KEY

First Name:_____ Last Name:_____

L15 – Dynamics Unit Test

IMPORTANT: Do not open your tests until instructed to do so.

This test is broken into three sections, split up by competency. Each section corresponds to a summative quiz that was written in class. If you show improved knowledge on any of these sections, I will modify your quiz mark to show the same ability (percentage). In short, this test acts as a retest for each of your summative quizzes.

Competency 2 – Forces and Motion
- Forces and Acceleration
- Friction and Newton's Third Law

Your score on this test will be recorded by competency, under each competency. The corresponding sections of this test will account for 40% of each competency.

Good luck!

This section for the teacher's use only.

Competency 2 – Forces and Acceleration	_____ / 6 x1.67 = _____ / 10
Competency 2 – Friction and Newton's Third Law	_____ / 7 x1.43 = _____ / 10

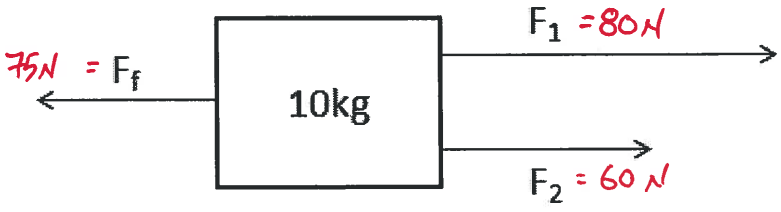
KEY

Competency 2 – Forces and Acceleration

/3

Q1: A 10kg box initially at rest is being pulled by two individuals. The first individual applies a force of 80N [forward]. The second individual applies a force of 60N [forward]. The force of friction on the object is 75N [backward]. If the mass of the object is 10kg and it travels for 5 seconds, what is the final velocity? *(3 marks)*

- ⟷ +



$F_{net} = 80N[f] + 60N[f] - 75N[f]$

(1) $\vec{F}_{net} = 65N\ [f]$

$a = \frac{F_{net}}{m} = \frac{65N[f]}{10kg}$

(1) $\vec{a} = 6.5\ m/s^2\ [f]$

$a = 6.5\ m/s^2$
$V_i = 0\ m/s$
$V_f = ?$
$t = 5s$

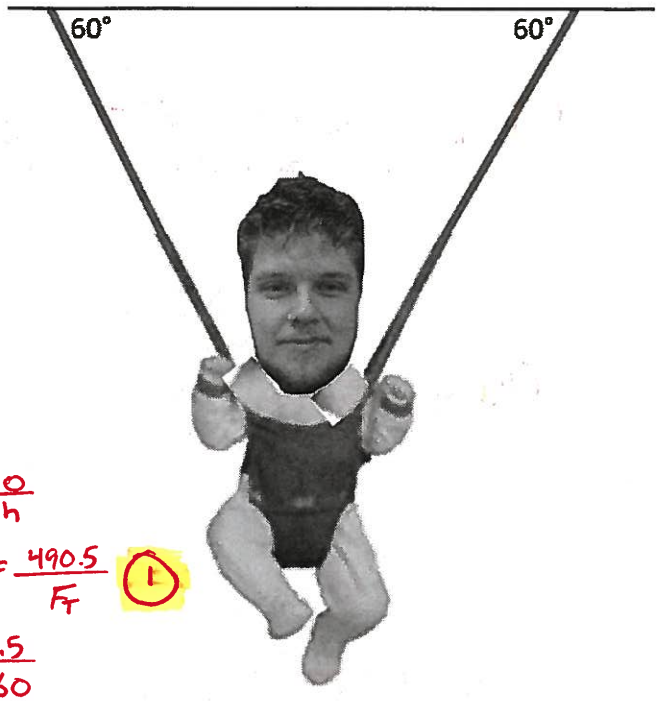
$a = \frac{V_f - V_i}{t}$

$6.5\ m/s^2 = \frac{V_f - 0\ m/s}{5s}$

(1) $32.5\ m/s\ [f] = \vec{V}_f$

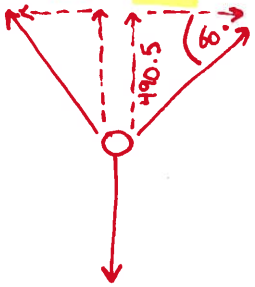
KEY

Q2: A 100kg Mr. Melnyk decides to test out the jolly-jumper he purchased for his baby. He hangs from the jumper, stationary. If the cables can only sustain 500N of tension each, determine if Mr. Melnyk breaks the cables. ***Show all of your work.*** *(3 marks)*



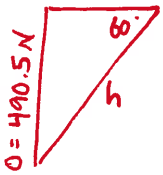
METHOD #1

FBD (1)



$F_g = mg = (100kg)(9.81\ m/s^2)$

$= 981\ N$



$\sin\theta = \frac{O}{h}$

$\sin 60^\circ = \frac{490.5}{F_T}$ (1)

$F_T = \frac{490.5}{\sin 60}$

$F_T = 566.38\ N$

Yes, it will break. (1)

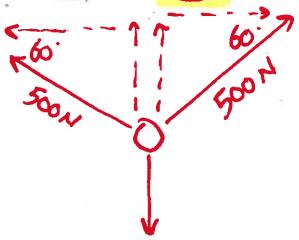
$F_T > 500\ N.$

Common mistake $F_T = \frac{981}{\sin 60}$

$F_T = 1132.76 N.$ $\frac{2}{3}$

METHOD #2

FBD (1)

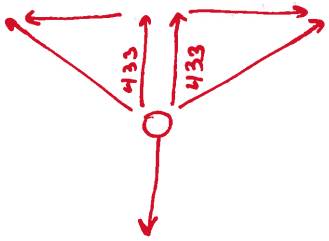


$F_{g_{max}} = ?$

$\sin\theta = \frac{O}{h}$

$\sin 60^\circ = \frac{O}{500}$ (1)

$opp = 433.01\ N$



$F_{g_{max}} = 866\ N$

$F_g = mg$

$866\ N = \quad m(9.81\ m/s^2)$

$m_{max} = 86.28kg.$

$m_{melnyk} > m_{max}$

Yes, it will break. (1)

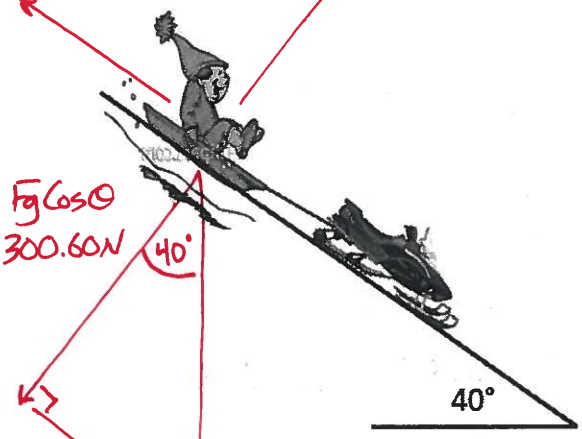
KEY

Competency 2 – Friction & Newton's Third Law

Q3: A child on a sled (40kg combined) is being towed downhill by a snowmobile. The coefficient of kinetic friction between the sled and the hill is 0.04. If the sled is accelerating downhill at 8m/s^2, what is the force applied by the snowmobile (F_{APP})? *(4 marks)*

(1) $F_{fk} = \mu_k F_N = (0.04)(300.60) = 12.02\,N$

$F_N = 300.60\,N$



(1/2) $F_{g\perp} = F_g \cos\theta = 300.60\,N$ (40°)

$F_{g\parallel} =$

$F_g = mg = (40kg)(9.81\,m/s^2) = 392.4\,N$

$F_g \sin\theta = 252.23N$ (1/2)

(1) $F_{net} = ma = (40kg)(8m/s^2) = 320\,N\,[downhill]$

$F_{net} = F_{g\parallel} + F_{app} + F_{fk}$

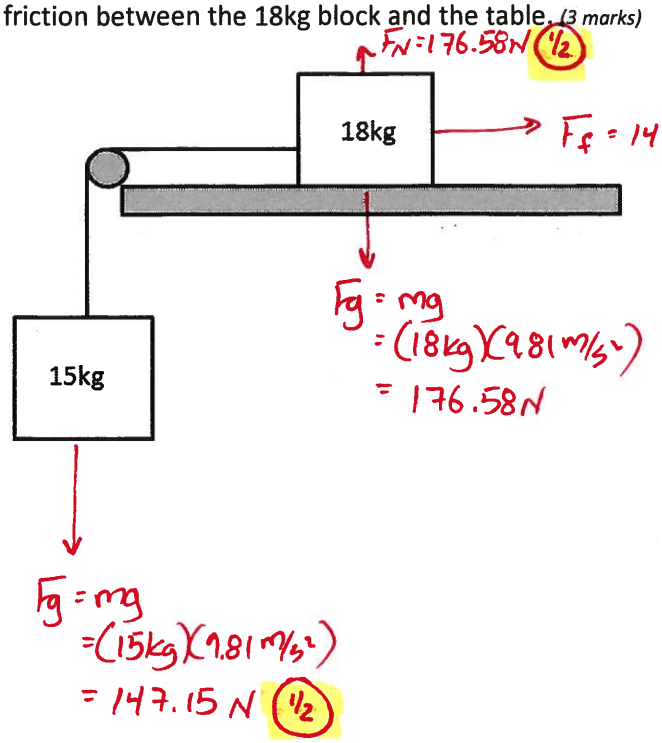
$320N\,[down] = 252.23N\,[down] + F_{app} - 12.02N\,[down]$

(1) $F_{app} = 79.97N\,[downhill]$

KEY

Q4: An 18kg block on the table is moving left with a ***constant speed*** of 2m/s. Calculate the coefficient of friction between the 18kg block and the table. *(3 marks)*

$\vec{a} = 0\ m/s^2$



$F_{f_k} = \mu_k F_N$

$147.15N = \mu_k (176.58N)$

(1) $\mu_k = 0.8\bar{3}$

Note: If $a = 2\ m/s^2$, $F_{net} = 66\ N$

$F_f = 81.15\ N$

$\mu_k = 0.459$

$\frac{2}{3}$

KEY