

3.1 Equation of a Straight Line

3.1.1 Basic Coordinate Geometry / 3.1.2 Parallel & Perpendicular Gradients / 3.1.3 Equation of a Straight Line / 3.1.4 Modelling with Straight Lines

Easy (11 questions)	/48
Medium (10 questions)	/46
Hard (10 questions)	/53
Very Hard (11 questions)	/54
Total Marks	/201

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Easy Questions

1 The equation of a straight line is $y = 2x - 6$.

Write down:

- (i) the gradient of the line,
- (ii) the coordinates of the point where the line intercepts the y-axis,
- (iii) the coordinates of the point where the line intercepts the x-axis.

(3 marks)

2 Find the coordinates of the midpoint of the straight line connecting the following points:

- (i) (2 , 4) and (6 , 10),
- (ii) (-3 , 6) and (5 , 9),
- (iii) (0 , -8) and (3 , 2).

(5 marks)

3 Find the length of the straight line segments connecting the following points:

- (i) (2, 4) and (5, 8),
- (ii) (3, -6) and (-2, -14),
- (iii) (5, -13) and (2, -7).

(5 marks)

4 Find the equations of the following straight lines, given the gradient, m , and a point $P(x, y)$ that each line passes through.

Give your answers in the form $y = mx + c$.

- (i) $m = 2$, $P(3, 5)$,
- (ii) $m = -2$, $P(-1, 3)$,
- (iii) $m = \frac{1}{2}$, $P(5, -2)$.

(6 marks)

- 5 Given that a straight line passes through the points $P(x_1, y_1)$ and $Q(x_2, y_2)$, work out the gradient of the following lines:

- (i) $P(2, 6), Q(4, 12),$
- (ii) $P(-3, 4), Q(-8, 24),$
- (iii) $P(1, -3), Q(-3, 6).$

(6 marks)

- 6 Write the equations of the straight lines below in the form $ax + by + c = 0$, where a, b and c are integers.

- (i) $y = 3x - 5,$
- (ii) $y = \frac{1}{2}x + 7,$
- (iii) $\frac{1}{3}y = \frac{1}{6}x - \frac{1}{9}.$

(5 marks)

- 7 (i) Write down an equation of a straight line that is parallel to $y = 4x + 3$.
(ii) Write down an equation of a straight line that is perpendicular to $y = 8x - 5$.

(3 marks)

- 8 The line L is parallel to the line with equation $2x + y - 3 = 0$, and passes through the point $(1, 1)$.

Find the equation of the line L .

(3 marks)

- 9 The line L is perpendicular to the line with equation $y - \frac{1}{3}x + \frac{2}{3} = 0$, and passes through the origin.

Find the equation of the line L .

(3 marks)

- 10 A straight line passes through the points $(4, 8)$ and $(-4, 10)$.

- (i) Find the gradient of the straight line.
(ii) Hence, or otherwise, find the equation of the straight line, giving your answer in the form $y = mx + c$.

(4 marks)

11 (a) A gardener is modelling the rate at which a shrub grows using the equation $h = 3t + 5$.

h is the height of the shrub in centimetres t weeks after planting.

Write down the height of the shrub when it was first planted.

(1 mark)

(b) Work out the height of the shrub after six weeks.

(2 marks)

(c) How long should it take the shrub to reach a height of 29 cm?

(2 marks)

Medium Questions

- 1 Find the equation of a line with gradient -2 that passes through the point (7, -3), giving your answer in the form $y = mx + c$.

(2 marks)

- 2 Find the equation of a line that passes through the points (-2, 3) and (3, 7), giving your answer in the form $ax + by + c = 0$, where a , b and c are integers to be found.

(4 marks)

- 3 Find the equation of a line parallel to $y = 2x + 3$ and passing through the point (3, 12).

(2 marks)

4 (a) The line l passes through the points (3, 4) and (9, 2).

Find the equation of the line l , giving your answer in the form $y = mx + c$.

(2 marks)

(b) Write down the gradient of a line perpendicular to l .

(1 mark)

5 (a) The coordinates at the ends of the diameter of a circle are $(-3, 5)$ and $(3, -3)$.

Find the length of the diameter.

(2 marks)

(b) Find the centre of the circle.

(2 marks)

6 (a) Three points A , B and C , have coordinates $(-5, -11)$, $(1, 1)$ and $(4, 7)$ respectively.

Find the gradient of the line segment AB .

(2 marks)

(b) Find the gradient of the line segment BC .

(1 mark)

(c) What do you notice about the gradients of the lines AB and BC ?

(1 mark)

(d) Explain why your answers to (a) and (b) show that the lines AB and BC are collinear?

(1 mark)

- 7 (a)** A dog breeder is measuring the rate at which a puppy grows by measuring its “back-length”— that is the distance from the base of the neck to the base of the tail.

At 3 weeks old the puppy measured 6 cm and at 6 weeks old it measured 8 cm

Find an equation in the form $L = mw + c$, linking L , the length of the puppy in centimetres to w , the age of the puppy in weeks. m and c are constants to be found.

(4 marks)

- (b)** The equation found in part (a) is to be used as a model for the puppy’s growth.

How many centimetres per week does the model suggest the puppy grows?

(1 mark)

- (c)** Use the model to find the length of the puppy after 15 weeks.

(1 mark)

- (d)** Use the model to find the age of a puppy that has a back-length of 17 cm.

(2 marks)

8 (a) The line l has equation $2x - y + 3 = 0$.

l crosses the x -axis at point A and crosses the y -axis at point B .

Find the coordinates of points A and B .

(2 marks)

(b) Find the area of the triangle OAB , where O is the origin.

(2 marks)

9 (a) An electrician charges a fixed fee of £50 plus £20 per hour.

Using h for the number of hours a job takes, and P for the total cost of a job in pounds, write down an equation connecting h and P .

(2 marks)

(b) The electrician quotes a customer a price of £200 to complete a job, how long is the electrician expecting the job will take?

(2 marks)

(c) A rival electrician charges a fixed fee of £38 and £24 per hour.

Write down an equation for the total cost of a job from the rival electrician.

(2 marks)

(d) Determine which electrician would be the cheapest for a job taking 4 hours.

(3 marks)

10 (a) A line passing through the origin O , is perpendicular to a line with equation $x + y = 16$.

The two lines meet at point R . P is a point such that $OP : PR = 3 : 1$.

Find the equation of the perpendicular line and hence, the co-ordinates of point R .

(3 marks)

(b) Find the coordinates of P .

(2 marks)

Hard Questions

- 1 Lines l_1 and l_2 are both parallel to the line with equation $3x - y + 4 = 0$. l_1 passes through the origin and l_2 passes through the point $(-4, 7)$.

Find the equations of l_1 and l_2 , giving your answers in form $y = mx + c$.

(2 marks)

- 2 The line l passes through the points $(4, 2)$ and $(8, 5)$.

Find the equation of the line l , giving your answer in the form $ax + by + c = 0$ where a, b and c are integers to be found.

(4 marks)

- 3 The line segment AB is the diameter of a circle.

A has coordinates $(-7, -9)$ and B has coordinates $(9, 3)$.

Find the coordinates of the centre of the circle and the length of the diameter.

(3 marks)

4 (a) Three points A , B and C , have coordinates $(-8, 1)$, $(4, 4)$ and $(12, 6)$ respectively.

Find the gradients of the line segments AB and BC .

(3 marks)

(b) Explain why your answer to part (a) shows that AB and BC are collinear.

(1 mark)

- 5 (a)** A dog breeder is measuring the rate at which a puppy grows by measuring its “back-length”— that is the distance from the base of the neck to the base of the tail.

At 1.5 weeks old the puppy measured 2.3 cm and at 6.5 weeks old it measured 6.3 cm.

Using a linear model, find an equation linking L , the length of the puppy in centimetres, to w , the age of the puppy in weeks.

(4 marks)

- (b)** Use the model to find the length of the puppy at age 20 weeks.

(1 mark)

- (c)** Use the model to find the age of a puppy that has a back-length of 11.9 cm.

(2 marks)

- 6** The line l_1 has equation $3x - 2y + 4 = 0$ and crosses the x -axis at point A .

The line l_2 has equation $y = 5 - x$ and crosses the y -axis at point B .

Find the area of the triangle OAB , where O is the origin.

(4 marks)

7 (a) Two perpendicular lines l_1 and l_2 intersect at point $P(2, 5)$.

l_2 crosses the x -axis at point $Q(-3, 0)$.

Find an equation for the line l_1 .

(4 marks)

(b) l_1 crosses the x -axis at the point R .

Find the area of the triangle PQR .

(4 marks)

8 The intersections of the following straight lines form a parallelogram.

Find the coordinates of all four vertices of the parallelogram.

$$2y = 3x + 12 \quad 3x - 2y - 12 = 0$$

$$2y = 8 - x \quad \frac{1}{2}x + y + 2 = 0$$

(4 marks)

9 (a) An electrician charges a fixed fee of £45 plus £22 per hour.

Defining suitable variables, write down an equation to represent the charges made by the electrician.

(3 marks)

(b) A rival electrician charges a fixed fee of £36 and £25 per hour. Determine which electrician is cheapest for a job taking 4 hours?

(4 marks)

10 (a) The line l_1 has equation $5x - 2y + 12 = 0$.

The line l_2 has equation $2x + 5y + 28 = 0$.

Determine if the lines l_1 and l_2 are parallel, perpendicular, or neither.

(2 marks)

(b) l_1 and l_2 intersect at the point P .

Find the coordinates of P .

(4 marks)

(c) l_1 meets the y -axis at point Q .

Point R lies on the line PQ such that $PR:RQ = 3:1$.

Find the coordinates of R .

(4 marks)

Very Hard Questions

- 1 Find the equation of a line perpendicular to $2x + 3y - 4 = 0$ that passes through the point $(-1, -1)$, giving your answer in the form $ax + by + c = 0$, where a , b and c are integers.

(3 marks)

- 2 (a)** The line l passes through the points $(p, 2p)$ and $(3p, 9p)$.

Find an equation for the line l .

(3 marks)

- (b)** l intercepts the y -axis at $(0, 3)$.

Find the value of p .

(2 marks)

- 3** A line segment AB is the tangent to a circle at point M . The end points of AB have coordinates $(-5, 16)$ and $(5, 14)$ respectively and M is the midpoint of AB .

The line MN is the diameter of the circle and N has coordinates $(-4, -5)$.

Find the coordinates of the centre of the circle C and the area of the circle to three significant figures.

(4 marks)

- 4** Three points A , B and C , have coordinates $(-4, -16)$, $(2, 5)$ and $(10, 33)$ respectively.

Show that the lines AB and BC are collinear.

(4 marks)

- 5 (a)** A dog breeder is measuring the rate at which a puppy grows by measuring its “back-length”— that is the distance from the base of the neck to the base of the tail. At 2 weeks old the puppy measured 5 cm. Six weeks later the puppy’s back-length had increased by 4.2 cm.

Using a linear model, find an equation linking L , the length of the puppy in centimetres, to w , the age of the puppy in weeks.

(3 marks)

- (b)** What was the back-length of the puppy at birth?

(1 mark)

- (c)** Use the model to find the age of a puppy that has a back-length of 23.9 cm.

(1 mark)

- (d)** This particular breed of dog is fully grown after 40 weeks.
Find the dog’s length at 40 weeks and comment on the suitability of the model.

(2 marks)

- 6** The line l_1 has equation $3x - 2y + 10 = 0$ and crosses the x -axis at point A

The line l_2 is perpendicular to l_1 and crosses the x -axis at $(9, 0)$.

l_2 crosses the y -axis at point B .

Find the area of the triangle OAB , where O is the origin.

(5 marks)

- 7 The point $P(-5, -2)$ lies on the line l_1 , l_1 crosses the x -axis at the point R .

Another line, l_2 , is perpendicular to l_1 at the point P and crosses the x -axis at the point $Q(-1, 0)$.

Find the area of the triangle PQR .

(5 marks)

- 8 (a)** A plumber charges a fixed fee of £27.50 plus £21 per hour. The plumber then charges VAT on top of the total cost at a rate of 20%.

Defining suitable variables write down an equation to represent the charges, including VAT, made by the plumber.

(2 marks)

- (b)** A rival plumber charges a fixed fee of £37.80 plus £24 per hour. These prices already account for VAT.

Find the number of hours for which both plumbers would charge the same amount.

(4 marks)

- 9** A quadrilateral has four vertices with coordinates $(-1, 6)$, $(-3, 2)$, $(0, -4)$ and $(2, 0)$.

Find the equation for each of the four lines that form the quadrilateral and state its mathematical name.

(5 marks)

- 10** Two perpendicular lines intersect at $(-4, -4)$. One of the lines also passes through the point $(0, 6)$, the other passes through the point $(0, -5.6)$.

A kite is formed by these two lines and two others. The kite has a line of symmetry along the y -axis.

Find the area of the kite.

(4 marks)

- 11** The tangent to a circle passes through the points $A(-8, -1)$ and $B(16, 7)$.

The tangent meets the circle at the point N , where $AN : NB = 5 : 3$.

Find the equation of the line of the diameter of the circle NM , giving your answer in the form $ax + by + c = 0$, where a , b and c are integers to be found.

(6 marks)