

Vectors, Polar Coordinates, and Complex Numbers: math test, Grade 12 – download the PDF

Suggested time: 45 minutes. Out of 20 points. Calculator allowed only when the problem says so.

1 Vector basics

/ 3 pts

Let $\mathbf{u} = \langle -4, 3 \rangle$ and $\mathbf{v} = \langle 5, 12 \rangle$. (No calculator.)

- Find $\|\mathbf{u}\|$ and $\|\mathbf{v}\|$.
- Compute $2\mathbf{u} + \mathbf{v}$.
- Compute $\mathbf{u} \cdot \mathbf{v}$.

2 Work and angle

/ 3 pts

A force $\mathbf{F} = \langle 8, 6 \rangle$ lb moves a crate through the displacement $\mathbf{d} = \langle 6, 8 \rangle$ ft.

- Compute the work $W = \mathbf{F} \cdot \mathbf{d}$ with its unit.
- Find $\|\mathbf{F}\|$ and $\|\mathbf{d}\|$.
- With a calculator, find the angle between $\mathbf{F}$ and $\mathbf{d}$ to the nearest tenth of a degree.

3 Polar conversions

/ 4 pts

- Convert $\left(6, \frac{11\pi}{6}\right)$ to rectangular coordinates.
- Convert $(-3, 3)$ to polar coordinates with $r > 0$ and $0 \leq \theta < 2\pi$.
- Convert $r = 8 \sin \theta$ to rectangular form and name the graph.

4 A polar curve

/ 3 pts

Consider the curve $r = 2 - 2 \sin \theta$.

- Complete the table: r when $\theta = 0, \frac{\pi}{6}, \frac{\pi}{2}, \frac{3\pi}{2}$.
- Name the type of curve and its axis of symmetry.

5 Complex numbers in polar form

/ 4 pts

Let $z_1 = 2 \operatorname{cis} 100^\circ$ and $z_2 = 5 \operatorname{cis} 35^\circ$.

- Find $z_1 z_2$ in polar form and in the form $a + bi$.
- Find z_1^3 in polar form and in the form $a + bi$.

6 Cube roots

/ 3 pts

Solve $z^3 = -64$ in the complex numbers. Give the three solutions in the form $a + bi$.



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