T = 2a$

$\vec{F} = m\vec{a}$

$T - Mg\sin\theta = M.a$

$T - 15 = 3a$

$T = 3a + 15$

$T = 20 - 2a$

$a = 1\ \mathrm{m/s^2}$

$T = 18\ \mathrm{N}$

PHYS 101: General Physics 1 **KOÇ UNIVERSITY** **Fall Semester 2010**

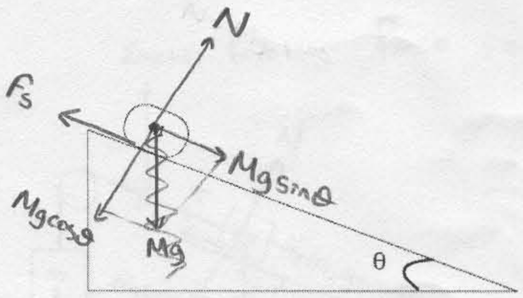
College of Sciences

Section 4 **Quiz 3** **21 October 2010**

Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

Name: **Student ID:** **Signature:**

A block of mass M is at rest on an adjustable inclined plane of angle θ and static coefficient of friction μ_s. Find the range of possible values of θ for which the block remains at rest.



If the system is at rest, from Newton's first law: $\sum F = 0$

so $N = Mg\cos\theta$

$f_s = Mg\sin\theta$

we also know that $f_s = \mu_s . N = \mu_s . Mg\cos\theta$

If $Mg\sin\theta > f_s$, then the block moves. We don't wont that.

$\boxed{Mg\sin\theta \leq f_s}$ is our condition.

$\cancel{Mg}\sin\theta \leq \mu_s . \cancel{Mg}\cos\theta$

$\mu_s \geq \frac{\sin\theta}{\cos\theta} = \tan\theta$

$\boxed{\tan\theta \leq \mu_s}$

PHYS 101: General Physics 1 KOÇ UNIVERSITY Fall Semester 2010

College of Sciences

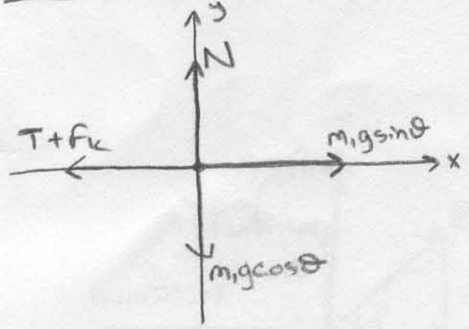
Section 5 Quiz 3 21 October 2010

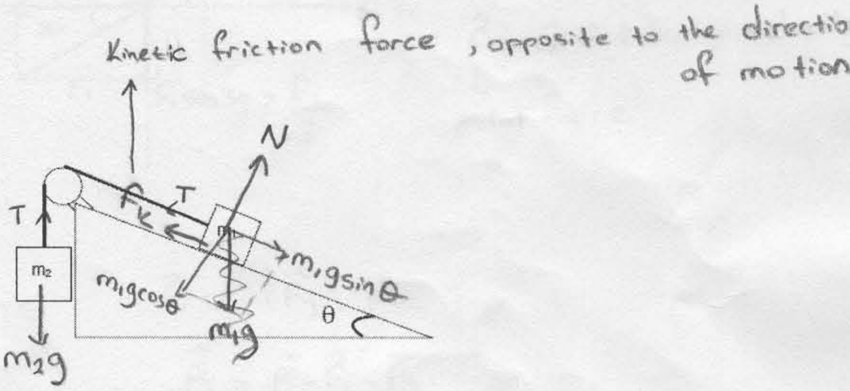
Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

Name: Student ID: Signature:

A block of mass m_1 moves at constant velocity on an inclined plane of angle θ and kinetic coefficient of friction μ_k. Find the m_2 in terms of m_1, θ, and μ_k.

Free body diagram for m_1





system moves with constant velocity, which means that zero acceleration. Then Newton's first law can be applied: $\Sigma F = 0$.

So, $m_1 g \cos\theta = N$

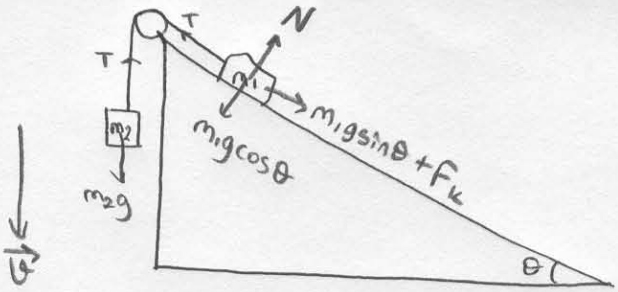
$T + F_k = m_1 g \sin\theta$

We know that $F_k = \mu_k . N = \mu_k . m_1 g \cos\theta$

and $m_2 g = T$.

So, $m_2 g + \mu_k m_1 g \cos\theta = m_1 g \sin\theta$

$$\boxed{m_2 = m_1 \sin\theta - \mu_k m_1 \cos\theta}$$



If the motion is in downwards direction:

$$\boxed{m_2 g = T}$$

$$F_k = \mu_k . m_1 g \cos\theta$$

$$T = m_1 g \sin\theta + F_k = m_1 g \sin\theta + \mu_k m_1 g \cos\theta$$

$$\boxed{m_2 = m_1 \sin\theta + \mu_k m_1 \cos\theta}$$