Quiz 01 - solution

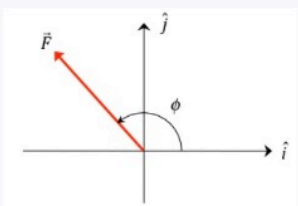
Q1 dot products
4 Points

Consider two vectors in the xy-plane: $\vec{a} = a_x\hat{i} + a_y\hat{j}$ and $\vec{b} = b_x\hat{i} + b_y\hat{j}$. Choose the answer below that best describes the dot product of these two vectors:

- $\vec{a} \cdot \vec{b} = |\vec{a}|\,|\vec{b}|$
- $\vec{a} \cdot \vec{b} = (a_x b_y - a_y b_x)\,\hat{k}$
- **$\vec{a} \cdot \vec{b} = a_x b_x + a_y b_y$**
- $\vec{a} \cdot \vec{b} = a_x b_x \hat{i} + a_y b_y \hat{j}$
- $\vec{a} \cdot \vec{b} = \sqrt{(a_x b_x)^2 + (a_y b_y)^2}$
- none of the above

$\vec{a}\cdot\vec{b} = (a_x\hat{i}+a_y\hat{j})\cdot(b_x\hat{i}+b_y\hat{j})$
$= a_x b_x \hat{i}\cdot\hat{i} + a_x b_y \hat{i}\cdot\hat{j} + a_y b_x \hat{j}\cdot\hat{i} + a_y b_y \hat{j}\cdot\hat{j}$
$= a_x b_x + a_y b_y$

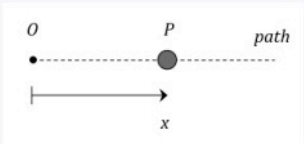
Q2 vector projections
4 Points



Consider the force vector $\vec{F}$ in the xy-plane, as shown above. Choose the answer below that best describes this vector in terms of its xy-components:

- $\vec{F} = |\vec{F}|\left(-\cos\phi\hat{i} + \sin\phi\hat{j}\right)$
- $\vec{F} = |\vec{F}|\left(-\sin\phi\hat{i} + \cos\phi\hat{j}\right)$
- $\vec{F} = |\vec{F}|\left(\sin\phi\hat{i} + \cos\phi\hat{j}\right)$
- **$\vec{F} = |\vec{F}|\left(\cos\phi\hat{i} + \sin\phi\hat{j}\right)$**
- $\vec{F} = -|\vec{F}|\,\hat{i}$
- $\vec{F} = |\vec{F}|\,\hat{j}$
- none of the above

Q3 kinematics
4 Points



Particle P travels along a straight path, with the position of P on the path being described by the coordinate x. The speed of P is known in terms of the position x to be $v(x) = 2x^2$. Choose the answer below that best describes the acceleration of P in terms of x, for $x > 0$:

- $a = 2x$
- $a = 4x$
- **$a = 8x^3$**
- $a = 2$
- $a = 0$
- none of the above

$a = \frac{dv}{dt} = \frac{dv}{dx}\frac{dx}{dt} = v\frac{dv}{dx}$; chain rule
$= (2x^2)(4x) = 8x^3$

Q4 angles between vectors
4 Points

Consider two vectors $\vec{b}$ and $\vec{c}$, where $\vec{b} = \left(6\hat{i} + 8\hat{j}\right)$ ft and $\vec{c} = \left(-12\hat{i} - 16\hat{j}\right)$ ft. Let θ represent the angle between $\vec{b}$ and $\vec{c}$. Choose the answer below that describes the angle θ:

- $\theta = 0$
- $\theta = 36.87^\circ$
- $\theta = 53.13^\circ$
- $\theta = 90^\circ$
- $\theta = 126.87^\circ$
- **$\theta = 180^\circ$**
- none of the above

$\cos\theta = \frac{\vec{a}\cdot\vec{b}}{|\vec{a}||\vec{b}|} = \frac{(6)(-12)+(8)(-16)}{(10)(20)} = -1$

$\hookrightarrow \theta = 180^\circ$