## 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]

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**(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.

Question 2: For this question use the vectors

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

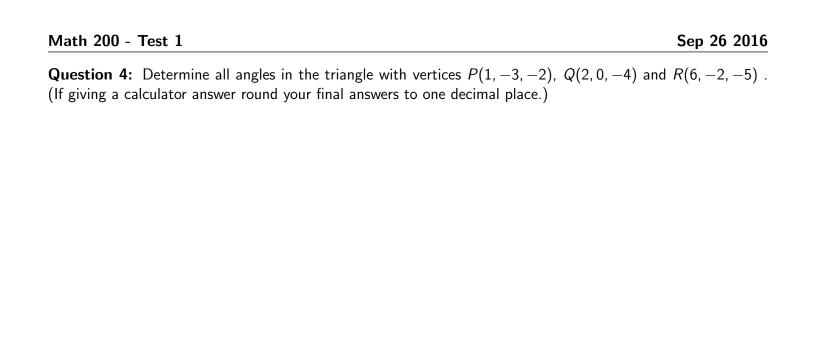
(a) Compute  $|2\mathbf{a} - 4\mathbf{b}|$ .

[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 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).

**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]

[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  $\mathbf{r}_2 = \langle 1, 2, -5 \rangle + t \langle 1, 1, 1 \rangle$ .