Learning Area : ALGEBRA

LINEAR LAW

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5 Golden Reminders

01 Jaga hubungan dengan Allah.

02 Apa yang kita fikir, rasa, cakap, tulis dan buat segalanya adalah **DOA**.

03 Confidence

I must practice what I have learnt in class.
The more I practice, the better I get.
The better I get, the more confident I become.
The more confident I become, the easier my exams shall be.

04 Time Management

1 markah = 1.5 minit
10 markah = 15 minit

05 Niat

LINEAR LAW

Forming Equations

Convert non-linear relation to linear relations

Line of best Fit

Solving problem involving linear law

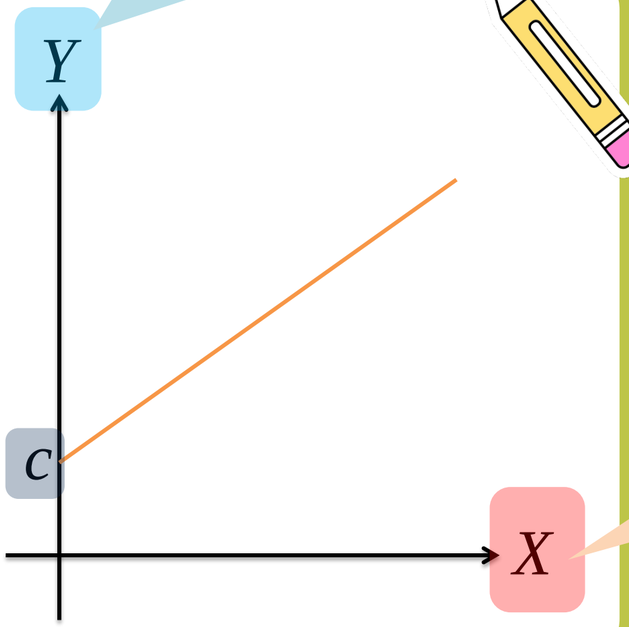
Forming Equations

FLASHBACK

For a linear graph, $Y = mX + c$, X represents the variable on the horizontal axis, Y represents the variable on the vertical axis, m represents the gradient and c represents the Y-intercept.

y $\quad \frac{y}{x}$ $\quad y^2$

$y\sqrt{x}$ $\quad \log_{10} y$



x^2 $\quad \frac{1}{x^2}$ $\quad x+2$

$\sqrt{x}$ $\quad \log_{10} x$

$Y = mX + c$

gradient

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

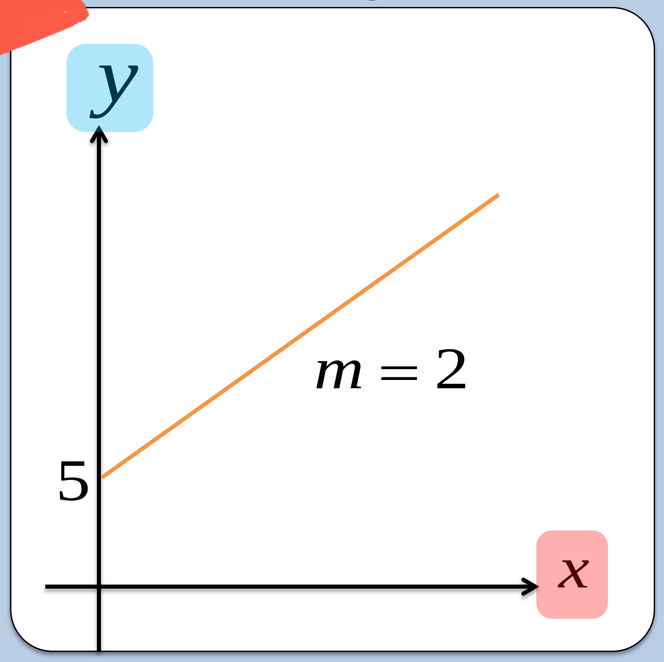
Y-intercept

$(0, y)$

Forming Equations

Example 1 Write equations for each of the following diagrams.

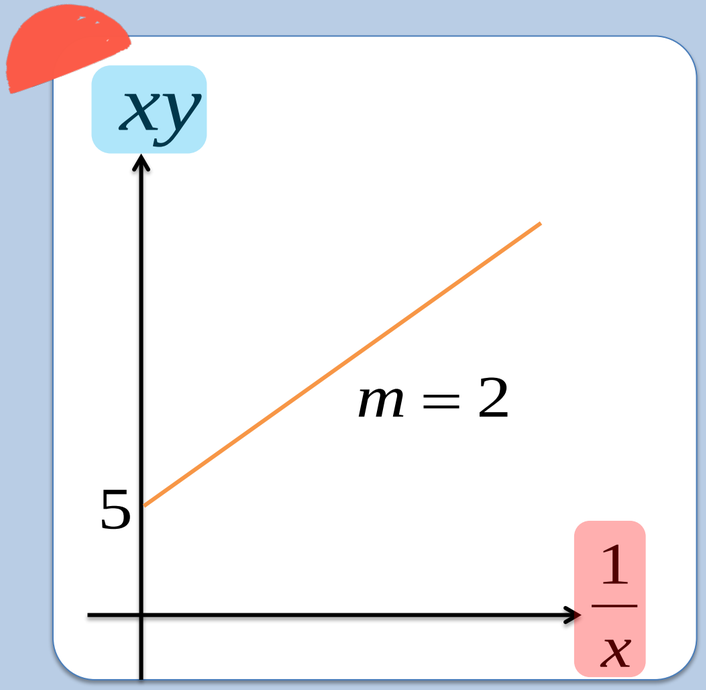
(a)



$$Y = mX + c$$

$$y = 2x + 5$$

(b)



$$Y = mX + c$$

$$xy = 2\left(\frac{1}{x}\right) + 5$$

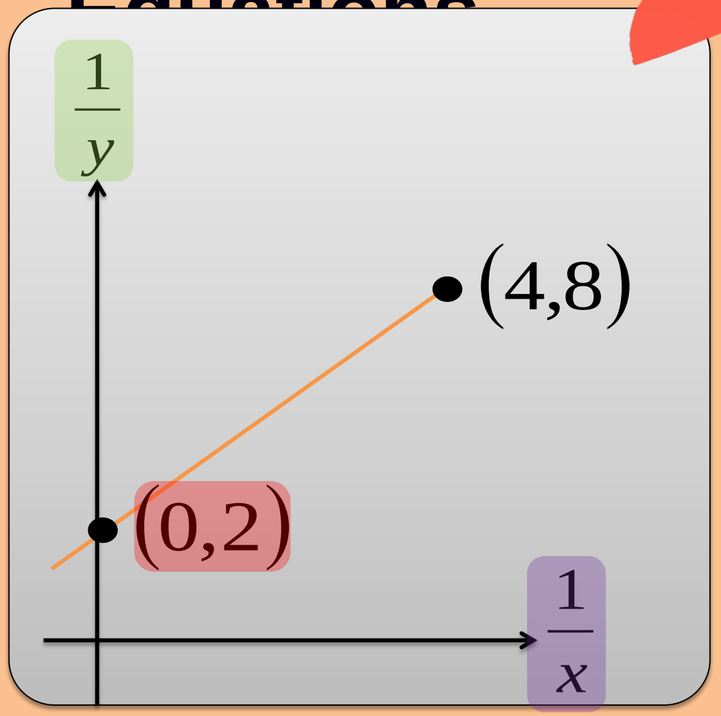
$$2\left(\frac{1}{x}\right) = \frac{2}{x}$$

$$xy = \frac{2}{x} + 5$$

Example 1

Forming Equations

(c)



$$Y = mX + c$$

$$\frac{1}{y} = m\left(\frac{1}{x}\right) + c$$

$$m = \frac{8-2}{4-0}$$

$$= \frac{6}{4}$$

$$= \frac{3}{2}$$

$$c = 2$$

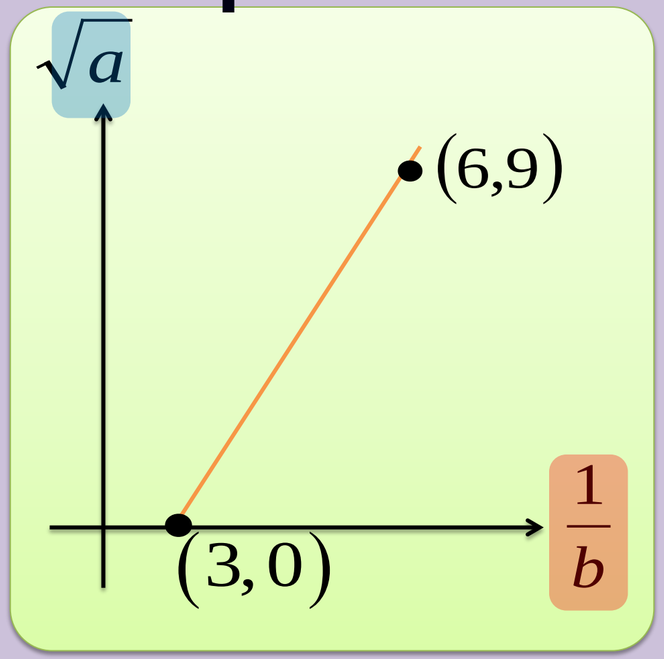
$$\frac{1}{y} = \frac{3}{2}\left(\frac{1}{x}\right) + 2$$

$$\frac{1}{y} = \frac{3}{2x} + 2$$

Forming Equations

Example 1

(d)



$$Y = mX + c$$

$$\sqrt{a} = m\left(\frac{1}{b}\right) + c$$

$$m = \frac{9-0}{6-3}$$

$$= 3$$

$$at(6,9)$$

$$\sqrt{a} = 3\left(\frac{1}{b}\right) + c$$

$$9 = 3(6) + c$$

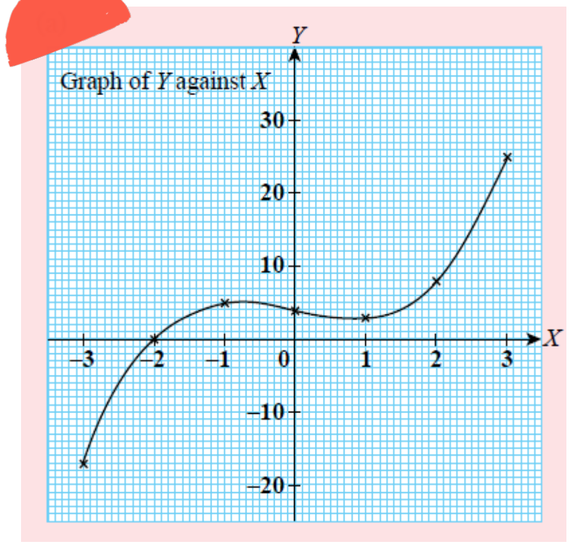
$$c = -9$$

$$\sqrt{a} = 3\left(\frac{1}{b}\right) - 9$$

$$\sqrt{a} = \frac{3}{b} - 9$$

Convert non-linear relation to linear relations

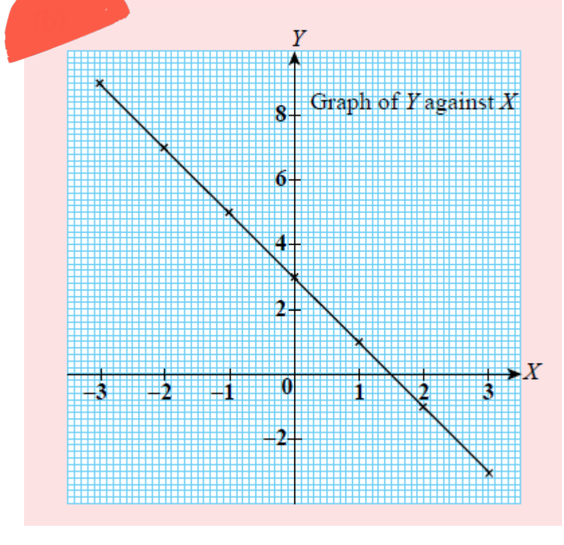
Non-linear



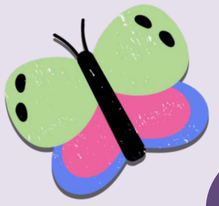
The graph which does not forms a straight line.

To reduce equation, create the Y-intercept or refer Y-axis

Linear



The graph which forms a straight line.



Convert non-linear relation to linear

Create Y-intercept (constant)

Example 2

Convert $y = px^2 + qx$ to linear form. Hence, identify Y, X, gradient and Y-intercept.

q

$$y = px^2 + qx$$

Divide both sides of the equation by x

$$\frac{y}{x} = \frac{px^2}{x} + \frac{qx}{x}$$

$$\frac{y}{x} = px + q$$

Compare with $Y = mX + c$

$$Y = mX + c$$

$$Y = \frac{y}{x} \qquad m = p \qquad X = x \qquad c = q$$

p

$$y = px^2 + qx$$

Divide both sides of the equation by x^2

$$\frac{y}{x^2} = \frac{px^2}{x^2} + \frac{qx}{x^2}$$

$$\frac{y}{x^2} = p + \frac{q}{x}$$

$$\frac{q}{x} = q\left(\frac{1}{x}\right)$$

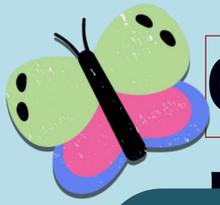
$$\frac{y}{x^2} = q\left(\frac{1}{x}\right) + p$$

Compare with $Y = mX + c$

$$Y = mX + c$$

$$Y = \frac{y}{x^2} \qquad m = q \qquad X = \frac{1}{x} \qquad c = p$$

Refer Y-axis



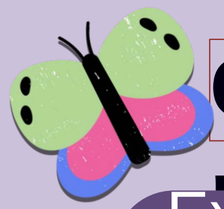
Convert non-linear relation to linear relations

Example 3 (a)

Reduce the following non-linear equations to linear form. Hence, identify *Y*, *X*, gradient,*m* and *Y*-intercept,*c*.

Non-linear	Linear	Y-axis, X-axis, m and c.
(a) $y = 2px + \frac{q}{5x}$ Plot graph xy against x^2	Multiply both sides of the equation by *x* $x(y) = x\left(2px + \frac{q}{5x}\right)$ $xy = 2px^2 + \frac{q}{5}$	$Y = xy$ $X = x^2$ $m = 2p$ $c = \frac{q}{5}$

Refer Y-axis



Convert non-linear relation to linear relations

Example 3 (b)

Non-linear	Linear	Y-axis, X-axis, m and c.
(b) $y = \frac{2k}{p^x}$ Plot graph $\log_{10} y$ against x	$\log_{10} y = \log_{10}\left(\frac{2k}{p^x}\right)$ Take log both sides $\log_{10} y = \log_{10} 2k - \log_{10} p^x$ $\log_{10} y = \log_{10} 2k - x\log_{10} p$ $\log_{10} y = -x\log_{10} p + \log_{10} 2k$ $\log_{10} y = (-\log_{10} p)x + \log_{10} 2k$	$Y = \log_{10} y$ $X = x$ $m = -\log_{10} p$ $c = \log_{10} 2k$

Refer Y-axis

Convert non-linear relation to linear relations

Example 3 (c)

Non-linear	Linear	Y-axis, X-axis, *m* and *c*.
(c) $nx = py - xy$ Plot graph $\frac{1}{y}$ against $\frac{1}{x}$	$\frac{nx}{y} = \frac{py}{y} - \frac{xy}{y}$ Divide both sides of the equation by *y* $\frac{nx}{y} = p - x$ Divide both sides of the equation by *nx* $\frac{nx}{y(nx)} = \frac{p}{nx} - \frac{x}{nx}$ $\frac{1}{y} = \frac{p}{n}\left(\frac{1}{x}\right) - \frac{1}{n}$	$Y = \frac{1}{y}$ $X = \frac{1}{x}$ $m = \frac{p}{n}$ $c = -\frac{1}{n}$

Convert non-linear relation to linear relations

NOTES

Equations	Method
$y = 5x^2 + 3x$ $y = 2px + \frac{q}{5x}$ $nx = py - xy$ $y\sqrt{x} = ab\sqrt{x} + \frac{b}{\sqrt{x}}$ $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$	Using multiplication, $\div x = \times\left(\frac{1}{x}\right)$ division, square, factorization, rearrange … $\div\sqrt{x} = \times\left(\frac{1}{\sqrt{x}}\right)$
$y = ax^b$ $y = a^{b+x}$ $y = \frac{2k}{p^x}$ $y = pk^{\sqrt{x}}$ $L = A(3)^{\frac{b}{T}}$	Using logarithms $\log_a xy = \log_a x + \log_a y$ $\log_a \frac{x}{y} = \log_a x - \log_a y$ $\log_a x^n = n\log_a x$

Convert non-linear relation to linear relations

NOTES

create the Y-intercept / constant	refer Y-axis
1. Choose suitable constant, then eliminate the variable. 2. The variables X and Y must contain the variables only they cannot contain the unknown constants. 3. *m* and *c* must contain only constant (no variables x/y).	1. Refer Y-axis 2. Using multiplication, division, square, factorization, rearrange or logarithms 3. Rearrange in the form $Y = mX + c$

SHORT QUESTION

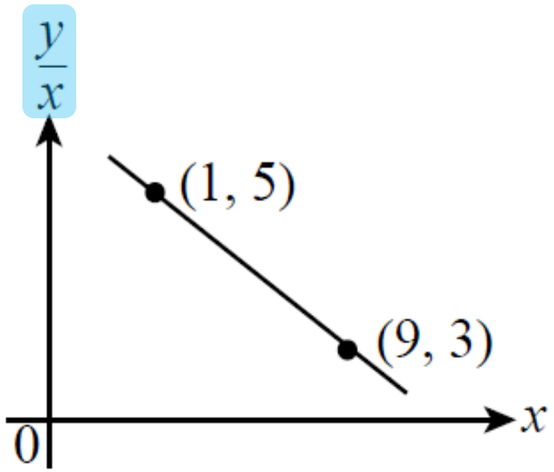
Example 4

The variables x and y are related by equation $y = px^2 + qx$, such that p and q are constant.

The diagram below shows part of the line of best fit obtained by plotting the graph $\frac{y}{x}$ against x.

(a) Convert the equation $y = px^2 + qx$ to the linear form.

(b) Find the value of p and q.



Solution

(a) $y = px^2 + qx$

Divide both sides of the equation by x

$$\frac{y}{x} = \frac{px^2}{x} + \frac{qx}{x}$$

$$\frac{y}{x} = px + q$$

Compare with Y=mX+c

$m = p, c = q$

$$Y = mx + c$$

(b) $$p = \frac{5-3}{1-9}$$

$$= \frac{2}{-8}$$

$$= -\frac{1}{4}$$

$$\frac{y}{x} = -\frac{1}{4}x + q,$$

at point $(1,5)$

$$(5) = -\frac{1}{4}(1) + q$$

$$q = \frac{21}{4}$$

Example 5

Diagram 2 shows a straight line graph of $\frac{y}{x}$ against x.

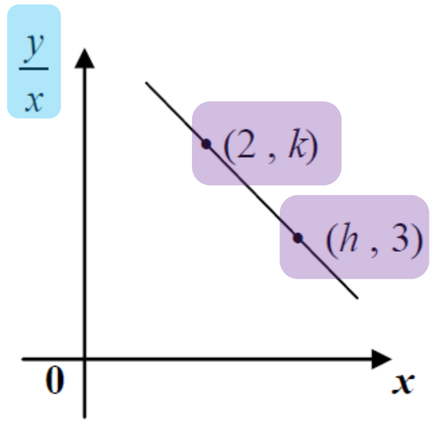


Diagram 2

Given that $y = 6x - x^2$, calculate the value of k and of h.

Solution

$$y = 6x - x^2$$

Divide both sides of the equation by x

$$\frac{y}{x} = \frac{6x}{x} - \frac{x^2}{x}$$

$$\frac{y}{x} = 6 - x$$

$$\frac{y}{x} = -x + 6$$

at $(2, k)$

$$k = -(2) + 6$$

$$= 4$$

at $(h, 3)$

$$\frac{y}{x} = -x + 6$$

$$3 = -h + 6$$

$$h = 3$$

Example 6

The variables x and y are related by the equation $y = kx^4$, where k is a constant.

(a) Convert the equation $y = kx^4$ to linear form.

(b) Diagram 3 shows the straight line obtained by plotting $\log_{10} y$ against $\log_{10} x$.

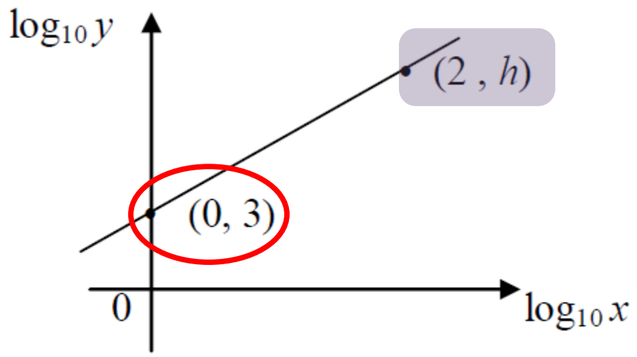


Diagram 3

Find the value of

(i) $\log_{10} k$,

(ii) h.

Solution

Take log both sides

(a) $y = kx^4$

$$\log_{10} y = \log_{10} kx^4$$

$$\log_{10} y = \log_{10} k + \log_{10} x^4$$

$$\log_{10} y = \log_{10} k + 4\log_{10} x$$

$Y = mX + c$

$$\log_{10} y = 4\log_{10} x + \log_{10} k$$

(b) (i) $\log_{10} k = 3$

(ii) at $(2, h)$

$$h = 4(2) + 3$$

$$= 11$$

$$\frac{h-3}{2-0} = 4$$

$$h - 3 = 8$$

$$h = 11$$

Example 7

Diagram 4(a) shows the curve $y = -3x^2 + 5$. Diagram 4(b) shows the straight line graph obtained when $y = -3x^2 + 5$ is expressed in the linear form $Y = 5X + c$.

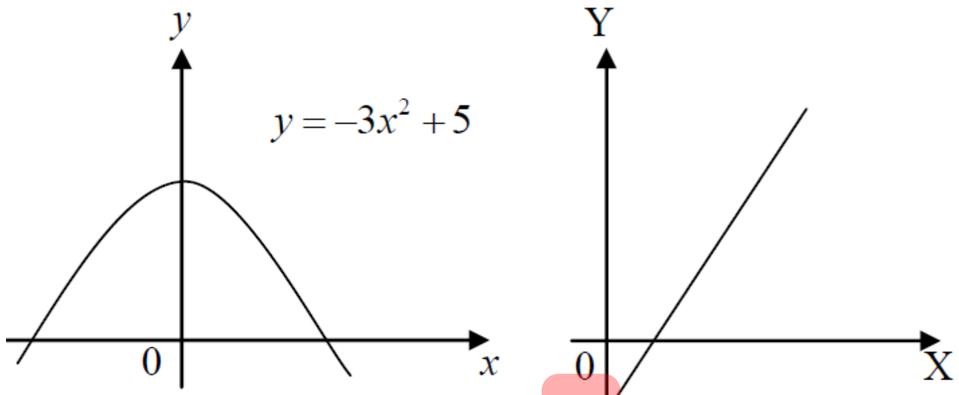


Diagram 4(a)

Diagram 4(b)

Express X and Y in terms of x and/or y.

Solution

Hint : c = –3

$$y = -3x^2 + 5$$

Divide both sides of the equation by x^2

$$\frac{y}{x^2} = \frac{-3x^2}{x^2} + \frac{5}{x^2}$$

$$\frac{y}{x^2} = -3 + \frac{5}{x^2}$$

$$\frac{y}{x^2} = \frac{5}{x^2} - 3$$

Compare with Y=mX+c

$$\frac{y}{x^2} = 5\left(\frac{1}{x^2}\right) - 3$$

$$Y = \frac{y}{x^2} \qquad X = \frac{1}{x^2}$$

Example 8

The variables x and y are related by the equation $y\sqrt{x} = ab\sqrt{x} + \frac{b}{\sqrt{x}}$, where a and b are constants.

A straight line is obtained by plotting y against $\frac{1}{x}$ and passes through the points $(0, 6)$ and $(-2, 0)$.

Find the value of a and of b.

Solution

$\sqrt{x} \times \sqrt{x} = x$

$$y\sqrt{x}\left(\frac{1}{\sqrt{x}}\right) = ab\sqrt{x}\left(\frac{1}{\sqrt{x}}\right) + \frac{b}{\sqrt{x}}\left(\frac{1}{\sqrt{x}}\right)$$

$$y = ab + \frac{b}{x}$$

$$y = \frac{b}{x} + ab$$

Compare with $Y = mX + c$

$$y = b\left(\frac{1}{x}\right) + ab$$

$m = b$ $c = ab$

$$y\sqrt{x} = ab\sqrt{x} + \frac{b}{\sqrt{x}}$$

Divide both sides of the equation by $\sqrt{x}$

Multiply both sides of the equation by $\frac{1}{\sqrt{x}}$

$$b = \frac{6-0}{0-(-2)}$$

$$= \frac{6}{2}$$

$$= 3$$

$$ab = 6$$

$$a(3) = 6$$

$$a = 2$$

Example 9

Diagram 6 shows the graph of $\frac{y}{x}$ against x^2.

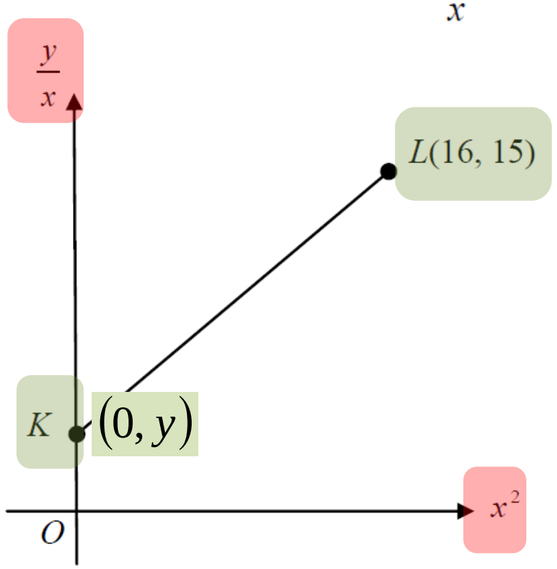


Diagram 6

It is given that the gradient of $KL = \frac{3}{4}$ and point K lies on the $\frac{y}{x}$-axis.

(a) Find the coordinates of K.

(b) Express y in terms of x.

Solution

(a) $m = \dfrac{15-y}{16-0}$

$\dfrac{3}{4} = \dfrac{15-y}{16}$

$3(16) = 4(15-y)$

$48 = 60 - 4y$

$4y = 12$

$y = 3$

$K(0,3)$

(b) $Y = mX + c$

$\dfrac{y}{x} = \dfrac{3}{4}x^2 + 3$

Multiply both sides of the equation by x

$\dfrac{y}{x}(x) = \dfrac{3}{4}x^2(x) + 3(x)$

$y = \dfrac{3}{4}x^3 + 3x$

Example 10

The variables x and y are related by the equation $y = px^r$ where p and r are constants. Diagram 7 shows the straight line graph obtained by plotting $\log_{10} y$ against $\log_{10} x$.

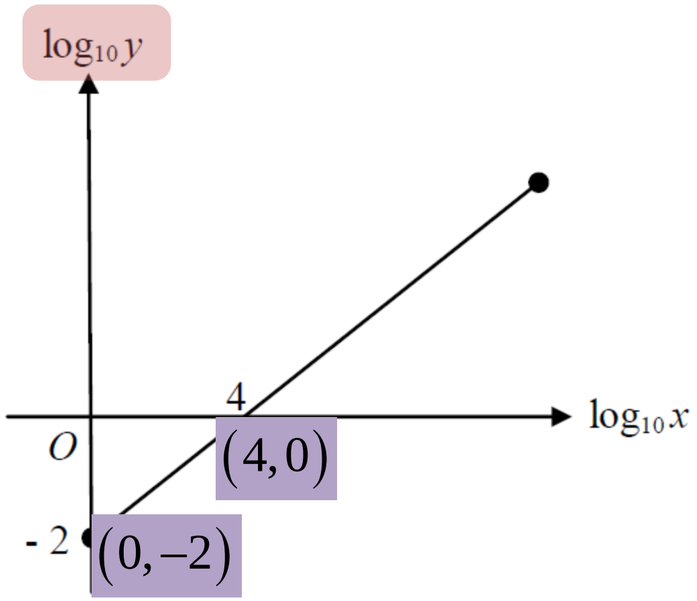


Diagram 7

Calculate the values of p and of r. Gradient

Solution

$$y = px^r$$ Take log both sides

$$\log_{10} y = \log_{10} px^r$$

$$\log_{10} y = \log_{10} p + \log_{10} x^r$$

$$\log_{10} y = \log_{10} p + r \log_{10} x$$

$$\log_{10} y = r \log_{10} x + \log_{10} p$$ Compare with Y=mX+c

$$Y = mx + c$$

$$\log_{10} p = -2$$ Write in index form

$$p = 10^{-2}$$

$$p = 0.01$$

$$r = \frac{0-(-2)}{4-0}$$

$$r = \frac{1}{2}$$

LONG QUESTION PAPER 2

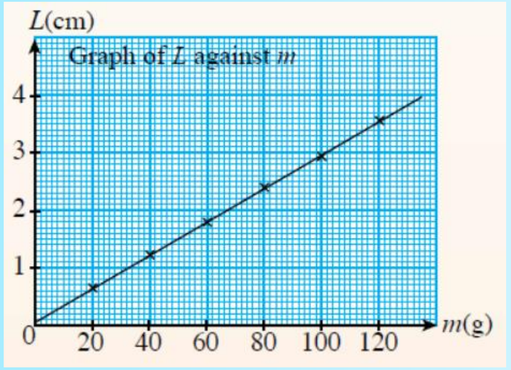
What you need…

RULER

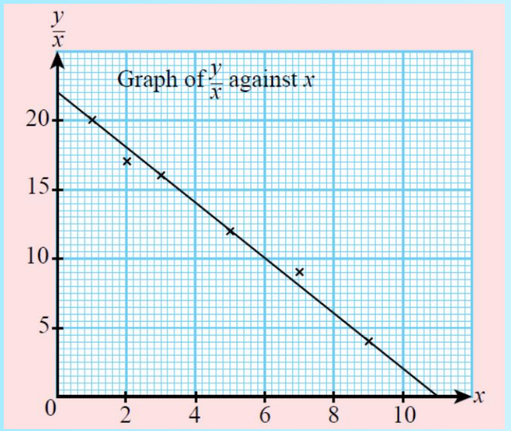
CALCULATOR

GRAPH

Routine

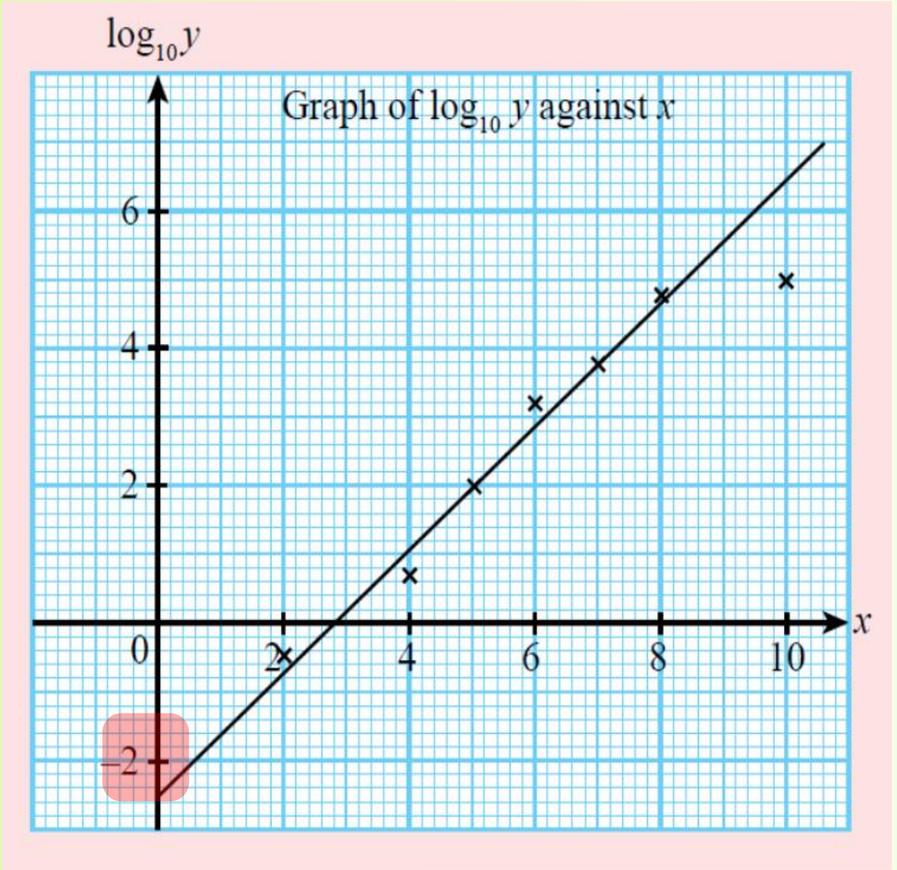


positive



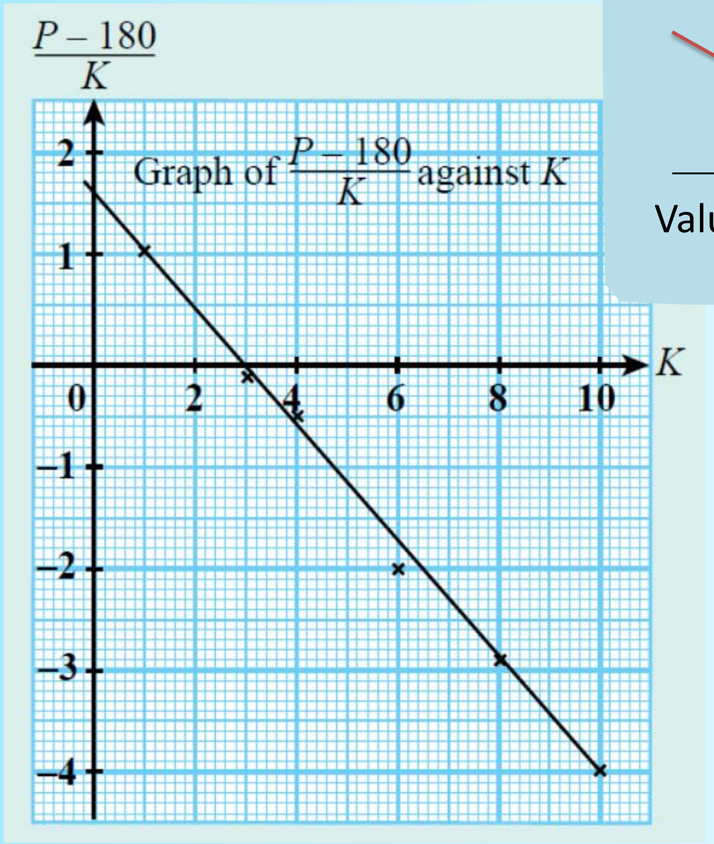
negative

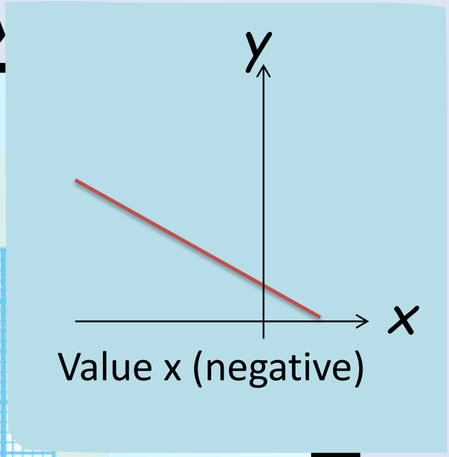
Non Routine



c (negative)

Non Routine

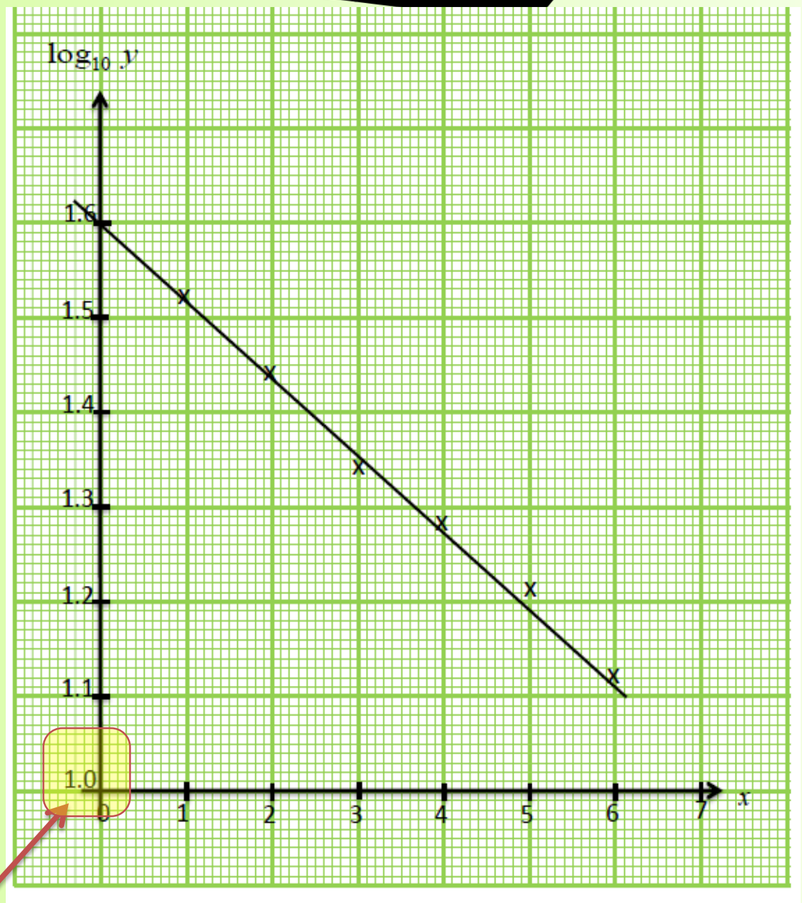




Value x (negative)

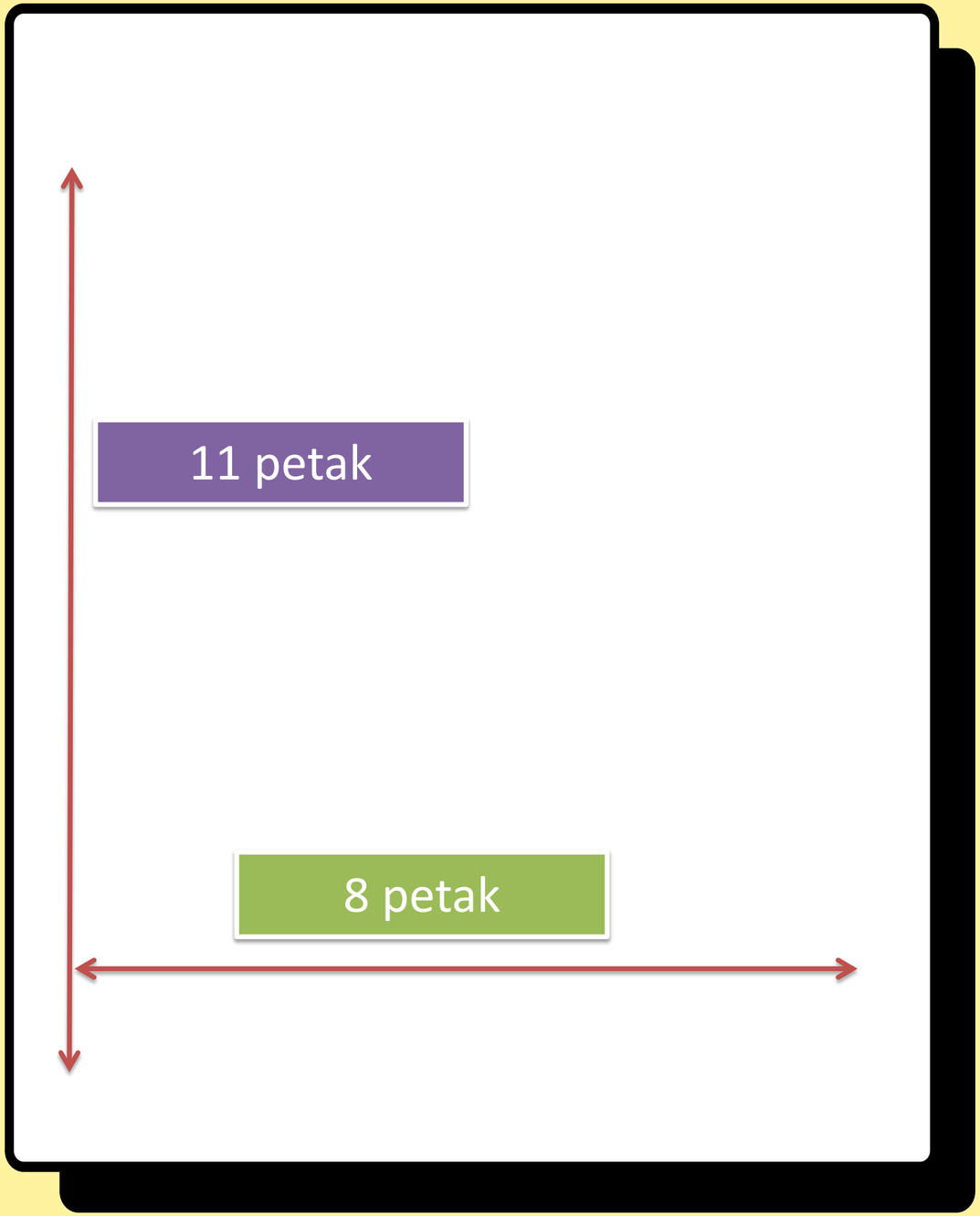
Value x/y-axis (negative)

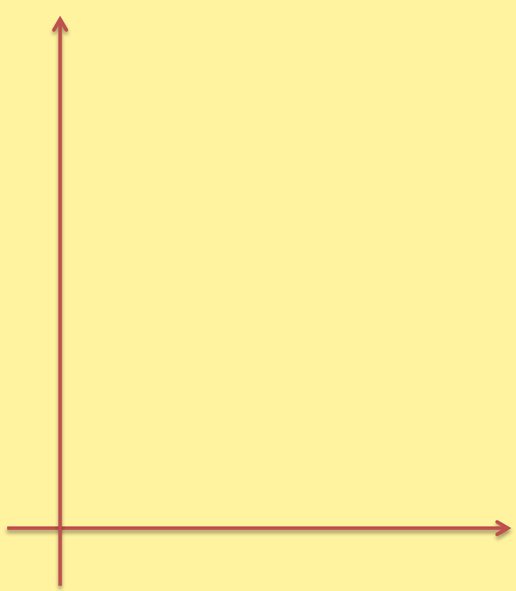
Non Routine

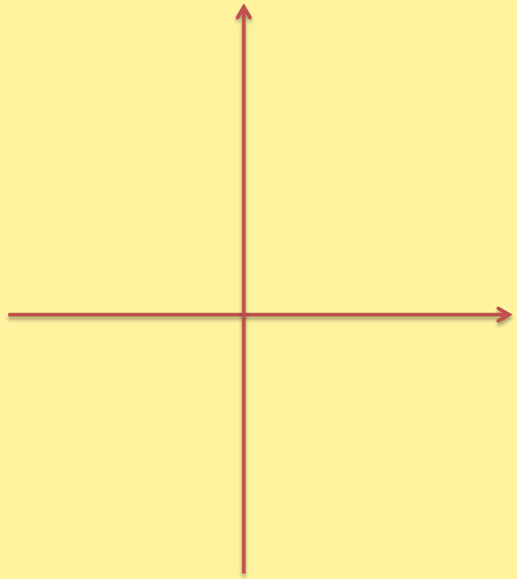


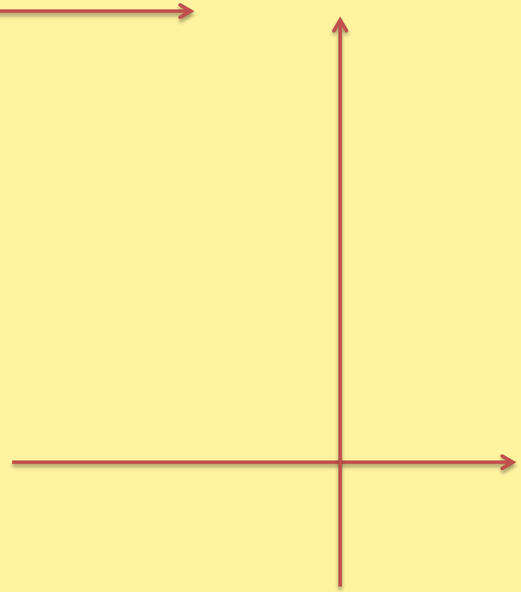
Y-axis not start from 0

Graph paper









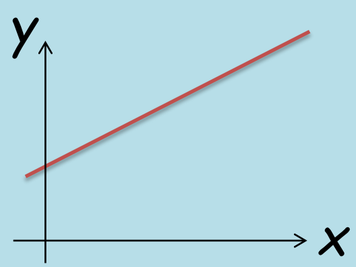
Observe Table Value ✓ Type of graph ✓ Estimate graph

maximum value
given scale

X	1	4	9	16	25	36
Y	3.10	4.60	6.99	9.40	13.60	18.00

2 cm to 5 units on X-axis and 2 cm to 2 units on the Y-axis

1 Type of graph

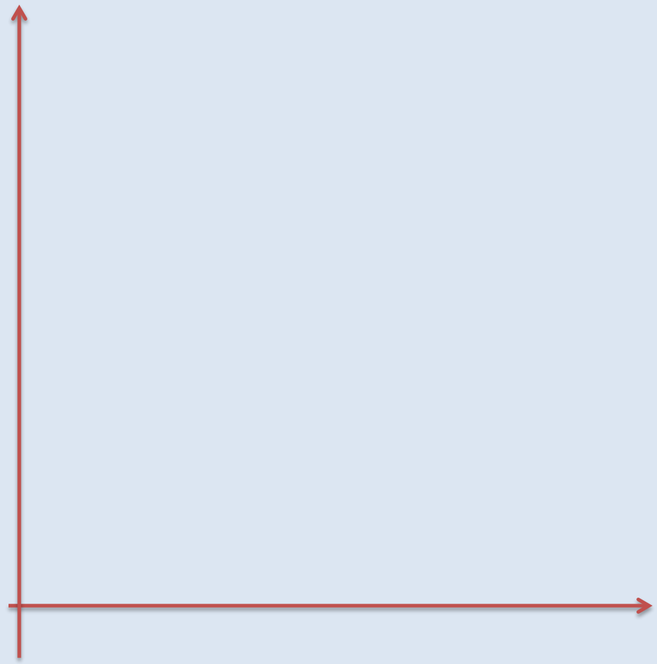


2 X-axis

$$= \frac{36}{5}$$
$$= 7.2$$
$$= 8 \text{ petak}$$

3 Y-axis

$$= \frac{18}{2}$$
$$= 9$$
$$= 9 \text{ petak}$$



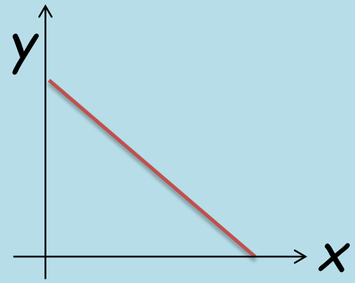
Observe Table Value ✓ Type of graph ✓ Estimate graph

maximum value
given scale

x	0.67	0.50	0.33	0.25	0.20	0.17
y	0.50	1.30	2.15	2.60	2.85	2.95

2 cm to 0.1 unit on X-axis and 2 cm to 0.5 units on the Y-axis

1 Type of graph



negative

2 X-axis

$$= \frac{0.67}{0.1}$$

$$= 6.7$$

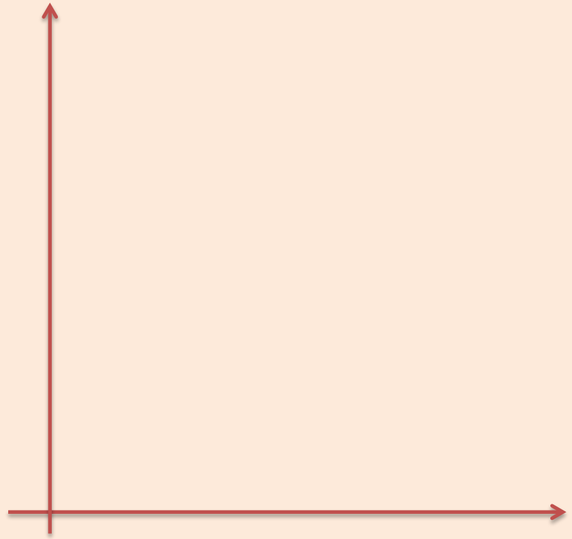
$= 7$ petak

3 Y-axis

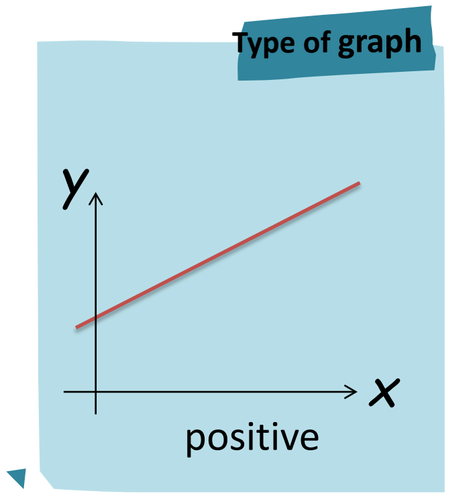
$$= \frac{2.95}{0.5}$$

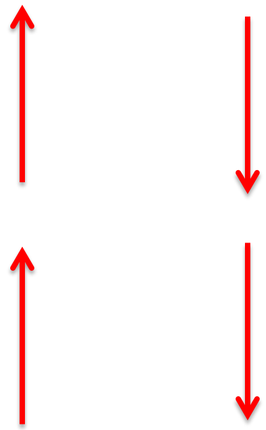
$$= 5.9$$

$= 6$ petak

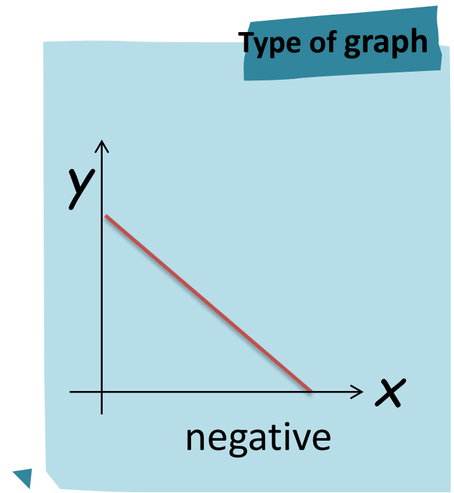


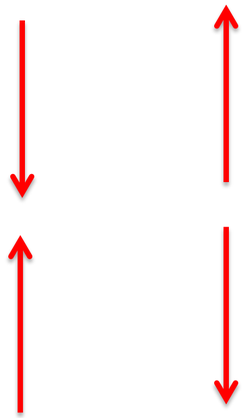
Observe Table Value





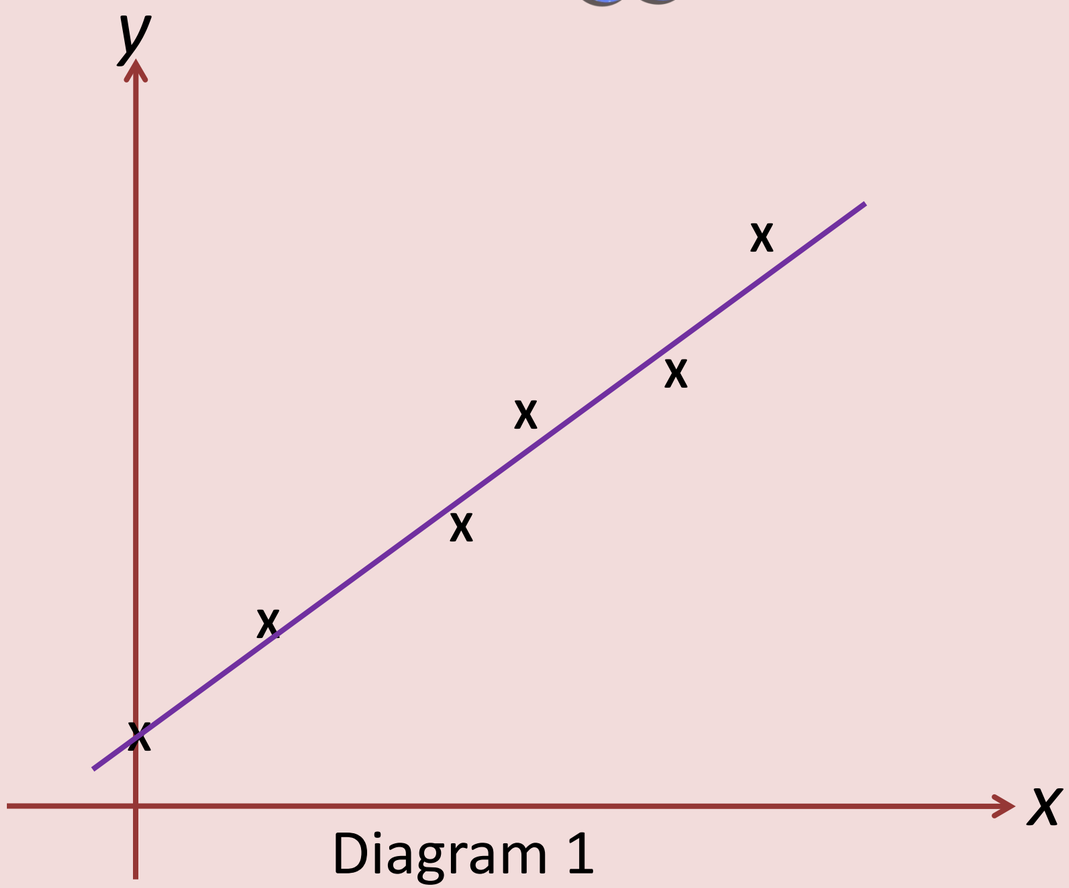
Same direction

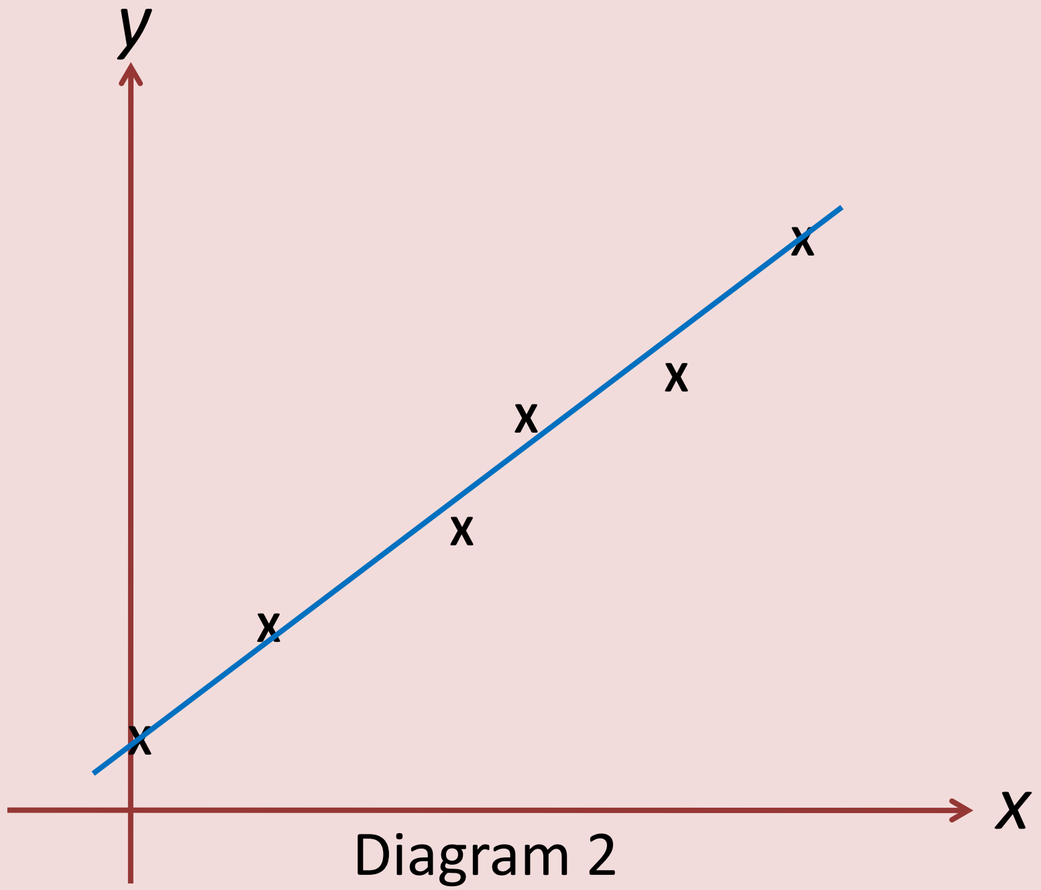




Opposite direction

Line of best fit

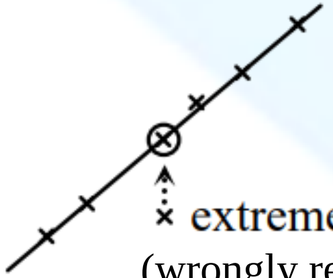
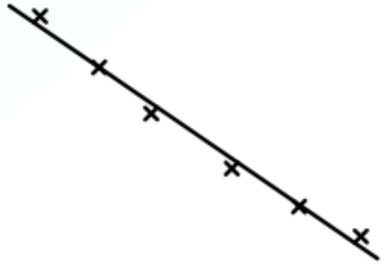




Line of best fit:

1. Points lie as close as possible to line
2. Line pass through as many points as possible
3. Points that do not fit onto the line should be more or less than same on both sides of the line.

SPM ANALYSIS

Line of Best Fit				
passes 3 points	***passes 2 points***	***passes 4 points***	***passes 4 points***	***passes 2 points***
				
SPM 2010	*SPM 2016*	*SPM 2017*	*SPM 2018*	*SPM 2019*

T

- Construct new **table**
- 2 d.p
- Rounding off

G

- Plot **graph** (mark ‘X’) using pencil
- Line of best fit
- Identify y-intercept and find gradient

C

- Reduce Equation - non linear to linear Y=mX+c, then **compare** with unknown. (Hint: refer y-axis)

Example 11

Use the graph paper provided to answer this question.

Table 1 shows the values of two variables, x and y, obtained from an experiment. Variable x and y are related by the equation $nx = py + xy$, where n and p are constants.

x	1.5	2.0	3.0	4.0	5.0	6.0
y	2.020	0.770	0.465	0.385	0.351	0.339

Table 1

(a) Base on table 1, construct a table for the values of $\frac{1}{x}$, against $\frac{1}{y}$. [2m]

(b) Plot $\frac{1}{y}$, against $\frac{1}{x}$, using a scale of 2 cm to 0.1 unit on the $\frac{1}{x}$-axis and 2 cm to 0.5 unit on the $\frac{1}{y}$-axis. Hence, draw the line of best fit. [3m]

(c) Using the graph in (b), find the value of

(i) n,

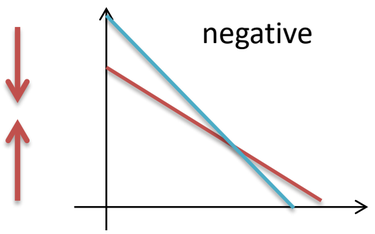
(ii) p. [5m]

(a) Base on table 1, construct a table for the values of $\frac{1}{x}$, against $\frac{1}{y}$. [2m]

x	1.5	2.0	3.0	4.0	5.0	6.0
y	2.020	0.770	0.465	0.385	0.351	0.339

$\frac{1}{x}$	0.67	0.50	0.33	0.25	0.20	0.17
$\frac{1}{y}$	0.50	1.30	2.15	2.60	2.85	2.95

✓ Type of graph



(b) Plot $\frac{1}{y}$, against $\frac{1}{x}$, using a scale of 2 cm to 0.1 unit on the $\frac{1}{x}$-axis and 2 cm to 0.5 unit on the $\frac{1}{y}$-axis. Hence, draw the line of best fit. [3m]

✓ Estimate graph

maximum value given scale

X-axis:

$$= \frac{0.67}{0.1}$$

$$= 6.7$$

$$= 7 \text{ petak}$$

Y-axis:

$$= \frac{2.95}{0.5}$$

$$= 5.9$$

$$= 6 \text{ petak}$$

(c) Using the graph in (b), find the value of

(i) n,

(ii) p.

$nx = py + xy$

Divide both sides by y

$$\frac{nx}{y} = \frac{py}{y} + \frac{xy}{y}$$

$$\frac{nx}{y} = p + x$$

Divide both sides by nx

$$\frac{1}{y} = \frac{p}{nx} + \frac{x}{nx}$$

✓P1 $\frac{1}{y} = \frac{p}{n}\left(\frac{1}{x}\right) + \frac{1}{n}$

Compare with Y=mX+c

$Y = mX + c$

$m = \frac{p}{n}, c = \frac{1}{n}$

(i) $\frac{1}{n} = 3.80$ ✓K1

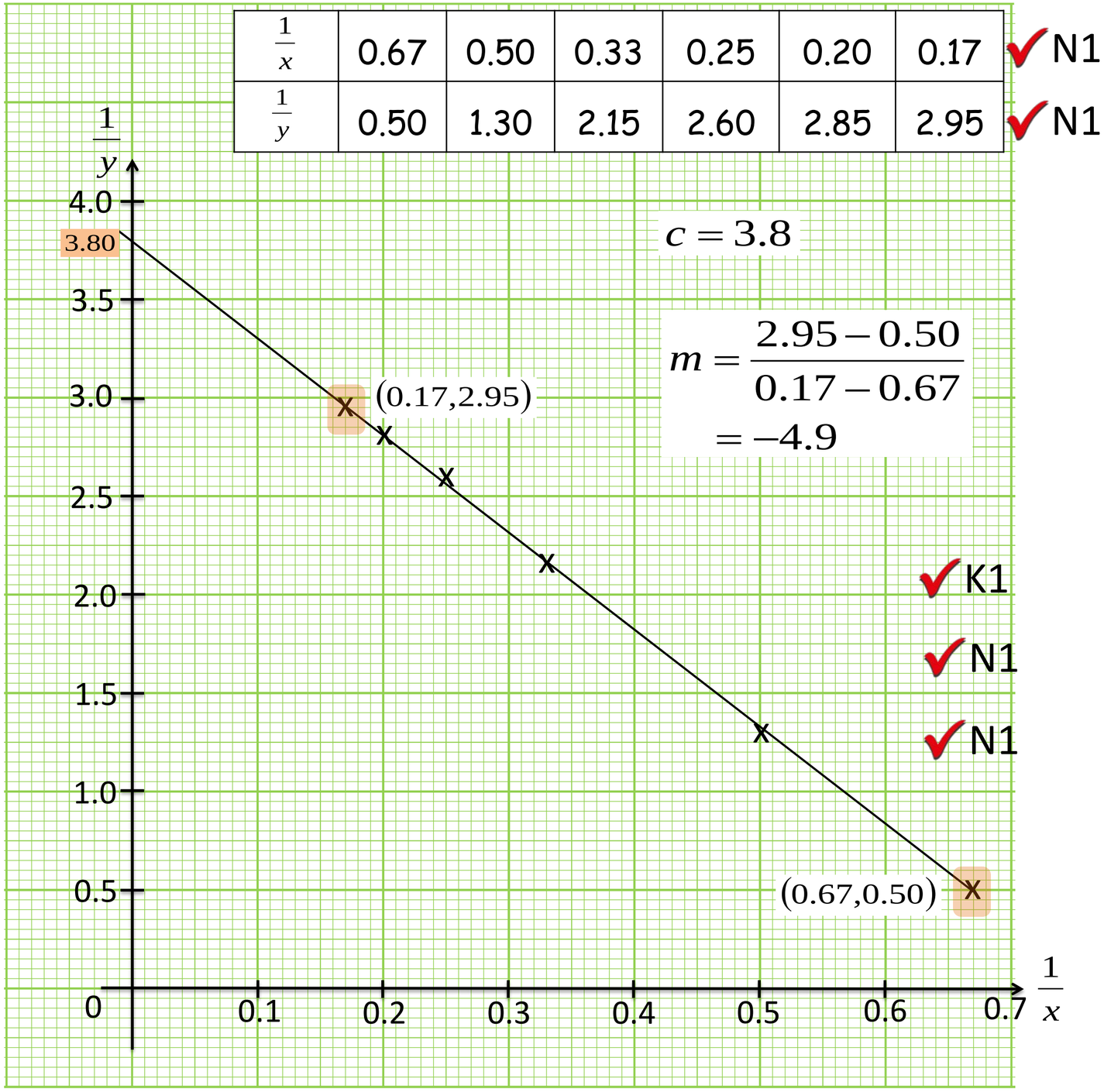
$n = 0.263$ ✓N1

(ii) $\frac{p}{n} = -4.9$ ✓K1

$\frac{p}{0.263} = -4.9$

$p = -1.289$ ✓N1

$\frac{1}{x}$	0.67	0.50	0.33	0.25	0.20	0.17	✓N1
$\frac{1}{y}$	0.50	1.30	2.15	2.60	2.85	2.95	✓N1



Example 12

Use the graph paper provided to answer this question.

Table 1 shows the data of two variables, *x* and *y*, obtained from an experiment.
A straight line will be obtained when a graph of $\frac{y^2}{x}$, against $\frac{1}{x}$, is plotted.

x	1.25	1.43	2.00	2.50	4.00	5.00
y	4.47	4.38	4.18	3.87	2.83	2.24

(a) Base on table 1, construct a table for the values of $\frac{1}{x}$ and $\frac{y^2}{x}$. [2m]

(b) Plot $\frac{y^2}{x}$, against $\frac{1}{x}$, using a scale of 2 cm to 0.1 unit on the $\frac{1}{x}$-axis and 2 cm to 2 units on the $\frac{y^2}{x}$-axis. Hence, draw the line of best fit. [3m]

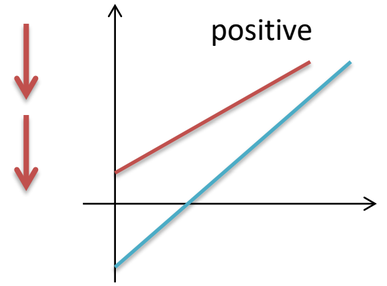
(c) Using the graph in (b),
Find the value of *y* when *x* = 2.7,
Express *y* in terms of *x*. [5m]

(a) Base on table 1, construct a table for the values of $\frac{1}{x}$ and $\frac{y^2}{x}$. [2m]

x	1.25	1.43	2.00	2.50	4.00	5.00
y	4.47	4.38	4.18	3.87	2.83	2.24

$\frac{1}{x}$	0.80	0.70	0.50	0.40	0.25	0.20
$\frac{y^2}{x}$	15.98	13.42	8.74	5.99	2.00	1.00

✓ Type of graph



(b) Plot $\frac{y^2}{x}$, against $\frac{1}{x}$, using a scale of 2 cm to 0.1 unit on the $\frac{1}{x}$-axis and 2 cm to 2 units on the $\frac{y^2}{x}$-axis. Hence, draw the line of best fit. [3m]

✓ Estimate graph

maximum value
given scale

X-axis:

$$= \frac{0.8}{0.1}$$

$$= 8$$

$= 8$ petak

Y-axis:

$$= \frac{15.98}{2}$$

$$= 7.99$$

$= 8$ petak

(c) Using the graph in (b),

(i) Find the value of y when $x = 2.7$,

(ii) Express y in terms of x.

(i) when $x = 2.7, \frac{1}{x} = 0.37$

From graph, $\frac{y^2}{x} = 5.2$

$$\frac{y^2}{x} = 5.2$$

$$\frac{y^2}{2.7} = 5.2$$

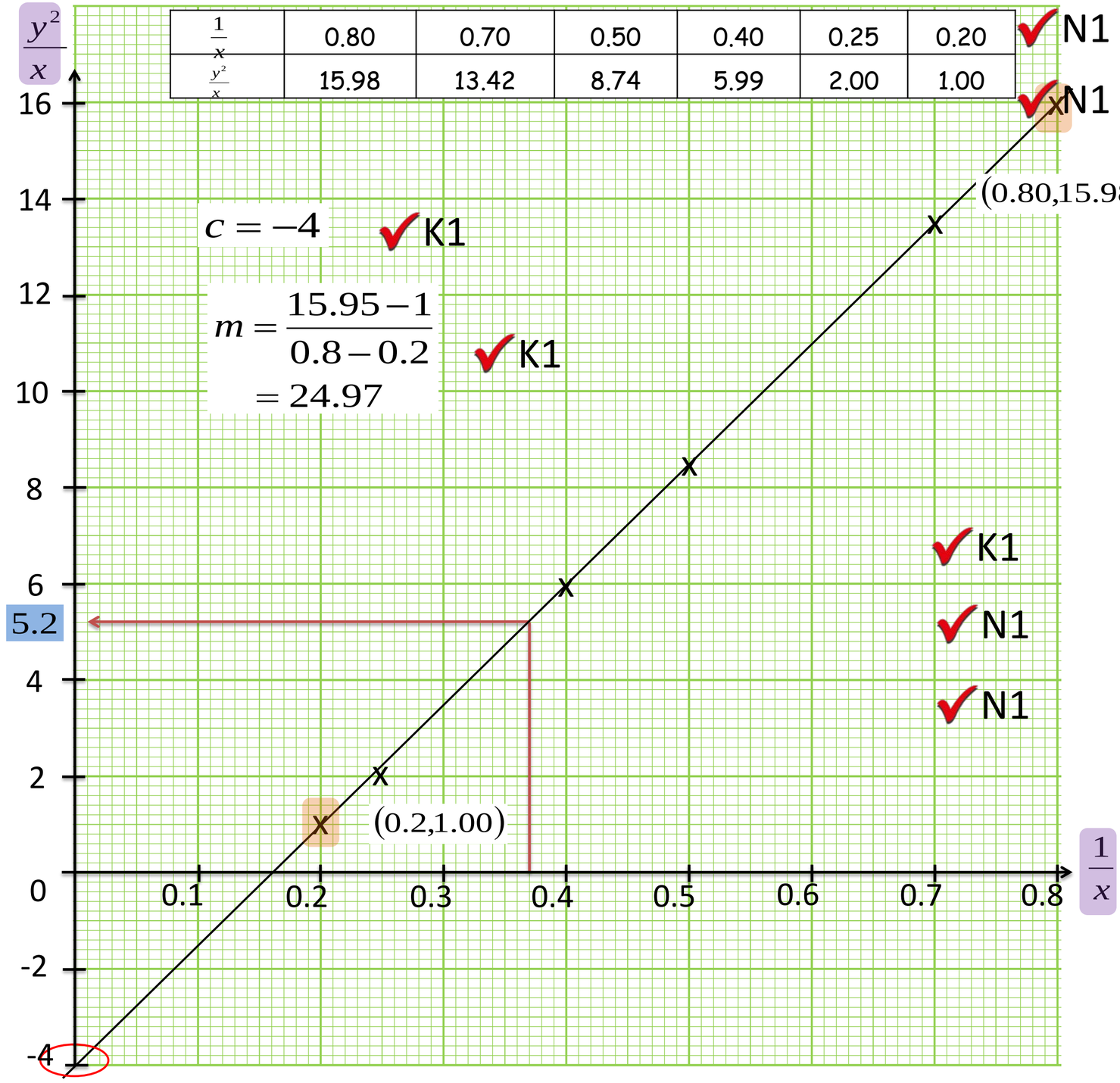
$$y = 3.75$$ ✓N1

(ii) $Y = mX + c$

$$\frac{y^2}{x} = m\left(\frac{1}{x}\right) + c$$

$$\frac{y^2}{x} = 24.97\left(\frac{1}{x}\right) + (-4)$$ ✓K1

$$y = \sqrt{24.97 - 4x}$$ ✓N1



Example 13

Use the graph paper provided to answer this question.

Table 8 shows the values of two variables, x and y, obtained from an experiment. Variables x and y are related by the equation $y = \frac{q}{p^{2x}}$, where p and q are constants.

x	1	2	3	4	5	6
y	33.11	27.54	21.88	19.05	16.22	13.18

(a) Base on table 8, construct a table for the values of $\log_{10} y$. [1 *mark*]

(b) Plot $\log_{10} y$ against x, using a scale of 2 cm to 1 unit on the x-axis and 2 cm to 0.1 unit on the $\log_{10} y$-axis. Hence, draw the line of best fit. [3 *marks*]

(c) Using the graph in (*a*), find the value of

(i) p,

(ii) q,

(iii) x when $y = 20$. [6 *marks*]

(a) Base on table 8, construct a table for the values of $\log_{10} y$.

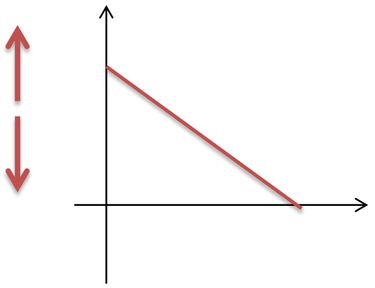
[1 *mark*]

x	1	2	3	4	5	6
y	33.11	27.54	21.88	19.05	16.22	13.18

x	1	2	3	4	5	6
$\log_{10} y$	1.52	1.44	1.34	1.28	1.21	1.12

✓ Type of graph

negative



(b) Plot $\log_{10} y$ against x, using a scale of 2 cm to 1 unit on the x-axis and 2 cm to 0.1 unit on the $\log_{10} y$-axis.

Hence, draw the line of best fit. [3 *marks*]

✓ Estimate graph

maximum value given scale

X-axis:

$$= \frac{6}{1}$$

$$= 6$$

$$= 6 \text{ petak}$$

Y-axis:

$$= \frac{1.52}{0.1}$$

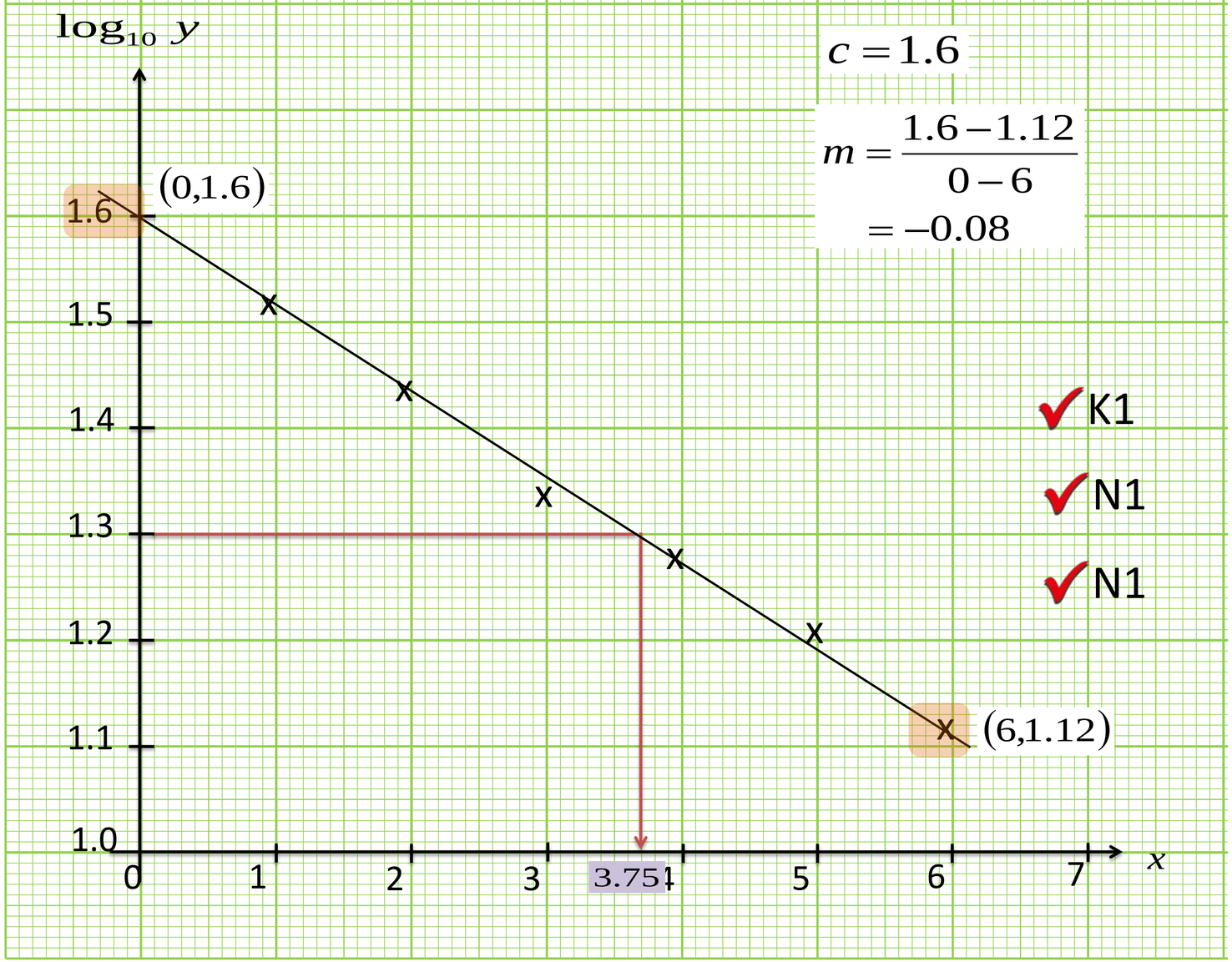
$$= 15.2$$

$$= 16 \text{ petak}$$

Y-axis not start from 0

x	1	2	3	4	5	6
$\log_{10} y$	1.52	1.44	1.34	1.28	1.21	1.12

✓N1



$c = 1.6$

$$m = \frac{1.6 - 1.12}{0 - 6}$$
$$= -0.08$$

✓K1

✓N1

✓N1

(c) Using the graph in (*a*), find the value of

(i) p,

(ii) q,

(iii) x when $y = 20$.

$$y = \frac{q}{p^{2x}}$$

Take log both sides

$$\log_{10} y = \log_{10}\left(\frac{q}{p^{2x}}\right)$$

$$\log_{10} y = \log_{10} q - \log_{10} p^{2x}$$

$$\log_{10} y = \log_{10} q - 2x\log_{10} p$$

$$\log_{10} y = (-2\log_{10} p)x + \log_{10} q$$

Compare with Y=mX+c

✓P1

(i) $-2\log_{10} p = m$

$-2\log_{10} p = -0.08$ ✓K1

$$\log_{10} p = \frac{-0.08}{-2}$$

$p = 10^{0.04}$

$p = 1.10$ ✓N1

(ii) $\log_{10} q = 1.6$ ✓K1

$= 10^{1.6}$

$= 39.81$

✓N1

(iii) when $y = 20, \log_{10} y = 1.30$

From graph, $x = 3.75$ ✓N1

Example 14

Use the graph paper provided to answer this question.

Table 1 shows the values of two variables, x and y, obtained from an experiment. Variables x and y are related by the equation $y - \sqrt{h} = \frac{hk}{x}$, where h and k are constants.

x	1.5	2.0	3.5	4.5	5.0	6.0
y	4.5	**5.25**	5.5	6.3	6.4	6.5

Table 1

(a) Plot xy against x, using a scale of 2 cm to 1 unit on x-axis and 2 cm to 5 units on xy-axis.
Hence, draw the line of best fit. [4 marks]

(b) Using the graph in (a), find the value of

(i) the value of h and of k,

(ii) the correct value of y if one of the value of y has been wrongly recorded during the experiment. [6 marks]

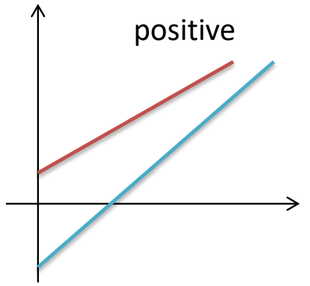
(a) Plot *xy* against *x*, using a scale of 2 cm to 1 unit on *x*-axis and 2 cm to 5 units on *xy*-axis.Hence, draw the line of best fit.

x	1.5	2.0	3.5	4.5	5.0	6.0
y	4.5	5.25	5.5	6.3	6.4	6.5

x	1.5	2.0	3.5	4.5	5.0	6.0
xy	6.75	10.50	19.25	28.35	32.00	39.00

Ralat pada soalan asal, (2.25) nilai sebenar adalah 5.25

✓ Type of graph



✓ Estimate graph

maximum value
given scale

X-axis:

$$= \frac{6.0}{1}$$

$$= 6$$

$= 6$ petak

Y-axis:

$$= \frac{39.00}{5}$$

$$= 7.8$$

$= 8$ petak

(b) Using the graph in (*a*), find the value of

(i) the value of h and of k,

(ii) the correct value of y if one of the value of y has been wrongly recorded during the experiment.

(i) $y-\sqrt{h}=\frac{hk}{x}$ Add $\sqrt{h}$ both sides

$y=\frac{hk}{x}+\sqrt{h}$

$xy=hk+\sqrt{h}(x)$ Multiply with x both sides

✔P1 $xy=\sqrt{h}(x)+hk$ Compare with Y=mX+c

$Y=mX+c$ $m=\sqrt{h}, c=hk$

$\sqrt{h}=7.17$ ✔K1 $hk=-4$ ✔K1

$h=51.41$ ✔N1 $(51.41)k=-4$

$k=-0.08$ ✔N1

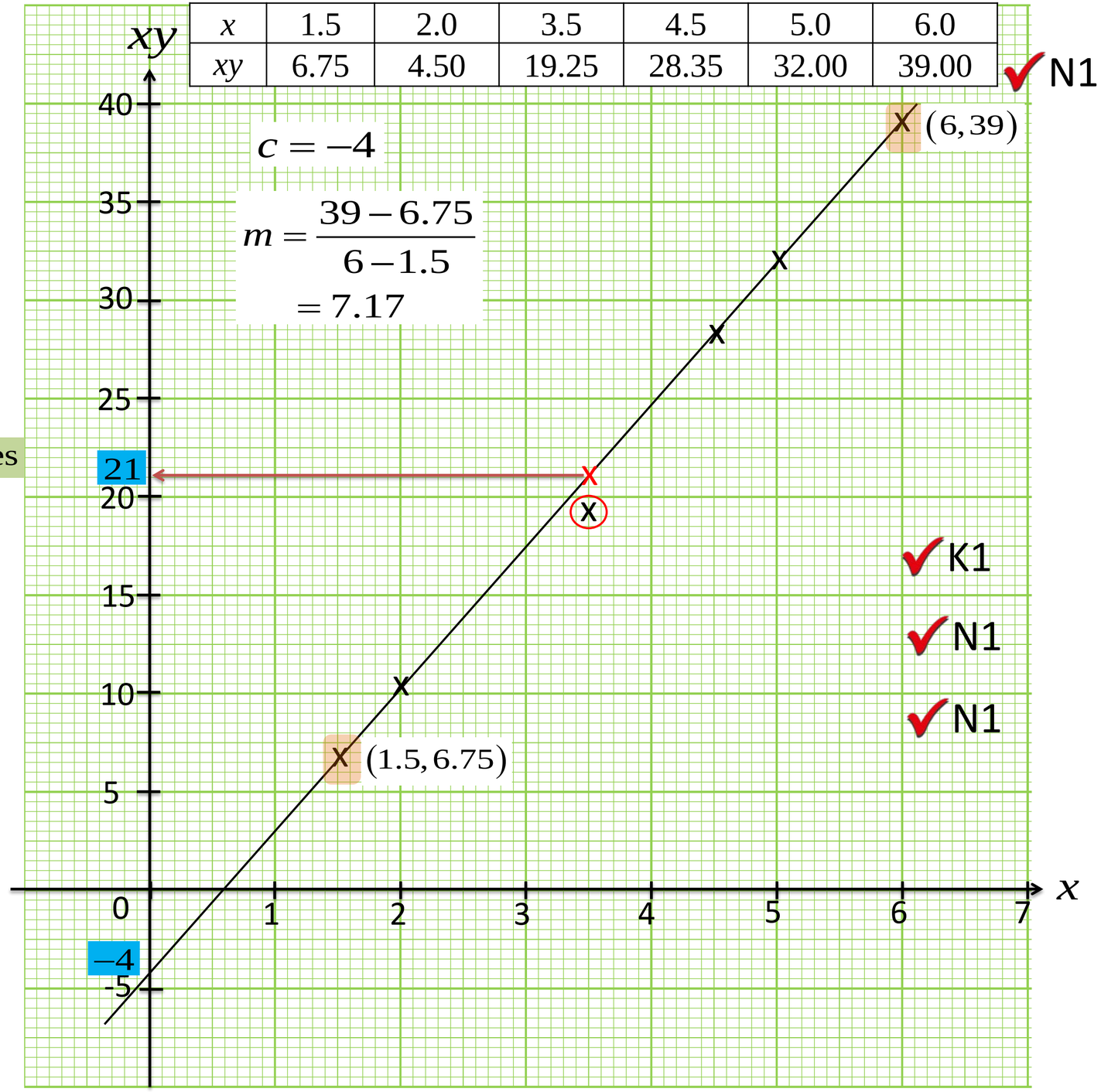
(ii) From graph, $xy=21$

$(3.5)y=21$

$y=6$ ✔N1

x	1.5	2.0	3.5	4.5	5.0	6.0
xy	6.75	4.50	19.25	28.35	32.00	39.00

✔N1



✔K1

✔N1

✔N1

Check your answer

x	0.67	0.33	0.17
y	0.50	2.15	2.95

CASIO fx-570MS

1. SHIFT > MODE > 3 > =
2. MODE 2X
3. PRESS 2 – REG
4. PRESS 1 – LIN

   Key in data

   0.67, 0.50 press M+ n=1

   0.33, 2.15 press M+ n=2

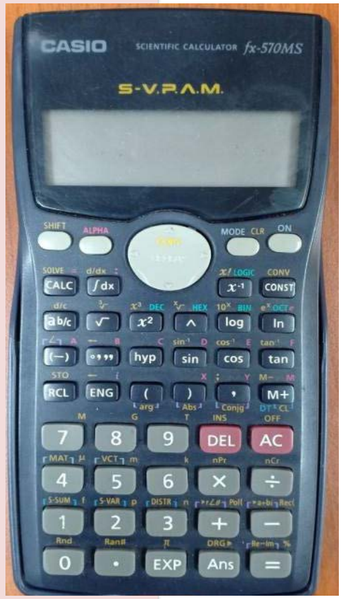
   0.17, 2.95 press M+ n=3
5. PRESS AC
6. SHIFT 2
7. RIGHT 2X

   A B r

   1 : A = 3.7748
8. SHIFT 2
9. RIGHT 2X

   A B r

   2 : B = - 4.8926



CASIO fx-570EX CLASSWIZ

1. MENU
2. PRESS 6
3. PRESS 2- y=a+bx

   Key in data

   x y

   0.67 | 0.50

   0.33 | 2.15

   0.17 | 2.95

4. Press AC –

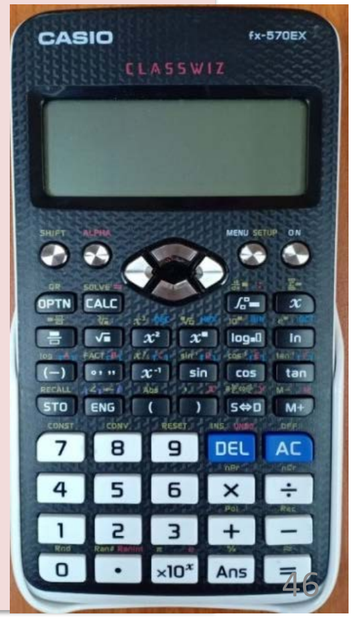
   Statistics

   y=a+bx
5. Press OPTN – press 3

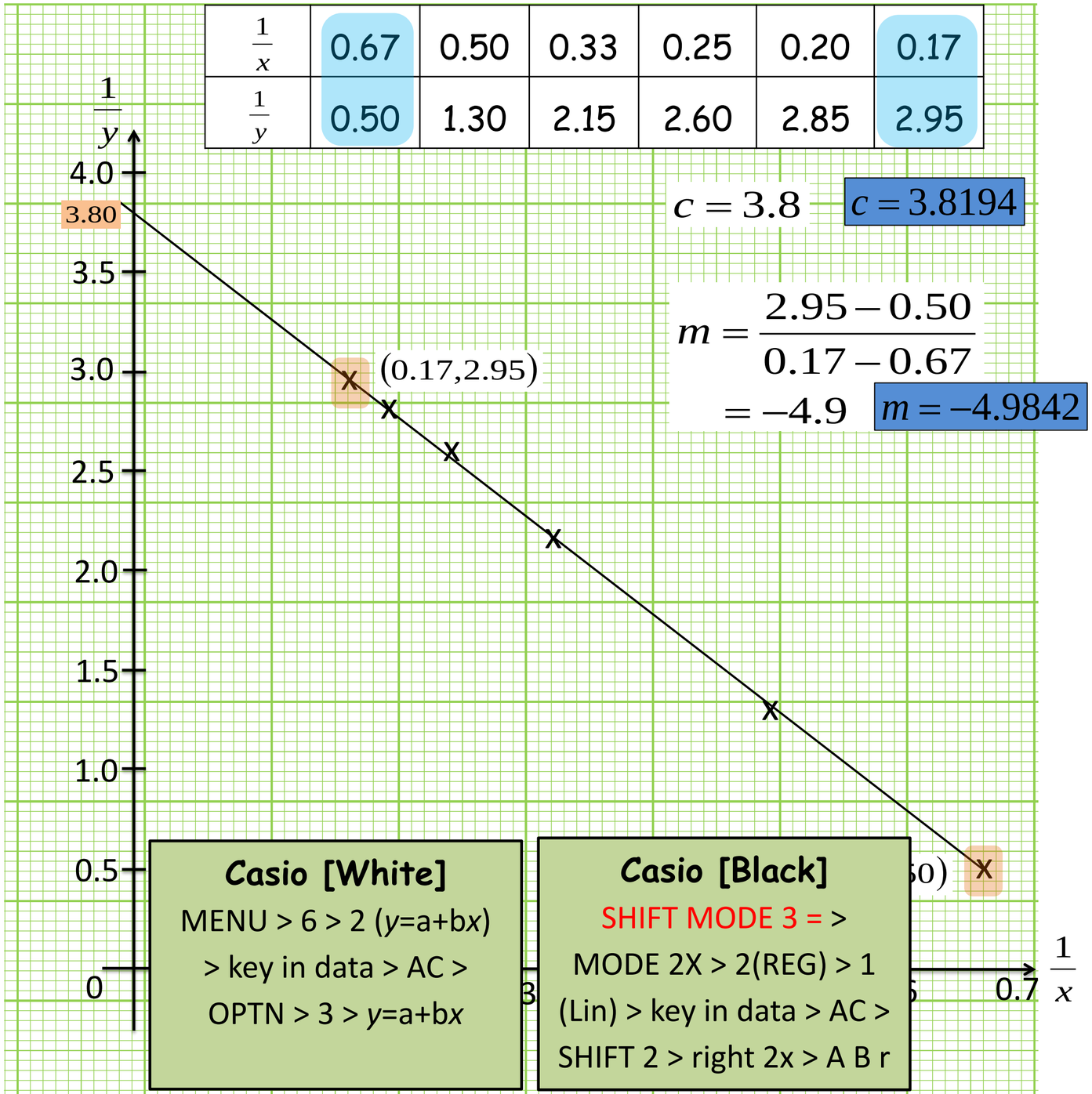
   y=a+bx

   a = 3.7748

   b = -4.8926



$\frac{1}{x}$	0.67	0.50	0.33	0.25	0.20	0.17
$\frac{1}{y}$	0.50	1.30	2.15	2.60	2.85	2.95



$c = 3.8$ $c = 3.8194$

$$m = \frac{2.95 - 0.50}{0.17 - 0.67}$$
$$= -4.9$$

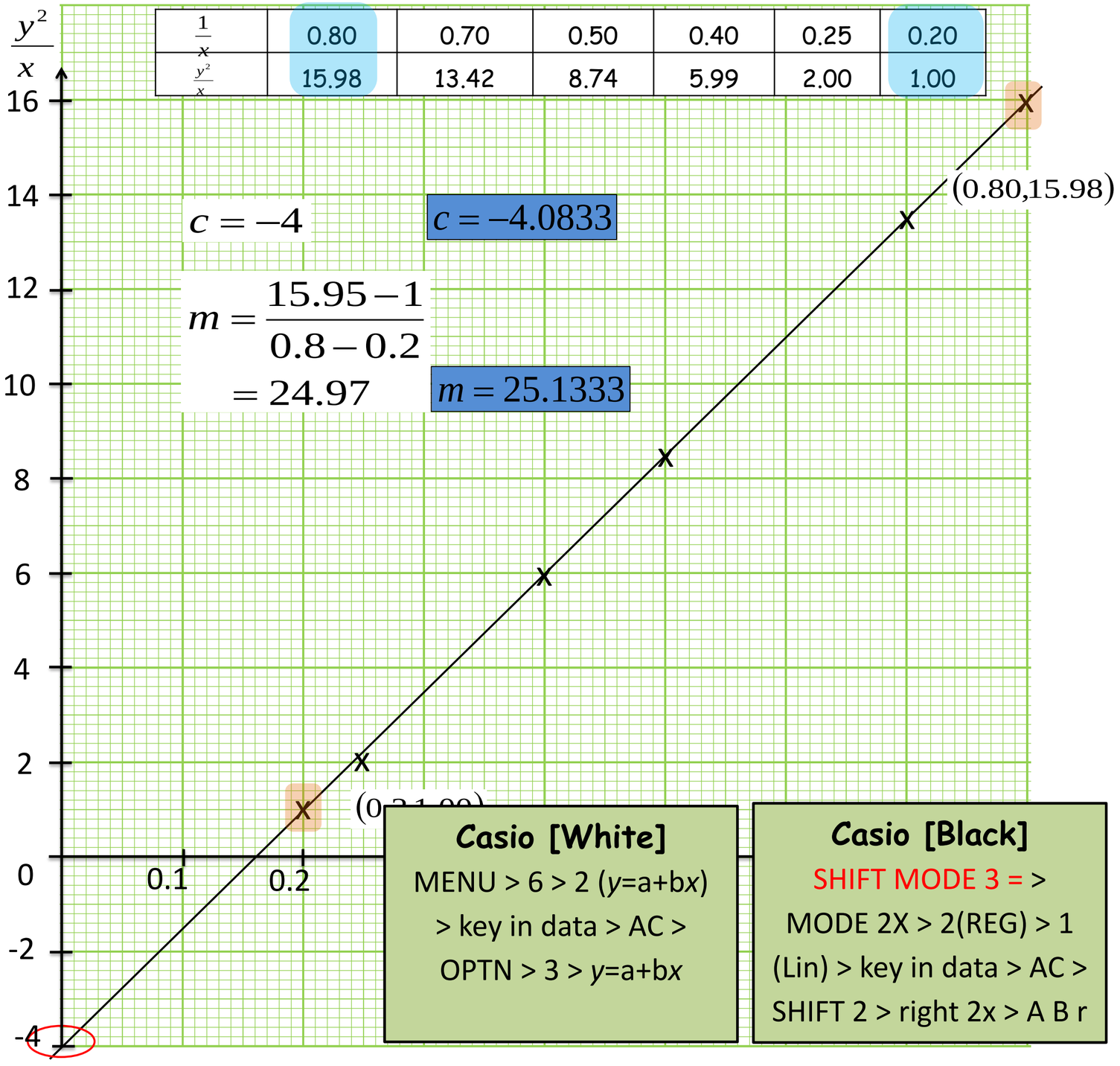
$m = -4.9842$

Casio [White]

MENU > 6 > 2 (y=a+bx)
> key in data > AC >
OPTN > 3 > y=a+bx

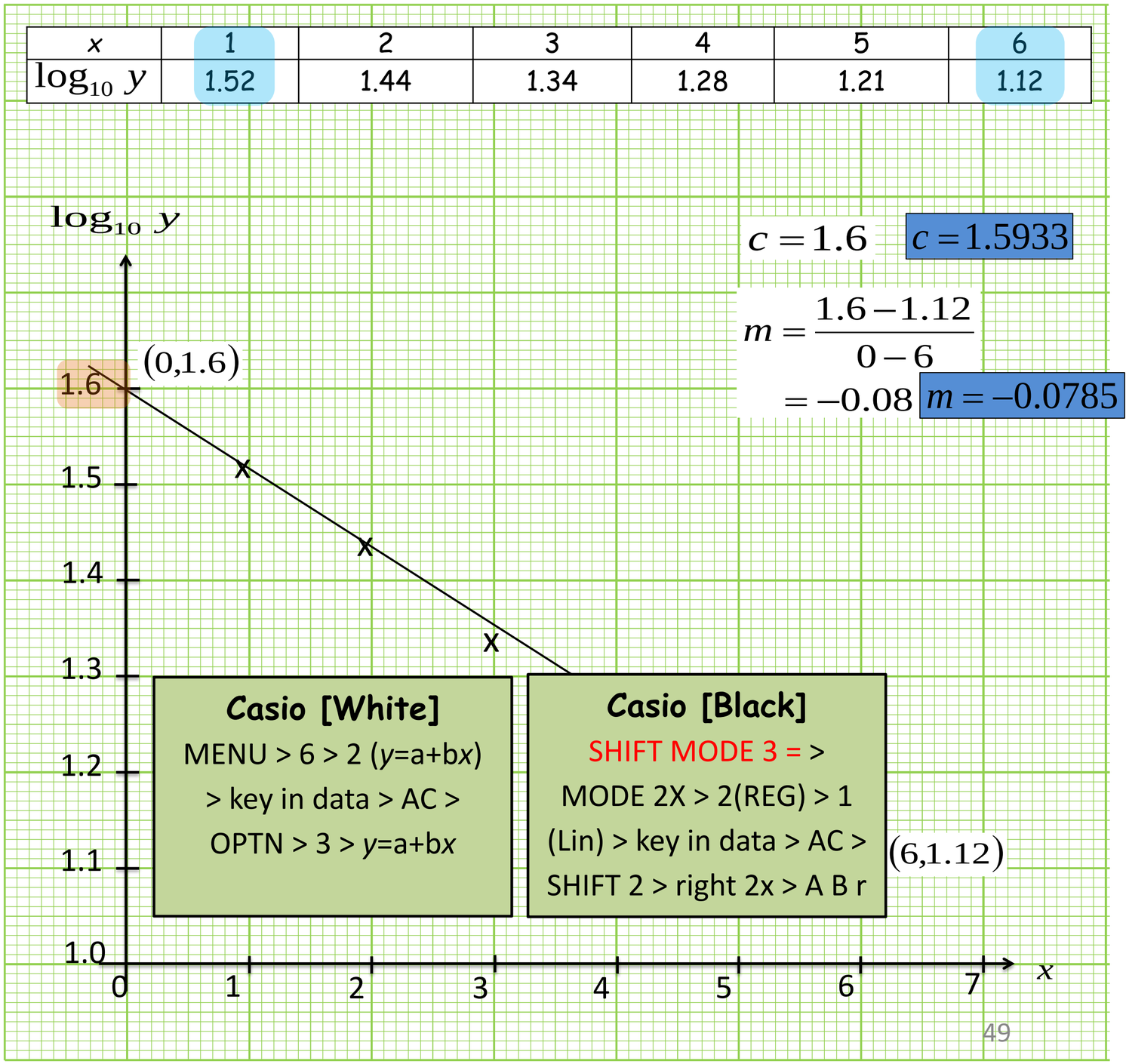
Casio [Black]

SHIFT MODE 3 = >
MODE 2X > 2(REG) > 1
(Lin) > key in data > AC >
SHIFT 2 > right 2x > A B r



$\frac{1}{x}$	0.80	0.70	0.50	0.40	0.25	0.20
$\frac{y^2}{x}$	15.98	13.42	8.74	5.99	2.00	1.00

x	1	2	3	4	5	6
$\log_{10} y$	1.52	1.44	1.34	1.28	1.21	1.12



$c = 1.6$ $c = 1.5933$

$$m = \frac{1.6 - 1.12}{0 - 6}$$
$$= -0.08$$ $m = -0.0785$

Casio [White]

MENU > 6 > 2 (y=a+bx) > key in data > AC > OPTN > 3 > y=a+bx

Casio [Black]

SHIFT MODE 3 = > MODE 2X > 2(REG) > 1 (Lin) > key in data > AC > SHIFT 2 > right 2x > A B r

TO DO NOTES

- Construct table – 2 decimal places
  - ✓ Type of graph
    - Positive / negative
  - ✓ Estimate graph
    - maximum value given scale
- Draw line best fit - must passes through Y-axis
- Gradient – 2 points lies on line of best fit
- Reduce Equation – Hint refer y-axis
- Find unknown – compare with $Y=mX+c$

Check your answer

SUMMARY OF CHAPTER 6