KEY

REWRITE

First Name:_____ Last Name:_____

Phys20 – Dynamics – Unit Exam Rewrite

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

Competency 4 – Gravitational Forces and Fields
- Gravitational Forces and Fields

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 3 – Forces and Acceleration	_____ / 6 x1.67 = _____ / 10
Competency 3 – Friction and Newton's Third Law	_____ / 7 x1.43 = _____ / 10
Competency 4 – Gravitational Forces and Fields	_____ / 6 x2 = _____ / 12

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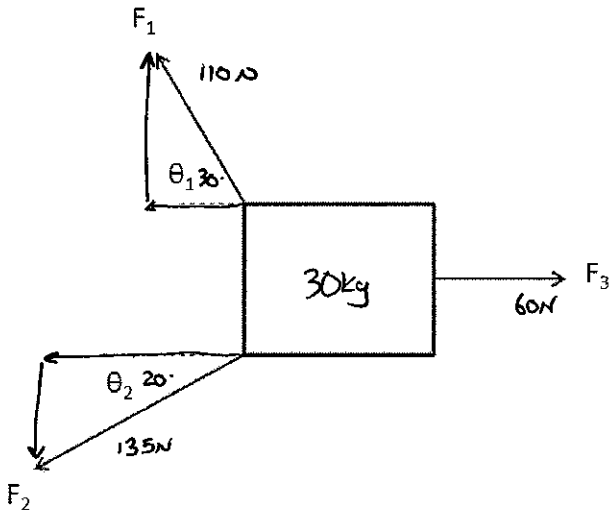
Competency 3 – Forces and Acceleration

Q1: A 30kg box initially at rest is being pulled by three individuals. The first individual applies a force of 110N [30° N of W]. The second individual applies a force of 135 N [20° S of W]. The third individual applies a force of 60 N [E]. How long does it take for the box to travel 20 m? *(3 marks)*



	x-comp	y-comp
F_1	$= 110\cos 30^\circ$ $= -95.26N$	$= 110\sin 30^\circ$ $= 55N$
F_2	$= 135\cos 20^\circ$ $= -126.86N$	$= 135\sin 20^\circ$ $= -46.17N$
F_3	$= 60N$	$= 0N$
F_{net}	$-162.12\ N$	$8.83N$

$$|F_{net}| = \sqrt{(-162.12)^2 + (8.83)^2}$$
$$= 162.36\ N$$

$F = ma$

$162.36N = (30kg)a$

$a = 5.41\ m/s^2$

$d = v_i t + \frac{1}{2}at^2$

$20m = (0m/s)t + \frac{1}{2}(5.41\ m/s^2)t^2$

$20 = 2.706\ t^2$

$7.39 = t^2$

$\boxed{t = 2.72s}$

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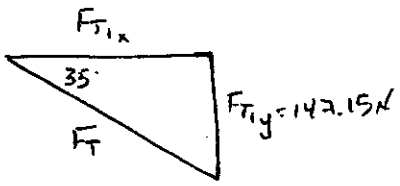
Q2: A sign of mass 15kg is hanging suspended, as shown below. If the angle between the left cable is 35°, what is the tension in each cable? ***Show all of your work.*** *(3 marks)*



$\tan\theta = \frac{o}{a}$

$\tan 35^\circ = \frac{147.15N}{F_{T_{1x}}}$

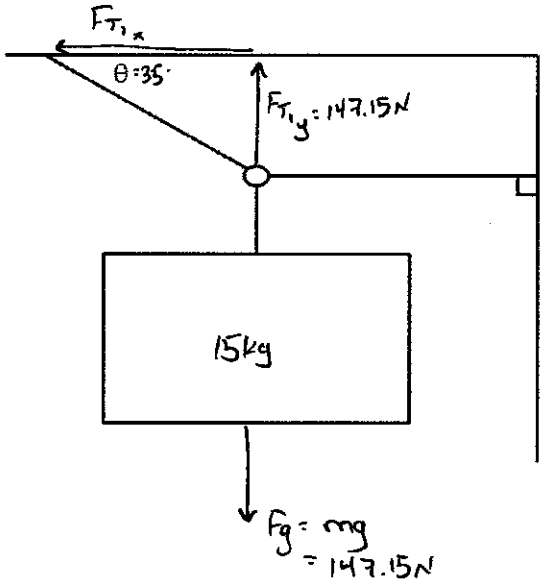
$F_{T_{1x}} = 210.15N$

$\boxed{F_{T_2} = 210.15N}$

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

$\sin 35^\circ = \frac{147.15N}{F_T}$

$\boxed{F_T = 256.55N}$



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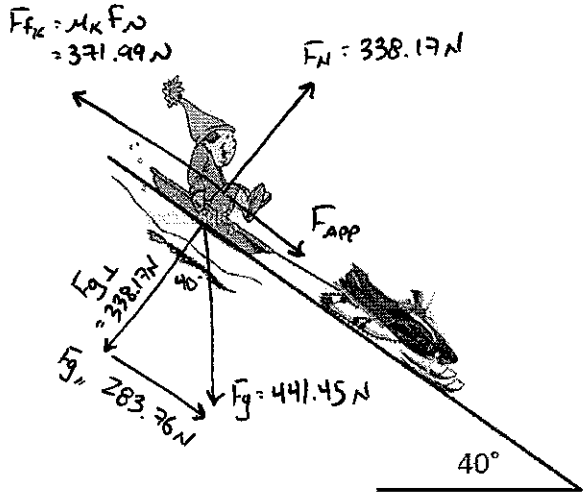
Competency 3 – Friction & Newton's Third Law

Q3: A child on a sled (45kg combined) is being towed downhill by a snowmobile. The coefficient of kinetic friction between the sled and the hill is 1.10. If the sled is pulling the child at a constant speed of 10 m/s, what is the force applied by the snowmobile (F_{APP})? *(4 marks)*

$F_{net_{//}} = 0N$



$F_{net_{//}} = F_{APP} + F_{g//} + F_{f_K}$

$0N = F_{APP} + 283.76N - 371.99N$

$\boxed{F_{APP} = 88.23N}$

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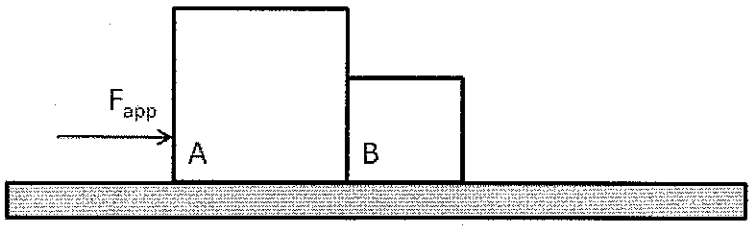
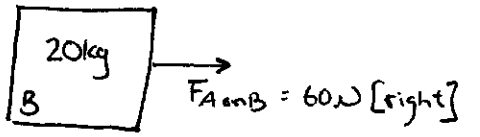
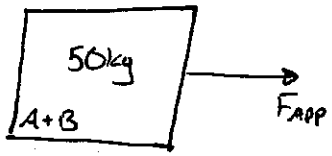
Q4: If m_A = 30 kg, m_B = 20kg, and the force that B applies on A is 60N [left], what is the force applied?
(3 marks)





$$\vec{a} = \frac{\vec{F}_{net}}{m} = \frac{60\text{N}[L]}{20\text{kg}} = \vec{3}\,\text{m/s}^2[L]$$



$$\vec{F}_{APP} = m\vec{a}$$
$$= (50\text{kg})(3\,\text{m/s}^2[L])$$
$$\vec{F}_{APP} = 150\text{N}[L]$$

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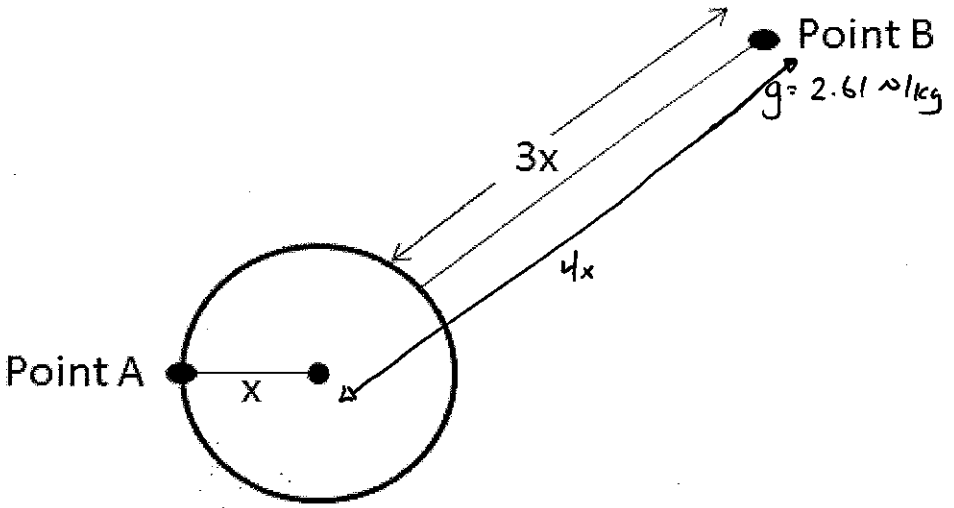
Competency 4 – Gravitational Forces and Fields

Use the following information to answer Q5 and Q6:

An Astronaut of mass 90kg is located at Point B. The gravitational field strength experienced by the Astronaut at this location is 2.61 N/kg.



m = 90kg

g = 2.61 N/kg

Q5: What is the Force of Gravity acting on the Astronaut at Point B? *(1 mark)*

$F_g = mg$
$= (90kg)(2.61\ N/kg)$
$= 234.9\ N$

Q6: What is the acceleration due to gravity at Point A? *(1 mark)*

At pt B, experiences $\frac{1}{16}$ th the gravitational field. (4x as far away)

On surface $g = 2.61 \times 16 = 41.76\ N/kg$

$\boxed{a = 41.76\ m/s^2}$

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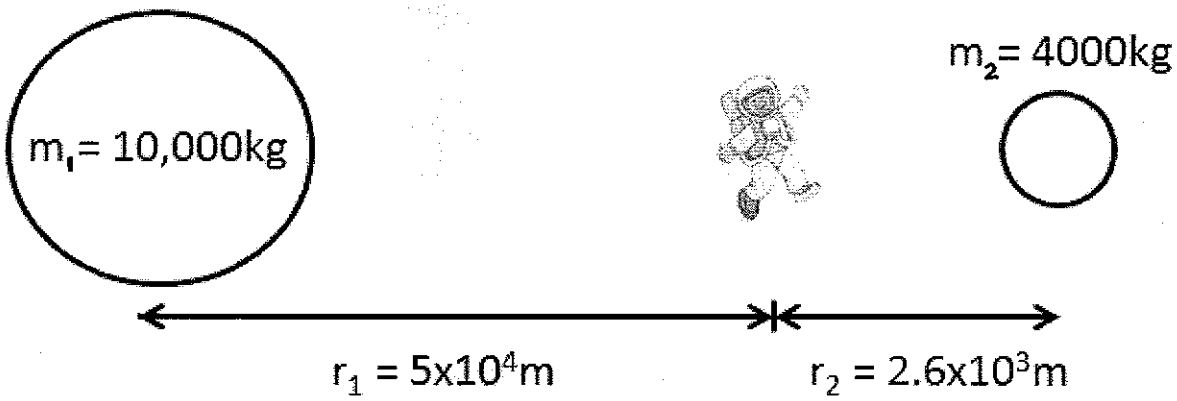
Q7: What is the instantaneous acceleration (magnitude and direction) of the astronaut of unknown mass? *(4 marks)*



$$g_1 = \frac{Gm_1}{r_1^2}$$

$$= \frac{(6.67\times10^{-11}\frac{Nm^2}{kg^2})(10{,}000kg)}{(5\times10^4 m)^2}$$

$$= 2.668\times10^{-16} N/kg$$

$$\vec{a}_1 = 2.668\times10^{-16} m/s^2 \text{ [left]}$$

$$g_2 = \frac{Gm_2}{r_2^2}$$

$$= \frac{(6.67\times10^{-11}\frac{Nm^2}{kg^2})(4000kg)}{(2.6\times10^3 m)^2}$$

$$= 3.947\times10^{-14} N/kg$$

$$\vec{a}_2 = 3.947\times10^{-14} m/s^2 \text{ [right]}$$

$$\vec{a}_{TOT} = \vec{a}_1 + \vec{a}_2$$

$$= -2.668\times10^{-16} m/s^2 + 3.947\times10^{-14} m/s^2$$

$$\boxed{\vec{a}_{TOT} = 3.920\times10^{-14} m/s^2 \text{ [right]}}$$