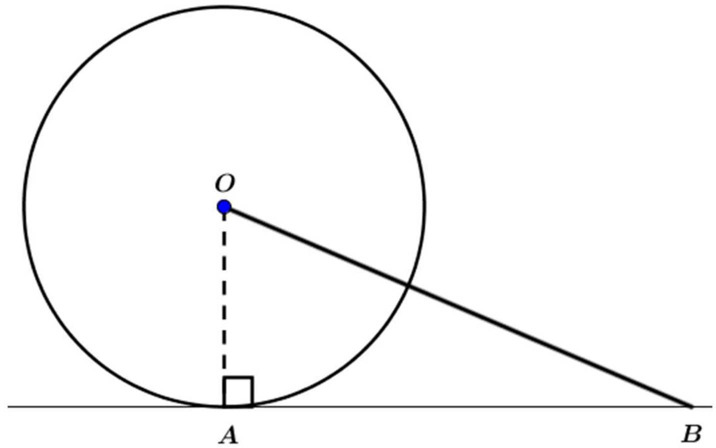
1. (a) Determine the equation of the curve which is the locus of the points $\sqrt{5}$ units from the point $(-2, 3)$. [2]

(b) The diagram below, not drawn to scale, shows a roller, centre O, on horizontal ground. The roller is represented by the equation $x^2 + y^2 - 8x - 6y = -16$, OB is the arm of the roller and B has coordinates $(11, 0)$.



(i) Determine the equation of the arm OB. [5]

(ii) Given that OA is a vertical line calculate the distance from the base of the roller to the point where the arm meets the ground. [5]

2. (a) Prove that $\sin^4\theta - \cos^4\theta + 1 = 2\sin^2\theta$. [4]

(b) Determine the general solutions of the equation $\sec\theta + 5\tan\theta = 3\cos\theta$ for $0 \leq \theta \leq 2\pi$. [7]

(c) (i) Given that $\sin A = \frac{3}{5}$ determine the values of

(a) $\sin 2A$ [2]

(b) $\cos 2A$ [2]

(c) $\cos 3A$ [3]

(ii) Using your answer for (c) (i) (a) and (b) determine which quadrant $2A$ is in giving a reason for your answer. [2]

(d) (i) Express $f(\theta) = 5\sin\theta + 12\cos\theta$ in the form $R\sin(\theta + \alpha)$ where $R > 0$ and $0 < \alpha < \pi$. [3]

(ii) Is 14 a possible value for $f(\theta)$. Give a reason for your answer. [2]

(iii) Solve the equation $f(\theta) = 2$ for $0 \leq \theta \leq 2\pi$. [5]

3. Relative to an origin O, the position vectors of the points A and B are given by

$$\overrightarrow{OA} = -i + 2j + 3k \text{ and } \overrightarrow{OB} = 4i + 2j - 3k$$

(i) Use a scalar product to find angle AOB, correct to the nearest degree. [4]

(ii) Find the unit vector in the direction of $\overrightarrow{AB}$. [3]

(iii) The vector $n = 6i + 4j + 5k$ is normal to the plane containing the points A and B. Determine the equation of this plane in the form $r.n = d$. [3]

4. (a) A curve is represented parametrically by

$$x = \frac{1}{t} \quad \text{and} \quad y = \frac{2 - t^2}{t}$$

Determine the equation of the curve in Cartesian form. [4]

(b) A curve C has parametric equations

$$x = \cos t, \quad y = 3 + 2\cos 2t, \quad \text{where } 0 \leq t \leq \pi$$

Show that the Cartesian equation of C is $y = ax^2 + b$ where a and b are constants. [4]