

Motion and Force in a Gravitational Field

Revision Problems 1: Vectors

Due: _____

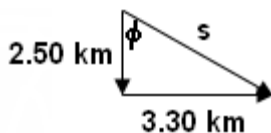
Name: _____ ANSWERS _____

(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)



$$s = \sqrt{(2.5^2 + 3.3^2)}$$

$$= 4.14 \text{ km [1 mark]}$$

$$\phi = \tan^{-1}(3.3 \div 2.5)$$

$$= 52.9^\circ \text{ [1 mark]}$$

$$s = 4.14 \times 10^3 \text{ m S } 52.9^\circ \text{ E [1 mark]}$$

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

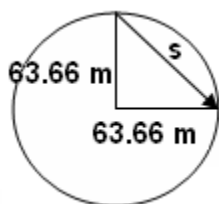
$$t = 30 \times 60$$

$$= 1800 \text{ s}$$

$$v = \frac{s}{t} = \frac{4140}{1800} \text{ [1 mark]}$$

$$v = 2.30 \text{ ms}^{-1} \text{ S } 52.9^\circ \text{ E [1 mark]}$$

2. Jennifer is running laps around the $4.00 \times 10^2 \text{ m}$ 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)



$$\text{circum} = 2\pi r$$

$$400 = 2\pi r$$

$$r = 63.66 \text{ m [1 mark]}$$

$$s = \sqrt{(63.66^2 + 63.66^2)}$$

$$s = 90.0 \text{ m [1 mark]}$$

$$t = \frac{1.12 \times 60}{4}$$

$$t = 16.8 \text{ s [1 mark]}$$

$$v = \frac{s}{t} = \frac{90}{16.8}$$

$$v = 5.36 \text{ ms}^{-1} \text{ [1 mark]}$$

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 $2.00 \times 10^{-2} \text{ s}$. Calculate the force of the wall on the ball. (3 marks)

$$m = 0.200 \text{ kg}$$

$$u = 5.00 \text{ ms}^{-1} \text{ E}$$

$$v = 3.50 \text{ ms}^{-1} \text{ W}$$

$$v - u = 3.5 \text{ W} - 5 \text{ E}$$

$$= 3.5 \text{ W} + 5 \text{ W}$$

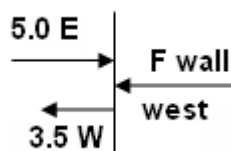
$$= 8.50 \text{ ms}^{-1} \text{ W [1 mark]}$$

$$t = 20 \times 10^{-3} \text{ s}$$

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

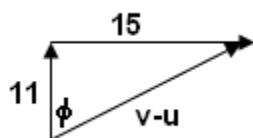
$$F = \frac{0.200 \times 8.50}{0.02} \text{ [1 mark]}$$

$$F = 85.0 \text{ N West [1 mark]}$$



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)

$$\begin{aligned} u &= 15.0 \text{ ms}^{-1} \text{ W} \\ v &= 11.0 \text{ ms}^{-1} \text{ N} \\ v-u &= 11 \text{ N} - 15 \text{ W} \\ &= 11 \text{ N} + 15 \text{ E} \end{aligned}$$



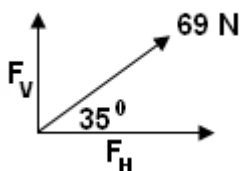
[1 mark]

$$\begin{aligned} v-u &= \sqrt{(11^2 + 15^2)} \\ &= 18.6 \text{ ms}^{-1} \\ \phi &= \tan^{-1}(15 \div 11) \\ &= 53.7^\circ \\ v-u &= 18.6 \text{ ms}^{-1} \text{ N } 53.7^\circ \text{ E} \quad [1 \text{ mark}] \end{aligned}$$

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

$$a = 6.64 \text{ ms}^{-2} \text{ N } 53.7^\circ \text{ E} \quad [1 \text{ mark}]$$

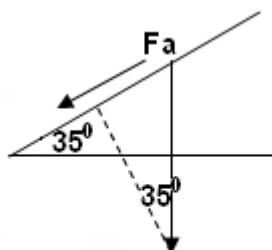
5. Kristian is flying a model airplane attached to a string. The string is at an angle of 35.0° to the horizontal and has a tension of 69.0 N . Determine the horizontal and vertical components of the tension. (2 marks)



$$\begin{aligned} F_H &= F \cos \phi \\ &= 69 \cos 35 \\ F_H &= 56.5 \text{ N} \quad [1 \text{ mark}] \end{aligned}$$

$$\begin{aligned} F_V &= F \sin \phi \\ &= 69 \sin 35 \\ F_V &= 39.6 \text{ N} \quad [1 \text{ mark}] \end{aligned}$$

6. A boy on a bike is free-wheeling down a hill which has a slope of 35.0° . 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)



$$\begin{aligned} W &= 90 \times 9.8 \\ &= 882 \text{ N} \end{aligned}$$

[1 mark]

$$\begin{aligned} Fa &= W \sin 35 \\ &= 882 \sin 35 \\ Fa &= 506 \text{ N} \quad [1 \text{ mark}] \end{aligned}$$