

Question 1:

- (a) Find all points on the unit sphere (radius 1 and centred at the origin) that are a distance $1/\sqrt{2}$ from each of the xy -plane and xz -plane.

[5]

- (b) A sphere with radius 5 and centre $(2, -6, 4)$ intersects the xy plane to form a circle. Determine the radius of this circle.

[5]

Question 2: For this question use the vectors

$\mathbf{a} = \mathbf{i} - 3\mathbf{j} + 2\mathbf{k}$ and $\mathbf{b} = 3\mathbf{i} - \mathbf{k}$

(a) Compute $|2\mathbf{a} - 4\mathbf{b}|$.

[3]

(b) Find a vector \mathbf{c} which when added to $\mathbf{a} + \mathbf{b}$ gives $\mathbf{a} - \mathbf{b}$.

[2]

Question 3: A ship is travelling north at 20 km/hr. A woman on the deck of the ship walks south-east at $\sqrt{2}$ km/hr. What is the speed of the woman relative to the surface of the water?

[5]

Question 4: Determine all angles in the triangle with vertices $P(1, -3, -2)$, $Q(2, 0, -4)$ and $R(6, -2, -5)$.
(If giving a calculator answer round your final answers to one decimal place.)

[5]

Question 5: What angle does the vector $\langle 1, 2, 3 \rangle$ make with the xy -plane? (If giving a calculator answer round your final answers to one decimal place.)

[5]

Question 6: Determine the area of the triangle with vertices $P(1, -3, -2)$, $Q(2, 0, -4)$ and $R(6, -2, -5)$.

[5]

Question 7: If $\mathbf{a} \cdot \mathbf{b} = \sqrt{3}$ and $\mathbf{a} \times \mathbf{b} = \langle 1, 2, 2 \rangle$ find the angle between \mathbf{a} and \mathbf{b} .

[5]

Question 8: Find an equation of the line through $A(1, 0, -2)$ which is orthogonal to the plane containing the points $P(1, -3, -2)$, $Q(2, 0, -4)$ and $R(6, -2, -5)$. State your answer in parametric form.

[5]

Question 9: Find an equation of the plane through $P(1, -1, 1)$ that is parallel to both $\mathbf{r}_1 = \langle 2, 1, 3 \rangle + t \langle 2, 1, 3 \rangle$ and $\mathbf{r}_2 = \langle 1, 2, -5 \rangle + t \langle 1, 1, 1 \rangle$.

[5]