The Straight Line

1. A line l has equation $3y + 2x = 6$.

What is the gradient of any line parallel to l?

2. A line L is perpendicular to the line with equation $2x - 3y - 6 = 0$.

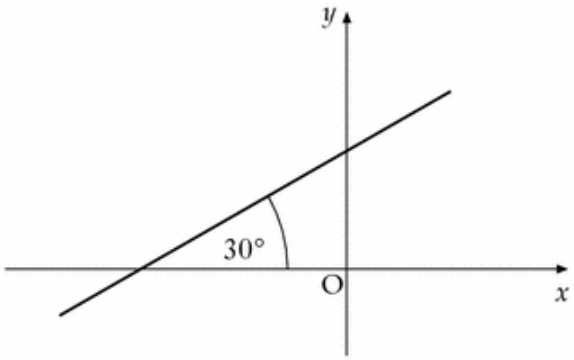
What is the gradient of the line L?

3. The line l_1 passes through the point $(1, 10)$ and is perpendicular to the line with equation $x + 2y = 1$.
Find the equation of l_1.

4. The line with equation $y = ax + 4$ is perpendicular to the line with equation $3x + y + 1 = 0$.

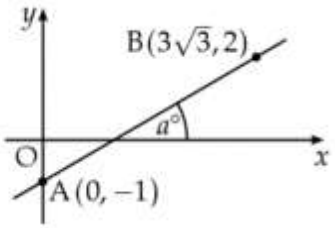
What is the value of a?

5. A line makes an angle of $30°$ with the positive direction of the x-axis as shown.

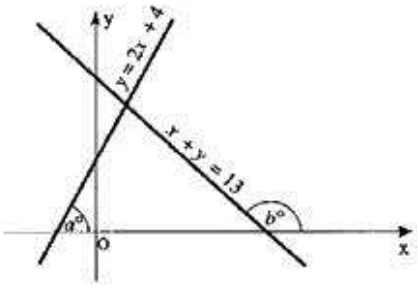


What is the gradient of the line?

6. Find the size of the angle $a°$ that the line joining the points $A(0, -1)$ and $B(3\sqrt{3}, 2)$ makes with the positive direction of the x-axis.



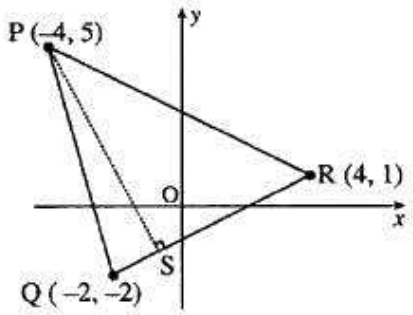
7. The lines $y = 2x + 4$ and $x + y = 13$ make angles of $a°$ and $b°$ with the positive direction of the x-axis, as shown in the diagram.



(a) Find the values of a and b.
(b) **Hence** find the acute angle between the two given lines.

8.

P(–4,5), Q(–2,–2) and R(4, 1) are the vertices of triangle PQR as shown in the diagram. Find the equation of PS, the altitude from P.



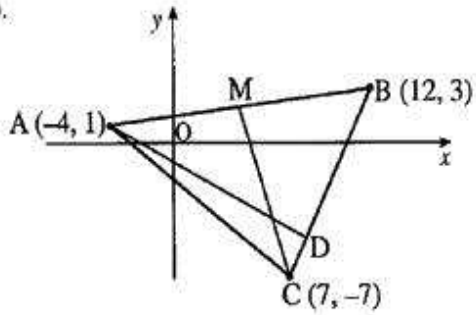
9.

A triangle ABC has vertices A (–4, 1), B (12, 3) and C (7, –7).

(*a*) Find the equation of the median CM.

(*b*) Find the equation of the altitude AD.

(*c*) Find the coordinates of the point of intersection of CM and AD.



10.

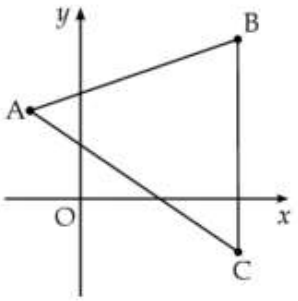
Triangle ABC has vertices $A(-3,5)$, $B(9,9)$ and $C(9,-3)$.

(*a*) Write down the equation of BC.

(*b*) Find the equation of the altitude from A.

(*c*) Find the equation of the perpendicular bisector of AB.

(*d*) Find where the perpendicular bisector of AB and the altitude from A intersect.



Vectors

1. The vectors p, q and r are defined as follows:

$$p = 3i - 3j + 2k,\ q = 4i - j + k,\ r = 4i - 2j + 3k.$$

(*a*) Find $2p - q + r$ in terms of i, j and k.

(*b*) Find the value of $|2p - q + r|$.

2. The point Q divides the line joining $P(-1,-1,0)$ to $R(5,2,-3)$ in the ratio $2:1$.
Find the coordinates of Q.

3. Show that $P(2,2,3)$, $Q(4,4,1)$ and $R(5,5,0)$ are collinear and find the ratio in which Q divides PR.

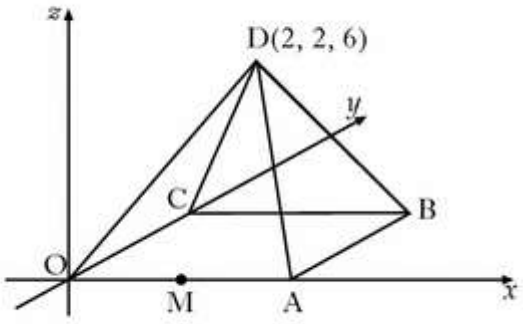
4. ABCD is a quadrilateral with vertices $A(4,-1,3)$, $B(8,3,-1)$, $C(0,4,4)$ and $D(-4,0,8)$.

(*a*) Find the coordinates of M, the midpoint of AB.

(*b*) Find the coordinates of the point T, which divides CM in the ratio $2:1$.

(*c*) Show that B, T and D are collinear and find the ratio in which T divides BD.

5. D,OABC is a square based pyramid as shown in the diagram below.



O is the origin, D is the point $(2,2,6)$ and $OA = 4$ units.
M is the mid-point of OA.

(*a*) State the coordinates of B.

(*b*) Express $\overrightarrow{DB}$ and $\overrightarrow{DM}$ in component form.

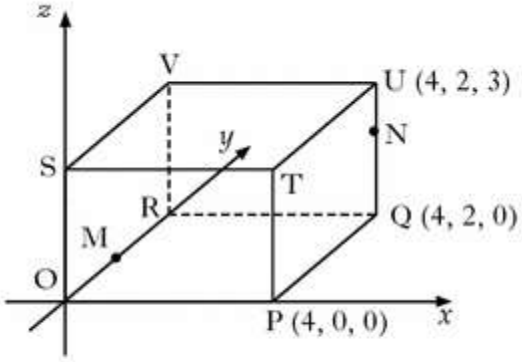
(*c*) Find the size of angle BDM.

6. The diagram shows a cuboid OPQR,STUV relative to the coordinate axes.

P is the point $(4,0,0)$, Q is $(4,2,0)$ and U is $(4,2,3)$.

M is the midpoint of OR.

N is the point on UQ such that $UN = \frac{1}{3}UQ$.



(*a*) State the coordinates of M and N.

(*b*) Express the vectors $\overrightarrow{VM}$ and $\overrightarrow{VN}$ in component form.

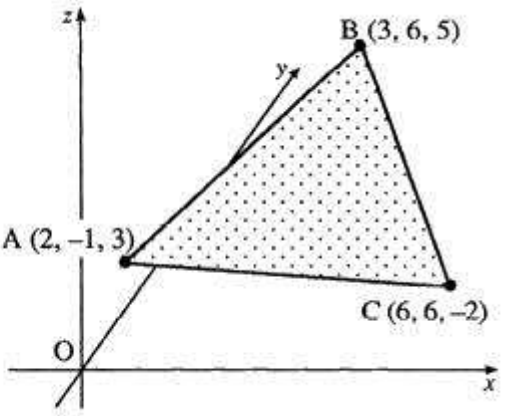
(*c*) Calculate the size of angle MVN.

7. **A triangle ABC has vertices**
A (2, –1, 3), B(3, 6, 5) and C (6, 6, –2).

(*a*) **Find $\overrightarrow{AB}$ and $\overrightarrow{AC}$.**

(*b*) **Calculate the size of angle BAC.**

(*c*) **Hence find the area of the triangle.**

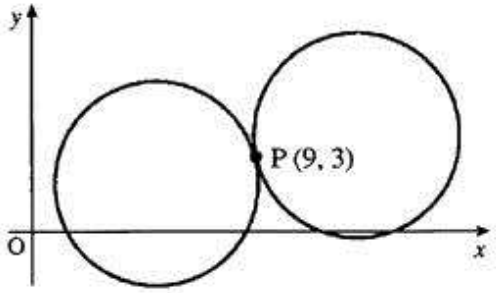


The Circle

1. Find the equation of the circle which has $P(-2,-1)$ and $Q(4,5)$ as the end points of a diameter.

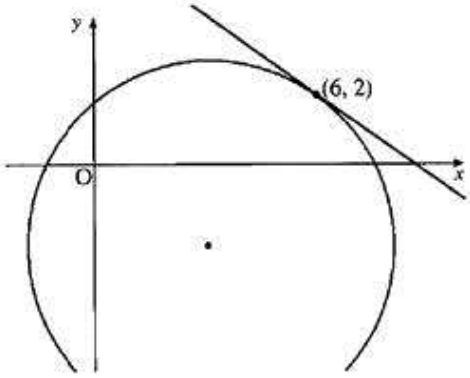
2. Two identical circles touch at the point P (9, 3) as shown in the diagram. One of the circles has equation $x^2 + y^2 - 10x - 4y + 12 = 0$.

Find the equation of the other circle.



3. The circle shown has equation $(x-3)^2 + (y+2)^2 = 25$.

Find the equation of the tangent at the point (6, 2).



4. Find the equation of the tangent at the point (3, 4) on the circle with equation $x^2 + y^2 + 2x - 4y - 15 = 0$.

5. Show that A(1, 3) lies on the circle $x^2 + y^2 + 6x + 2y - 22 = 0$.

6. Find out how many points of intersection (if any) there are between the line $2x - y + 6 = 0$ and the circle $x^2 + y^2 + 2x + 2y - 8 = 0$.

7. (*a*) Find the equation of AB, the perpendicular bisector of the line joing the points $P(-3,1)$ and $Q(1,9)$.

(*b*) C is the centre of a circle passing through P and Q. Given that QC is parallel to the y-axis, determine the equation of the circle.

(*c*) The tangents at P and Q intersect at T. Write down

(i) the equation of the tangent at Q

(ii) the coordinates of T.