20. [4 marks]

From a group of nine people, a sample of six is taken.

(a) How many such samples are possible? [1]

The sample of six contains four boys.

(b) In how many ways can all six be arranged for a photo, if:

(i) there is no restriction? [1]

(ii) the boys are together? [2]

Use proof by contradiction to show that if x is even then $x+2$ is also even

End of Section Two

14. [7 marks]

PQ and PR are chords of equal length in a circle, where PS is a diameter.

(a) Draw a well labelled diagram. [1]

(b) Prove:

(i) QS = RS. [3]

(ii) PS bisects QR. [3]

Question 13 **(9 marks)**

The points A, B and C have position vectors $\mathbf{a} = 3\mathbf{i} + 4\mathbf{j}$, $\mathbf{b} = 14\mathbf{i} - 3\mathbf{j}$ and $\mathbf{c} = -5\mathbf{i} + 2\mathbf{j}$.

(a) Determine the angle between vectors **b** and **c**, giving your answer rounded to one decimal place. (2 marks)

(b) Find the position vector of point D which divides $\overline{AC}$ internally in the ratio $5:3$. (3 marks)

(c) Express the vector **b** in terms of **a** and **c**. (4 marks)

Question 10 **(10 marks)**

Three points are given by $A(1,\ 2)$, $B(p,-2)$ and $C(12,4)$.

(a) Determine a unit vector parallel to the line through AC. (2 marks)

(b) Write down a vector equation of the line through AC. (1 mark)

(c) Find the value of p if the lines through AB and BC are perpendicular and $p < 8$. (3 marks)

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Question 17 **(7 marks)**

M is the mid-point of line segment AB.

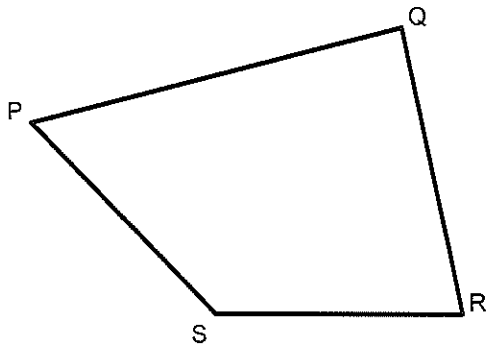
If $\overrightarrow{OA}$, $\overrightarrow{OB}$ and $\overrightarrow{OM}$ are $\underline{a}$, $\underline{b}$, $\underline{m}$ respectively

(a) Find an expression for $\underline{m}$ in terms of $\underline{a}$ and $\underline{b}$. (4)

(b) Hence, or otherwise state the coordinates of *S* if *S* divides the line segment joining F(1,4) to G(6,9) in the ratio 1:1. (3)

Question 13 **(6 marks)**

In the diagram $\overrightarrow{PQ} = 2\underline{b}$, $\overrightarrow{PS} = 4\underline{a}$ and $\overrightarrow{SR} = 2\underline{a} + \underline{b}$



(a) Express as simply as possible, in terms of $\underline{a}$ and/or $\underline{b}$ (2)

(i) $\overrightarrow{SQ}$

(ii) $\overrightarrow{QR}$

There is another point, *T*.

(b) If $\overrightarrow{PT} = h\overrightarrow{PR}$, express $\overrightarrow{PT}$ in terms of $h, \underline{a}$ and $\underline{b}$ (1)

(c) Given that $4\overrightarrow{ST} = \overrightarrow{SQ}$, calculate the value of *h*. (3)

Question 9 **(10 marks)**

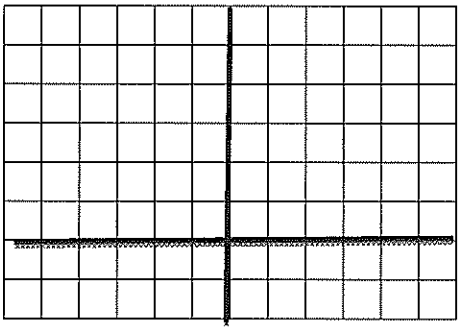
(a) Point A has position vector $k\underline{i} - \underline{j}$. Point B has position vector $6\underline{i} - k\underline{j}$.

If $\left|\overrightarrow{AB}\right| = 5$, find the value(s) of *k*. (4)

(b) Let A= (5,1), B=(0,4), C=(-1,0)

Find

(Hint: Use the grid below to help you find the points)



(i) D such that $\overrightarrow{AB} = \overrightarrow{CD}$ (2)

(ii) F such that $\overrightarrow{AF} = \overrightarrow{-BC}$ (2)

(iii) G such that $\overrightarrow{AB} = \overrightarrow{2GC}$ (2)

Question 7 **(10 marks)**

(a) If $\underline{a} = 6\underline{i} - 4\underline{j}$, $\underline{b} = 3\underline{i} + 4\underline{j}$, $\underline{c} = 2\underline{i} + 5\underline{j}$

(i) Determine $|\underline{c} - \underline{b}|$ Leave your answer as a surd (2)

(ii) Determine $2\underline{b} - 3\underline{a} + \underline{c}$ (2)

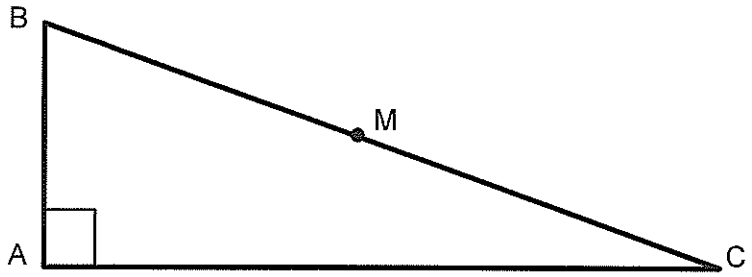
(iii) Determine a vector in the direction of $\underline{a}$ but with a magnitude of 5. (3)

(b) Find the value of k if $\underline{p}$ and $\underline{q}$ are parallel vectors.

$$\underline{p} = \sqrt{2}\begin{pmatrix} k \\ -3 \end{pmatrix}, \quad \underline{q} = \begin{pmatrix} 2 \\ 1 \end{pmatrix}$$ (3)

Question 15 **(4 marks)**

In the diagram below ABC is a right-angled triangle, and M is the mid-point of the hypotenuse BC.



Prove that M is equidistant from each of the vertices A, B and C.

Hint: Start by drawing the line through M that is parallel to the side AB.

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19. [6 marks]

(a) Given 8 students in a class are good debaters,

(i) in how many ways can a team of three be chosen from the 8 students? [1]

(ii) in how many ways can a team of three be chosen if one particular student is chosen as captain and another student of the 8 cannot attend the debate? [2]

(b) Annie has a street stall. She sells T shirts in ten different colours but can only display six T shirts at a time.

(i) In how many ways can she display six different colour T-shirts in a line at the back of her stall? [1]

Annie's football team wear yellow and blue.

(ii) In how many ways can Annie display six different coloured T-shirts with a yellow T-shirt next to a blue T-shirt? [2]