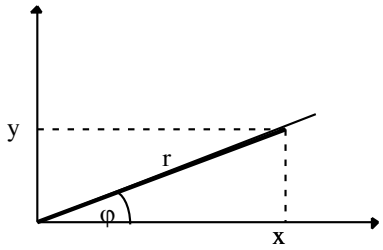
Trigonometry

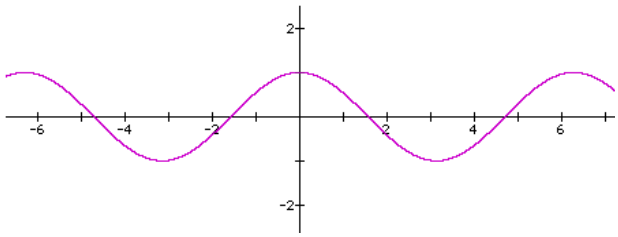
1. For x, y, r and φ, as shown in the figure below, $tan\varphi$ is defined as the quotient:

- ❑ x/r
- ❑ y/r
- ❑ x/y
- ❑ y/x



2. The graph shown below is a plot of the function:

- ❑ y = sin x
- ❑ y = cos x
- ❑ y = tan x
- ❑ y = arctan x



Line equations

3. Which of the following is a parametric equation of a line:

- ❑ y = ax +b
- ❑ $x = x_0 + k\,(x_1 - x_0)$
  $y = y_0 + k\,(y_1 - y_0)$
- ❑ Ax + By + C = 0
- ❑ x cos φ + y sin φ - p = 0

4. Which of the following expressions specifies the gradient of the line defined by the equation ax + by + c = 0

- ❑ c
- ❑ -b/c
- ❑ c/a
- ❑ -a/b

Vector arithmetics

In the next 4 questions $\bar{\mathbf{u}}$ and $\bar{\mathbf{v}}$ denote 2D vectors: $\bar{\mathbf{u}} = [\ \mathbf{u}_x\ \ \mathbf{u}_y\ ]$
$\bar{\mathbf{v}} = [\ \mathbf{v}_x\ \ \mathbf{v}_y\ ]$

and *a* denotes a constant.

5. The result of $a \cdot \bar{\mathbf{u}}$ is:
   - ❑ $[\, a \cdot \mathbf{u}_x \;\; a \cdot \mathbf{u}_y]$
   - ❑ $[\, a \cdot \mathbf{u}_x \;\; \mathbf{u}_y]$
   - ❑ $a \cdot \mathbf{u}_x + a \cdot \mathbf{u}_y$
   - ❑ $a \cdot \mathbf{u}_x + \mathbf{u}_y$

6. The result of $\bar{\mathbf{u}} \cdot \bar{\mathbf{v}}$ (dot product) is:
   - ❑ $[\mathbf{u}_x \cdot \mathbf{v}_x \;\; \mathbf{u}_y \cdot \mathbf{v}_y]$
   - ❑ $[\mathbf{u}_x \;\; \mathbf{v}_y]$
   - ❑ $\mathbf{u}_x \cdot \mathbf{v}_x + \mathbf{u}_y \cdot \mathbf{v}_y$
   - ❑ $\mathbf{u}_x \cdot \mathbf{v}_y + \mathbf{v}_x \cdot \mathbf{u}_y$

7. The result of $\bar{\mathbf{u}} \times \bar{\mathbf{v}}$ (cross-product) is:
   - ❑ $[\mathbf{u}_x \cdot \mathbf{v}_x \;\; \mathbf{u}_y \cdot \mathbf{v}_y]$
   - ❑ $\mathbf{u}_x \cdot \mathbf{v}_x + \mathbf{u}_y \cdot \mathbf{v}_y$
   - ❑ $[\mathbf{u}_x \;\; \mathbf{v}_y]$
   - ❑ $\mathbf{u}_x \cdot \mathbf{v}_y - \mathbf{v}_x \cdot \mathbf{u}_y$

8. The dot product two non-zero vectors $\bar{\mathbf{u}}$ and $\bar{\mathbf{v}}$ is zero, i.e. $\bar{\mathbf{u}} \cdot \bar{\mathbf{v}} = 0$ if:
   - ❑ vectors $\bar{\mathbf{u}}$ and $\bar{\mathbf{v}}$ are perpendicular
   - ❑ vectors $\bar{\mathbf{u}}$ and $\bar{\mathbf{v}}$ are parallel
   - ❑ vectors $\bar{\mathbf{u}}$ and $\bar{\mathbf{v}}$ are of the same length

Matrix arithmetics

In the next question $\bar{\mathbf{u}}$ denotes a vector: $\bar{\mathbf{u}} = [\, 3 \;\; 1 \,]$

and **M** denotes a matrix: $\mathbf{M} = \begin{bmatrix} 1 & 2 \\ 4 & 0 \end{bmatrix}$

9. The result of multiplication of vector $\bar{\mathbf{u}}$ and matrix M, $\bar{\mathbf{u}} \cdot$ M, is:
   - ❑ [3 2]
   - ❑ 11
   - ❑ $\begin{bmatrix} 3 & 2 \\ 12 & 0 \end{bmatrix}$
   - ❑ [7 6]

Solutions

Trigonometry

1. For x, y, r and φ, as shown in the figure below, $tan\varphi$ is defined as the quotient:

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- ☐ x/y
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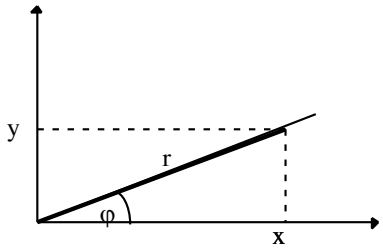

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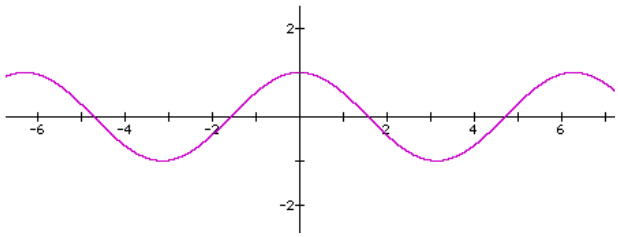

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and a denotes a constant.

5. The result of $a \cdot \bar{\mathbf{u}}$ is:
   - [x] $[\, a \cdot \mathbf{u}_x \;\; a \cdot \mathbf{u}_y]$
   - [ ] $[\, a \cdot \mathbf{u}_x \;\; \mathbf{u}_y]$
   - [ ] $a \cdot \mathbf{u}_x + a \cdot \mathbf{u}_y$
   - [ ] $a \cdot \mathbf{u}_x + \mathbf{u}_y$

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   - [ ] $[\mathbf{u}_x \cdot \mathbf{v}_x \;\; \mathbf{u}_y \cdot \mathbf{v}_y]$
   - [ ] $[\mathbf{u}_x \;\; \mathbf{v}_y]$
   - [x] $\mathbf{u}_x \cdot \mathbf{v}_x + \mathbf{u}_y \cdot \mathbf{v}_y$
   - [ ] $\mathbf{u}_x \cdot \mathbf{v}_y + \mathbf{v}_x \cdot \mathbf{u}_y$

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   - [ ] $[\mathbf{u}_x \cdot \mathbf{v}_x \;\; \mathbf{u}_y \cdot \mathbf{v}_y]$
   - [ ] $\mathbf{u}_x \cdot \mathbf{v}_x + \mathbf{u}_y \cdot \mathbf{v}_y$
   - [ ] $[\mathbf{u}_x \;\; \mathbf{v}_y]$
   - [x] $\mathbf{u}_x \cdot \mathbf{v}_y - \mathbf{v}_x \cdot \mathbf{u}_y$

8. The dot product two non-zero vectors $\bar{\mathbf{u}}$ and $\bar{\mathbf{v}}$ is zero, i.e. $\bar{\mathbf{u}} \cdot \bar{\mathbf{v}} = 0$ if:
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   - [ ] $[\, 3 \;\; 2 \,]$
   - [ ] 11
   - [ ] $\begin{bmatrix} 3 & 2 \\ 12 & 0 \end{bmatrix}$
   - [x] $[\, 7 \;\; 6 \,]$