PRACTICE TEST

Part B: Physics 12 – Chapter 1 and 3.4 Test – Oct 2013 (version i)

QUESTIONS

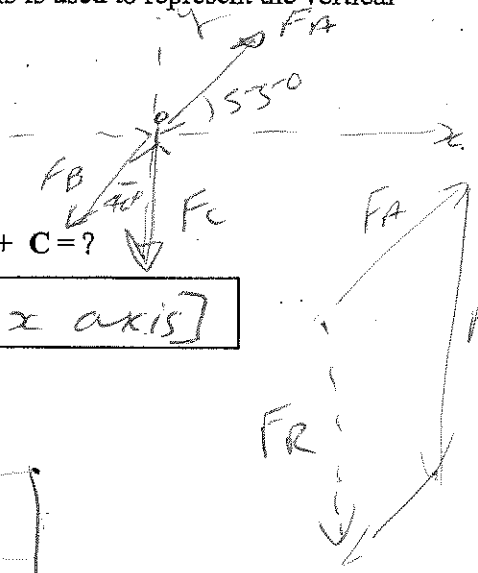
Name: KEY **Block:** _____

PART B: Solve these problems using **ANALYTICAL METHODS** (components) – Show all work in the space provided. All resultant vectors must include both magnitude and direction. Include appropriate units, and appropriate number of significant digits. You should also sketch a rough vector diagram (not to scale) for each question. ***You must use your calculator for this section.***

1. Three different forces are acting on a circus acrobat, of mass 81.1kg. For example, the forces could be gravity, the force exerted by another acrobat who is holding him, and the force of tension exerted by the trapeze rope on the person. An x-y axis is used to represent the vertical (y axis) and the horizontal (x axis).

The forces acting on the ~~body~~ acrobat are:

A = 560.0 N [55.0° above the positive x axis]
B = 355 N [40.0° to the left of the negative y axis]
C = 795 N [negative y direction]



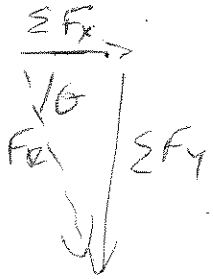
a) Determine the resultant force for the vector sum: **A** + **B** + **C** = ?

Answer: 615 N [81.3° below the +x axis]

Show your work here:

	x	y
A	560 cos 55°	560 sin 55°
B	−355 sin 40°	−355 cos 40°
C	0	−795
ΣF	93.0132 N	−608.22 N

sum



$\theta = \tan^{-1}\left[\frac{\Sigma F_y}{\Sigma F_x}\right] = \tan^{-1}\left[\frac{608.22}{93.0132}\right] = 81.3°$

$\Sigma F = \sqrt{F_x^2 + F_y^2} = \sqrt{93.0132^2 + 608.22^2} = 615\ N$

b) What is the acceleration of the acrobat?

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

$\vec{a} = \frac{\Sigma F}{m} = \frac{615\ N}{81.1\ kg}$

$\vec{a} = 7.58\ m/s^2\ [81.3°\ \text{below the} + x\ \text{axis}]$

c) Now the direction and magnitude of the forces has changed (perhaps another acrobat is hanging from the feet of the first acrobat, and/or the support team are pulling/pushing differently).
Determine the resultant force for the new relationship: $-0.75\mathbf{B} + 3\mathbf{A} + 2\mathbf{C} = ?$

Answer: $1.13 \times 10^3 N$ [0.498° below the +x axis]

Show your work here:

	x	y
-0.75B	$(-0.75)(-355\sin 40^\circ)$	$(-0.75)(-355\cos 40^\circ)$
3A	$(3)(560\cos 55^\circ)$	$(3)(560\sin 55^\circ)$
2C	0	$2(-795)$
Sum	1134.175	-9.8652

$\Sigma F = \sqrt{F_x^2 + F_y^2}$

$= 1134.79\ N$

$\theta = \tan^{-1}\left[\frac{F_y}{F_x}\right] = 0.498^\circ$

2. A horse running at a velocity of 12.0 m/s [20.0° South of East] takes 1.5 seconds to make a turn. Its velocity after turning is 15.5 m/s [30.0° West of South].
   a. What is the change in velocity of the horse? $(v_f - v_i)$ $v_f - v_i$
   b. What is the acceleration of the horse as it makes the turn?

(a)

	x	y
V_f	$-15.5\sin 30^\circ$	$-15.5\cos 30^\circ$
V_i	$12\cos 20^\circ$	$-12\sin 20^\circ$
$\Delta V = V_f - V_i$	-19.026	-9.31915

$\Delta V = \sqrt{\Delta V_x^2 + \Delta V_y^2} = 21.185$

$\theta = \tan^{-1}\left[\frac{\Delta V_y}{\Delta V_x}\right] = \tan^{-1}\left[\frac{9.31915}{19.026}\right] = 26.096$

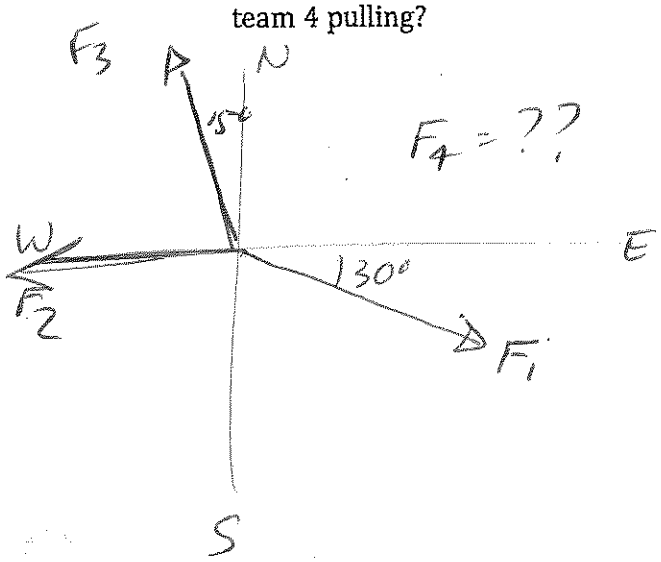
$\Delta V = 21.2\ m/s\ [26.1^\circ S\ of\ W]$

(b) $\vec{a} = \frac{\Delta \vec{V}}{\Delta t} = \frac{21.1857\ m/s}{1.5\ s} = 14.1238\ m/s^2$

$\vec{a} = 14.1\ m/s^2\ [26.1^\circ S\ of\ W]$

3. A group of friends is playing a new kind of tug-of-war game, with 4 teams all pulling against each other in different directions. The 4 ropes are connected together in the centre.
   - Team 1 pulls with a force of 3.5×10^2 N [30.0° South of East]
   - Team 2 pulls with a force of 6.5×10^2 N [due West]
   - Team 3 pulls with a force of 5.0×10^2 N [15.0° West of North]

If the group is in static equilibrium (not moving, and net force = 0N), with what force is team 4 pulling?



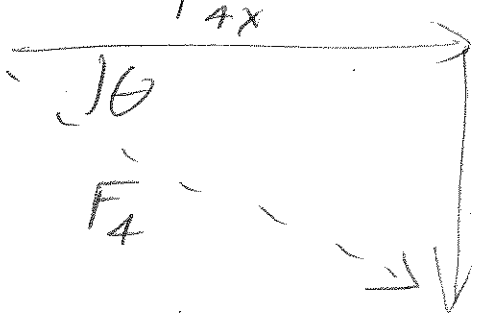
	x	y
1	$350\cos30°$	$-350\sin30°$
2	-650	0
3	$-500\sin15°$	$500\cos15°$
4	F_{4x}	F_{4y}
sum	0	0

x// $350\cos30° + (-650) + (-500\sin15°) + F_{4x} = 0$

$\therefore F_{4x} = 476.3\ N$

y// $(-350\sin30°) + 0 + (500\cos15°) + F_{4y} = 0$

$\therefore F_{4y} = -307.96\ N$



$F_4 = \sqrt{F_{4x}^2 + F_{4y}^2} = 567.1885$

$\theta = \tan^{-1}\left[\frac{F_{4y}}{F_{4x}}\right] = \tan^{-1}\left[\frac{307.96}{476.3}\right] = 32.885°$

$F_4 = 5.7\times10^2\ N\ [33°\ S\ of\ E]$