PHYS 1050 Tutorial 1

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chapter 3 - problem 57

If $\vec{B}$ is added to $\vec{A}$, the result is $6.0\hat{\mathrm{i}} + 1.0\hat{\mathrm{j}}$. If $\vec{B}$ is subtracted from $\vec{A}$, the result is $-4.0\hat{\mathrm{i}} + 7.0\hat{\mathrm{j}}$. What is the magnitude of $\vec{A}$?

$$\vec{A} = A_x\hat{\imath} + A_y\hat{\jmath}$$
$$\vec{B} = B_x\hat{\imath} + B_y\hat{\jmath}$$

$\vec{A} +$ $\hat{\jmath} = 6i + 1j$

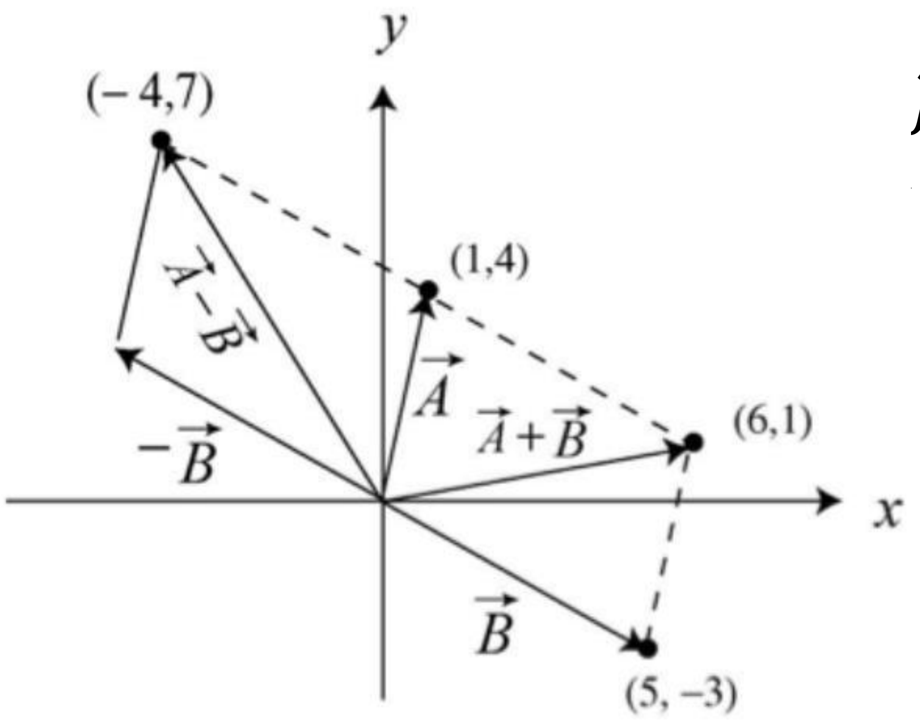
$\vec{A} -$ $= -4i + 7j$

$A_x +$

$A_x -$

$A_x =$

$B_x =$



$$|\vec{\boldsymbol{A}}| = \sqrt{\mathbf{1^2 + 4^2}} = \sqrt{\mathbf{17}} \approx \mathbf{4.123}$$

$$|\vec{\boldsymbol{B}}| = \sqrt{\mathbf{5^2 + (-3)^2}} = \sqrt{\mathbf{34}} \approx \mathbf{5.831}$$

chapter 4 - problem 11

The position $\vec{r}$ of a particle moving in an xy plane is given by $\vec{r} = (2.00t^3 - 5.00t)\hat{\mathrm{i}} + (6.00 - 7.00t^4)\hat{\mathrm{j}}$, with $\vec{r}$ in meters and t in seconds. In unit-vector notation, calculate (a) $\vec{r}$, (b) $\vec{v}$, and (c) $\vec{a}$ for $t = 2.00$ s. (d) What is the angle between the positive direction of the x axis and a line tangent to the particle's path at $t = 2.00$ s?

(a)

$$\vec{r}\Big|_{t=2s} = (2\times 2^3 - 5\times 2)i + (6 - 7\times 2^4)j$$
$$= 6i - 106j$$

(b)

$$\vec{v}\Big|_{t=2s} = \frac{d\vec{r}}{dt} = (6t^2 - 5)i + (-28t^3)j$$
$$= 19i - 224j$$

(c)

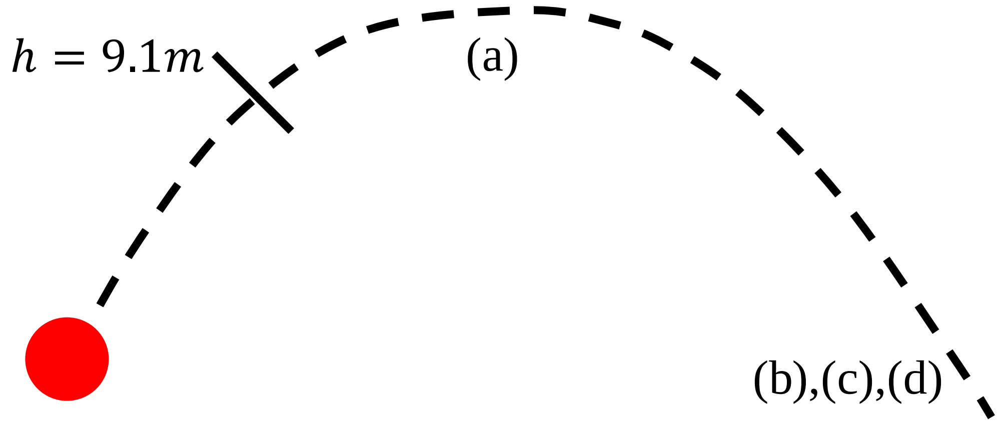
$$\vec{a}\Big|_{t=2s} = \frac{d^2\vec{r}}{dt^2} = (12t)i + (-84t^2)j$$
$$= 24i - 336j$$

(d)

$$\theta = \tan^{-1}(-\frac{224}{19}) = -85.15°$$

chapter 4 - problem 43

A ball is shot from the ground into the air. At a height of 9.1 m, its velocity is $\vec{v} = \left(7.6\hat{i} + 6.1\hat{j}\right)$ m/s. (a) To what maximum height does the ball rise? (b) What total horizontal distance does the ball travel? What are the (c) magnitude and (d) angle (below the horizontal) of the ball's velocity just before it hits the ground?



(a) $v_H^2 - v_y^2 = 2g \cdot h$

$$h = \frac{v^2 - v_0^2}{2a} = \frac{(6.1m/s)^2}{2 \times 9.8m/s^2} = 1.9m$$

$$H = h + \Delta h = 11.0\ m$$

(b) $v_{0y} = 14.7\text{m/s}$

$$0 = v_{0y}t - \frac{1}{2}gt^2$$

$$-\frac{1}{2} \times 9.8t^2 + 14.7t = 0 \qquad t_1 = 3s$$

$$R = v_x \cdot t_1 = 3s \times 7.6m/s = 22.8m$$

(c) $v_f = \sqrt{v_x^2 + v_y^2}$

$$= \sqrt{(7.6m/s)^2 + (14.7m/s)^2}$$

$$= 17m/s$$

(d) $\theta = \tan^{-1}\left(\frac{v_x}{v_y}\right) = -63°$

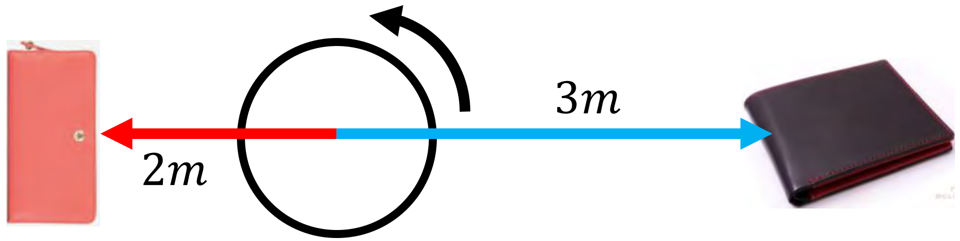
chapter 4 - problem 65

A purse at radius 2.00 m and a wallet at radius 3.00 m travel in uniform circular motion on the floor of a merry-go-round as the ride turns. They are on the same radial line. At one instant, the acceleration of the purse is $(2.00\ \mathrm{m/s^2})\hat{\mathrm{i}} + (4.00\ \mathrm{m/s^2})\hat{\mathrm{j}}$. At that instant and in unit-vector notation, what is the acceleration of the wallet?

$$a\Big|_{purse} = \omega^2 r_p$$

$$a\Big|_{walllet} = \omega^2 r_w$$

$$\frac{a|_{purse}}{a|_{walllet}} = \frac{r_p}{r_w} = \frac{2}{3}$$



$$a|_{walllet} = \frac{3}{2}\left(a|_{purse}\right)$$
$$= (3\mathrm{m/s^2})\mathrm{i} + (6\mathrm{m/s^2})$$

chapter 4 - problem 75

A train travels due south at 30 m/s (relative to the ground) in a rain that is blown toward the south by the wind. The path of each raindrop makes an angle of 70° with the vertical, as measured by an observer stationary on the ground. An observer on the train, however, sees the drops fall perfectly vertically. Determine the speed of the raindrops relative to the ground.

$$v_x\Big|_{wind} = v_x\Big|_{train}$$

$$v_y = \frac{v_x}{\tan^{-1}\theta} = \frac{30m/s}{\tan^{-1}70^\circ} = 10.9m/s$$

$$v = \sqrt{v_x^2 + v_y^2} = \sqrt{(30m/s)^2 + (10.9m/s)^2}$$
$$= 32m/s$$