SADLER MATHEMATICS METHODS UNIT 1

WORKED SOLUTIONS

Chapter 4 Linear functions

Exercise 4A

Question 1

Line	**Intersects *y*-axis at**	**Gradient**	**Equation of line**
A	(0, 1)	1	$y = x + 1$
B	(0, –1)	2	$y = 2x - 1$
C	(0, 0)	0.5	$y = 0.5x$
D	(0, 0)	–1	$y = -x$
E	(0, 6)	3	$y = 3x + 6$
F	(0, 2)	0	$y = 2$
G	(0, –3)	1	$y = x - 3$
H	(0, –3)	–2	$y = -2x - 3$
I	(0, 4)	0	$y = 4$
J	(0, –3)	–0.5	$y = -0.5x - 3$
K	(0, –0.5)	1.5	$y = 1.5x - 0.5$
L	$(0, \frac{4}{3})$	$\frac{1}{3}$	$y = \frac{1}{3}x + \frac{4}{3}$

Question 2

a y-values increase by 2 per x unit $\therefore m = 2$

When $x = 0, y = 5 \therefore c = 5$

$y = 2x + 5$

b y-values increase by 5 per x unit $\therefore m = 5$

When $x = 0, y = -7 \therefore c = -7$

$y = 5x - 7$

c y-values do not have a constant first difference per x unit

$\therefore$ a linear relationship does not exist

d y-values increase by 1 per x unit $\therefore m = 1$

When $x = 0, y = -4 \therefore c = -4$

$y = x - 4$

e y-values decrease by 2 per x unit $\therefore m = -2$

When $x = 0, y = 10 \therefore c = 10$

$y = -2x + 10$

f All points have a y co-ordinate of 5 $\therefore y = 5$

g When the points are re-ordered

x	1	2	3	4	5	6
y	16	13	9	4	–2	–9

y-values do not have a constant first difference per x unit

$\therefore$ a linear relationship does not exist

h When the points are re-ordered

x	1	2	3	4	5	6
y	–8	–3	2	7	12	17

there is a constant first difference of 5 per x unit $\therefore m = 5$

When $x = 0, y = -13 \therefore c = -13$

$y = 5x - 13$

Question 3

Equation of line	Gradient	y-axis intercept
$y = 2x + 3$	2	(0, 3)
$y = 3x + 4$	3	(0, 4)
$y = -2x - 7$	–2	(0, –7)
$y = 6x + 3$	6	(0, 3)

Question 4

$y = 4x + 6$

Question 5

$y = -x - 5$

Question 6

Line B: $y = 2x - 3$

Line D: $y = 2x$

Line E: $y = 5 + 2x$

Line F: $y = 2x + \frac{7}{2}$

Line G: $y = 5 + 2x$

Question 7

Line A: $y = 5(0) + 6 = 6$

Line D: $y = 6,$ all points are $(x, 6)$

Line E: $y = 6 + 0 = 6$

Line G: $y = -\frac{x}{2} + 6 \Rightarrow y = -\frac{0}{2} + 6 = 6$

Line H: $0 + 6 = 6$

Question 8

$y = -4x - 3$
$y = -4(-1) - 3 = 1$
$\therefore (-1, 1)$ is on this line

Question 9

$y = 2x - 3$

Point A	$7 = 2(5) - 3$	this point is on the line
Point B	$-1 \neq 2(-3) - 3$	this point is not on the line
Point C	$-4 = 2(-0.5) - 3$	this point is on the line
Point D	$2 = 2(2.5) - 3$	this point is on the line
Point E	$-1 \neq 2(-2) - 3$	this point is not on the line

Question 10

Equation of line	***y* = *mx* + *c***	**Gradient**	***y*-axis intercept**
$2y = 4x - 5$	$y = 2x - 2.5$	2	(0, –2.5)
$4y = 3x + 7$	$y = \frac{3}{4}x + \frac{7}{4}$	$\frac{3}{4}$	$(0, \frac{7}{4})$
$3y - 2x = 6$	$y = \frac{2}{3}x + 2$	$\frac{2}{3}$	(0, 2)
$4y + 3y - 6 = 0$	$y = -\frac{4}{3}x + 2$	$-\frac{4}{3}$	(0, 2)
$3x + 5y = 8$	$y = -\frac{3}{5}x + \frac{8}{5}$	-0.6	(0, 1.6)

Question 11

$y = 7x + 5$

$\text{A}(3, a)$ $x = 3$

$a = 7(3) + 5 = 26$

$\text{B}(5, b)$ $x = 5$

$b = 7(5) + 5 = 40$

$\text{C}(c, -9)$ $y = -9$

$-9 = 7c + 5$

$7c = -14$

$c = -2$

Question 12

Given $y = dx - 5$ and using D$(4, -3)$

$-3 = 4d - 5$

$4d = 2$

$d = 0.5$

$\therefore y = 0.5x - 5$

E$(8, e)$

$x = 8$

$e = 0.5(8) - 5 = -1$

F$(-2, f)$

$x = -2$

$f = 0.5(-2) - 5 = -6$

G$(13, g)$

$x = 13$

$g = 0.5(13) - 5 = 1.5$

H$(h, -4.5)$

$y = -4.5$

$-4.5 = 0.5h - 5$

$0.5h = 0.5$

$h = 1$

I$(i, -7.5)$

$y = -7.5$

$-7.5 = 0.5i - 5$

$0.5i = -2.5$

$i = 5$

Question 13

a P and t are directly proportional, linear relationship passing through (0, 0).

$P = t$

b P and t are not directly proportional, linear relationship does not pass through (0, 0).

c P and t are directly proportional, linear relationship passing through (0, 0).

$P = 4t$

d P and t are not directly proportional, linear relationship does not pass through (0, 0).

e P and t are directly proportional, linear relationship passing through (0, 0).

$P = \frac{1}{4}t$

f P and t are directly proportional, linear relationship passing through (0, 0).

$P = \frac{4}{3}t$

g P and t are not directly proportional, linear relationship does not pass through (0, 0).

h P and t are not directly proportional, linear relationship does not pass through (0, 0).

Exercise 4B

Question 1

Midpoint = $\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$

a $\left(\frac{4+10}{2}, \frac{6+12}{2}\right) = (7, 9)$

b $\left(\frac{6+4}{2}, \frac{7+13}{2}\right) = (5, 10)$

c $\left(\frac{4+2}{2}, \frac{5+5}{2}\right) = (3, 5)$

d $\left(\frac{-6+2}{2}, \frac{7+(-5)}{2}\right) = (-2, 1)$

e $\left(\frac{0-4}{2}, \frac{5+2}{2}\right) = (-2, 3.5)$

f $\left(\frac{5+19}{2}, \frac{3+(-1)}{2}\right) = (12, 1)$

g $\left(\frac{6+10}{2}, \frac{-2-9}{2}\right) = (8, -5.5)$

h $\left(\frac{-5+5}{2}, \frac{12+3}{2}\right) = (0, 7.5)$

i $\left(\frac{-6+8}{2}, \frac{8+(-6)}{2}\right) = (1, 1)$

Question 2

Gradient = $m = \dfrac{y_2 - y_1}{x_2 - x_1}$

a $m = \dfrac{6-2}{4-2} = 2$

b $m = \dfrac{7-3}{6-7} = -4$

c $m = \dfrac{5-1}{4-2} = 2$

d $m = \dfrac{7-5}{6-2} = \dfrac{2}{4} = 0.5$

e $m = \dfrac{3-4}{5-1} = -\dfrac{1}{4}$

f $m = \dfrac{3-2}{3-4} = -1$

g $m = \dfrac{3-7}{4-2} = -2$

h $m = \dfrac{2-(-3)}{5-3} = 2.5$

i $m = \dfrac{2-(-1)}{4-(-2)} = \dfrac{1}{2}$

Question 3

$$l = \sqrt{(\text{change in } y \text{ coordinate})^2 + (\text{change in } x \text{ coordinate})^2}$$
$$= \sqrt{(y_2 - y_1)^2 + (x_2 - x_1)^2}$$

a $l = \sqrt{(4-7)^2 + (6-10)^2}$
$= 5$

b $l = \sqrt{(6-3)^2 + (7-11)^2}$
$= 5$

c $l = \sqrt{(4-(-8))^2 + (5-10)^2}$
$= 13$

d $l = \sqrt{(6-(-1))^2 + (1-25)^2}$
$= 25$

e $l = \sqrt{(5-(-3)^2 + (-3-12)^2}$
$= 17$

f $l = \sqrt{(-6-0)^2 + (-8-0)^2}$
$= 10$

g $l = \sqrt{(4-1)^2 + (3-4)^2}$
$= \sqrt{50}$
$= 5\sqrt{2}$

h $l = \sqrt{(5-(-2))^2 + (2-5)^2}$
$= \sqrt{58}$

i $l = \sqrt{(9-3)^2 + (9-4)^2}$
$= \sqrt{61}$

Question 4

a $m = \dfrac{8-6}{43} = 2$

b $\text{CD} = \sqrt{(4-3)^2 + (8-6)^2}$

$= \sqrt{5}$

c $\left(\dfrac{3+4}{2}, \dfrac{6+8}{2}\right) = (3.5, 7)$

Question 5

a $m = \dfrac{9-1}{4-(-1)} = \dfrac{8}{5}$

b $\text{EF} = \sqrt{(4-(-1))^2 + (9-1)^2}$

$= \sqrt{89}$

c $\left(\dfrac{-1+4}{2}, \dfrac{1+9}{2}\right) = (1.5, 5)$

Question 6

$\text{AB}^2 = (7-1)^2 + (c-4)^2$

$100 = 36 + c^2 - 8c + 16$

$0 = c^2 - 8c - 48$

$0 = (c+4)(c-12)$

$c = -4, 12$

∗Solve by classpad or...

Question 7

a $\text{AB}^2 = (-5-4)^2 + (-4-(-3))^2$

$= 82$

$\text{AB} = \sqrt{82} \approx 9.06 \text{ km}$

b $\text{AC}^2 = (-5-2)^2 + (-4-3)^2$

$= 98$

$\text{AC} = \sqrt{98} = 7\sqrt{2} \text{ km}$

c $\text{BC}^2 = (4-2)^2 + (-3-3)^2$

$= 40$

$\text{AC} = \sqrt{40} = 2\sqrt{10} \text{ km}$

Question 8

Stage 1: $m = \dfrac{0.4}{2} = 0.2$

Stage 2: $m = \dfrac{1}{1.8} = \dfrac{5}{9}$

Stage 3: $m = \dfrac{1}{0.4} = 2.5$

Exercise 4C

Question 1

Line A: $y = -3$

Line B: $y = 1$

Line C: $y = -0.5x + 5$

Line D: $x = 5$

Line E $y = x + 3$

Line F: $y = 9$

Line G: $x = -3$

Line H: $y = 3x + 2$

Line I: $x = 7$

Line J: $y = x$

Question 2

$y = 0$

Question 3

$x = 0$

Question 4

$y = 3x + 4$
$y = 3(-1) + 4 = 1$
$\therefore (-1, 1)$ is on the line

Question 5

$y = \frac{1}{2}x + 2$

A : $1 \neq \frac{1}{2}(2) + 2$ A is not on the line

B : $0 \neq \frac{1}{2}(2) + 2$ B is not on the line

C : $2 \neq \frac{1}{2}(4) + 2$ C is not on the line

D : $-1 = \frac{1}{2}(-6) + 2$ D is on the line

E : $4 = \frac{1}{2}(4) + 2$ E is on the line

Question 6

a
$$y = x + c$$
$$5 = 3 + c$$
$$c = 2$$
$$y = x + 2$$

b
$$y = -x + c$$
$$-1 = -6 + c$$
$$c = 5$$
$$y = -x + 5$$

c
$$y = -2x + c$$
$$2 = -2(3) + c$$
$$c = 8$$
$$y = -2x + 8$$

d
$$y = 5x + c$$
$$-2 = 5(-2) + C$$
$$c = 8$$
$$y = 5x + 8$$

e $y = \frac{1}{2}x + c$

$9 = \frac{1}{2}(8) + c$

$c = 5$

$y = \frac{1}{2}x + 5$

f $y = -\frac{1}{2}x + c$

$0 = -\frac{1}{2}(-3) + c$

$c = -1.5$

$y = -\frac{1}{2}x - 1.5$

g $y = 1.5x + c$

$2 = 1.5(9) + c$

$c = -11.5$

$y = 1.5x - 11.5 \Rightarrow 2y = 3x - 23$

h $y = -\frac{1}{3}x + c$

$-1 = -\frac{1}{3}(7) + c$

$c = \frac{4}{3}$

$y = -\frac{1}{3}x + \frac{4}{3} \Rightarrow 3y = -x + 4$

Question 7

a $m = \frac{9-5}{6-2} = 1 \Rightarrow y = 1x + c$

$5 = 1(2) + c \Rightarrow c = 3$

$\therefore$ required equation is $y = x + 3$

b $m = \frac{-9-(-1)}{2-0} = -4 \Rightarrow y = -4x + c$

y - intercept is (0,-1) $\Rightarrow$ c=-1

$\therefore$ required equation is $y = -4x - 1$

c $m = \dfrac{5-1}{16-14} = -3 \Rightarrow y = -3x + c$

$1 = -3(14)) + c \Rightarrow c = 43$

$\therefore$ required equation is $y = -3x + 43$

d $m = \dfrac{3-1}{2-1} = 2 \Rightarrow y = 2x + c$

$3 = 2(2) + c \Rightarrow c = -1$

$\therefore$ required equation is $y = 2x - 1$

e $m = \dfrac{6-2}{13-1} = \dfrac{1}{3} \Rightarrow y = \dfrac{1}{3}x + c$

$6 = \dfrac{1}{3}(13) + c \Rightarrow c = 1\dfrac{2}{3}$

$\therefore$ required equation is $y = \dfrac{1}{3}x + 1\dfrac{2}{3}$ or $3y = x + 5$

f $m = \dfrac{6-(-2)}{-1-3} = -2 \Rightarrow y = -2x + c$

$6 = -2(-1) + c \Rightarrow c = 4$

$\therefore$ required equation is $y = -2x + 4$

g $m = \dfrac{9-4}{3-0} = \dfrac{5}{3} \Rightarrow y = \dfrac{5}{3}x + c$

$(0,4)$ is the $y-$intercept $\Rightarrow c = 3$

$\therefore$ required equation is $y = \dfrac{5}{3}x + 4$ or $3y = 5x + 12$

h $m = \dfrac{5-(-5)}{0-2} = -5 \Rightarrow y = -5x + c$

$(0,5)$ is the $y-$intercept $\Rightarrow c = 5$

$\therefore$ required equation is $y = -5x + 5$

Question 8

$m = \dfrac{7-1}{4-1} = 2 \Rightarrow y = 2x + c$

$7 = 2(4) + c \Rightarrow c = -1$

$\therefore$ required equation is $y = 2x - 1$

A : $15 \neq 2(7) - 1$	A is not on the line
B : $13 = 2(7) - 1$	B is on the line
C : $2 \neq 2(2) - 1$	C is not on the line
D : $3 \neq 2(-1) - 1$	D is not on the line
E : $11 = 2(6) - 1$	E is on the line

Question 9

$y = 0.5x + c$

$4 = 0.5(3) + c \Rightarrow c = 2.5$

$\therefore$ required equation is $y = 0.5x + 2.5$

F$(9, f)$

$x = 9$

$f = 0.5(9) + 2.5 = 7$

G$(-9, g)$

$x = -9$

$g = 0.5(-9) + 2.5 = -2$

H$(h, 9)$

$y = 9$

$9 = 0.5h + 2.5$

$0.5h = 6.5$

$h = 13$

I$(i, 1.5)$

$y = 1.5$

$1.5 = 0.5i + 2.5$

$0.5i = -1$

$i = -2$

J(3.8, j)

$x = 3.8$

$j = 0.5(3.8) + 2.5 = 4.4$

Question 10

$2y = x - 4$ cuts x-axis when $y = 0$

$0 = x - 4$

$x = 4$

$\therefore (4,0)$ is the $x-$intercept

$$m = \frac{10-0}{-1-4} = -2 \Rightarrow y = -2x + c$$

$0 = -2(4) + c \Rightarrow c = 8$

$\therefore$ required equation is $y = -2x + 8$

Question 11

$2y = -x + 6$ cuts x-axis when $y = 0$

$0 = -x + 6$

$x = 6$

$\therefore (6,0)$ is the $x-$intercept

$$m = \frac{8-0}{8-6} = 4 \Rightarrow y = 4x + c$$

$8 = 4(8) + c \Rightarrow c = -24$

$\therefore$ required equation is $y = 4x - 24$

Question 12

Each point is of the format $(°C, °F)$

$(100, 212)$ and $(50,122)$ are both on the required line

$$m = \frac{212-122}{100-50} = 1.8 \Rightarrow y = 1.8C + c$$
$$212 = 1.8(100) + c \Rightarrow c = 32$$
$$\therefore \text{required equation is } y = 1.8C + 32$$

a $F = 1.8(55) + 32 = 131°$

b $F = 1.8(125) + 32 = 257°$

c $F = 1.8(-10) + 32 = 14°$

d
$$59 = 1.8C + 32$$
$$1.8C = 27$$
$$C = 15°$$

e
$$86 = 1.8C + 32$$
$$1.8C = 54$$
$$C = 30°$$

f
$$-40 = 1.8C + 32$$
$$1.8C = 72$$
$$C = -40°$$

Question 13

$(100, 64)$ and $(175,82)$ are both on the required line

$$\text{m} = \frac{82-64}{175-100} = 0.24 \Rightarrow A = 0.24N + c$$
$$64 = 0.24(100) + c \Rightarrow c = 40$$
$$\therefore A = 0.24N + 40$$

Question 14

a A(−80, 20) B(120, 120) C(−100, 60) D(−60, −20) E(100, 160) F(140, 80)

b $AB = \sqrt{(120-(-80)^2 + (120-20)^2}$

$= \sqrt{50000}$

$= 100\sqrt{5}$ $(\approx 224\,\text{m})$

c $m = \dfrac{120-20}{120-(-80)} = 0.5 \Rightarrow y = 0.5x + c$

$120 = 0.5(120) + c \Rightarrow c = 60$

$\therefore y = 0.5x + 60$

d $m = \dfrac{60-(-20)}{-100-(-60)} = -2 \Rightarrow y = -2x + c$

$60 = -2(100) + c \Rightarrow c = -140$

$\therefore y = -2x - 140$

e $m = \dfrac{160-80}{100-140} = -2 \Rightarrow y = -2x + c$

$160 = -2(100) + c \Rightarrow c = 360$

$\therefore y = -2x + 360$

Question 15

(t hours, A Litres)

When $t = 2, A = 4000 - 2 \times 60 \times 0.25 = 3970L$

When $A = 3850$,

$3850 = 4000 - t \times 60 \times 0.25$

$= 400 - 15t$

$15t = 150$

$t = 10$

$(0, 4000), (2, 3970)$ and $(10, 3850)$ are points on the line $A = mt + c$

$c = 4000$ from the initial information

$m = \dfrac{4000-3970}{2} = -15$

$\therefore$ required equation is $A = -15t + 4000$

Question 16

$445 = 3T + c \rightarrow (Eq1)$

$625 = 4.5T + c \rightarrow (Eq2)$

Solve using Classpad or $Eq2 - Eq1$ produces

$180 = 1.5m$

$m = 120$

$445 = 3(120) + c \Rightarrow c = 85$

$\therefore$ required equation is $C = 120T + 85$

Question 17

$P = mN + c$

Using points $(900, 400)$ & $(1100, 1300)$:

$m = \dfrac{1300 - 400}{1100 - 900} = 4.5 \Rightarrow P = 4.5N + c$

$400 = 4.5(900) + c \Rightarrow c = -3650$

$\therefore$ required equation is $P = 4.5N - 3650$

a $P = 4.5(1500) - 3650 = \$3100$

b $P = 4.5(2500 - 150) - 3650 = \$6925$

c $P = 4.5N - 3650 = 0$

$4.5N = 3650$

$N = 811.1$

$\therefore 812$ tickets need to be sold

Question 18

a $P = mx - c$

$(10,560) \Rightarrow 560 = 10m - c \quad \rightarrow Eq1$

$(5,10) \Rightarrow 10 = 5m - c \quad \rightarrow Eq2$

Solve by classpad or $Eq\ 2$ - $Eq\ 1$ produces

$550 = 5m \Rightarrow m = 110$

$560 = 10(110) - c \Rightarrow c = 540$

$\therefore$ required equation is $P = 110x - 540$

b $P = 110(20) - 540 = \$1660$

Question 19

$L = \text{k}M + L_0$

$k = \dfrac{1.05 - 0.85}{3 - 2} = 0.2 \Rightarrow L = 0.2M + L_0$

$0.85 = 0.2(2) + L_0 \Rightarrow L_0 = 0.45$

$\therefore L = 0.2M + 0.45$

$L = 0.2(0.25) + 0.45 = 0.5\,\text{m}$

The spring has been extend by 5cm.

Exercise 4D

Question 1

Line A $y = 2x + 3$ is parallel to Line E $y = 2x - 1$

Line B $y = 3x + 4$ is parallel to Line J $y = 3x - 2$

Line C $y = 5x + 3$ is parallel to Line H $y - 5x = 4$

Line F $y = 5 - \frac{1}{2}x$ is parallel to Line K $2y + x = 6$

Line G $y + 5x = 3$ is parallel to Line I $y = 1 - 5x$

Question 2

Required gradient for a parallel line $m = 2$.

$y = 2x + c$

$-7 = 2(-1) + c \Rightarrow c = -5$

$y = 2x - 5$

Question 3

Line A $y = -2x + 3$ is perpendicular to Line D $y = \frac{1}{2}x + 1$

Line B $y = 3x$ is perpendicular to Line G $3y + 3 = x$ $(y = -\frac{1}{3}x + 1)$

Line C $y = x + 3$ is perpendicular to Line E $y = -x + 1$

Line F $y = 3$ is perpendicular to Line K $x = -2$

Line I $2y + 3x = 8$ $(y = -\frac{3x}{2} + 1)$ is perpendicular to Line J $3y = 2x - 9$ $(y = \frac{2}{3}x - 3)$

Question 4

$y = 2x + c$ has $m = 2$ so we need to find the gradient for a perpendicular line.

$2m = -1 \therefore m = -\frac{1}{2}$

$y = -\frac{1}{2}x + c$

$7 = -\frac{1}{2}(-4) + c \Rightarrow c = 5$

$\therefore y = -\frac{1}{2}x + 5$

Question 5

$3y = 5 - x$ rearranges to $y = \frac{5}{3} - \frac{x}{3}$ and has $m = -\frac{1}{3}$.

We need to find the gradient for a perpendicular line.

$-\frac{1}{3}m = -1 \therefore m = 3$

$y = 3x + c$

$2 = 3(-1) + c \Rightarrow c = 5$

$\therefore y = 3x + 5$

Question 6

a $y = x - 3$ and $y = 3x - 7$

$x - 3 = 3x - 7$

$2x = 4$

$x = 2$

$y = -1$

point of intersection $(2, -1)$

b

$2y + x = 8 \Rightarrow y = -\frac{1}{2}x + 8$ has $m = -\frac{1}{2}$

required gradient $m = 2$

$\therefore y = 2x + c$

$-1 = 2x + c \Rightarrow c = -5$

$y = 2x - 5$

Question 1

A	$y = 2x + 3$
C	$y = 3x - 1$
E	$y = 4 - 3x$
F	$2y = 4x + 5$
H	$y = 4x$
O	$x = 4y$
J	$2x + 3x = 5$
L	$y = \frac{x+1}{2}$

Question 2

A : $12 \neq 3(6) - 5$	A is not on the line
B : $11 \neq 3(5)$	B is not on the line
C : $1 = 3(2) - 5$	C is on the line
D : $-13 \neq 3(-3) - 5$	D is not on the line
E : $-8 = 3(-1) - 5$	E is on the line

Question 3

F : $5 = -1 + 6$	F is on the line
G : $6 = -0 + 6$	G is on the line
H : $8 \neq -2 + 6$	H is not on the line
I : $-4 \neq -(-1) + 6$	I is not on the line
J : $0 = -6 + 6$	J is on the line

Question 4

a $f(4) = 2(4) + 3 = 11$

b $f(-2) = 2(-2) + 3 = -1$

c $f(10) = 2(10) + 3 = 23$

d $g(2) = 5(2) - 18 = -8$

e $g(-2) = 5(-2) - 18 = -28$

f $g(6.5) = 5(6.5) - 18 = 14.5$

g $f(1) + f(2) = 2(1) + 3 + 2(2) + 3 = 12$

h $g(1) + g(2) = 5(1) - 18 + 5(2) - 18 = -21$

i $f(m) + g(m) = 2m + 3 + 5m - 18 = 7m - 15$

j
$$f(m) = 2m + 3 = 15$$
$$2m = 12$$
$$m = 6$$

k
$$g(p) = 5p - 18 = 7$$
$$5p = 25$$
$$p = 5$$

l
$$f(q) = g(q)$$
$$2q + 3 = 5q - 18$$
$$21 = 3q$$
$$q = 7$$

m
$$f(r) = 2r + 3 = r$$
$$r = -3$$

n
$$g(s) = 5s - 18 = s$$
$$4s = 18$$
$$s = 4.5$$

Question 5

a $2x-11=-3x+4$

$5x=15$

$x=3$

$y=2(3)-11=-5$

$\therefore$ point of intersection $(3, -5)$

b $5x+2y=3 \quad \rightarrow Eq1$

$2x+3y=10 \quad \rightarrow Eq2$

$Eq1\times 2 : Eq3 \quad 10x+4y=6$

$Eq2\times 5 : Eq4 \quad 10x+15y=50$

$Eq4-Eq3: \quad 11y=44$

$y=4$

$5x+2(4)=3$

$5x=-5$

$x=-1$

$\therefore$ point of intersection $(-1, 4)$

Question 6

a Domain : $\{x \in \mathbb{R}\}$

Range : $\{y \in \mathbb{R}\}$

b Domain : $\{x \in \mathbb{R}, x \geq 5\}$

Range : $\{y \in \mathbb{R}, y \geq 0\}$

c Domain : $\{x \in \mathbb{R}\}$

Range : $\{y \in \mathbb{R}, y \geq 0\}$

d Domain : $\{x \in \mathbb{R}, x \neq 5\}$

Range : $\{y \in \mathbb{R}, y \neq 0\}$

e Domain : $\{x \in \mathbb{R}, x \neq 5\}$

Range : $\{y \in \mathbb{R}, y \geq 0\}$

f Domain : $\{x \in \mathbb{R}, x > 5\}$

Range : $\{y \in \mathbb{R}, y \neq 0\}$

Question 7

a If A, B, C, D, E and F are on the same circle with centre O, then

$OA = OB = OC = OD = OE = OF$, as they are all radii.

O(5,9) A(29,16)

$OA^2 = (29-5)^2 + (16-9)^2$

$= 625$

$OA = 25$

O(5,9) B(25,24)

$OB^2 = (25-5)^2 + (24-9)^2$

$= 625$

$OB = 25$

O(5,9) C(-2,33)

$OC^2 = (5-(-2))^2 + (9-33)^2$

$= 625$

$OC = 25$

O(5,9) D(-10,29)

$OD^2 = (5-10)^2 + (9-29)^2$

$= 625$

$OD = 25$

O(5,9) E(-15,-6)

$OE^2 = (5-(-15))^2 + (9-(-6))^2$

$= 625$

$OE = 25$

O(5,9) F(29,2)

$OF^2 = (5-29)^2 + (9-2)^2$

$= 625$

$OF = 25$

b $m_{OC} = \dfrac{33-9}{-2-5} = -\dfrac{24}{7}$

$m_{OA} = \dfrac{16-9}{29-5} = \dfrac{7}{24}$

$m_{OC} \times m_{OA} = -\dfrac{24}{7} \times \dfrac{7}{24} = -1$

c $\left(\dfrac{25+(-15)}{2}, \dfrac{24+(-6)}{2}\right) = (5,9)$

Question 8

$y = mx + c$

Using (3, 14) and (5, 24)

$14 = 3m + c$

$24 = 5m + c$

By subtraction $10 = 2m \Rightarrow m = 5$

$14 = 3(5) + c \Rightarrow c = -1$

$\therefore y = 5x - 1$ is the required equation

$a = -1$

$b = 5(1) - 1 = 4$

$c = 5(2) - 1 = 9$

$d = 5(4) - 1 = 19$

$e = 5(6) - 1 = 29$

$54 = 5f - 1$

$55 = 5f$

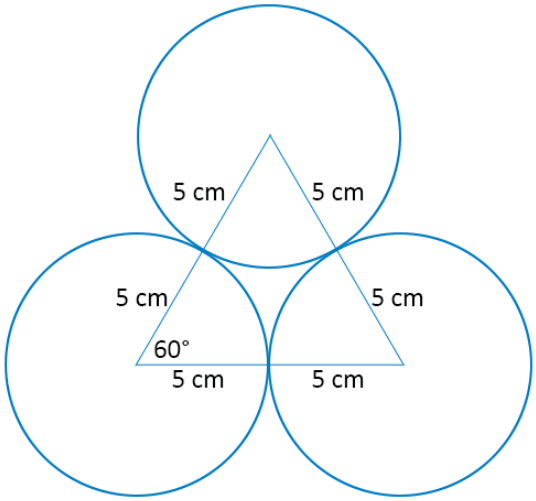
$f = 11$

$494 = 5g - 1$

$5g = 495$

$g = 99$

Question 9



Area of triangle

$$\frac{1}{2}\times 10\times 10\sin 60°$$

$$= 25\sqrt{3}$$

Area of sector

$$= \frac{1}{2}\times 5^2 \times \frac{\pi}{3}$$

$$= \frac{25\pi}{6}$$

Remaining area

$$25\sqrt{3} - 3\times\frac{25\pi}{6}$$

$$= 25\sqrt{3} - \frac{25}{2}$$

$$= 25(\sqrt{3} - \frac{\pi}{2})$$

$$= \frac{25}{2}(2\sqrt{3} - \pi)\,\text{cm}^2$$