Quiz #2 Ch.#3 T133 Phys101.02-v1

Student ID:..... Student Name:.....

Q1. Q#7: If vector A = 28 i + 11 j and vector B (magnitude of B = 25) as shown in figure 2, what is the magnitude of the sum of these two vectors? (Ans: 32)

$B_x = B\cos 130 = -16.07$

$B_y = B\sin 130 = 19.15$

$\vec{C} = \vec{A} + \vec{B} = 28\vec{i} + 11\vec{j} - 16.07\vec{i} + 19.15\vec{j}$

$\vec{C} = 11.93\vec{i} + 30.15\vec{j}$

$|\vec{C}| = \sqrt{(11.93)^2 + (30.15)^2} = 32.4$

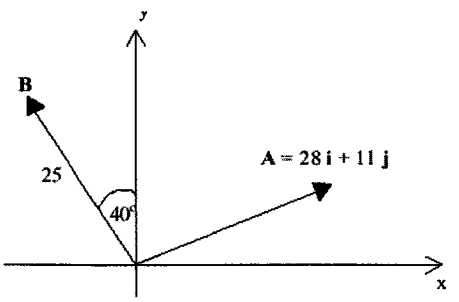


Figure 2

Q#2. Three vectors $\vec{F}$, $\vec{v}$ and $\vec{B}$ are related through $\vec{F} = 5.0(\vec{v} \times \vec{B})$. If vector $\vec{v} = 3.0\,\hat{i} - 5.0\,\hat{j}$ and $\vec{B} = -2.0\,\hat{k}$, then vector $\vec{F}$ is: (Ans: $50\,\hat{i} + 30\,\hat{j}$)

$F = 5[(3\vec{i} - 5.0\vec{j}) \times (-2.0\vec{k})]$

$= 5[(3\vec{i}) \times (-2.0\vec{k}) + (5\vec{j}) \times (2.0\vec{k})]$

$= 5[-6(\vec{i} \times \vec{k}) + 10(\vec{j} \times \vec{k})]$

$= 5[6\vec{j} + 10\vec{i}] = 50\vec{i} + 30\vec{j}$

Quiz #2 Ch.#3 T133 Phys101.02-v2

Student ID:..... Student Name:.....

Q#1..Vectors $\vec{a}$, $\vec{b}$, and $\vec{c}$ are related through equations $\vec{a}+\vec{b}=\vec{c}$ and $\vec{a}-\vec{b}=5.0\vec{c}$. If $\vec{c}=3.0\hat{i}+4.0\hat{j}$, what is the magnitude of vector $\vec{a}$? (Ans: 15)

$$\vec{a}+\vec{b}=\vec{c}$$
$$\vec{a}-\vec{b}=5.0\vec{c}$$
$$2\vec{a}=6.0\vec{c}$$
$$|\vec{a}|=\frac{36}{2}|\vec{c}|=3|\vec{c}|=3\times\sqrt{3^2+4^2}=3\times5=15$$

Q#2.

You are given the two vectors $\vec{A}$ and $\vec{B}$. If $\vec{A}\cdot\vec{B}=4.00$ and $|\vec{A}\times\vec{B}|=3.00$, then the angle between $\vec{A}$ and $\vec{B}$ is:

A) 36.9

$$A\cdot B=|A||B|\cdot\cos\theta$$
$$A\times B=|A||B|\sin\theta$$
$$\frac{A\times B}{A\cdot B}=\tan\theta=\frac{3}{4}$$
$$\theta=\tan^{-1}\left(\frac{3}{4}\right)=36.9^0$$

Quiz #2 Ch.#3 T133 Phys101.02-v3

Student ID:..... Student Name:.....

Q1 . Two vectors A and B are shown in Fig 1. Each vector has a magnitude of 5.0 m. Find the magnitude of the resultant vector R = A + B and the angle (theta) between R and the positive x-axis (counter clockwise.(Ans: magnitude = 7.1 m, theta = 90 degrees)

$A_x = 5\cos 45 = 3.53$

$A_y = 5\sin 45 = 3.53$

$B_x = 5\cos 135 = -3.53$

$B_y = 5\sin 135 = +3.53$

$\vec{R} = \vec{A} + \vec{B} = (A_x + B_x)\hat{i} + (A_y + B_y)\hat{j}$

$= (3.53 + (-3.53))\hat{i} + (3.53 + 3.53)\hat{j}$

$\vec{R} = 7.06\,\hat{j} = 7.1\,\hat{j}$

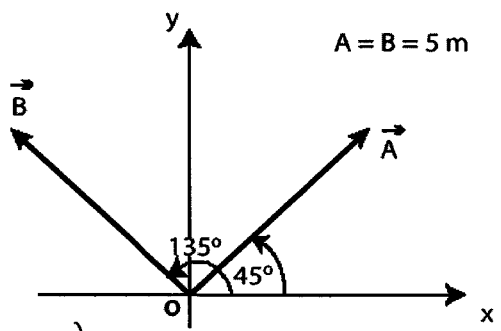


Figure 1

Q2. Consider two vectors $\vec{A}$ and $\vec{B}$ with magnitudes 5 cm and 8 cm, respectively. Vector $\vec{A}$ is along the positive x-axis and vector $\vec{B}$ is along the positive y-axis. Find $\vec{A} \cdot (\vec{A} + \vec{B})$. (Ans: 25 cm^2)

$\vec{A} = 5\hat{i}$, $\vec{B} = 8\hat{j}$

$\vec{A} + \vec{B} = 5\hat{i} + 8\hat{j}$

$\vec{A} \cdot (\vec{A} + \vec{B}) = 5\hat{i} \cdot (5\hat{i} + 8\hat{j}) = 25\ cm^2$

Quiz #2 Ch.#3 T133 Phys101.02-v4

Student ID:..... Student Name:.....

Q1. Vectors $\vec{a}$, $\vec{b}$, and $\vec{c}$ are related through equations $\vec{a}+\vec{b}=\vec{c}$ and $\vec{a}-\vec{b}=5.0\vec{c}$. If $\vec{c}=3.0\hat{i}+4.0\hat{j}$, what is the magnitude of vector $\vec{a}$? (Ans: 15)

$$\vec{a}+\vec{b}=\vec{c}$$

Q2. For the following three vectors; A=2i+3j+4k, B=4i+4j and C= 2i+2k, find A.(BxA). (Ans: 0.)

$$\vec{A}\cdot(\vec{B}\times\vec{A})=(3\vec{i}+3\vec{j}+4\vec{k})\cdot((4\vec{i}+4\vec{j})\times(2\vec{i}+2\vec{k}))$$

$$\vec{D}=(4\vec{i}+4\vec{j})\times(2\vec{i}+2\vec{k})=8(\vec{i}\times\vec{i})+(8\vec{i}\times\vec{k})+8(\vec{j}\times\vec{i})+8(\vec{j}\times\vec{k})$$

$$\vec{D}=-8\vec{j}-8\vec{k}+8\vec{i}=8\vec{i}-8\vec{j}-8\vec{k}$$

$$\vec{A}\cdot\vec{D}=(2\vec{i}+3\vec{j}+4\vec{k})\cdot(8\vec{i}-8\vec{j}-8\vec{k})$$

$$=16-24-32=24$$

$$\vec{D}=\vec{B}\times\vec{A}=(4\vec{i}+4\vec{j})\times(3\vec{i}+3\vec{j}+4\vec{k})=12(\vec{i}\times\vec{i})+12(\vec{i}\times\vec{j})+16(\vec{i}\times\vec{k})+12(\vec{j}\times\vec{i})+12(\vec{j}\times\vec{j})+16(\vec{j}\times\vec{k})$$

$$=12\vec{k}-16\vec{j}-12\vec{k}+16\vec{i}=16\vec{i}-16\vec{j}$$

$$\vec{D}=\vec{B}\times\vec{A}=16\vec{i}-16\vec{j}+24\vec{k}=16\vec{i}+12\vec{k}$$

$$\vec{A}\cdot\vec{D}=(3\vec{i}+3\vec{j}+4\vec{k})\cdot(16\vec{i}+12\vec{k})=48$$

Quiz #2 Ch.#3 T133 Phys101.02-v5

Student ID:..... Student Name:.....

Q#1 : As shown in Fig. 3, a block moves down on a 45-degree inclined plane of 2.5 m length, then horizontally for another 2.5 m, and then falls down vertically a height of 2.5 m. Find the magnitude and direction of the resultant displacement vector of the block. (Ans: 6.0 m and 45 degrees below horizontal axis)

$\vec{D} = \vec{A} + \vec{B} + \vec{C}$

$= +2.5\cos 225\, i + 2.5 \sin 225\, j - 2.5 i - 2.5 j$

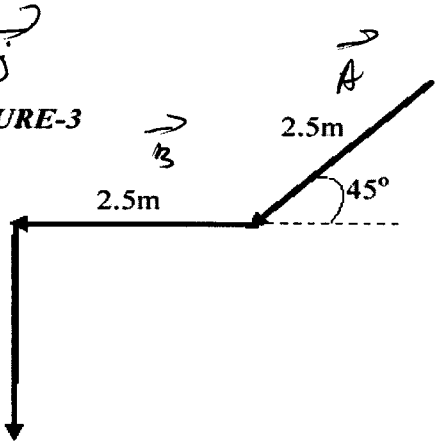
$= -1.77 i - 1.77 j - 2.5 i - 2.5 j$

$= -4.27 i - 4.27 j$

$|\vec{D}| = \sqrt{(-4.27)^2 + (-4.27)^2} = 6.04\,m$

$\theta = \tan^{-1}\left(\frac{-4.27}{-4.27}\right) = 45^0$ in third Quadrant

FIGURE-3



Q2. Vectors $\vec{F}$ and $\vec{G}$ are defined as $\vec{F} = 3.0\hat{i} + 4.0\hat{j}$, and $\vec{G} = -\hat{i} + \hat{j}$. Find the component (projection) of vector $\vec{G}$ along the direction of vector $\vec{F}$.(Ans: 0.20)

Component of $\vec{G}$ along $\vec{F} = |G|\cos\theta$

$|F| = \sqrt{3^2+4^2} = 5$, $|G| = \sqrt{1+1} = \sqrt{2} = 1.41$

$\theta = \cos^{-1}\left[\frac{F_x G_x + F_y G_y}{|G||F|}\right] = \cos^{-1}\left[\frac{-3+4}{5 \times 1.41}\right]$

$= \cos^{-1}\left(\frac{1}{7.07}\right) = \cos^{-1}(0.14) = 81.9^0$

Component $= |G|\cos\theta = 1.41 \cos(81.9) = 0.20$

Quiz #2 Ch.#3 T133 Phys101.02-v6

Student ID:..... Student Name:.....

Q#1: Two vectors are given by: $\vec{P} = -1.5\hat{i} + 2.0\hat{j}$, $\vec{Q} = 1.0\hat{j}$. The angle that the vector $2\vec{P} - \vec{Q}$ makes with the **positive** x-axis is: (A: 135°)

$\vec{A} = 2\vec{P} - \vec{Q} = 2(-1.5\vec{i} + 2.0\vec{j}) - 1.0\vec{j} = -3.0\vec{i} + 4.0\vec{j} - 1.0\vec{j}$

$= -3\vec{i} + 3\vec{j}$

$\theta = \tan^{-1}\left(\frac{3}{-3}\right) = \tan^{-1}(-1) = -45^{\circ} = 180 - 45 = 135^{\circ}$

Q#2: Three vectors are given as: A=-3.0i; B= -5.0 k *and* C=2.0 j. The value of $A.(BxC)$ is: (Ans -30)

$B \times C = -5.0\vec{k} \times 2.0\vec{j} = -10.0(\vec{k} \times \vec{j}) = 10(-\vec{i})$

$= +10\vec{i}$

$A.(B \times C) = (-3.0\vec{i}) \cdot (+10\vec{i}) = -30$

Quiz #2 Ch.#3 T133 Phys101.02-v7

Student ID:..... Student Name:.....

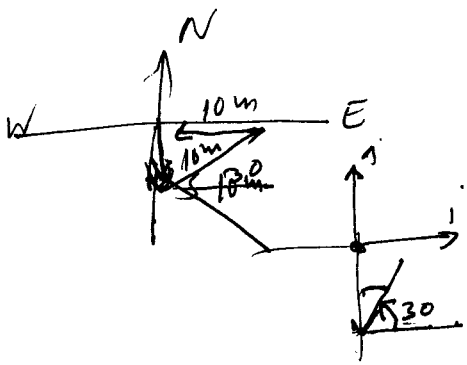
Q#1: Starting from the origin, a boy walks 3.5 m south, then 10 m at 30 degrees North of East, and finally 10 m West. Find the resultant displacement vector. Take East along the positive x-axis and North along the positive y-axis. (Ans: (-1.34 i - 1.5 j) m.

$\vec{A} = -3.5\vec{j}$; $\vec{B} = 10\cos 30\,\vec{i} + 10\sin 30\,\vec{j}$; $\vec{C} = -10\vec{i}$

$\vec{D} = \vec{A} + \vec{B} + \vec{C}$

$= -3.5\vec{j} + 8.66\vec{i} + 5\vec{j} - 10\vec{i}$

$= -1.34\vec{i} + 1.5\vec{j}$



Q2.. Let A=2.0*i*+ 3.0 *k* and *B*=2.0 *i*+ *k* .The vector *D*=*(A-B)xA* is: (Ans: -8.0 *j*)

$\vec{A} - \vec{B} = 2\vec{i} + 3\vec{k} - (2\vec{i} + \vec{k}) = 2\vec{k}$

$\vec{D} = (\vec{A} - \vec{B}) \times \vec{A} = 2\vec{k} \times (2\vec{i} + 3\vec{k})$

$= 4(\vec{k} \times \vec{i}) + 6\underbrace{(\vec{k} \times \vec{k})}_{=0} = 4\vec{j}$

Quiz #2 Ch.#3 T133 Phys101.02-v8

Student ID:..... Student Name:.....

Q1) If vector A = 6 i - 7 j and vector B = -12 i + 10 j, what angle does vector C = 2*A - B make with +x-axis measured counterclockwise. (Ans: 315 deg.)

$$C = 2A - B = 2(6\vec{i} - 7\vec{j}) - (-12\vec{i} + 10\vec{j})$$

$$= 12\vec{i} - 14\vec{j} + 12\vec{i} - 10\vec{j} = 24\vec{i} - 24\vec{j}$$

$$\theta = \tan^{-1}\left(\frac{C_y}{C_x}\right) = \tan^{-1}\left(\frac{-24}{+24}\right) = -45^\circ = 360 + 45 = 315^\circ$$

Q2

Two vectors $\vec{A}$ and $\vec{B}$ have magnitudes 3.0 and 4.0 respectively. Their vector product is $\vec{A} \times \vec{B} = -5.0\vec{k} + 2.0\vec{i}$. Find the angle between $\vec{A}$ and $\vec{B}$.

A) 27o

$$\theta = \sin^{-1}\left(\frac{|\vec{A} \times \vec{B}|}{|A||B|}\right) = \sin^{-1}\left(\frac{\sqrt{25+4}}{3 \times 4}\right)$$

$$= \sin^{-1}\left(\frac{5.385}{12}\right) = 26.6^\circ$$

Quiz #2 Ch.#3 T133 Phys101.02-v9

Student ID:..... Student Name:.....

Q1: The two vectors A and B shown in Fig. 1 have equal magnitudes of 10.0 m. Find the magnitude of the resultant, R, of these vectors and the angle theta it makes with the positive x-axis. (Ans: R = 14.1 m, THETA = 75 degrees)

$\vec{R} = \vec{A} + \vec{B}$

$\vec{R} = (A_x + B_x)\hat{i} + (A_y + B_y)\hat{j}$

$= (10\cos 30 + 10\cos 120)\,\hat{i}$

$+ (10\sin 30 + 10\sin 120)\,\hat{j}$

$= (8.66 + (-5))\,\hat{i} + (5 + 8.66)\,\hat{j}$

$= +3.66\,\hat{i} + 13.66\,\hat{j} \Rightarrow |R| = \sqrt{R_x^2 + R_y^2} = 14.1$

$\theta = \tan^{-1}\left(\frac{13.66}{3.66}\right) = 75^0$

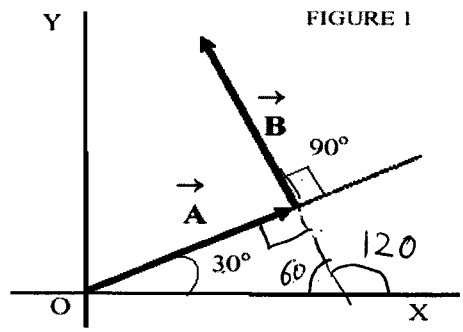


FIGURE 1

Q2. Three vectors are A =1.00i + 2.00 j -3.00 k , B = 3.00 k and C = 6.00 i - 7.00 j. Find 2C.(A X B) . (Ans: 114)

$\vec{A} \times \vec{B} = (1\hat{i} + 2\hat{j} - 3\hat{k}) \times 3\hat{k} = 3(\hat{i} \times \hat{k}) + 6(\hat{j} \times \hat{k})$

$= -3\hat{j} + 6\hat{i} = 6\hat{i} - 3\hat{j}$

$2C \cdot (A \times B) = 2(6\hat{i} - 7\hat{j}) \cdot (6\hat{i} - 3\hat{j})$

$= 2(36 + 21) = 2 \times 57 = 114$

Quiz #2 Ch.#3 T133 Phys101.02-v10

Student ID:..... Student Name:.....

Q1: :Given the vectors A = 3 j + 6 k , B = 15 i + 21 k. Find the magnitude of vector C that satisfies equation 2A + 3C - B = 0. (Ans: 6.16)

$$2\vec{A}+3\vec{C}-\vec{B}=0 \Rightarrow C=\frac{\vec{B}-2\vec{A}}{3}$$

$$C=\frac{15\vec{i}+21\vec{k}-2(3\vec{j}+6\vec{k})}{3}=\frac{15\vec{i}-6\vec{j}+9\vec{k}}{3}$$

$$C=5\vec{i}-2\vec{j}+3\vec{k}$$

$$|C|=\sqrt{5^2+(-2)^2+(3)^2}=6.16$$

Q2

For the following three vectors, find $\vec{C}\cdot(2\vec{A}\times\vec{B})$

$\vec{A}=2.00\hat{i}+3.00\hat{j}$, $\vec{B}=-3.00\hat{i}+4.00\hat{j}$ *and* $\vec{C}=7.00\hat{i}+3.00\hat{k}$

A) 102

$$2(\vec{A}\times\vec{B})=2\left[(2\vec{i}+3\vec{j})\times(-3\vec{i}+4\vec{j})\right]$$

$$=2\left[8(\vec{i}\times\vec{j})-9(\vec{j}\times\vec{i})\right]=2\left[8\vec{k}+9\vec{k}\right]$$

$$=34\vec{k}$$

$$\vec{C}\cdot(2\vec{A}\times\vec{B})=(7\vec{i}+3\vec{k})\cdot 34\vec{k}=3\times 34=102$$