Solutions to CSEC Maths P2 June 2011

Question 1a part (i)

Calculate the exact value of

$$\frac{2\frac{1}{4}+1\frac{1}{8}}{4\ \frac{1}{2}}$$

$$=\frac{\frac{9}{4}+\frac{9}{8}}{\frac{9}{2}}$$

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

$$=\frac{\frac{18+9}{8}}{\frac{9}{2}}$$

$$=\frac{\frac{27}{8}}{\frac{9}{2}}$$

$$=\frac{27}{8}\ \div\ \frac{9}{2}$$

$$=\frac{27}{8}\ \times\ \frac{2}{9}$$

$$=\frac{54}{72}$$

$$=\frac{3}{4}\ in\ exact\ form$$

Question 1a part (ii)

Calculate the exact value of

$$3.96\times 0.25-\sqrt{0.0256}$$

$$=\ 0.99-0.16$$

$$=\ 0.83$$

Question 1b

Data Given

Pamela's shopping bill as shown below.

Items	Quantity	Unit Price $	Total Cost $
Rice	$6\frac{1}{2}$ kg	2.40	$\boxed{W}$
Potatoes	4 bags	$\boxed{X}$	52.80
Milk	$\boxed{Y}$ cartons	2.35	14.10
Sub Total			**82.50**
$\boxed{Z}$ % VAT			9.90
TOTAL			**92.40**

Calculate the values of W, X, Y and Z.

$$W = Quantity\ of\ rice \times Unit\ Price$$

$$W = 6.5 \times \$2.40$$

$$= \$15.60$$

$$X = \frac{Total\ cost\ of\ potatoes}{Quantity\ of\ potatoes}$$

$$X = \frac{\$52.80}{4\ bags}$$

$$= \$13.20$$

$$Y = \frac{Total\ cost\ of\ milk}{Unit\ Price\ of\ milk}$$

$$Y = \frac{\$14.10}{\$2.35}$$

$$= 6$$

$$Z = \frac{VAT}{Sub\ Total} \times 100$$

$$Z = \frac{\$9.90}{\$82.50} \times 100$$

$$= 12$$

Question 2a

Simplify $\frac{x-2}{3} + \frac{x+1}{4}$

$$\frac{x-2}{3} + \frac{x+1}{4}$$

$$= \frac{4(x-2) + 3(x+1)}{12}$$

$$= \frac{4x - 8 + 3x + 3}{12}$$

$$= \frac{7x-5}{12} \quad as\ a\ fraction\ in\ its\ lowest\ terms$$

Question 2b

Data Given

$$a * b = (a+b)^2 - 2ab$$

Calculate the value of $3 * 4$

$$3 * 4 = (3+4)^2 - 2(3)(4)$$

$$= 49 - 24$$

$$= 25$$

Question 2c

(i) **Factorise** $xy^3 + x^2y$

$$xy^3 + x^2y = xy \cdot y^2 + xy \cdot x$$

$$= xy\,(y^2 + x)$$

(ii) **Factorise** $2mh - 2nh - 3mk + 3nk$

$$2mh - 2nh - 3mk + 3nk = 2h(m-n) - 3k(m-n)$$

$$= (2h - 3k)(m - n)$$

Question 2d

Data Given

y varies directly to x

x	2	5	b
y	12	a	48

Calculate the values of a and b

$$y \propto x$$

$$y = kx$$

Using x = 2 and y = 12

$$12 = k(2)$$

$$k = 6$$

$$a = 6(5)$$

$$a = 30$$

$$48 = 6(b)$$

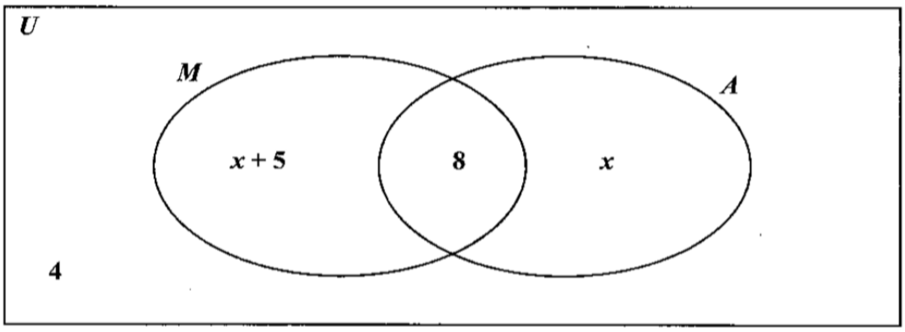
$$b = 8$$

$$\therefore a = 30 \; and \; b = 8.$$

Question 3a

Data Given

$$U = \{students\ in\ the\ class\} = 35\ students$$
$$M = \{students\ who\ study\ Music\}$$
$$A = \{students\ who\ study\ Art\}$$



(i) **Find** the number of students who do not study either Art or Music.

$$(MUA)' = 4$$

4 students study neither Art nor Music

(ii) **Calculate** the value of x

$$35 = 4 + (x + 5) + 8 + x$$
$$35 = 2x + 17$$
$$2x = 18$$
$$x = 9$$

(iii) **State** the $number\ of\ students\ who\ study\ music\ only$

$$Number\ of\ students\ who\ study\ music\ only = x + 5$$
$$= 9 + 5$$

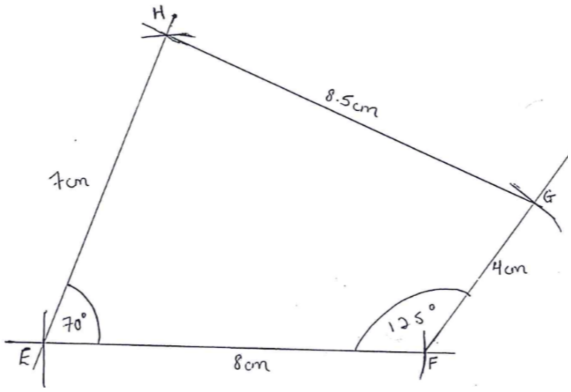
$$= 14\ students$$

Question 3b part (i)

Data Given

$$EF = 8cm \quad E\hat{F}G = 125° \quad FG = 4cm \quad H\hat{E}F = 70° \quad EH = 7\ cm$$

Draw quadrilateral $EFGH$



Question 3b part (ii)

Measure and state the $length\ of\ GH$

$$Length\ of\ GH = 8.5\ cm$$

Question 4a part (i)

Solve $5 - 2x < 9$

$$5 - 2x < 9$$

$$5 < 9 + 2x$$

$$5 - 9 < 2x$$

$$-4 < 2x$$

$$2x > -4$$

$$x > -2$$

Question 4a part (ii)

Determine the smallest value of x that satisfies $5 - 2x < 9$

$$For \quad 5 - 2x < 9$$

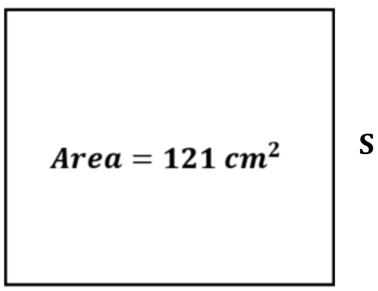
$$x > -2$$

$$\therefore\ x_{min} = -1$$

Question 4b part (i)

Data Given

$$\pi = 3.14$$



(a) **Calculate** the length of each side of the square

$$Area\ of\ Square = S \times S$$

$$121 = S^2$$

$$S = \sqrt{121}$$

$$S = 11\ cm$$

(b) **Calculate** the perimeter of the square

$$Perimeter\ of\ the\ Square = 4 \times S$$

$$= 4 \times 11$$

$$= 44\ cm$$

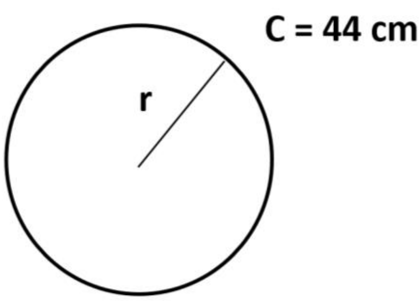
Question 4b part (ii)

Data Given

The piece of wire used to form the square is used to form a circle.

(a) **Calculate** the radius of the circle

$$Perimeter\ of\ the\ square = Circumference\ of\ the\ circle = 44cm$$



$$Circumference\ of\ the\ circle = 2\pi r$$

$$44 = 2\pi r$$

$$r = \frac{44}{2\pi}$$

$$r = \frac{44}{2\left(\frac{22}{7}\right)}$$

$$r = 7\ cm$$

(a) **Calculate** the area of the circle

$$Area\ of\ the\ circle\ = \pi r^2$$

$$= \pi \times\ 7^2$$

$$= \frac{22}{7} \times 49$$

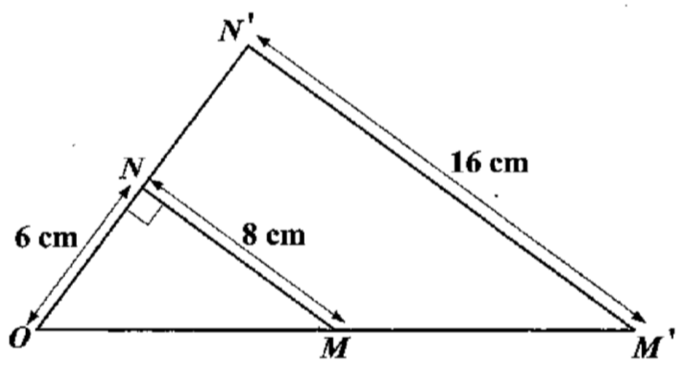
$$= 154\ cm^2$$

Question 5a

Data Given

Triangle OMN and its image OM'N' under an enlargement with centre, O, and scale factor, k.

$$O\widehat{M}N = 90°$$



(i) **Calculate** the value of k

$$Length\ of\ NM\ for\ triangle\ ONM = 8\ cm$$

$$Length\ of\ N'M'\ for\ triangle\ ON'M' = 16\ cm$$

$$k = \frac{Length\ of\ N'M'\ for\ triangle\ ON'M'}{Length\ of\ NM\ for\ triangle\ ONM}$$

$$k = \frac{16}{8}$$

$$k = 2$$

(ii) **Calculate** the length of OM

Using Pythagoras' Theorem

$$OM^2 = ON^2 + NM^2$$

$$OM^2 = 6^2 + 8^2$$

$$OM^2 = 100$$

$$OM = \sqrt{100}$$

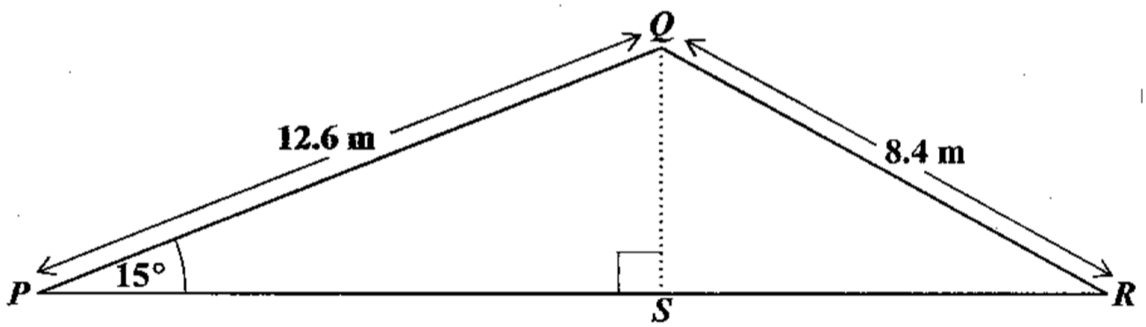
$$OM = 10\ cm$$

(iii) **Calculate** the length of OM'

$$Length\ of\ 0M' = k\ \times length\ of\ OM$$
$$= 2\ \times 10$$
$$= 20\ cm$$

Question 5b

Data Given



(i) **Calculate** the length of QS

Considering triangle PQS

$$sin\,sin\,15° = \frac{opp}{hyp}$$
$$sin\,sin\,15° = \frac{QS}{PQ}$$
$$QS = PQ\ \times sin\,sin\,15°$$
$$= 12.6\ \times sin\,sin\,15°$$
$$= 3.26\ m$$

(ii) **Calculate** $R\hat{Q}S$

Considering triangle RQS

$$\cos\cos\ R\hat{Q}S\ = \frac{adj}{hyp}$$

$$\cos\cos\ R\hat{Q}S\ = \frac{QS}{QR}$$

$$\cos\cos\ R\hat{Q}S\ = \frac{3.26}{8.4}$$

$$R\hat{Q}S = \left(\frac{3.26}{8.4}\right)$$

$$=\ 67.2°$$

(iii) **Calculate** the area of PQR

$$Area\ of\ PQR = \frac{1}{2}\ (QP)\ (QR)\ sin\,sin\ P\hat{Q}R$$

$$QP\ = 12.6\ m$$

$$QR\ = 8.4\ m$$

$$P\hat{Q}R = P\hat{Q}S + R\hat{Q}S$$

$$P\hat{Q}S = 180° - (15° + 90°)$$

$$P\hat{Q}S = 180° - 105°$$

$$= 75°$$

$$P\hat{Q}R = 75° + 67.2° = 142.2°$$

$$Area\ of\ PQR = \frac{1}{2}\ (QP)\ (QR)\ sin\,sin\ P\hat{Q}R$$

$$Area\ of\ PQR = \frac{1}{2}\ (12.6)\ (8.4)\ sin\, sin\ 142.2°$$

$$= \ 32.4\, m^2$$

Question 6a part (i)

Data Given

$$f(x) = \ 6x + 8\ and\ g(x) = \frac{x-2}{3}$$

Calculate $g\left(\frac{1}{2}\right)$

$$g(x) = \frac{x-2}{3}$$

$$g\left(\frac{1}{2}\right) = \frac{\frac{1}{2} - 2}{3}$$

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

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

Question 6a part (ii)

Write an expression in terms of x for $gf(x)$

Replacing x in $g(x\ )$ with $f(x)$

$$gf(x) = \frac{6x + 8 - 2}{3}$$

$$= \frac{6x + 6}{3}$$

$$= 2x + 2$$

Question 6a part (iii)

Find the inverse function $f^{-1}(x)$

$$Let\ y = f(x)$$

$$y = 6x + 8$$

$$Switch\ x\ and\ y$$

$$x = 6y + 8$$

$$6y = x - 8$$

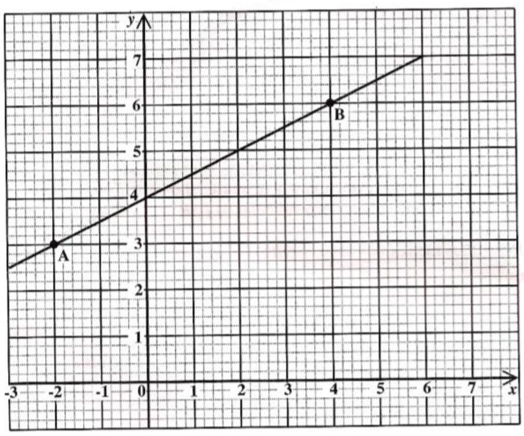
$$y = \frac{x-8}{6}$$

$\therefore f^{-1}(x) = \frac{x-8}{6}$

Question 6b

Data Given

Line segment passing through two points, A and B.



(i) **Determine** the coordinates of A and B

Reading off the graph;

$A = (-2, 3)$ and $B = (4, 6)$

(ii) **Determine** the gradient of the line segment AB

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

$$A = (x_1, \ y_1) = (-2, 3)$$

$B = (x_2, \ y_2) = (4, 6)$

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

$$= \frac{6 - 3}{4 - (-2)}$$

$$= \frac{3}{6}$$

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

(iii) **Determine** the equation of the line passing through A and B

Using Point B (4, 6)

$$y - y_1 = m\,(x - x_1)$$

$$y - 6 = \frac{1}{2}\,(x - 4)$$

$$y - 6 = \frac{1}{2}\,x - 2$$

$$y = \frac{1}{2}\,x - 2 + 6$$

$$y = \frac{1}{2}\,x + 4$$

$$2y = \ x + 8$$

Question 7a

Data Given: Table showing the distribution of the masses of 100 packages

Copy and complete the table to show the cumulative frequency of the distribution

Mass (kg)	No. of Packages	Cumulative Frequency
1-10	12	12
11-20	28	40
21-30	30	**70**
31-40	22	**92**
41-50	8	**100**

For

21-30 kg; $Cumulative\ Frequency = 40 + 30 = 70$

31-40 kg; $Cumulative\ Frequency = 70 + 22 = 92$

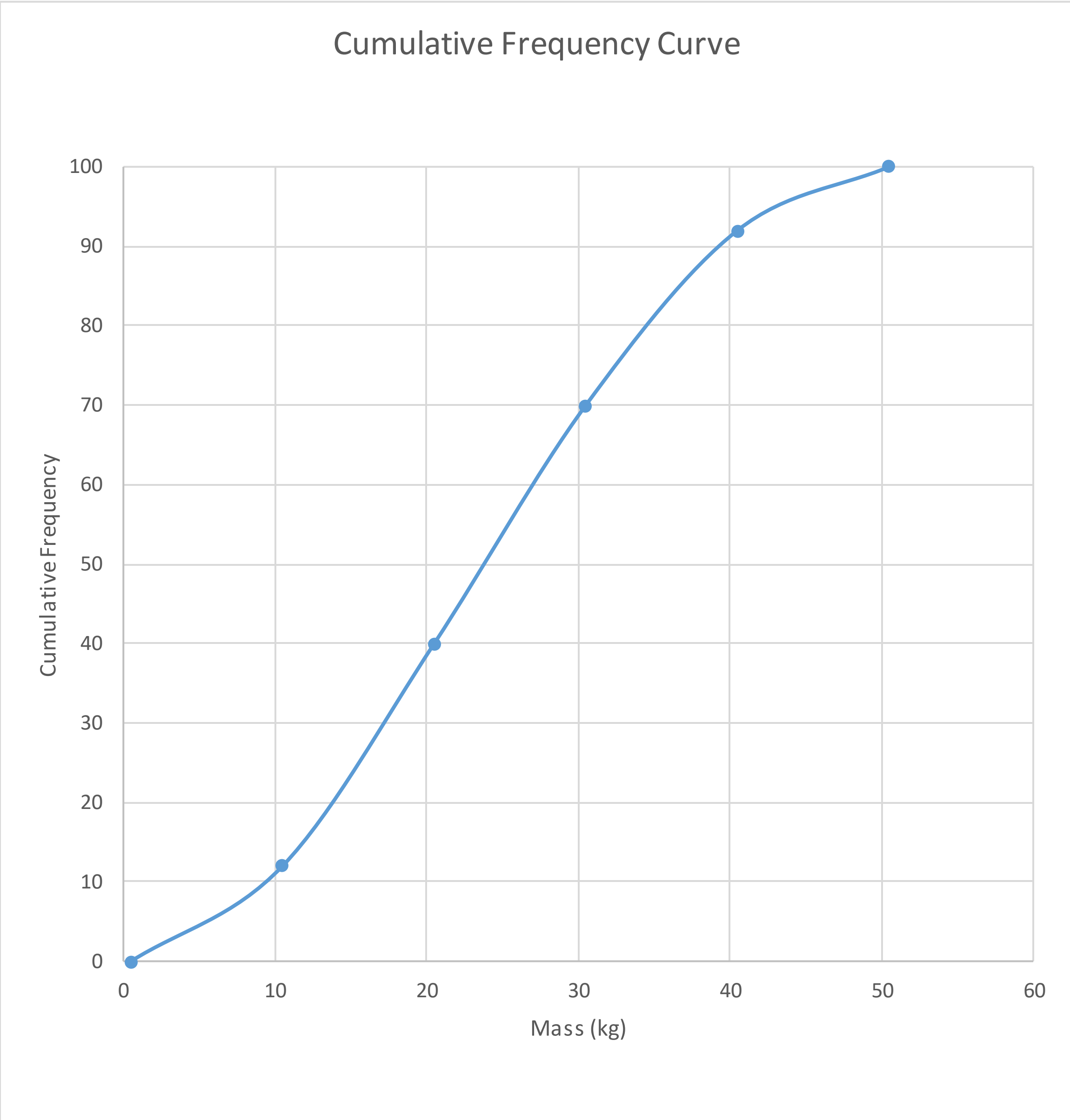
41-50 kg; $Cumulative\ Frequency = 92 + 8 = 100$

Question 7b

Draw the cumulative frequency curve

Mass (kg)	Lower Class Boundary	Upper Class Boundary	No. of Packages	Cumulative Frequency
-	-	-	0	0
1-10	**0.5**	**10.5**	12	12
11-20	**10.5**	**20.5**	28	40
21-30	**20.5**	**30.5**	30	70
31-40	**30.5**	**40.5**	22	92
41-50	**40.5**	**50.5**	8	100

Points to be plotted= (Upper Class Boundary, Cumulative Frequency)



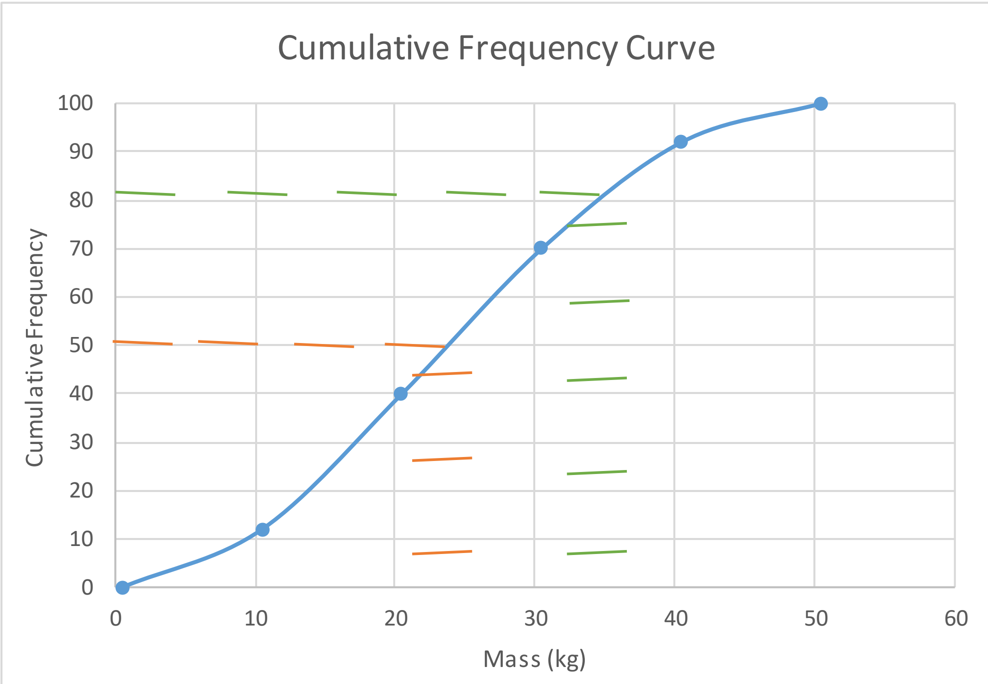
Where

$$y - axis; \quad 1\ cm = 10\ packages$$

$$x - axis; \quad 2\ cm = 10\ kg$$

Question 7c

(i) **Estimate** from the graph the median mass of the packages



$$Cumulative\ Frequency\ =\ 100$$

$$\frac{Cumulative\ Frequency}{2}\ =\ 50$$

Based on the graph above; when cumulative frequency = 50;

Median mass of the packages = 24 kg

(ii) **Estimate** from the graph the probability that a randomly chosen package has a mass less than 35 kg

$$P\ (mass\ < 35\ kg) = \frac{Number\ of\ packages\ with\ mass\ < 35kg}{Total\ number\ of\ packages}$$

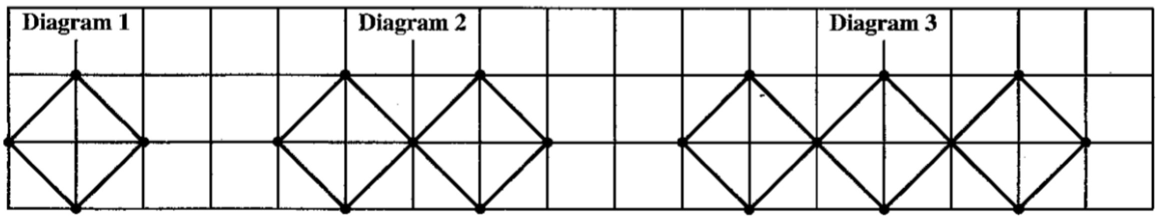
Based on the graph above; when mass of package = 35 kg;

Cumulative frequency = 81

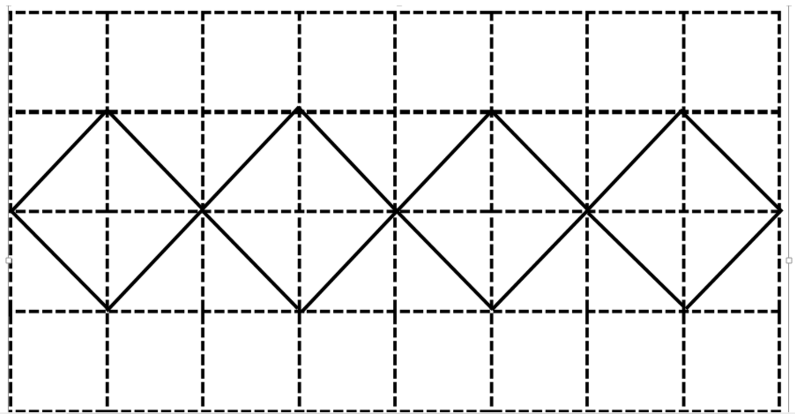
$$P\,(mass\ < 35\ kg) = \frac{81}{100}$$

Question 8a

Data Given



Draw the fourth diagram



Question 8b

(i) **Determine** the number of sticks in the sixth diagram

Based on the data given each successive diagram increases by 4 sticks.

No. of sticks in 4^{th} diagram = 16 sticks

No. of sticks in 5^{th} diagram = 16 + 4 = 20 sticks

$$Therefore, no. of\ sticks\ in\ 6th\ diagram\ =\ 20\ +\ 4\ =\ 24\ sticks$$

(ii) **Determine** the number of thumb tacks in the seventh diagram

Based on the data given each successive diagram increases by 3 thumb tacks.

No. of thumb tacks in 4th diagram = 13 thumb tacks

No. of thumb tacks in 5th diagram = 13 + 3 = 16 thumb tacks

No. of thumb tacks in 6th diagram = 16 + 3 = 19 thumb tacks

$$Therefore, no. of\ thumb\ tacks\ in\ 7th\ diagram\ =\ 19 +\ 3\ =\ 22\ thumb\ tacks$$

Question 8c

Complete the table by filling in (i) and (ii)

	No. of Sticks s	Rule Connecting t and s	No. of Thumb Tacks t
	4	$1 + \left(\frac{3}{4} \times 4\right)$	4
	8	$1 + \left(\frac{3}{4} \times 8\right)$	7
	12	$1 + \left(\frac{3}{4} \times 12\right)$	10
(i)	52	$1 + \left(\frac{3}{4} \times 52\right)$	**40**
(ii)	**72**	$1 + \left(\frac{3}{4} \times 72\right)$	55

(i) $Rule\ connecting\ t\ and\ s =\ 1 + \left(\frac{3}{4} \times 52\right) = 1 + (3 \times 13) = 40\ thumb\ tacks$

(ii) $Number\ of\ thumb\ tacks = 1 + \left(\frac{3}{4} \times s\right)$

$$55 = 1 + \left(\frac{3}{4} \times s\right)$$

$$\frac{3}{4} \times s = 54$$

$$s = \frac{54}{\frac{3}{4}}$$

$$= 72$$

Question 8d

Write the rule connecting t and s to demonstrate the relationship between them

$$t = 1 + \left(\frac{3}{4} \times s\right)$$

Question 9a

Solve the pair of simultaneous equations

$$y = x^2 - x + 3 \ldots \ldots. \ldots.\,.\,.\,\ldots \ldots.\,.\ldots Equation\ 1$$
$$y = 6 - 3x \ldots \ldots \ldots. \ldots \ldots.\,.\,.\ldots \ldots. \ldots Equation\ 2$$

Solving simultaneously

Equating Equation 1 and Equation 2

$6 - 3x = x^2 - x + 3$

$$x^2 + 2x - 3 = 0$$

Factorizing the Quadratic

$$x^2 + 3x - x - 3 = 0$$
$$x(x + 3) - 1(x + 3) = 0$$
$$(x + 3)\ (x - 1) = 0$$
$$x = \ -3 \quad or \quad x = 1$$

$$When\ x = -3; \quad y = 6 - 3x$$
$$= 6 - 3(-3)$$
$$= 6 - 3(-3)$$
$$= 6 + 9$$
$$= 15$$
$$When\ x = 1; \qquad y = 6 - 3x$$
$$= 6 - 3(1)$$
$$= 6 - 3$$
$$= 3$$

x	-3	1
y	15	3

Question 9b part (i)

Express the function $f(x) = 4x^2 - 8x - 2$, in the form $a(x + h)^2 + k$

$$4x^2 - 8x - 2 \equiv a(x + h)^2 + k$$

$$\equiv [a\,(x + h)(x + h)] + k$$

$$\equiv [a\,(x^2 + 2hx + h^2)] + k$$

$$\equiv ax^2 + 2ahx + ah^2 + k$$

Equating coefficients

$$x^2; \quad a = 4$$

$$x; \quad 2ah = -8$$

$$2(4)h = -8$$

$$8h = -8$$

$$h = -1$$

$$constant; \quad ah^2 + k = -2$$

$$(4)(-1)^2 + k = -2$$

$$4 + k = -2$$

$$k = -6$$

$$\therefore 4x^2 - 8x - 2 \equiv 4(x-1)^2 - 6$$

$in\ the\ form\ \ a(x+h)^2 + k\ \ where\ \ a = 4\ ,\ h = -1\ and\ \ k = -6.$

Question 9b part (ii)

State the maximum value of $4x^2 - 8x - 2$

$$4x^2 - 8x - 2 \equiv 4(x-1)^2 - 6$$

$$Maximum\ value\ of\ \ 4x^2 - 8x - 2 = 4(0) - 6$$

$$= -6$$

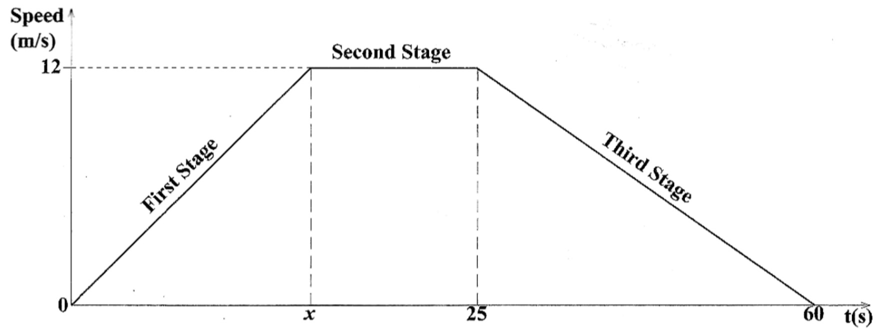
Question 9b part (iii)

State the value of x for which $f(x)$ is a minimum

$$f(x) is\ a\ minimum\ when\ 4(x-1)^2 = 0\ and\ x = 1.$$

Question 9c

Data Given



In the 1st Stage, the speed of the car increases from 0 m/s to 12 m/s in x seconds accelerating at 0.6 m/s^2.

(i) **Calculate** the value of x

$$Gradient\ of\ 1st\ Stage = Acceleration\ in\ 1st\ Stage$$

$$\frac{y_2 - y_1}{x_2 - x_1} = 0.6$$

Where Points being used are $(0,0)$ and $(x, 12)$.

$$\frac{12 - 0}{x - 0} = 0.6$$

$$\frac{12}{x} = 0.6$$

$$x = \frac{12}{0.6}$$

$$x = 20\ s$$

(ii) **Explain** the gradient of the graph in the 2nd Stage with respect to the car's actions.

In the 2nd stage, the car is moving at a constant speed of 12 m/s so the gradient is fixed as a change in acceleration only would affect the gradient.

(iii) **Calculate** the distance travelled by the car in the 3rd Stage

Since area under a speed-time graph gives distance, we consider the 3rd stage as a separate triangle.

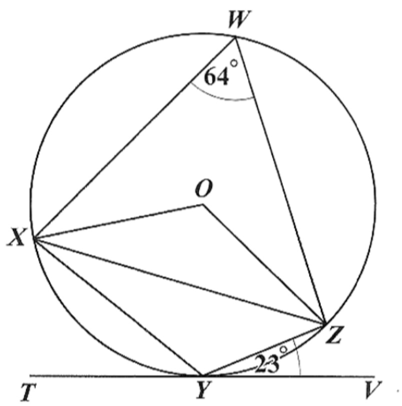
$$Area = \frac{B \times H}{2}$$

$$= \frac{(60 - 25) \times 12}{2}$$

$$= 210\ m$$

Question 10a

Data Given



(i) **Calculate** $< XYZ$

XYZO is a quadrilateral so the opposite angles are supplementary and the total sum of angles in a triangle is 180°.

$$X\hat{Y}Z = 180° - 64° = 116°$$

(ii) **Calculate** $< YXZ$

For a tangent, at its point of contact with the circle the angle created would be equivalent to the angle in the alternate segment.

$$Y\hat{X}Z = Z\hat{Y}V = 23°$$

(iii) **Calculate** $< OXZ$

Triangle OXZ is an isosceles triangle since the radius of a circle is constant;

$$Length\ of\ OX = Length\ of\ OZ = radius\ of\ the\ circle$$

Therefore the base angles would be equivalent.

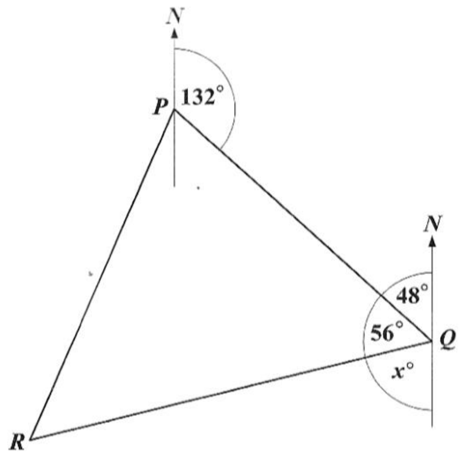
$$O\hat{X}Z = \frac{180° - 128°}{2} \quad since\ the\ total\ sum\ of\ angles\ in\ a\ triangle = 180°$$

$$= \frac{52°}{2}$$

$$= 26°$$

Question 10b part (i)

Data Given



Calculate the value of x

$$Since\ the\ total\ sum\ of\ angles\ for\ a\ straight\ line = 180°$$

$$x = 180° - (56° + 48°)$$

$$= 76°$$

Question 10b part (ii)

Data Given

PQ = 220 km

QR = 360 km

Calculate the distance RP

Applying cosine rule $a^2 = b^2 + c^2 - 2bc\ cos\ cos\ A$

Where

$$a = RP, \quad b = PQ, \quad c = QR \quad and \quad A = P\hat{Q}R$$

$$a^2 = b^2 + c^2 - 2bc\ cos\,cos\ A$$

$$RP^2 = PQ^2 + QR^2 - 2\,(PQ)(QR)\ \ cos\,cos\ (\,P\hat{Q}R)$$

$$RP^2 = (220)^2 + (360)^2 - 2\,(220)(360)\ \ cos\,cos\ (\,56°)$$

$$RP^2 = 48400 + 129600 - (158400)(cos\,cos\ 56°\ )$$

$$RP = \sqrt{[48400 + 129600 - (158400)(cos\,cos\ 56°\ )]}$$

$$RP = 299\ km$$

Question 10b part (iii)

Calculate the bearing of R from P

Applying sine rule to triangle PQR

$$\frac{a}{sin\,sin\ A} = \frac{b}{sin\,sin\ B}$$

Where

$$a = RQ, \qquad A = R\hat{P}Q, \qquad b = RP \qquad and \qquad B = \ \ P\hat{Q}R$$

$$\frac{a}{sin\,sin\ A} = \frac{b}{sin\,sin\ B}$$

$$\frac{RQ}{sin\,sin\ (R\hat{P}Q)} = \frac{RP}{sin\,sin\ (\ \ P\hat{Q}R\ )}$$

$$\frac{360}{sin\,sin\ (R\hat{P}Q)} = \frac{299}{sin\,sin\ (\,56°\ )}$$

$$(R\hat{P}Q)\ \ = \frac{360}{\frac{299}{sin\,sin\ (\,56°\ )}}$$

$$R\hat{P}Q = \left(\frac{360\ \times sin\,sin\ 56°}{299}\right)$$

$$R\hat{P}Q = 86.5°$$

$$Bearing\ of\ J\ from\ L\ (in\ a\ clockwise\ direction) = 132° + R\hat{P}Q$$

$$= 132° + 86.5°$$

$$= 218.5°$$

Question 11a

Determine the inverse of $(3\ 5\ 2\ 4)$

Let $A = (3\ 5\ 2\ 4)$

$$A^{-1} = det\ det\ A\ \times A$$

$$det\ det\ A = (4)(3) - (5)(2)$$

$$= 12 - 10$$

$$= 2$$

$$Now\ A^{-1} = \frac{1}{2}(\ 4\ -5\ -2\ \ 3)$$

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

Question 11b part (i)

Data Given

Under a matrix transformation $M = (0\ a\ b\ 0)$, the points R and T were mapped onto R' and T':

$$R\ (7, 2) \rightarrow R'\ (2, -7)$$

$$T\ (-5,4) \to T'\ (4,5)$$

Determine the values of $a\ and\ b$

$$M \times R = R'$$

$$(0\ a\ b\ 0) \times (7\ 2) = (\ \ 2\ \ -7\ )$$

$$(0 + 2a\ 7b + 0) = (\ \ 2\ \ -7\ )$$

Equating terms gives

$$2a = 2$$

$$a = 1$$

$$7b = -7$$

$$b = -1$$

$$\therefore M = (\ \ 0\ 1\ \ -1\ 0\ )$$

Question 11b part (ii)

Describe the geometric transformation, M

The transformation matrix, $M = (\ \ 0\ 1\ -1\ 0\ )$ rotates the matrix it is applied to in a clockwise manner about the origin O at an angle of 90°.

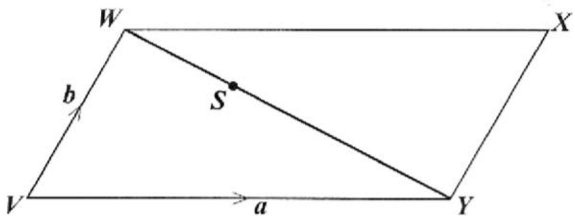
Question 11c part (i)

Data Given

$$WXYV\ is\ a\ parallelogram\ where;$$

$$\overrightarrow{VY} = a \quad and \quad \overrightarrow{VW} = b$$

$$Point, S; \quad WS : SY = 1 : 2$$



(a) **Write** $\overrightarrow{WY}$ *in terms of a and b*

$$\overrightarrow{WY} = \overrightarrow{WV} + \overrightarrow{VY}$$
$$= (-b) + a$$

(b) **Write** $\overrightarrow{WS}$ *in terms of a and b*

$$\overrightarrow{WS} = \frac{1}{3}\overrightarrow{WY}$$
$$= \frac{1}{3}(a - b)$$
$$= \frac{1}{3}a - \frac{1}{3}b$$

(c) **Write** $\overrightarrow{SX}$ *in terms of a and b*

Applying the vector triangle law

$$\overrightarrow{SX} = \overrightarrow{SW} + \overrightarrow{WX} \qquad where\ \overrightarrow{SW} = -\overrightarrow{WS}$$
$$= -\frac{1}{3}a + \frac{1}{3}b + a$$
$$= \frac{2}{3}\ a + \frac{1}{3}b$$

Question 11c part (ii)

Data Given

R is the midpoint of VW.

Prove R, S and X are collinear.

Applying the vector triangle law

$$\overrightarrow{RX} = \overrightarrow{RW} + \overrightarrow{WX}$$
$$= \frac{1}{2}b + a$$

Using $\overrightarrow{RX}$ *and* $\overrightarrow{SX}$; in order for the points to be collinear

$$\overrightarrow{SX} = k\left(\overrightarrow{RX}\right) \quad where\ k\ is\ a\ scalar\ multiple$$
$$\overrightarrow{RX} = \left(a + \frac{1}{2}b\right)$$
$$\overrightarrow{SX} = \left(\frac{2}{3}a + \frac{1}{3}b\right) = \frac{2}{3}\left(a + \frac{1}{2}b\right) \quad where\ k = \frac{2}{3}$$

The vectors $\overrightarrow{RX}$ *and* $\overrightarrow{SX}$ are parallel since $\overrightarrow{SX}$ is a scalar multiple of $\overrightarrow{RX}$ and X is a common point for the both vectors; therefore R, S and X are collinear.