

Mathematics Questions by Topic

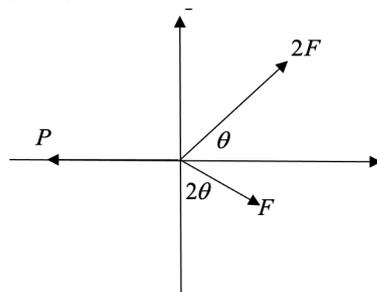
Motion and Force

Answer 14

Source: K16SM2Q17

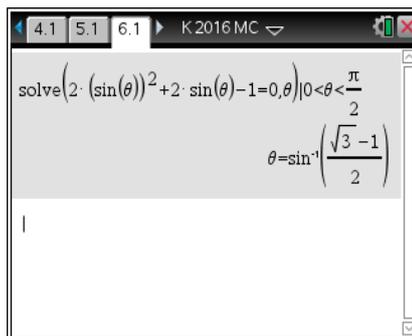
Question 14

A body is on a horizontal smooth plane and acted upon by three forces, with magnitudes and directions as shown in the diagram below.



The correct statement relating the magnitude of the forces and the angle θ is

- A. $P = 3F$
- B. $P = 3F \sin(3\theta)$
- C. $P = 3F \cos(3\theta)$
- D. $P = 2F \sin(\theta) + F \cos(2\theta)$
- E. $\theta = \sin^{-1}\left(\frac{\sqrt{3}-1}{2}\right)$



ANSWER E

$$\text{resolving horizontally (1) } 2F \cos(\theta) + F \sin(2\theta) - P = 0$$

$$\text{resolving vertically (2) } 2F \sin(\theta) - F \cos(2\theta) = 0 \quad (2) \Rightarrow F(2 \sin(\theta) - \cos(2\theta)) = 0$$

$$2 \sin(\theta) - \cos(2\theta) = 0$$

$$2 \sin(\theta) - (1 - 2 \sin^2(\theta)) = 0$$

$$2 \sin^2(\theta) + 2 \sin(\theta) - 1 = 0$$

$$\sin(\theta) = \frac{\sqrt{3}-1}{2}$$

$$\text{since } 0 < \sin(\theta) < 1 \text{ and } 0 < \theta < \frac{\pi}{2}$$

$$\Rightarrow \theta = \sin^{-1}\left(\frac{\sqrt{3}-1}{2}\right)$$