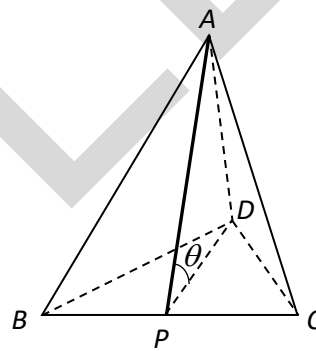


PolyU SCIENCE Young Talents Competition

Mathematics - Sample Questions

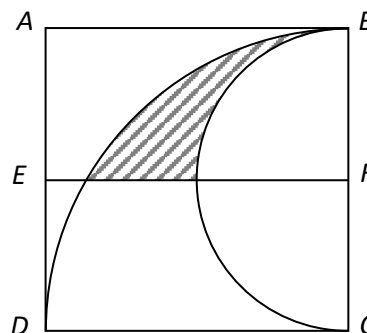
1. In the figure, $ABCD$ is a regular tetrahedron and P is the mid-point of BC . If $\angle APD = \theta$, find the value of $\cos \theta$.

- A) $\frac{1}{3}$
 B) $\frac{2}{3}$
 C) $\frac{1}{\sqrt{3}}$
 D) $\sqrt{\frac{2}{3}}$



2. In the figure, $ABCD$ is a square of side 4 cm. E and F are the midpoints of AD and BC , \widehat{BC} and \widehat{BD} are the part of circles with radii 4 cm and 2 cm, respectively. Find the area of the shaded region.

- A) $\frac{5}{3}\pi - 2\sqrt{3}$
 B) $\frac{1}{3}\pi - 2\sqrt{3}$
 C) $\frac{5}{3}\pi - 3\sqrt{2}$
 D) $\frac{1}{3}\pi - 3\sqrt{2}$



3. Fill in 1 or -1 in each cell of the following table such that the product of numbers of each row or column is equal to -1 . For example,

 \rightarrow

1	1	-1
1	-1	1
-1	1	1

How many ways are there to fill in this table?

- A) 3
B) 6
C) 11
D) 16
4. Find the maximum value of the function $f(x) = \frac{(3^x - 4 \sin x) \sin x}{9^x}$ for $0 \leq x \leq 2\pi$.

- A) $\frac{1}{12}$
B) $\frac{1}{16}$
C) $\frac{1}{18}$
D) $\frac{1}{27}$