

**NATIONAL BUSINESS AND TECHNICAL EXAMINATIONS BOARD
MAY/JUNE NBC/NTC EXAMINATION
MATHEMATICS**

1(a) Evaluate, $\frac{0.285 \times 0.267}{3.36}$ leaving your answer in standard form.

(b) If the angles of a polygon are given as x° , $(x+20)^\circ$, $(2x-10)^\circ$, $(3x+10)^\circ$ and $(x-10)^\circ$. Find the value of x .

Solution (a) $\frac{0.285 \times 0.267}{3.36}$
 $= \frac{0.076095}{3.36}$
 $= 0.022647$ In standard form we have it as 2.265×10^{-3}

(b) sum of angles = 540°
 $x + x + 20 + 2x - 10 + 3x + 10 + x - 10 = 540^\circ$
 $8x = 540^\circ$
 $x = 67.5^\circ$

ALITER for 1(b)

The corresponding exterior angles are $(180 - x)^\circ$, $(160 - x)^\circ$, $(190 - 2x)^\circ$, $(170 - 3x)^\circ$, $(190 - x)^\circ$

Equating sum of the exterior angles to 360° , we have $x = 67.5^\circ$

2(a) If the angles of a pentagon are x° , x° , $2x^\circ$, $(2x+40)^\circ$, $(2x+10)^\circ$. Find the value of the biggest angle.

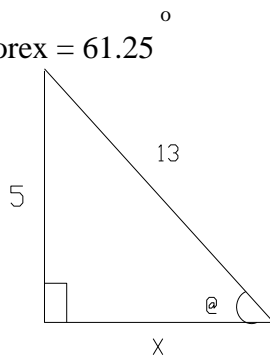
(b) Given that $0^\circ < \theta < 90^\circ$ and $\sin \theta = \frac{5}{13}$, Find without using tables or calculator $\cot^2 \theta$

Solution

Sum of angles of a pentagon is 540°

$$\theta + x + 2x + 2x + 40 + 2x + 10 = 540^\circ$$

Therefore $x = 61.25^\circ$



2(b)

By Pythagoras' theorem

$$x^2 + 13^2 = 15^2$$

$$\cot^2 \theta = \frac{\text{Adjacent}^2}{\text{Opposite}^2} = \frac{144}{25}$$

$$\cot \theta = \frac{12}{5}$$

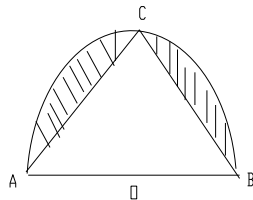
ALITER

$\cot^2 \theta = \frac{1}{\text{cosec}^2 \theta}$ Equivalent

$$\text{cosec}^2 \theta = \frac{169}{25}$$

$$\cot^2 \theta = \frac{19}{25}$$

3(a) The 1st and 5th terms of a G.P are 81 and 1 respectively. Determine the three terms between the two numbers.



In the figure AB is the diameter of a semi-circle, AOC. If $\angle AOB = 100^\circ$ and $\angle AOC = 80^\circ$. Calculate the area of the shaded portion.

Solution

(a) $a = 81$ and $ar^{5-1} = ar^4 = 1$

Solving the equation, we have $r^4 = \frac{1}{81}$

$$r = \frac{1}{3}$$

$$\cot \theta = \frac{12}{5}$$

Using ar^{n-1} , we have between 81 and 1, $n=2, 3$ and 4 ; 27, 9 and 3

b) Area of a circle = $\pi r^2 = 22 \times 5^2 = 78.55 \text{cm}^2$

7

□ Area of semicircle = 39.275cm^2

Area of triangle = $\frac{1}{2} bh$

Height $h = 9.6 \text{cm}$

□ $\frac{1}{2} \times 5 \text{cm} \times 9.6 \text{cm} = 24 \text{cm}^2$

4(a) Solve for t in the equation, $-\frac{t}{4} + 6 = \frac{2t}{3}$

(b) The dimensions of a room are 15m long, 8m wide and 10m high. Calculate the angle which the diagonal of the room makes with the floor.

Solution

(a) $-\frac{t}{4} + 6 = \frac{2t}{3}$ $1t$, collecting like terms, we have $\frac{2t}{3} + \frac{t}{4}$

$\frac{22}{3} = \frac{2t}{3} + \frac{t}{4}$

ALITER

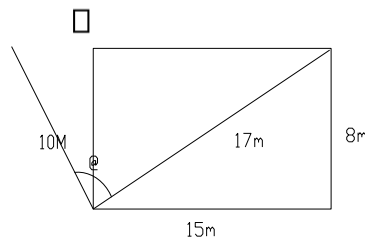
Solving and clearing fractions, $-\frac{t}{4} + 6 = \frac{2t}{3}$

$\frac{22}{3} = \frac{2t}{3} + \frac{t}{4}$

(a) the diagonal of the floor of the room = 17m; by Pythagoras' theorem.

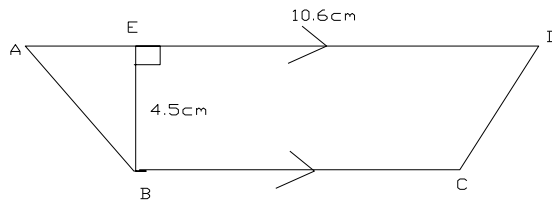
$\frac{\text{Opposite}}{\text{Adjacent}} = \tan \phi = \frac{10}{17} = 0.5882$

□ □



$\tan \phi = 0.5882$ and $\phi = 30.47^\circ$

5(a) Find the sum of the first 100 even numbers



(b)

In the figure $AD \parallel BC$, BE is perpendicular to AD . If the area of $ABCD$ is 40.5cm^2 , find the length of BC .

Solution

5(a) Even numbers, $a = 2, d = 2, n = 100$

$$S_n = \frac{n}{2} [2a + (n-1)d]$$

$$S_n = \frac{100}{2} [4 + (99)2] = 10,100$$

(b) Total Area = $\frac{1}{2} (4.5) (10.6 + BC) = 40.5$
 Solving for BC , we have $BC = 7.4\text{cm}$

6(a) Given that $p = \frac{r}{r+4}, q = \frac{r}{r+2}$, express $2q+8p$ in terms of r in the simplest form.

(b) Solve the equation $3x^2+4x-7 = 0$, leaving your answer to 2 decimal places. (c) Simplify: $\log_6 + \frac{1}{2} \log_8 - \log_7$

Solution

(a) Substituting the values of p, q and taking L.C.M.

$$\frac{2p+8q}{(r+2)(r-2)} = \frac{2r(r-2)+8r}{r^2}$$

(b) $(3x+7)(x-1) = 0$
 $3x+7=0$ or $x-1 = 0$ either $x = -2.333$ or $x = 1$

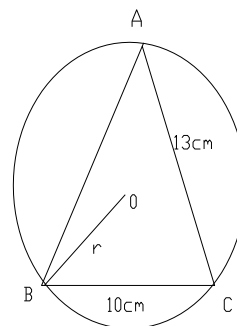
ALITER

$$\frac{16\sqrt{4(3)(7)-x}}{2(3)}$$

either $x = -2.33$ or $x = 1$.

(c) $\log 6 + \frac{1}{2} \log 81 - \log 27$; NB: $\log \sqrt[3]{81} = \log 81^{\frac{1}{3}}$
 $= \log 6 + \log \sqrt[3]{81} - \log 27$
 $= \log 6 + \log 9 - \log 27$
 $= \log \frac{6 \times 9}{27}$
 $= \log \frac{54}{27}$
 $= \log 2$

7(a) The difference between the reciprocal of a number and the reciprocal of the sum of 3 and the number is $\frac{3}{40}$. What is the number?



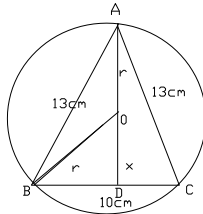
(b)

In the figure given ABC is an isosceles triangle inscribed in a circle centre O. If $\angle BAC = 120^\circ$ and $AB = AC = 13\text{cm}$ and $BC = 10\text{cm}$. Calculate the radius of the circle to the nearest whole number.

Solution

(a) Let the number be x. From the question we have: $\frac{1}{x} - \frac{1}{x+3} = \frac{3}{40}$

Simplifying, we obtain $x^2 + 3x - 40 = 0$
 $\square x = -8$ or $x = 5$



(b) $r^2 = x^2 + 5^2 \dots\dots\dots$ (i)

$AD = 12 \text{ cm}$

$x = 12 - r \dots\dots\dots$ (ii)

Solving for r: $r^2 = (12-r)^2 + 5^2$
 $r = 7.042$

$\square r = 7.0 \text{ cm}$

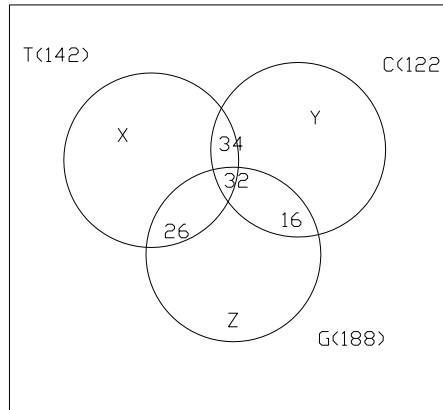
8(a) In an opinion survey, a group of people were interviewed about the daily newspaper read by them. 142 read the Tribune, 122 read the Champion and 118 read the Guardian. 66 read both the Tribune and the Champion. 48 read the Champion and the Guardian while 58 read the Tribune and the Guardian. 32 read all the three newspapers.

- (i) Illustrate the information using a Venn diagram.
- (ii) How many people were interviewed?

(iii) How many people read the Guardian only?

Solution

(i)



(ii) $x + 26 + 34 + 32 = 142$

$x = 50$ □

$y + 34 + 16 + 32 = 122$

$y = 40$ □

$z + 26 + 32 + 16 = 118$

□ $z = 44$

Total number of people that were interviewed = $50 + 40 + 44 + 26 + 34 + 16 + 32 = 242$

(iii) $z + 26 + 32 + 16 = 118$

□ $z = 44$ (read Guardian only)

9(a) Complete the table of values for the relation $y = 2 + x - x^2$ for $-3 \leq x \leq 4$

x	-3	-2	-1	0	1	2	3	4
y		-4		2				

(b) Using a scale of 2cm to 1 unit on the x-axis and 2 units along the y-axis, draw the graph of $y = 2 + x - x^2$ with your values in 9(a)

(c) From your graph

(i) Find the co-ordinates of the point at which y is greatest.

(ii) Estimate the roots of the equation $2 + x - x^2 = 0$

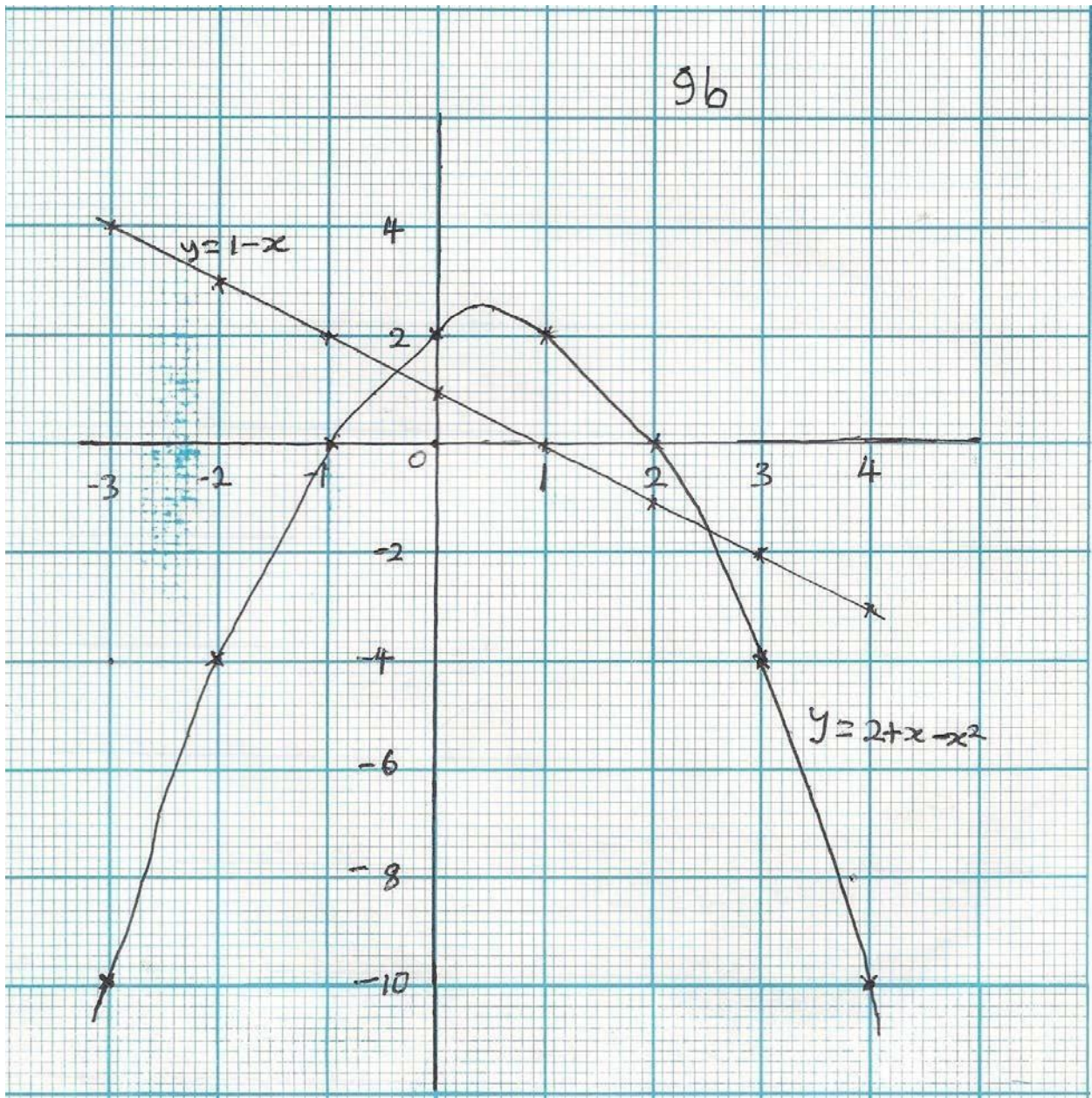
(d) Using the same scale and axes, draw the graph of $y = 1 - x$

(e) Use your graphs to solve the equation $1+2x - x^2 = 0$

Solution

(a)

x	-3	-2	-1	0	1	2	3	4
y	-10	-4	0	2	2	0	-4	-10



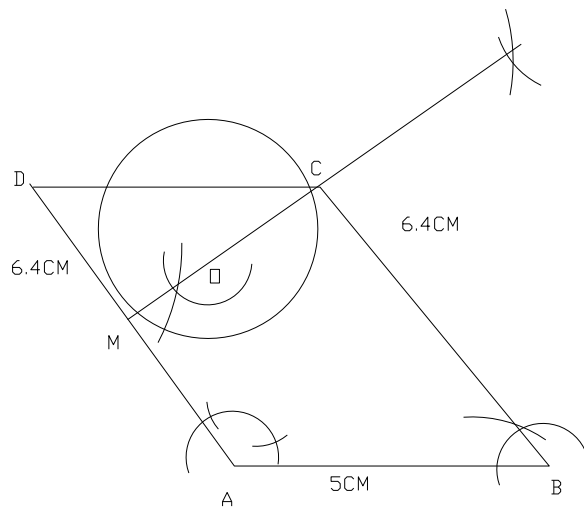
- (c) (i) The co-ordinates = $(0.5, 2.3) \pm 0.1$ (ii) The roots $x = -1$ or $x = 2$

- (d) The graph of $y = 1 - x$
Table of $y = 1 - x$

x	-3	-2	-1	0	1	2	3	4
y	4	3	2	1	0	-1	-2	-3

- (e) From the graph, the roots of $1 + 2x - x^2 = 0$ are $x = -0.4 \pm 0.1$, and $x = 2.4 \pm 0.1$
- 10(a) With a pair of compasses and ruler only, construct parallelogram ABCD such that $\angle A = 60^\circ$, $\angle B = 60^\circ$ and $\angle C = 60^\circ$
- Bisect $\angle C$ and let the bisector meet AD at M.
 - Draw a circle centre O with CM as diameter.
 - Measure $\angle ODM$ and $\angle OCM$.
- (b) Given two points X (lat. 50°N , long 85°E) and Y (lat. 50°N , long 25°E). Find the distance between them along the common parallel of latitude. Take R to be 6400km. π to be 3.14 and correct your answer to 2 decimals.

Solution



- (a)
- (b) The distance between the two points, difference in longitude = 60°
 $= 60^\circ \times 2\pi \times 6400 \times \cos 50^\circ$

$$= \frac{360}{360} \times 2\pi \times 6400 \times \cos 50^\circ$$

$$= 4305.90\text{km}$$

11(a) The cost of sewing a set of suit is partly constant and partly varies inversely with the number of days it takes to sew the suit. If the suit takes 3 days to sew, the cost is ₦3,000. If it takes 5 days, the cost is ₦2,500. Find the cost if the tailor takes 4 days to sew a particular set of suit.

(b) Calculate the perimeter of the major segment of a circle radius 17.5cm determined at the centre of the circle. Take $\pi = 22/7$

Solution

We can represent the question with the following equations:

$$3a + b = 900$$

$$5a + b = 12,500$$

$$a = 1750 \quad \text{and } b = 3750$$

The law of the variation, $C = 1750 + \frac{3750}{D}$

$$\begin{aligned} \text{For 4days, } D &= 4, \\ C &= 1750 + \frac{3750}{4} \\ &= \text{N } 2687.50 \end{aligned}$$

(b) Perimeter of a segment of a circle = length of arc + length of chord

$$\text{length of the semi circular arc} = \frac{22}{7} \times \frac{35}{2} = 55\text{cm}$$

$$\text{length of chord} = 17.5\text{cm} + 17.5\text{cm} = 35\text{cm}$$

$$\text{perimeter} = 55\text{cm} + 35\text{cm} = 90\text{cm}.$$

12(a) Mention two uses of averages

(b) List two merits and two demerits of the

- (i) mean, and
- (ii) median, as measures of central tendency.

(c) Calculate

- (i) range, and
- (ii) standard deviation of the set of data: 4,5,8,3,9,10,15,12,8,16

Solution

12(a) Two (2) uses of average

(b) Listing of two (2) merits and two (2) demerits of mean and median.

(c) (i) range = 16 - 3 = 13

$$(ii) S.D = \sqrt{\frac{\sum x^2 - \frac{(\sum x)^2}{N}}{N}}$$

$$= \sqrt{\frac{174 - \frac{174^2}{10}}{10}}$$

$$S.D. = \sqrt{\frac{174 - \frac{174^2}{10}}{10}}$$

$$S.D. = \sqrt{17.4} = 4.17$$

13(a) A man saves a sum of money in a bank which pays simple interest at the rate of 4% per annum. If after 3 years the money amounts to ₦20,000.00. Find the sum invested.

(b) Three boys did a business together and shared the profit they made. The first got 20% of the share and got 37½ % of the remainder. If the third boy received ₦450.00, how much was the profit they shared?

Solution

$$(a) I = \frac{PRT}{100} = \frac{3P}{25}$$

$$\text{Amount} = A = P + \frac{3p}{25}$$

$$\text{sum invested} = P + \frac{3p}{25} = 20,000$$

$$P = ₦17857.14$$

(b) remainder after the first boy's share = 100% - 20% = 80% $\times \frac{80}{100} = \frac{4}{5}$

$$\text{The second boy's share} = \frac{75}{100} \times \frac{4}{5} = 60\%$$

$$= \frac{300}{10} = 30 \quad \square \quad \frac{30}{100} = 3$$

Proportion left for the third boy = $\frac{1}{2}$.

If the third boy received ₦450, therefore the total profit shared would be
 $\text{₦}450 + \text{₦}450 = \text{₦}900.00$

14(a) A man's total salary for 4 months in a particular year was ₦14,001.00. Then there was salary review in which monthly salaries were doubled. Calculate his total salary in that year.

(b) Ojo, Obi and Bala are three partners who own a business venture. It was agreed that the profit will be shared such that Ojo received $\frac{2}{5}$. Obi receives $\frac{2}{3}$ and Bala receives $\frac{1}{4}$ of the total profit made. If at the end of the year Ojo receives ₦3,200 less than Obi, what is Bala's share of the total profit?

Solution

14(a) Monthly pay before salary review = $\frac{\text{₦}14001}{4}$

$$= \text{₦}3,500.25$$

$$\text{monthly salary after review} = \text{₦}3,500.25 \times 2$$

$$= \text{₦}7000.50$$

$$8 \text{ months salary after review} = \text{₦}7000.50 \times 8$$

$$= \text{₦}56004.00$$

$$\text{Total salary for the year} = \text{₦}56004 + \text{₦}14001$$

$$= \text{₦}70,005.00$$

(b) Let x represent the total profit. Therefore we have the equation $\frac{2x}{5} + 3200 = \frac{2x}{3}$

$$= \frac{2x}{5} - \frac{2x}{3} = -3200$$

$$\text{L.C.M approach} - \frac{4x}{15} = -3200$$

$$x = \text{₦}12,000$$

then Bala's share will be $\frac{1}{4}$ of ₦12,000 = ₦3,000.00

15(a) A man bought 10,000 ₦1.00 shares of FELGRA PLC at ₦1.50 per share through a broker. If the brokerage commission rate is 5.4% plus ₦300 for any transaction of ₦5,000 or more, calculate the:

- (i) broker's commission and
- (ii) amount the man received if a dividend of 15% was declared.
- (b) Afman is to pay back a loan of ₦48,000 monthly for 3 years. If the amount is borrowed at the rate of 12½ % per annum, what will be his monthly installment payment?

Solution

(a) (i) Market value of the shares = ₦1.50 x 10,000 = ₦15,000

$$\begin{aligned} \text{Broker's commission} &= \frac{\text{₦15,000}}{100} \times 5.4 + \text{₦300} \\ &= \text{₦810} + \text{₦300} \\ &= \text{₦1110.00} \end{aligned}$$

- (ii) Amount the man received if a dividend of 15% was declared.

Nominal value of the share = ₦10,000

Dividend received ₦1500.00

(b) $I = \frac{PTR}{100}$

Interest on the loan = $\frac{\text{₦48,000} \times 3 \times 12\frac{1}{2}}{100} = \text{₦18,000}$

total money owed = ₦48,000 + ₦18,000 = ₦66,000

the monthly installment will be $\frac{\text{₦66,000}}{36 \text{ months}} = \text{₦1833.33}$

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MATHEMATICS**

1(a) Solve for x in $8^{3x} \times 8^{-1} = 32$

(b) Simplifying without using tables, $\frac{\log 27}{\log 3}$

Solution

(a) $2^{3(3x)} \times 2^{3(-1)} = 2^5$

$3(3x) - 3 = 5$

$$9x - 3 = 5$$

$$\square x = 8/9$$

$$\log 2$$

$$7 \log 3$$

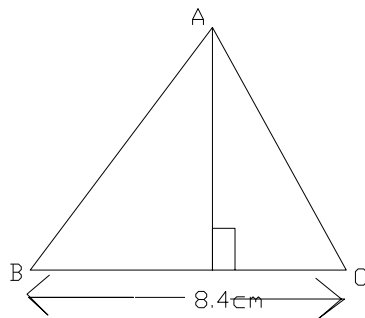
$$3 \log$$

$$3$$

(b) $\square \square \square 3 \log 3 \log 3 \log 3$

2(a) The 6th term of a G.P is 1215. If the common ratio is 3; find its 3rd term. (b)

ABC is a triangle with BC = 8.4cm, $\angle C = 90^\circ$ and area 40.16cm². Find /AD/.



Solution

(a) $T_6 = ar_{n-1} \square a(3)^5 = 1215$
 $a = 1215 \square =$

$$5$$

$$243$$

$$\square 3rd \text{ term} = 5 \times 3^2 = 45$$

(b) Area of a triangle = $\frac{1}{2} \times 8.4 \times /AD/$
 $= 40.16 \text{cm}^2$

$$\square /AD/ = \frac{40.16 \times 2}{8.4 \times 1}$$

$$= 9.56 \text{cm}$$

3(a) Simplify , $\frac{0.054 \times 8.19}{0.000243}$ leaving your answer in standard form.

- (b) A length of 8.85m is increased to 9.37m. Calculate the increase.

Solution

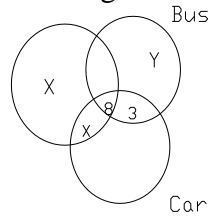
(a)
$$\frac{54 \times 10^{-3} \times 819 \times 10^{-2}}{243 \times 10^{-5}}$$

$$= 1.82 \times 10^2$$
 or
$$\frac{0.054 \times 819}{0.00243} = \frac{0.44226}{0.00243} = 182$$

$$= 1.82 \times 10^2$$

(b) increase in length = $(9.37 - 8.85)\text{m}$
 $= 0.52\text{m}$
 percentage increase = $\frac{0.52}{8.85} \times 100$
 $= 5.876\% = 5.88\%$ approx.

4. 65 of the workers in a certain company in Lagos were interviewed about the means of transportation to work on a particular day. Each of them used one or more of the means shown on the Venn diagram below.



Given that 37 workers used Bike and 20 used Bus, find

- (a) x
 (b) the number of workers who used cars only

Solution

4(a)
$$x + x + 5 + 8 = 37$$

$$2x + 13 = 37$$

$$2x = 37 - 13$$

$$2x = 24$$

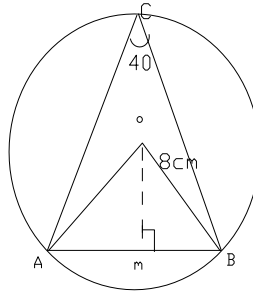
$$x = 12$$

(b) $y = 20 - (5+8+3) = 4$
 (Bike Bus) = $12+12+5+8+3+4$

= 44 n (cars only) = 65 - 44
 = 21

5. The centre of the circle ABC is O. If its radius is 8cm and $\angle ACB = 40^\circ$,
 Calculate the length of the

- (a) Chord AB
- (b) Perpendicular OM



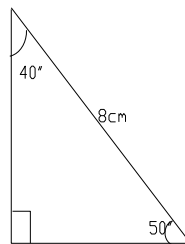
Solution

$\angle AOB = 2\angle ACB = 2 \times 40^\circ = 80^\circ$

$\angle BOM = \frac{1}{2} \text{ of } 80^\circ = 40^\circ$

Considering triangle OMB,

$\frac{MB}{OB} = \sin 40^\circ$
 or $8 \cos 50^\circ = 5.142\text{cm}$

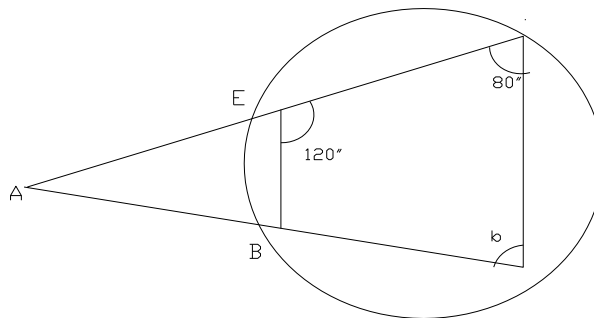


$$\begin{aligned} \text{Length of the chord } AB &= 2/MB/ = 2 \times 5.142 \\ &= 10.28\text{cm} = 10.3\text{cm approx} \end{aligned}$$

(b) $\angle OM/ = 8 \cos 40^\circ$ or $8 \sin 50^\circ$
 $= 6.128\text{cm} = 6.13\text{cm} = 6.1\text{cm}$

ALITER: Using Pythagoras' rule
 $OM = \sqrt{(OB)^2 - (MB)^2} = 6.1\text{cm}$

6(a) Find the value of a and b in the figure below



(b) Five years ago, a father was twice as old as his son. In 4 years' time, the sum of their ages will be 78. Find their present ages.

Solution(a) $b = 180^\circ - 120^\circ = 60^\circ$ (opposite angles in cyclic quad are supplementary)

Considering $\triangle ACD$,

$$a + b + 80^\circ = 180^\circ \text{ (}\sphericalangle \text{ in a } \triangle \text{) } \quad a$$

$$\sphericalangle = 180^\circ - 80^\circ - 60^\circ = 40^\circ$$

(b) Let the present ages be son, x yrs,
 father y yrs, then 5 years ago, we
 have $y - 5 = 2(x - 5)$

$$\sphericalangle \quad 2x - y = 5$$

_____ (1) in 4

years' time, we have

$$(x + 4) + (y + 4) = 78$$

$$\sphericalangle \quad x + y = 70 \text{ _____ (2)}$$

From (1) and (2), we have, $x = 25$ and $y = 45$ their

\sphericalangle present ages are son = 25 yrs, father = 45 years

(a) **ALITER**

5 year ago if son is y year's old father was $2y$ years old. In 4 years time, son will be

$(y+5+4)$ yrs father = $(2y+5+4)$ yrs which gives $y + 9 + 2y + 8 = 78$; $y = 20$ the present ages are $y + 5 = 25$ yrs and $2y + 5 = 45$ yrs for the son and father respectively.

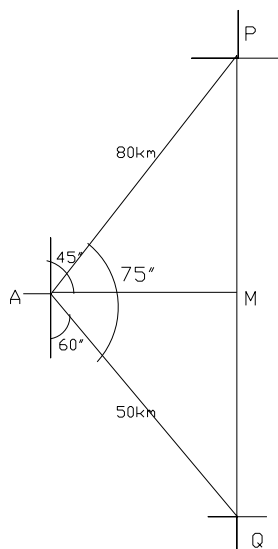
7. The bearings of points P and Q from 045° and 120° respectively. If the distance AP is 80km and AQ is 50km, calculate the:

(a) distance between P and Q to 3 significant figures (b) bearing of Q from P, to the nearest degree.

(c) how far east of A is Q?

Solution

(a)



Correct diagram with at least three of 50km, 80km, 45°, 60° or 120° shown $\angle PAQ = 75^\circ$

$$(PQ)^2 = 80^2 + 50^2 - (80)(50)\cos 75^\circ = 6829.6$$

$$\square PQ = \sqrt{6829.6} = 82.6\text{km}$$

Solution

7(b) $\sin \angle APQ = \frac{50 \times \sin 75^\circ}{82.6} = 0.5847$

- $\angle APQ = \sin^{-1} 0.5847 = 35.78^\circ$
 $\angle QPN = 45^\circ - 35.78^\circ = 9.22^\circ$
 The bearing of Q from P = $180^\circ + 9.22^\circ$
 = 189° (to the nearest degree)
 $\angle QAM = 30^\circ$
 (c) A is $50 \times \cos 30^\circ = 43.3\text{km}$ east of Q

8(a) The table below shows the scores of a group of 40 students in a test.

Score (x)	1	2	3	4	5	6	7	8	9	10
Frequency (f)	3	4	5	7	8	6	3	2	1	1

- Find the (i) mode, (ii) median and (iii) mean
- (b) The 2nd and 4th terms of a G.P. are 10 and 40 respectively. Find the
- common ratio
 - first term
 - 8th term of the series

Solution

- (a) (i) mode = 5
 (ii) median = $\frac{5+5}{2} = 5$
 (iii) $\sum fx = 3 + 8 + 15 + 28 + 40 + 36 + 21 + 16 + 9 + 10$
 = 186
 mean = $\frac{186}{40} = 4.65$
- (b) $ar^{2-1} = 10 = ar = 10$
 $ar^{4-1} = 40 = ar^3 = 40$
 $\frac{40}{ar} = 4$

- (i) $\angle r = \pm 2, r = 2 \text{ or } -2$
- (ii) Hence $2a = \pm 10 \angle a = \pm 5$

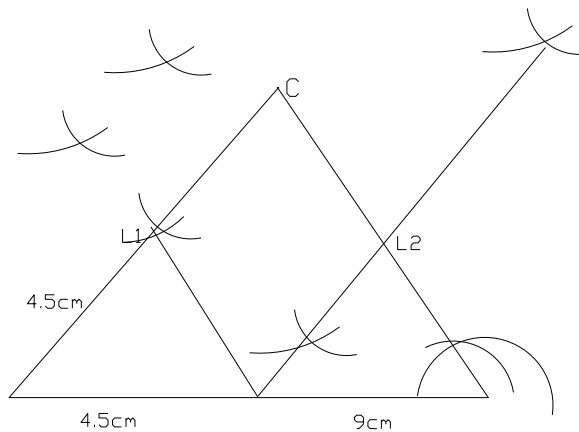
(iii) $T_8 = \pm 5 \times 27 = 640$

9 Using a ruler and a pair of compasses only construct: (a) A triangle ABC such that $\angle A = 90^\circ$, $\angle B = 60^\circ$ and $\angle C = 45^\circ$.

- (b) (i) Construct the locus l_1 of points 4.5cm from A.
 (ii) Construct the locus l_2 of points equidistant from B and C to intersect l_1 at x_1 and x_2 measure $\angle x_1x_2$.

Solution

(a) Drawing a side 9cm long constructing angle 60° , angle 45° measuring angle $BAC = 76^\circ$ completing the triangle ABC.



- (b) (i) Constructing l_1 4.5cm from A
 (ii) Constructing l_2 of points equidistant from B and C to intersect l_1 at x_1 and x_2 measuring $\angle x_1x_2 = 8.5\text{cm}$; ($\pm 0.1\text{cm}$) or its equivalent.

10(a) A bucket is 28cm in diameter at the top, 18cm in diameter at the bottom and 20cm deep. Find the capacity, in litres, of the bucket (take $\pi = 3.142$) (b)

The hypotenuse of a right angled triangle is 17cm and one of the angles is 43° , find the

- (i) third angle
 (ii) side opposite the smallest angle.

Solution

(a) Let the height of the smaller cone be h cm then, we have $\frac{h}{2} = \frac{9}{14}$

$14h = 180 + 9h$

$5h = 180$

$h = 36$

Volume of the small cone = $\frac{1}{3} \times 3.142 \times 9^2 \times 36$
 = 3054.02 cm³

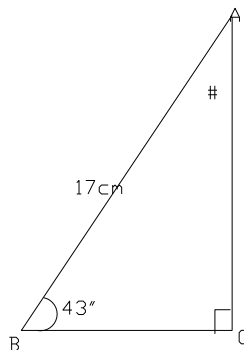
Volume of the big cone = $\frac{1}{3} \times 3.142 \times 14^2 \times 56$
 = 11495.53 cm³

Volume of the bucket in litres = 11495.53 – 3054.02
 = 8441.51 cm³

Capacity of the bucket in litres = 8.44 litres or 8.4 litres.

We can also get the volume if we use $\frac{\pi}{3}(R^2H - r^2h)$

Substituting for R, H, r and h, we get 8.44 litres
 3rd angle $\theta = 180^\circ - (90^\circ + 43^\circ) = 47^\circ$



AC is opposite the smallest angle.

Hence $AC = 17 \times \sin 43^\circ$ or $AC = 17 \times \cos 47^\circ = 11.594 \text{ cm}$ or = 11.59 cm

11(a) The sum to nth term of an AP is given by $S = n \left[a + \frac{(n-1)d}{2} \right]$, where a = first term

d = common difference

- (i) make d the subject of the formula
 (ii) Hence calculate the common difference of an AP whose sum is 338, n = 13 and a = 5.

(b) The angles of a polygon are $(x-10)^\circ$, x° , x° , $(x+20)^\circ$ and $(x+30)^\circ$. Find the value of x.

Solution

$$S = n \left(a + \frac{(n-1)d}{2} \right)$$

Removing the fraction and brackets to get $2s = na + n^2d - nd$

Isolating d, we get

$$d(n^2 - n) = 2s - na$$

$$d = \frac{2s - na}{n^2 - n}$$

$$\begin{aligned} \text{(ii) } d &= \frac{2s - na}{n^2 - n} = \frac{2(338) - 13(5)}{13^2 - 13} \\ &= \frac{611}{156} = 3.92 \end{aligned}$$

(b) The polygon has 5 sides
 sum of interior angles = $3 \times 180^\circ = 540^\circ$

$$(x-10)^\circ + x^\circ + x^\circ + (x+20)^\circ + (x+30)^\circ = 540^\circ$$

$$5x + 40^\circ = 540^\circ$$

$$5x = 500$$

$$x = 100^\circ$$

- 12(a) An article costing ₦32.50 is sold for a gain of 13½. Find the selling price. (b) Find the simple interest on ₦4500.00 in 2½ years at 4% per annum. (c) A businessman borrowed ₦200,000 from a bank for 3 years at 5% compound interest.
- (i) Calculate the interest on the loan at the end of the period.
 (ii) If he repays ₦230,000 at the end of the 3 years, how much does he still owe?

Solution

(a) Cost price of the article : 100% = ₦32.50
 Selling price of the article 113½ % = $\frac{113.5}{100} \times 32.50$
 = ₦36.89

(b) $S.I = \frac{PTR}{100} = \frac{4500 \times 5 \times 2.5}{100 \times 100}$
 = ₦450.00

(c) Interest at the end of 1st year = $\frac{200,000 \times 1 \times 5}{100}$
 = ₦10,000.00

Interest at the end of 2nd year = $\frac{210,000 \times 1 \times 5}{100}$
 = 10,500.00

Interest at the end of 3rd year = $\frac{220,500 \times 1 \times 5}{100}$
 = ₦11,025.00

(i) Total interest owed at the end of 3rd year
 $= \frac{200,000 \times 15}{100} = ₦231,525.00$

Total interest = ₦ (231,525 – 200,000) = ₦31,525.00

ALITER

(i) Total interest = ₦(10,000 + 10,500 + 11,025) = ₦31,525.00

(ii) Amount still owed = (231,525 – 230,000)
 = ₦1,525.00

- 13(a) A trader allows a discount of $33\frac{1}{3}$ % on his marked prices. What should be the marked prices of article he wishes to receive ₦500.00?

- (b) The prices of kerosene per litre on the first week of each of the 12 months of the year are as given in the table below.

Month	Jan.	Feb.	March	April	May	June	July	Aug.	Sept	Oct	Nov	Dec.
Price	18	21	25	30	40	52	48	50	55	43	26	18

Find the three month moving averages for the period.

Solution

- (a) Selling price less discount: $66 \frac{2}{3}\% = \text{N}500$ Marked price:
 100% = $\text{N}100 \times 500$

$$= \frac{66 \frac{2}{3}}{100} \times 500$$

$$= 749.96 = \text{N}750 \text{ approx}$$

- (b) Moving averages: $\frac{18 + 21 + 25}{3} = 21.33$

$$\frac{21+25+30}{3} = 25.33, \frac{25+30+40}{3} = 31.67$$

$$\frac{30+40+52}{3} = 40.67, \frac{40+52+48}{3} = 46.67$$

$$\frac{52+48+50}{3} = 50.00, \frac{48+50+55}{3} = 51$$

$$\frac{50+55+43}{3} = 49.33, \frac{55+43+26}{3} = 41.33$$

$$\frac{43+26+18}{3} = 29.00$$

- 14(a) A man's salary is 298,886.40 per annum. Before receiving his salary, the employer makes the following deductions of the salary less personal allowance

- Income Tax1%,
- Federal Housing Scheme
- ...2½%, and union dues
-2%

If his annual personal allowances is $\text{N}108,110.40$

Calculate:

- (i) his monthly income tax (ii) the net monthly take home pay.
 (b) A bankrupt's assets realize ₦5000.00 and his liabilities are ₦8000.00 (i) What dividend will he pay?
 (ii) How much will be paid to a creditor for ₦600.00?

Solution

(a) Salary – Personal allowances = ₦ (298,886.40 – 108,110.40)
 = ₦190,776.00

(i) Monthly income tax = $\frac{190,776}{100} \times \frac{1}{12}$
 = ₦158.98

(ii) Gross monthly salary = $\frac{298,886.4}{12}$
 = ₦24,907.20

monthly deductions: FHS: 2% of ₦24,907.20
 = ₦622.68

monthly union due = 2% of ₦24,907.20
 = ₦498.14

monthly tax deduction: 1% of ₦24,907.20
 = ₦249.07

monthly total deductions = ₦ (622.68 + 498.14 + 249.07)
 = ₦1369.89

Net monthly pay = (24,907.20 – 1369.89)
 = ₦23,537.31

(b) (i) Dividend = $\frac{5,000}{8,000} \times 100k$
 = 63k in ₦

(ii) To a creditor for ₦600 he pays $\frac{63}{100} \times ₦600$
 = ₦378.00

15(a) Find the weighted mean of 15,20,25,30, if they are assigned weightings of 2,1,3,4 respectively.

(b) A man bought 23 crates of bottled drink at ₦310.00 per crate. There were 24 bottles per crate and each bottle was sold for ₦15. If two bottles per crate got broken during sales, calculate the following:

- (i) cost price of the 23 crates
- (ii) percentage profit per crate.

Solution (a) weighted mean = $\frac{(2 \times 15) + (1 \times 20) + (3 \times 25) + (4 \times 30)}{2 + 1 + 3 + 4}$
 $= \frac{275}{10} = 27.5$

(b) (i) Cost price of 23 crates = $23 \times \text{₦}310$
 $= \text{₦}7130.00$

No of bottles sold in a crate = 22

Selling price of a crate = $22 \times \text{₦}15 = \text{₦}330.00$

Profit on a crate = $\text{₦}330.00 - \text{₦}310.00$
 $= \text{₦}20$

(ii) Percentage profit per crate
 $= \frac{20}{310} \times 100$
 $= 6.45\% = 6.5\% \text{ approx.}$

NATIONAL BUSINESS AND TECHNICAL EXAMINATION BOARD

NTC / NBC EXAMINATION MAY / JUNE,

1(a) Simplify $1\frac{1}{4}$ _____
 $2 + \frac{1}{4}$ of 28

(b) The sides of a triangle are in the ratio 4:7:8 and its perimeter is 38cm. Find the sides.

Solution

$$\frac{1}{4} \times 28 = 7$$

(a) $\frac{5}{9} \times 9 = 5$

(b) Total ratio = $4 + 7 + 8 = 19$
 Getting: $\frac{38}{19} \times 4 = 8\text{cm}$

$$\frac{38}{19} \times 7 = 14\text{cm}$$

$$\frac{38}{19} \times 8 = 16\text{cm}$$

2. Find the value of x and y in the following equations:

$$32x + 51y = 1010$$

$$23x + 42y = 710$$

Solution

$$(3x + 2) + (5y + 1) = 10 \quad \Rightarrow 3x + 5y = 7$$

$$(2x + 3) + (4y + 2) = 7 \quad \Rightarrow 2x + 4y = 2$$

Solving the set of equations, we have $x = 9$ and $y = -4$

$$\frac{3x}{2} = \frac{\sqrt{x}}{8}$$

3.(a) If 4 find x.

$$4$$

(b) A shopkeeper gained 8% by selling a table for ₦2,700.00. What is the cost price of the table?

Solution

$$\frac{3x}{2} = \frac{\sqrt{x}}{8} + 8$$

(a) 4 find x

$$4$$

$$3x \quad 3x$$

$$4 \times 2^x = 2^{2x} \times 2^{3x}$$

$$\frac{\sqrt{x}}{4} = \frac{2^{\frac{2}{2}}}{2^{\frac{3}{2}}} = 2^{\frac{3-2}{2}}$$

$$\frac{\sqrt{x}}{4} = 2^{\frac{1}{2}}$$

$$\frac{\sqrt{x}}{4} = 2^{\frac{1}{2}} \implies \sqrt{x} = 4 \times 2^{\frac{1}{2}} = 4 \times \sqrt{2} = 4\sqrt{2}$$

- (b) Selling price = 108% = ₦2,700
 Cost price = 100% = $\frac{100}{108} \times ₦2,700 = ₦2500$

4(a) Simplify $\log_3 54 + \log_3 15 - \log_3 10$

(b) If -8, x, y, 19 are a sequence in arithmetic progression (A.P), find the value of x and y

Solution

(a) $\log_3 54 + \log_3 15 - \log_3 10 = \log_3 \frac{54 \times 15}{10}$
 $= \log_3 81$
 $= \log_3 3^4 = 4 \log_3 3 = 4$

(b) $T_4 = 19 = -8 + (4 - 1)d$ Solving to get $d = 9$
 $x = -8 + 9 = 1, y = 1 + 9 = 10$

ALITER: $d = x + 8 = y - x \implies 2x - y = -8$
 or $19 - y = y - x \implies x + 2y = 19$

Solving simultaneously, we have
 $2x - y = -8 \dots\dots\dots (1)$
 $-x + 2y = 19 \dots\dots\dots (2)$
 $2x - y = -8 \dots\dots\dots (1) \times 2$

$$-x + 2y = 19 \dots\dots\dots (2) \times 1$$

$$4x - 2y = -16$$

$$\underline{-x + 2y = 19}$$

$$3x = 3$$

$$x = 1$$

Substitute for x in equation (1)

$$2x - y = -8$$

$$2(1) - y = -8$$

$$y = -8 - 2$$

$$-y = -10 \quad \square \quad y = 10$$

5. (a) A diagonal of a rectangle is 15cm. If the length is 3cm greater than the breadth, find the perimeter of the rectangle.

(c) The exterior angles of a pentagon are $4x^\circ$, $3x^\circ$, $(x - 60)^\circ$, $2x^\circ$ and 50° , find the value of x

(d)

Solution

(a) Let the breadth be x cm, then length = (x + 3) cm we

$$\text{have } 15^2 = x^2 + (x + 3)^2 \quad \square \quad x^2 + 3x - 108 = 0$$

Solving, we get x = 9 or -12

$$\text{Perimeter} = 2(9+12) \text{ cm} = 42\text{cm}$$

(b) $4x^\circ + 3x^\circ + (x - 60)^\circ + 2x^\circ + 50^\circ = 360^\circ$ Solving, we

$$\text{get } x = 37^\circ$$

6(a) Express U in terms of V and W in the equation:

V

U

$$\frac{\sqrt{3}}{U} \square \frac{W}{U}$$

(b) In a school, 115 students sat for an examination and the results were as follows:

Six - nine students passed Physics, 70 passed Chemistry and 80 passed Mathematics. Of these, 45 passed both Chemistry and Mathematics and 44 passed both Mathematics and Physics. Given that 14 of them passed all the three subjects, find the number of students who passed ONLY

(i) Physics

(ii) Chemistry (iii) Mathematics, and (iv) One of three subjects.

Solution

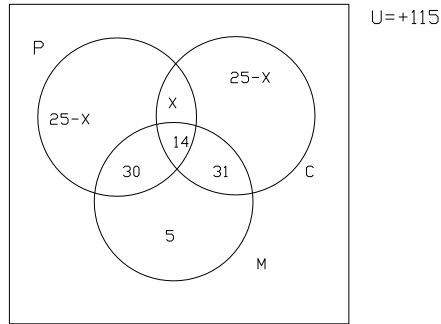
(a) Removing the fraction: $V(U+W) = \sqrt{3} U$

$$VU + VW = \sqrt{3} U$$

$$\sqrt{3} U - VU = VW$$

$$(\sqrt{3} - V) U = VW$$

$$U = \frac{VW}{\sqrt{3} - V}$$



(b)

$$80 + 25 - x + x + 25 - x = 115$$

Solving we get $x = 15$

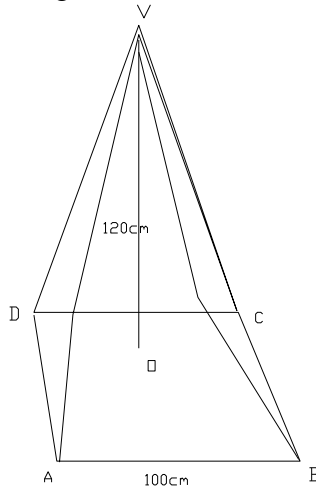
(i) Physics only = $25 - 15 = 10$

(ii) Chemistry = $25 - 15 = 10$

(iii) Mathematics only = 5

(iv) One of the three subjects = $10 + 10 + 5 = 25$

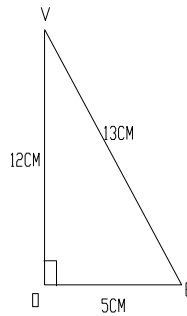
7. VABCD is a solid pyramid on a square base ABCD and has vertex V. The height of the pyramid, VO, is 12cm and the length AB is 10cm.



Calculate the:

- (a) total surface area and
- (b) volume, of the pyramid.

Solution



If VE is the height of any of the
 triangular faces. $VE^2 = 12^2 + 5^2$
 $VE = 13$ (Accept the use of
 Pythagoras' triple)

Area of each of the triangular faces = $4 \times \frac{1}{2} \times 12 \times 5 = 120 \text{ cm}^2$

Area of the square base = $10^2 = 100 \text{ cm}^2$

- (a) Total surface area = $(260 + 100) \text{ cm}^2 = 360 \text{ cm}^2$
- (b) Volume = $(\frac{1}{3} \times 12 \times 100) \text{ cm}^3 = 400 \text{ cm}^3$

8.(a) Two perfect dice are thrown together. Calculate the probability that the sum is (i) 9 or 10 (ii) at most 5

(b) An aero plane flies at 650km per hour along the parallel of latitude from a point X (15°S, 10°W) to Y (15°S, 48°E). Calculate the time spent by the aero plane to fly from X to Y to the nearest 1 hour (Take R = 6400km and $\pi = 3.142$).

Solution

- (a) Prob. (sum = 9) =

$$\text{Prob (sum = 10)} = \frac{4}{36} = \frac{1}{9}$$

$$(i) \quad \text{Prob} \quad \frac{3}{36} = \frac{1}{12} \quad (\text{sum} = 9 \text{ or } 10) =$$

$$(ii) \quad \text{At most} \quad \frac{1}{9} + \frac{1}{12} = \frac{7}{36} \quad 5, \text{ we have } (1,1) (1,2) (1,3) (1,4) (2,1) (2,2) \\ (2,3) \quad (3,1) (3,2) \text{ and } (4,1)$$

$$\text{Prob. (sum} = \text{at most } 5) = \frac{10}{36} = \frac{5}{18} \approx 0.28$$

- (b) $R = 6400 \cos 15^\circ = 6181.8$
 Angle between X and Y along the parallel = 58° .

$$\text{Distance } XY = \frac{58^\circ}{360^\circ} \times 2 \times 3.142 \times 6181.8$$

$$\text{Simplifying to get } /XY/ = 6258.55$$

$$\text{Time spent} = \frac{6258.55}{650} = 9.6 \text{ hours}$$

$$= 10 \text{ hrs to the nearest 1 hr.}$$

9. Using a ruler and a pair of compasses only, construct a triangle PQR in which $\angle PQR = 30^\circ$, $/PQ/ = 7\text{cm}$ and $/PR/ = 8\text{cm}$.
- (a) Construct a locus l which is always 5cm from the point P and which intercepts PQ and PR at M and N respectively.
- (b) What type of shape is MNRQ?
- (c) Construct line QX, the shortest distance from Q to PR
- (d) Measure $/QX/$ and $\angle PQR$

Solution

For constructing $/PQ/ = 7\text{cm}$

For constructing $\angle PQR = 30^\circ$

For completing $\triangle PQR$ and $/PR/ = 8\text{cm}$

- (a) For locus l = circle of radius 5cm. Drawing line MN to have MNRQ
- (b) The shape of MNRQ is a quad or trapezium.
- (c) Constructing \perp from Q to PR
- (d) For $/QX/ = 5.8 \pm 0.2\text{cm}$
 $\angle PQR = 30^\circ$

- 10 (a) Use logarithm tables to evaluate

$$\sqrt[4]{3.415^4 + 28.91}$$

, correct to 3 significant figures

0.267

(b) Given that $\log_{10}2 = 0.3010$ and $\log_{10}7 = 0.8451$, evaluate, without the use of tables, $\log_{10}3.92$

Solution

(a)

Number	Log
3.415	0.5334
$(3.415)^4$	2.1336
28.91	1.4611(+)
	3.5947
0.267	1.4265 (-)
	$4.1682 \div 2$
121.3	2.0841

Anti log of 2.0841 = 121.3
= 121 correct to 3 significant figures

(b)
$$\log_{10} 3.92 = \log_{10} \frac{392}{100} = \log_{10} 2^3 - \log_{10} 7 - \log_{10} 10^2$$

$$= 3\log_{10}2 + 2\log_{10}7 - 2\log_{10}10$$

$$= (3 \times 0.3010) + (2 \times 0.8451) - 2$$

$$= 2.3932 - 2$$

$$= 0.5932$$

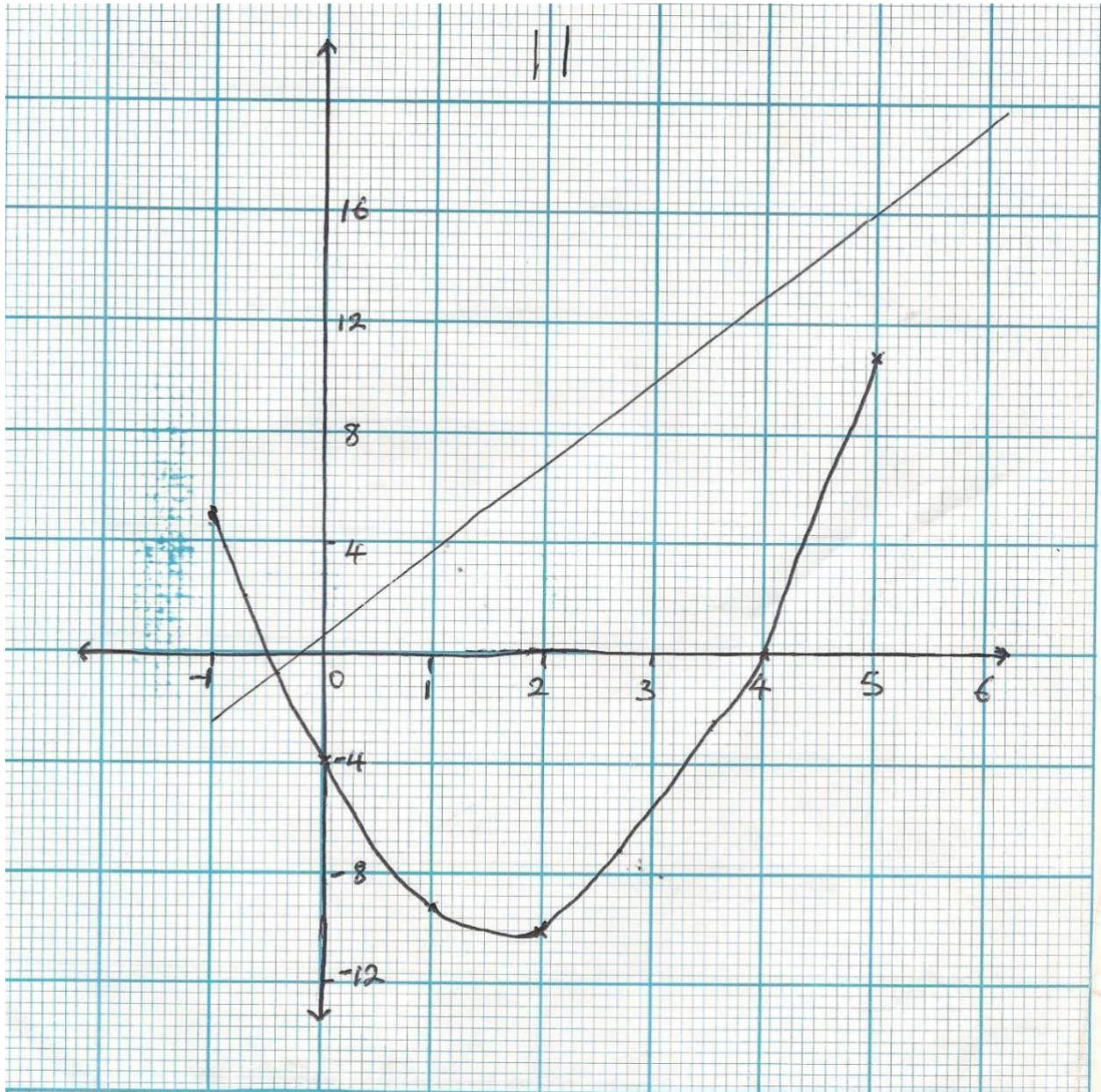
11 Construct a table of values for $-1 \leq x \leq 5$ for the function $y = 2x^2 - 7x - 4$

- (a) Using your table of values, plot the graph of $y = 2x^2 - 7x - 4$ taking 2cm to represent 1 unit and 4 units on the x-axis and y-axis respectively.
- (b) On the same axes and with the same scale, draw the graph of $y = 3x + 1$
- (c) Use your graphs to find the

- (i) least value of $y = 2x^2 - 7x - 4$ and the corresponding value(s) of x
(ii) roots of the equation $2x^2 - 10x - 5 = 0$

Solution

x	-1	0	1	2	3	4	5
y	5	-4	-9	-10	-7	0	11



For correct axes and scale plotting his points (-1/2 for each error)

- (c) Drawing line $y = 3x + 1$
 (d) Least value = -10.02 ± 0.05
 Corresponding value of $x = 1.85 \pm 0.05$
 Root of equation $2x^2 - 10x - 5 = 0$
 $x = -0.4 \pm 0.05$

12(a) Below are amounts of money given to 15 students as gifts in a school, in Nigeria

2, 3, 7, 5, 3, 9, 5, 6, 4, 5, 6, 6, 7, 5, 9

Calculate:

- (i) mean

- (ii) mode, and
- (iii) median, to the nearest ten kobo

(b) Three men provided capitals of ₦1000.00, ₦2000.00 and ₦6000.00 for a business on the understanding that the shares of the profit were proportional to the capital provided. If the profits were ₦450.00, what should each receive?

Solution

(a) $\text{Mean} = \frac{\text{₦}[2 + (3 \times 2) + 4 + (5 \times 4) + (6 \times 3) + (7 \times 2) + (9 \times 2)]}{15} = \frac{\text{₦}82}{15} = \text{₦}5.47$

$= \text{₦}5.50$

(ii) Mode = ₦5.00

(iii) The 8th term after arranging in ascending order of magnitude, median = ₦5.00

(b) Ratio of sharing: ₦1000: ₦2000: ₦6000 or 1:2:6

Share profit = $\frac{1}{9} \times \text{₦}450 = \text{₦}50.00$
 $= \frac{2}{9} \times 450 = 100.00$
 $= \frac{6}{9} \times 450 = \text{₦}300.00$

13(a) If ₦1,680.00 amounts to ₦1,890.00 at 5% per annum, find the time of interest.

(b) The rateable value of a town is ₦438,400.00. The local council has to estimate for an increase of ₦15,600.00 in Education costs. What is the rate of this increase, to the nearest half kobo?

(c) A good costing 300 dollars was imported into Nigeria. If ₦150.00 was exchanged for 1 dollar and an import duty of 9½% was paid, find, in Naira, the

- (i) duty paid on the good, and
- (ii) selling price of the good in order to make 20% profit.

Solution

(a) Profit = ₦1890 - ₦1680 = ₦210

Time of interest = $\frac{100 \times 210}{1680 \times 5}$ year

Simplifying we get 2½ years.

(b) Rate of the increase = $\frac{15600}{438400} \times 100\%$

$$= 3.558k = 3\frac{1}{2} k$$

(c) Cost of good in Naira = $300 \times \text{₦}150$
 $= \text{₦}45000.00$

(d) Import duty = $\frac{19}{200} \times 45000$
 $= \text{₦}4,275.00$

(e) Total cost of importing the good = $\text{₦} (45000 + 4275)$
 $= \text{₦}49,275.00$

Selling price to make 20% gain
 $= \frac{120}{100} \times \text{₦} 49275$
 $= \text{₦}59,130.00$

14. A man buys a car worth $\text{₦}250,000.00$ on hire purchase. He pays $\text{₦}100,000.00$ on delivery and is to pay the balance at an installment of $\text{₦}40,000.00$ yearly for three years. If compound interest is charged at 5% per annum by the seller, calculate the:

- (a) amount he pays for the car
- (b) balance he is to pay and
- (c) company's percentage profit, at the end of the three years.

Solution

$$I = \frac{PTR}{100}$$

Amount to pay interest on = 150,000

1st year: Interest = 5% of 150,000 = 7,500

$$\text{Balance after paying } \text{₦}40,000 = \text{₦} (150,000 + 7500 - 40,000)$$
$$= \text{₦}117,500$$

2nd year: Interest = $\frac{5}{100} \times 117,500$
 $= \text{₦}5875$

Balance $\text{₦} (123, 375 - 40,000) = \text{₦}83,375$ (Note: $117, 500 + 5, 875 = 123, 375$)

$$\begin{aligned} \text{3rd year: interest} &= \frac{5}{100} \times \text{N}83,375 \\ &= 4168.75 \end{aligned}$$

$$\text{Balance} = (87,543.75 - 40,000)$$

$$= \text{N}47,543.75$$

$$\begin{aligned} \text{Total interest} &= \text{N} (7,500 + 5,875 + 4,168.75) \\ &= \text{N}17,543.75 \end{aligned}$$

$$\begin{aligned} \text{(a) He pays} &= \text{N} (250,000 + 17,543.75) \\ &= \text{N}267,543.75 \end{aligned}$$

$$\begin{aligned} \text{(b) Balance he is to pay} &= \text{N} (87,543.75 - 40,000) \\ &= \text{N} 47,543.75 \end{aligned}$$

$$\begin{aligned} \text{(c) Percentage profit he is to pay} &= \frac{17,543.75}{250,000} \times 100 \\ &= 7.02\% \approx 7\% \end{aligned}$$

15. A man bought N12,000.00 4% stock at 85 and 800 75k shares at 90k each. If the broker's commission was ½ % on the stock and 1¼% per share on shares, calculate the:

- (i) broker's commission on the stock and shares
- (ii) total amount invested, and
- (iii) yearly income derived from the stock

Solution

Stock: N12,000 paid = market value + Broker's commission

Broker's commission = ½ % = 0.5% market

□ value (consideration) = $\frac{100}{100.5} \times \text{N}12,000$

$$= \text{N}11,940.30$$

$$= \text{N}11,940.30$$

□ brokers commission = N(12,000 - 11,940.30)

$$= \text{N}59.70$$

Nominal value = $\frac{100}{85} \times \text{N}11,940.30$

$$= \text{N}14,047.41$$

$$= \text{N}14,047.41$$

Shares: Market Value = $\frac{90}{100} \times \text{N}800$

$$\begin{aligned} & 100 \\ & = \text{N} 720 \end{aligned}$$

$$\begin{aligned} \text{Nominal Value} &= \frac{75}{100} \times \text{N}800 \end{aligned}$$

$$= \text{N}600$$

$$\begin{aligned} \text{Broker's Commission} &= \frac{5}{400} \times 720 \end{aligned}$$

$$= \text{N}9$$

(i) Broker's total commission = $(59.70 + 9)$
 $= \text{N}68.70$

(ii) Total amount invested = $\text{N}12,000 + \text{N}720 + \text{N}9 = \text{N}12,729$

(iii) Yearly income from stock = $\frac{4}{100} \times 14047.41$
 $= \text{N}5,618.96$