First Name:_____   Last Name:_____

L04 – FQ – Forces and Acceleration

Use the following information to answer questions #Q1-Q3

> Three young children are playing tug-of-war with a poor 5kg orange kitten. The first child pulls with a force of $F_1 = 80N$ [N]. The second child pulls with a force of $F_2 = 75N$ [60° N of W]. The third child pulls with a force of $F_3 = 30N$ [S].

Q1: Draw a Free-Body Diagram for the cat. *(1 mark)*

$\vec{F_1} = 80N$ [N]

$F_3 = 75N$

60°

CAT

$\vec{F_3} = 30N$ [S]
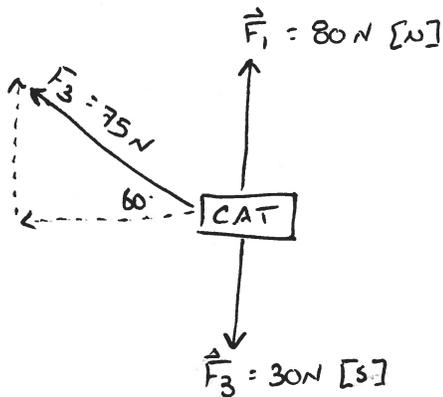
Q2: Which best describes the components of F_2?

	x-comp	y-comp
A.	+37.50	+64.95
B	-37.50	+64.95
C.	+64.95	+37.50
D.	-64.95	+37.50

75N

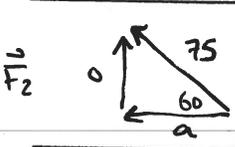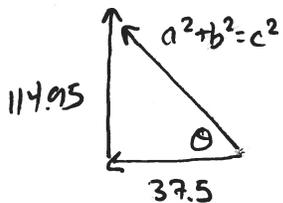+64.95

60°
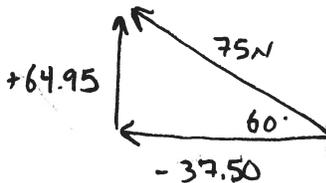
- 37.50

	x-comp	y-comp
F_2	$\cos\theta = \frac{a}{h}$	$\sin\theta = \frac{o}{h}$
	$F_{2x} = -37.50$	$F_{2y} = +64.95$

As a side note, we could also write this vector as

$$\vec{F_2} = -37.50\hat{i} + 64.95\hat{j}$$

Q3: What is the net force acting on the cat, with magnitude and direction? *(2 marks)*

	x-comp	y-comp
$\vec{F_1}$ ↑ 80	0	+80
$\vec{F_2}$ 75, 60, a	$\cos\theta = \frac{a}{h}$ $F_{2x} = -37.50$	$\sin\theta = \frac{a}{h}$ $F_{2y} = +64.95$
$\vec{F_3}$ ↓ 30	0	-30
$\vec{F}_{net}$	-37.50	+114.95

$a^2+b^2=c^2$ 114.95, 37.5, θ

$a^2+b^2=c^2$
$c = 120.91$

$\tan\theta = \frac{o}{a}$
$\theta = \tan^{-1}\left(\frac{114.95}{37.5}\right)$
$\theta = 71.93°$

$\vec{F}_{net} = 120.91\ N\ [71.93° \ N\ of\ W]$
$[18.07° \ W\ of\ N]$

Q4: The magnitude of the acceleration of the cat is **a.bc** x 10^d m/s², where **a, b, c,** and **d** are ___, ___, ___, and ___.

*(Record your **four-digit** answer in the Numerical Response boxes below)*

2	4	2	1

$\vec{a} = \frac{\vec{F}_{net}}{m} = \frac{120.91\ N\ [71.93° \ N\ of\ W]}{5\ kg}$

$\vec{a} = 24.182\ m/s²\ [71.93° \ N\ of\ W]$

$|\vec{a}| = 24.182\ m/s²$

$|\vec{a}| = 2.4182 \times 10^1\ m/s²$

$|\vec{a}| \approx 2.42 \times 10^1\ m/s²$

Use the following information to answer Q5:

Acceleration vs. Force
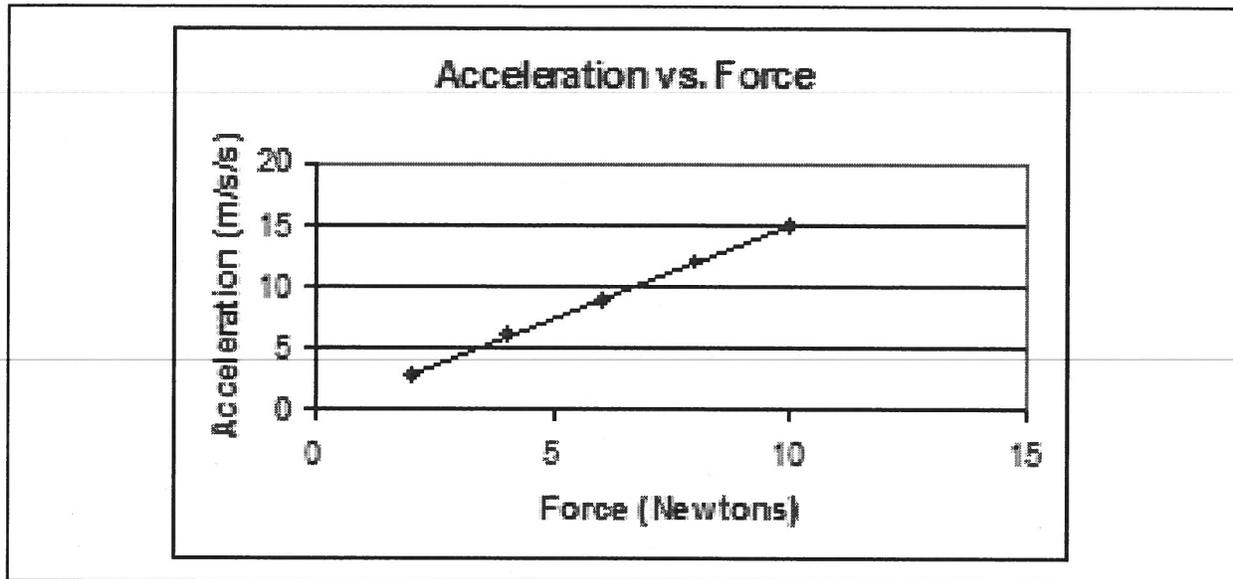
Q5: The mass of the object is

(a) 0.67 kg
b. 1.02 kg
c. 1.50 kg
d. 5.00 kg

Option #1: Pick a data point

When $F = 10N$, $a = 15 m/s^2$

$F = ma$

$10 = m(15)$

$m = 0.67 kg$

Option #2: Linearize the Graph

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

$a = \left(\dfrac{1}{m}\right)F + 0$

$y = (slope) x + b$

So slope $= \dfrac{1}{m}$

$\dfrac{rise}{run} = \dfrac{1}{m}$

$\dfrac{15}{10} = \dfrac{1}{m}$

$1.5 = \dfrac{1}{m}$

$1.5m = 1$

$m = 0.67 kg$

MARKING:

Beginning	0.0 – 2.5
Progressing	3.0 – 4.0
Competent	4.5 – 5.5
Exemplary	6.0