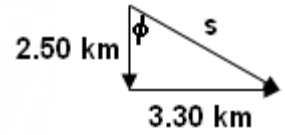
Motion and Force in a Gravitational Field

Revision Problems 1: Vectors Due: _____

Name: _____ ANSWERS _____ (20 marks)

1. Sam is out walking for exercise. He walks 2.50 km South then 3.30 km East.
   a. Calculate his displacement. (3 marks)



$s = \sqrt{(2.5^2 + 3.3^2)}$ **$\phi = \tan^{-1}(3.3 \div 2.5)$**

$= 4.14$ km [1 mark] **$= 52.9^0$ [1 mark]**

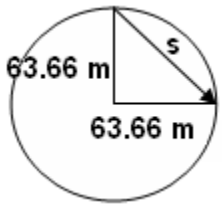
$s = 4.14 \times 10^3$ m S 52.9^0 E [1 mark]

   b. If the walk took 30.0 minutes, calculate his velocity. (2 mark)

t = 30 x 60 **$v = \frac{s}{t} = \frac{4140}{1800}$** **[1 mark]**

= 1800 s **v = 2.30 ms^{-1} S 52.9^0 E [1 mark]**

2. Jennifer is running laps around the 4.00×10^2 m circular track. She finds on average that it takes her 1.12 minutes to do a lap. Work out Jennifer's velocity when she is one quarter of the way around the track. (4 marks)



circum = $2\pi r$ **$s = \sqrt{(63.66^2 + 63.66^2)}$**

$400 = 2\pi r$ **s = 90.0 m [1 mark]**

r = 63.66 m [1 mark]

$t = \frac{1.12 \times 60}{4}$ **$v = \frac{s}{t} = \frac{90}{16.8}$**

t = 16.8 s [1 mark] **v = 5.36 ms^{-1} [1 mark]**

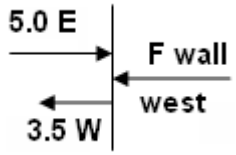
3. Ashley throws a 0.200 kg tennis ball against the wall of a house watched by Toby. The ball hits the wall at 5.00 ms^{-1} East and rebounds with a velocity of 3.50 ms^{-1} West. Toby determines that the change in velocity took 2.00×10^{-2} s. Calculate the force of the wall on the ball. (3 marks)

m = 0.200 kg
u = 5.00 ms^{-1} E
v = 3.50 ms^{-1} W
v-u = 3.5 W – 5 E
= 3.5 W + 5 W
= 8.50 ms^{-1} W [1 mark]
t = 20 x 10^{-3} s

$F = \frac{m(v - u)}{t}$

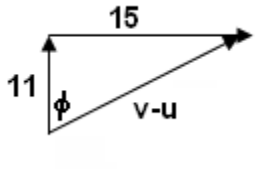
$F = \frac{0.200 \times 8.50}{0.02}$ **[1 mark]**

F = 85.0 N West **[1 mark]**



4. Lukah is driving her new car at 15.0 ms^{-1} West when she rounds a corner to be travelling at 11.0 ms^{-1} North. If the change in velocity took 2.80 s, what was the car's acceleration around the corner? (4 marks)

u = 15.0 ms^{-1} W
v = 11.0 ms^{-1} N
v-u = 11 N – 15 W
= 11 N + 15 E



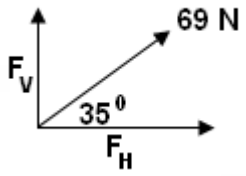
[1 mark]

v – u = $\sqrt{(11^2 + 15^2)}$
= 18.6 ms^{-1}
ϕ = $\tan^{-1}$ (15 ÷ 11)
= 53.7^0
v – u = 18.6 ms^{-1} N 53.7^0 E [1 mark]

$$a = \frac{v - u}{t} = \frac{18.6}{2.8}$$ **[1 mark]**

a = 6.64 ms^{-2} N 53.7^0 E [1 mark]

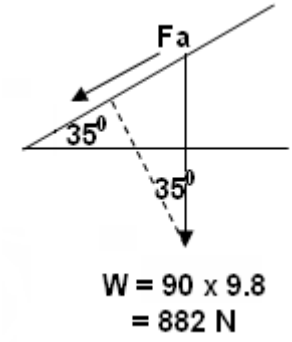
5. Kristian is flying a model airplane attached to a string. The string is at an angle of 35.0^0 to the horizontal and has a tension of 69.0 N. Determine the horizontal and vertical components of the tension. (2 marks)



F_H = F cos ϕ
= 69 cos 35
F_H = 56.5 N [1 mark]

F_v = F sin ϕ
= 69 sin 35
F_v = 39.6 N [1 mark]

6. A boy on a bike is free-wheeling down a hill which has a slope of 35.0^0. The mass of the boy and his bike is 90.0 kg. Assuming no friction, calculate the force accelerating him down the hill. (2 marks)



[1 mark]

Fa = W sin 35
= 882 sin 35
Fa = 506 N [1 mark]