PHYS 101: General Physics 1 | KOÇ UNIVERSITY | Fall Semester 2014

College of Sciences

Section 5 | Quiz 4 | 16 October 2014

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

Name: Student ID: Signature:

A block of mass m = 2.0 kg is acted on by two forces (measured in Newtons) given by $\vec{F}_1 = \hat{i} - 2\hat{j} + 4\hat{k}$ and $\vec{F}_2 = -2\hat{i} + 8\hat{j} - 4\hat{k}$. (i) What is the net force acting on the mass? (ii) What is the magnitude of the acceleration of the mass? (iii) Determine a force that would bring the mass to equilibrium. (iv) State the Newton's laws you have used in this problem.

i) $\vec{F}_{net} = F_{x\,net}\hat{i} + F_{y\,net}\hat{j} + F_{z\,net}\hat{k}$

$F_{x\,net} = F_{1x} + F_{2x} = (1-2)\,N = -1\,N$

$F_{y\,net} = F_{1y} + F_{2y} = (-2+8)\,N = 6\,N$

$F_{z\,net} = F_{1z} + F_{2z} = (4-4)\,N = 0$

$\vec{F}_{net} = -1\hat{i} + 6\hat{j}$

ii) $F_{net} = ma$

$F_{net} = \sqrt{(F_{x\,net})^2 + (F_{y\,net})^2} = \sqrt{(-1)^2 + (6)^2} = \sqrt{37}\,N$

$a = \frac{F_{net}}{m} = \frac{\sqrt{37}}{2.0\,kg}$

iii) For equilibrium $a = 0 \Rightarrow F_{net} = 0$

$\vec{F}_{net} + \vec{F}' = 0 \Rightarrow \vec{F}' = \hat{i} - 6\hat{j}$

iv) 1st law; A body acted by a no net force moves with constant or zero velocity and zero acceleration

2nd law; The mass of the body times the acceleration of te body equals to te net force.

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KOÇ UNIVERSITY
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Quiz 4

Fall Semester 2014

Section 2

16 October 2014

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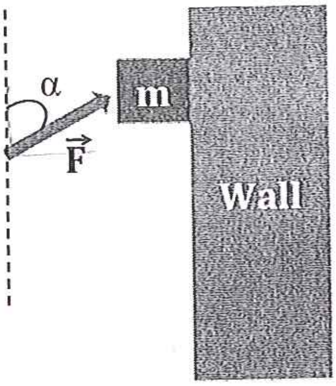
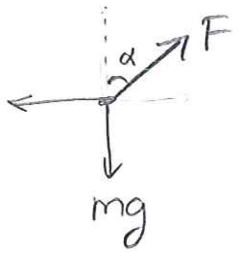
Quiz duration: 10 minutes

Name: Student ID: Signature:



A particle of mass m = 0.1 kg is held stationary against a vertical wall by pushing upwards by a force of magnitude F as shown in the figure. Assume there is no friction between the particle and the wall. The force makes an angle of α with the vertical. (i) Draw the free body diagram of m; (ii) and apply the Newton's laws by choosing a coordinate system to (iii) sketch F as function of α. (You may take g = 10 m/s^2).

i)



↑ +a

ii) ↑ +y → +x

$\Sigma F_y = 0$

$F\cos\alpha - mg = 0$

$F\cos\alpha = mg$

$F = \frac{mg}{\cos\alpha} = \frac{(0.1kg)(10m/s^2)}{\cos\alpha}$

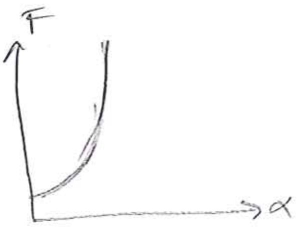
$F = \frac{1}{\cos\alpha}$

$\Sigma F_x = 0$

$N - F\sin\alpha = 0$

$N = F\sin\alpha$

iii) $F \propto \frac{1}{\cos\alpha}$



PHYS 101: General Physics 1 | KOÇ UNIVERSITY | Fall Semester 2014

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Section 4 | Quiz 4 | 16 October 2014

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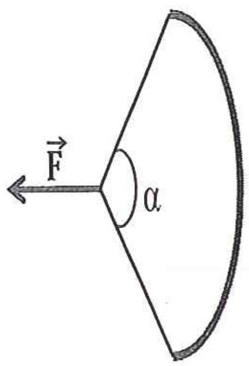
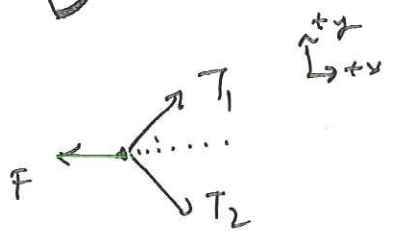
Quiz duration: 10 minutes

Name: Student ID: Signature:



An archer pulls a bow by applying a force of magnitude F = 100 N at the middle of the string as shown in the figure. If the opening angle is α = 120°, determine the tensions in either half of the string by (i) drawing the free body diagram for the application point of the force **F**, (ii) sketching the coordinate system, writing the corresponding components of the forces and applying the Newton's laws. (iii) State the Newton's laws you have used in the problem.

i)



ii)

$\Sigma F_x = 0$ $\quad \Sigma F_y = 0$

$-F + T_1 \cos 60^\circ + T_2 \cos 60^\circ = 0$

$\boxed{\frac{T_1}{2} + \frac{T_2}{2} = F}$

$\Sigma F_y = 0$

$T_1 \sin 60^\circ = T_2 \sin 60^\circ$

$T = \boxed{T_1 = T_2}$ //

$\Rightarrow \quad T = T_1 = T_2$

$T = F$

$T = 100\,N = T_1 = T_2$.

iii) 1st law: A body acted by a no net-force moves with constant or zero velocity and zero acceleration.

2nd law: The mass of te body times te acceleration of te body equals to te net force.

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Section 3 — Quiz 4 — 16 October 2014

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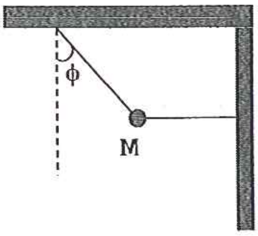
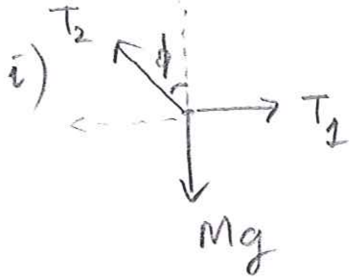
Name: Student ID: Signature:



A particle of mass M = 2 kg is attached to two light strings and held stationary in gravitational field (You may take g = 10 m/s^2 as shown in the figure. One string is horizontal and the other string makes an angle of □ = 45° with the vertical. Find the tensions in either strings by (i) drawing the free body diagram of mass M, (ii) choosing a suitable coordinate system to determine the components of the forces, and applying the Newton's laws. (iii) State the Newton's laws you have used in the problem.

i)



ii) +y, +x

held stationary $\sum \vec{F}_{net} = 0$

$\sum F_x = 0$ $\sum F_y = 0$

$T_1 - T_2 \sin\phi = 0$ $T_2 \cos\phi = Mg$

$T_1 = T_2 \sin 45°$ $\frac{T_2}{\sqrt{2}} = Mg$

$T_1 = \frac{T_2}{\sqrt{2}}$ $\boxed{T_2 = Mg\sqrt{2}}$ $= 20\sqrt{2}$ N

$\Rightarrow$ $T_1 = \frac{T_2}{\sqrt{2}} = Mg$

$\boxed{T_1 = Mg}$ $= 20$ N

iii) 2nd law: The mass of the body times the acceleration of the body equals to the net force vector.

1st law: A body acted by a no net force moves with constant or zero velocity and zero acceleration.

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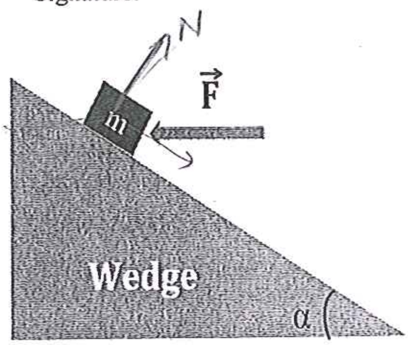
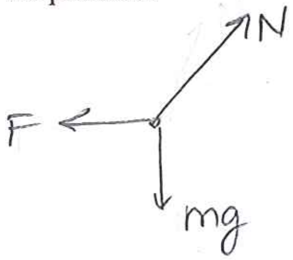
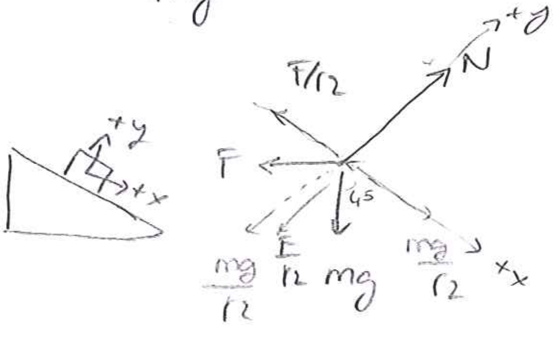
A particle of mass m = 0.5 kg is placed on the surface of a wedge, making an angle of $\alpha = 45^{o}$ with the horizontal. The particle is carried to the top of the wedge under the action of a force of magnitude F with a constant velocity. Assume there is no friction between the wedge and the particle. (i) Draw the free body diagram of the particle; (ii) choosing a suitable coordinate system, apply the Newton's laws to (iii) determine the F and the magnitude of the normal force N between the particle and the wedge. (You may take $g = 10\ m/s^2$). (iv) State the Newton's laws you have used in the problem.



i)



ii)



constant velocity ⇒ a = 0.

$\Sigma F_x = 0$ $\Sigma F_y = 0$

$\frac{mg}{\sqrt{2}} - \frac{F}{\sqrt{2}} = 0$ $N - \frac{mg}{\sqrt{2}} - \frac{F}{\sqrt{2}} = 0$

$\boxed{F = mg}$ $N - \frac{2mg}{\sqrt{2}} = 0$

$\boxed{F = 5N}$ $N = \frac{2mg}{\sqrt{2}}$

$\boxed{N = 5\sqrt{2}\,N}$

iii) 1st law; A body acted by a no net force moves with constant or zero velocity and zero acceleration

2nd law; The mass of the body times the acceleration of the body equals to the net force.

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3rd law: If a body exerts a force on body B then body B exerts a force on body A.