Please Kindly make corrections on number 19 and 20 based on the M/s

M/s

SUKELLEMO JOINT MOCK

NAME.. Admission Number..........

CLASS................................ Date....................

121/2 MATHEMATICS Paper 2

Time: $2\frac{1}{2}$ hours

Kenya Certificate of Secondary Education

MOCK EXAMINATIONS DECEMBER 2020

Instructions to candidates

Write your name, stream and index number in the spaces provided at the top of this page

This paper contains two sections: ***Section I and Section II***

Answer all questions in section I and any five in section II

Show all the steps in your calculations giving your answer at each stage in the spaces provided below each question.

Marks may be given for correct working even if the answer is wrong.

Non programmable *silent electronic calculators and KNEC mathematical table may be used except where stated otherwise*

For examiner's use only

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	TOTAL

17	18	19	20	21	22	23	24	TOTAL

This paper consists of 15 printed pages.

Candidates should check the question paper to ensure that all the pages are printed as indicated and no questions are missing

SECTION I (50 MARKS). **Attempt all the questions in this section.**

1. Find the selling price of 6 kg of a mixture of maize flour and millet flour if 4 kg of maize flour costing sh. 60 per kg is mixed with 6 kg of millet flour costing sh. 45 per kg and a profit of 20% is realized. (3 marks)

B.P per Kg $= \frac{(4\times60)+(6\times45)}{4+6}$

$=$ sh. 51 M1

B.P of 6Kg $= 51\times6 =$ sh. 306 M1

S.P per Kg $=$

$\frac{120}{100} \times 306$

$=$ sh. 367.20 A1

3

2. If x = 9.6, y= 3.60 and z = 5 are measurements, find the percentage error in the calculation of $\frac{x+y}{z}$, giving your answer to three significant figures. (3 marks)

Maximum value $=$

$\frac{9.65+3.605}{4.5} = 2.9456$

Minimum value $=$

$\frac{9.55+3.595}{5.5}$

$= 2.39$ M1

Actual value $= \frac{9.6+3.60}{5}$

$= 2.64$

Absolute error $= \frac{2.9456-2.39}{2}$

$= 0.2778$ M1

Percentage error $= \frac{0.2778}{2.64} \times 100\%$

$= 10.5\%$ A1

3

3. Solve the equation $\log_2(x^2-4) - \log_2(x+2) = -4$ (3 marks)

$\log_2 \frac{x^2-4}{(x+2)} = \log_2 2^{-4}$ M1

$\frac{(x+2)(x-2)}{(x+2)} = 2^{-4}$

$x-2 = \frac{1}{16}$ M1

$x = 2 + \frac{1}{16}$

$x = 2\frac{1}{16}$ A1

3

9

4. Form a quadratic equation whose roots are $2.5 + \sqrt{3}$ *and* $2.5 - \sqrt{3}$ giving your answer in the form $ax^2 + bx + c = 0$ where a, b and c are integers (3 marks)

$x = 2.5 + \sqrt{3}$, $x = 2.5 - \sqrt{3}$

$(x - 2.5 - \sqrt{3})(x - 2.5 + \sqrt{3}) = 0$ M1

$x^2 - 2.5x + \cancel{x\sqrt{3}} - 2.5x + 6.25 - 2.5\sqrt{3} - \cancel{x\sqrt{3}} + 2.5\sqrt{3}$
$- 3 = 0$.

$4 \times (x^2 - 5x + 3.25 = 0)$ M1 (3)

$= \underline{4x^2 - 20x + 13 = 0}$ A1

5. Make b the subject of the formula. (3 marks

$$x = \frac{a}{\sqrt{(a-b)(a+b)}}$$

$x = \dfrac{a}{\sqrt{a^2 - b^2}}$

$x^2 = \dfrac{a^2}{a^2 - b^2}$ M1

$a^2 = a^2x^2 - b^2x^2$

~~$b^2x^2 = a^2x^2 - b^2x^2$~~

$b^2x^2 = a^2x^2 - a^2$ M1

$b^2 = \dfrac{a^2x^2 - a^2}{x^2}$ (3)

$b^2 = a^2 - \dfrac{a^2}{x^2}$

$b = \pm\sqrt{a^2 - \dfrac{a^2}{x^2}}$ A1

6. Express in surd form and simplify by rationalizing the denominator. (3 marks)

$$\frac{3\sin 45° - 2\cos 30°}{\tan 30°}$$

$\sin 45° = \dfrac{1}{\sqrt{2}} \cdot \dfrac{\sqrt{2}}{\sqrt{2}} = \dfrac{\sqrt{2}}{2}$

$\cos 30° = \dfrac{\sqrt{3}}{2}$ M1

$\tan 30° = \dfrac{1}{\sqrt{3}} \cdot \dfrac{\sqrt{3}}{\sqrt{3}} = \dfrac{\sqrt{3}}{3}$

$\dfrac{\dfrac{3\sqrt{2}}{2} - 2\left[\dfrac{\sqrt{3}}{2}\right]}{\dfrac{\sqrt{3}}{3}}$

$= \dfrac{3\sqrt{2} - 2\sqrt{3}}{\dfrac{2\sqrt{3}}{3}}$ M1

$= \dfrac{(9\sqrt{2} - 6\sqrt{3})\sqrt{3}}{2\sqrt{3} \cdot (\sqrt{3})}$

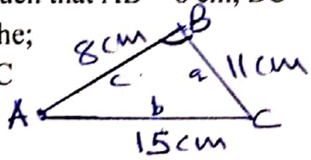
$= \dfrac{9\sqrt{6} - 18}{6}$. A1 (3)

$= \dfrac{3\sqrt{6} - 6}{2}$ or $\dfrac{3\sqrt{6}}{2} - 3$

9

7. Triangle ABC is such that AB = 8 cm, BC = 11 cm and AC = 15 cm. calculate correct to 2 decimal places the;

a) Angle ABC (2 marks)



$b^2 = a^2 + c^2 - 2ac\cos B$

$15^2 = 11^2 + 8^2 - 2(11\times 8)\cos B$ M1

$225 = 185 - 176\cos B$

$176\cos B = -40$

$\cos B = -0.2273$

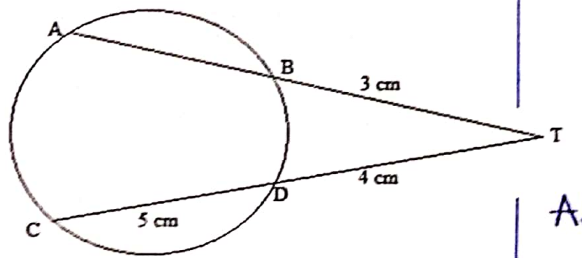
$B = \underline{103.14^\circ}$ A1 (2)

b) Radius of the circum circle (2 marks)

$\frac{15}{\sin 103.14^\circ} = 2R$ M1

$R = 7.70\text{cm}$ A1 (2)

8. In the figure below, the chords CD and AB intersect externally at T. DT = 4 cm, BT = 3 cm and CD = 5 cm. calculate the length AB. (3 marks)



$AT \cdot BT = CT \cdot DT$

$(AB+3)\cdot 3 = 9\times 4$ M1

$AB + 3 = \frac{36}{3}$

$AB = 12 - 3$ M1

$= \underline{9\text{ cm}}$ A1 (3)

9. Solve the following equation for $0^0 \leq x \leq 360^0$ $2\cos x = sin^2x + 2$ (3 marks)

$2\cos x = 1 - \cos^2 x + 2$

$\cos^2 x + 2\cos x - 3 = 0$ M1

$p = \cos x$

$p^2 + 2p - 3 = 0$ (3)

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

$p(p+3) - 1(p+3) = 0$

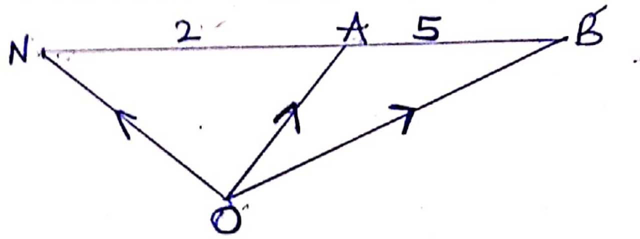
$p = 1$ or -3 (N/A) M1

$\cos x = 1$

(9) $x = 0^\circ, 360^\circ$ A1

10

10. Given that A (4, -2, 6) and B (-3, 1, -2) and that a point N divides AB in the ratio -2:7. Find the vector **ON** in terms of **i, j** and **k**. (3 marks)



$\vec{AB} = \begin{bmatrix} -3 \\ 1 \\ -2 \end{bmatrix} - \begin{pmatrix} 4 \\ -2 \\ 6 \end{pmatrix} = \begin{pmatrix} -7 \\ 3 \\ -8 \end{pmatrix}$

$\vec{NB} = \frac{7}{5}\begin{bmatrix} -7 \\ 3 \\ -8 \end{bmatrix} = \begin{bmatrix} -9.8 \\ 4.2 \\ -11.2 \end{bmatrix}$ M1 $\cancel{6.8i +}$

$\vec{ON} = \vec{OB} + \vec{BN}$

$\begin{pmatrix} -3 \\ 1 \\ -2 \end{pmatrix} + \begin{pmatrix} -9.8 \\ 4.2 \\ -11.2 \end{pmatrix}$ M1

$= \begin{pmatrix} 6.8 \\ -3.2 \\ 9.2 \end{pmatrix}$

$6.8i - 3.2j + 9.2k$ A1

3

11. The equation of a circle is given by $\frac{2}{3}x^2 + \frac{2}{3}y^2 - 4x + 2\frac{2}{3}y - 2 = 0$. Determine the centre and the radius of the circle. (3 marks)

$\frac{3}{2} \times \left(\frac{2}{3}x^2 + \frac{2}{3}y^2 - 4x + 2\frac{2}{3}y - 2 = 0\right)$

$= x^2 + y^2 - 6x + 4y - 3 = 0$ M1

$x^2 - 6x + 9 + y^2 + 4y + 4 = 3 + 9 + 4$

$(x-3)^2 + (y+2)^2 = 4^2$ M1

Centre $= (3, -2)$

Radius $= 4$ units A1

3

$\frac{9}{3} \times \frac{3}{2}$

12. Expand $\left(1 + \frac{2x}{3}\right)^8$ in ascending powers of x up to the fourth term. Hence use your expansion to evaluate $(0.98)^8$ to three significant figures. (3 marks)

$1 + 8\left(\frac{2x}{3}\right)^1 + 28\left(\frac{2x}{3}\right)^2 + 56\left(\frac{2x}{3}\right)^3$

$= 1 + \frac{16x}{3} + \frac{112x^2}{9} + \frac{448x^3}{27}$ B1

$\left(1 + \frac{2x}{3}\right) = [1 + (-0.02)]$

$\frac{2x}{3} = -0.02$

9

$x = -0.03$

3

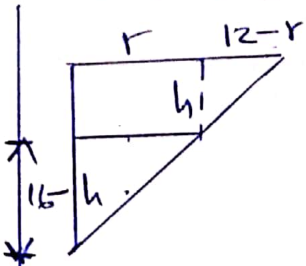
$(0.98)^8 =$

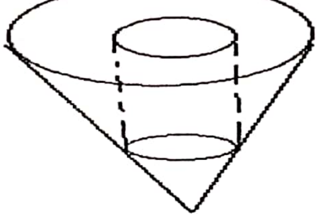
$1 + \frac{16}{3}(-0.03) + \frac{112}{9}(-0.03)^2 + \frac{448}{27}(-0.03)^3$ M1

$1 - 0.16 + 0.0112 - 0.000448$

$= 0.851$ A1

13. Find the base radius of a cylindrical hole with maximum volume which can be drilled into a cone of height 16 cm and radius 12 cm as shown below. (3 marks)





$\cancel{\frac{12}{16}}$ $\frac{r}{12} = \frac{16-h}{16}$.

$16r = 12(16-h)$

$\frac{4}{3}r = 16 - h$.

$h = 16 - \frac{4}{3}r$ M1

$V = \pi r^2 h$.

$= \pi r^2 (16 - \frac{4}{3}r)$

$= 16\pi r^2 - \frac{4}{3}\pi r^3$.

$\frac{dv}{dr} = 32\pi r - 4\pi r^2$ M1

At max, $\frac{dv}{dr} = 0$.

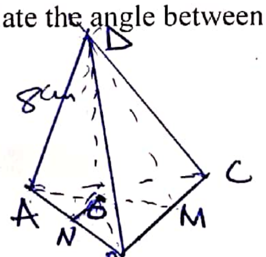
$4\pi r(8 - r) = 0$ 3

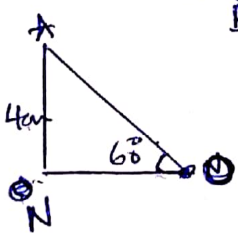
$r = 0$ or 8
ignore

$r = \underline{8\text{ cm}}$ A1

14. ABCD is a regular tetrahedron. AB=BC=CA=AD=BD=CD= 8cm.

* a) Calculate the angle between line AD and plane ABC. (2 marks)

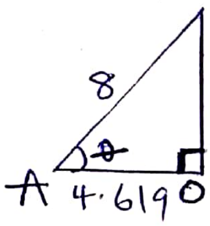




$\sin 60° = \frac{4}{AO}$ M1

$AO = \frac{4}{\sin 60°}$

$= 4.619\text{cm}$



$\cos\theta = \frac{4.619}{8}$ A1 4

$\theta = 54.73°$

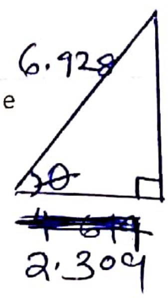
b) Calculate the angle between planes ABD and ABC (2 marks)

~~cos~~
$\tan 60 = \frac{4}{x}$

2.309

$h = \sqrt{8^2 - 4^2}$

$\underline{6.928\text{cm}}$



M1 2

$\cos\theta = \cancel{\frac{4.619}{6.928}}\ \frac{2.309}{6.928}$

$\theta = 70.53°$ A1

7

15. A contractor intends to transport 1000 bags of cement using a lorry and a pick up. The lorry can carry a maximum of 80 bags while a pick up can carry a maximum of 20 bags. The pickup has to make more than twice the number of trips the lorry makes and the total number of trips has to be less than 30. The cost per trip is sh 2000 for the lorry and sh 900 for the pickup and the contractor wishes to minimize cost. Let x and y be the trips for the lorry and pickup respectively.

a) State the objective function. (1 mark)

$2000x + 900y$ B1

3

b) Write down all the inequalities which govern the condition above. (2 marks)

$y > 2x$ B1 Any correct 2

$x + y < 30$ B1

$80x + 20y \geq 1000$, $4x + y \geq 50$. B1

[redacted].

16. The first, second and fifth terms of an arithmetic sequence are the first three consecutive terms of a geometric sequence. Find the common ratio (3 marks)

$a, a+d, a+4d$

$$\frac{a+d}{a} = \frac{a+4d}{a+d} \quad M1$$

$$a(a+4d) = (a+d)^2$$

$$a^2 + 4ad = a^2 + 2ad + d^2$$

$$2ad = d^2$$

$$2a = d \quad M1$$

Common ratio $(r) =$

$$\frac{a+2d}{a} = \frac{a+2a}{a}$$

$$= \frac{3a}{a} = \underline{\underline{3}} \quad A1$$

3

6

SECTION II (50 marks)

17. Using a ruler and a pair of compasses only for all constructions in this question.

a) Construct triangle ABC in which AB = 6 cm, BC = 7 cm and angle ABC = 75° (3 marks)

b) Find locus X such that AX = 3 cm (1 mark)

c) On the same side of BC as A, construct the locus of P such that angle BPC = 120° (3marks)

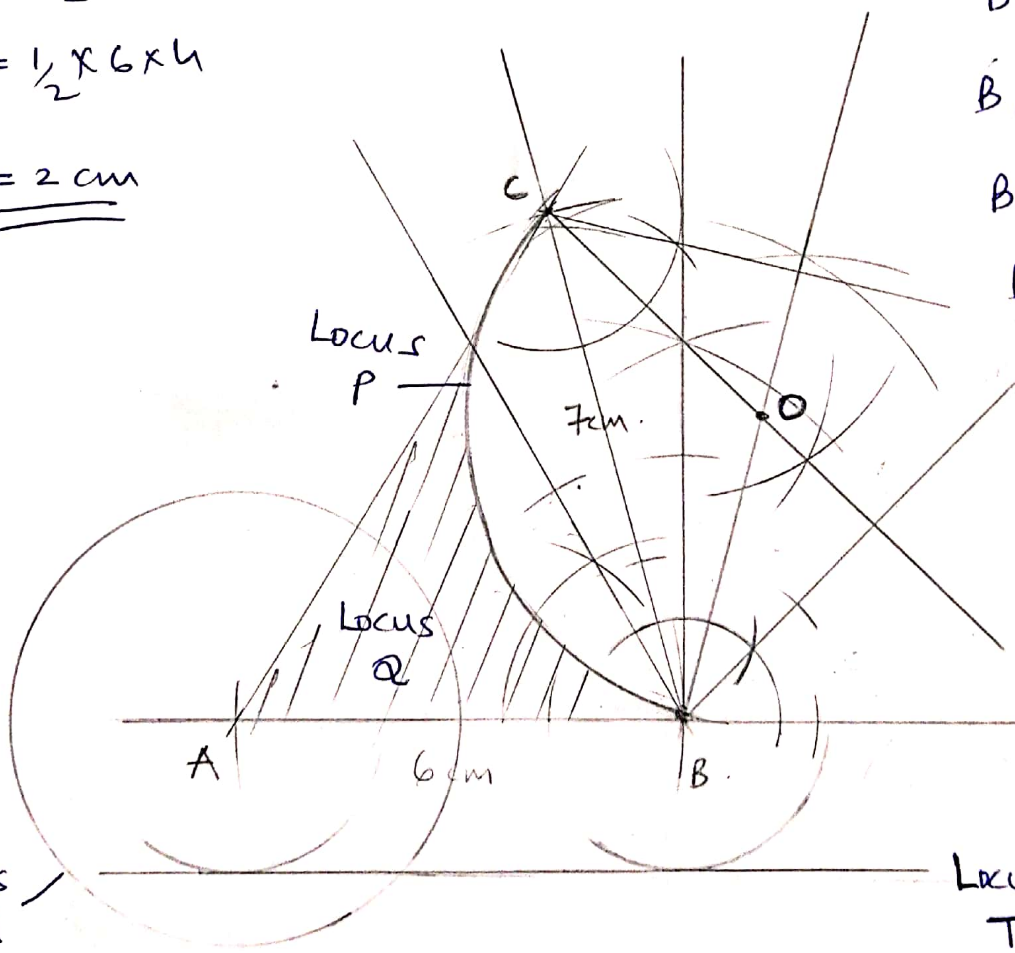
d) Show by shading the locus of Q inside triangle ABC such that angle $BPC \geq angle\ BQC$. (1 mark)

e) On the side of AB opposite C, construct the locus of T such that the area of triangle ATB = 6 cm² (2 marks)

$A = \frac{1}{2} \times b \times h$

$6 = \frac{1}{2} \times 6 \times h$

$h = 2\ cm$



Locus X

Locus T

B_1 $\angle 75°$

B_1 AC

B_1 ΔABC

B_1 Locus X

B_1 $\angle 30°$

B_1 Centre O

B_1 Locus P

B_1 shaded part

B_1 $(h = 2cm)$

B_1 Locus T.

10

Class	x	$d = x - A$	f	fd	fd^2	c.f.
130 − 139	134.5	−30	8	−240	7200	8
140 − 149	144.5	−20	10	−200	4000	18
150 − 159	154.5	−10	11	−110	1100	29
160 − 169	164.5	0	18	0	0	47
170 − 179	174.5	10	14	140	1400	61
180 − 189	184.5	20	12	240	4800	73
190 − 199	194.5	30	7	210	6300	80

B1

$\Sigma f = 80$

$\Sigma fd = 40$ B1

$\Sigma fd^2 = 24{,}800$ B1

18. The data below shows the heights of students in a class.

Height	130 -139	140 -149	150-159	160-169	170-179	180-189	190-199
Frequency	8	10	11	18	14	12	7

a) Using assumed mean of 164.5, calculate the mean and the standard deviation (5 marks)

5

$$\text{Mean} = A + \frac{\Sigma fd}{\Sigma f} \quad B1$$

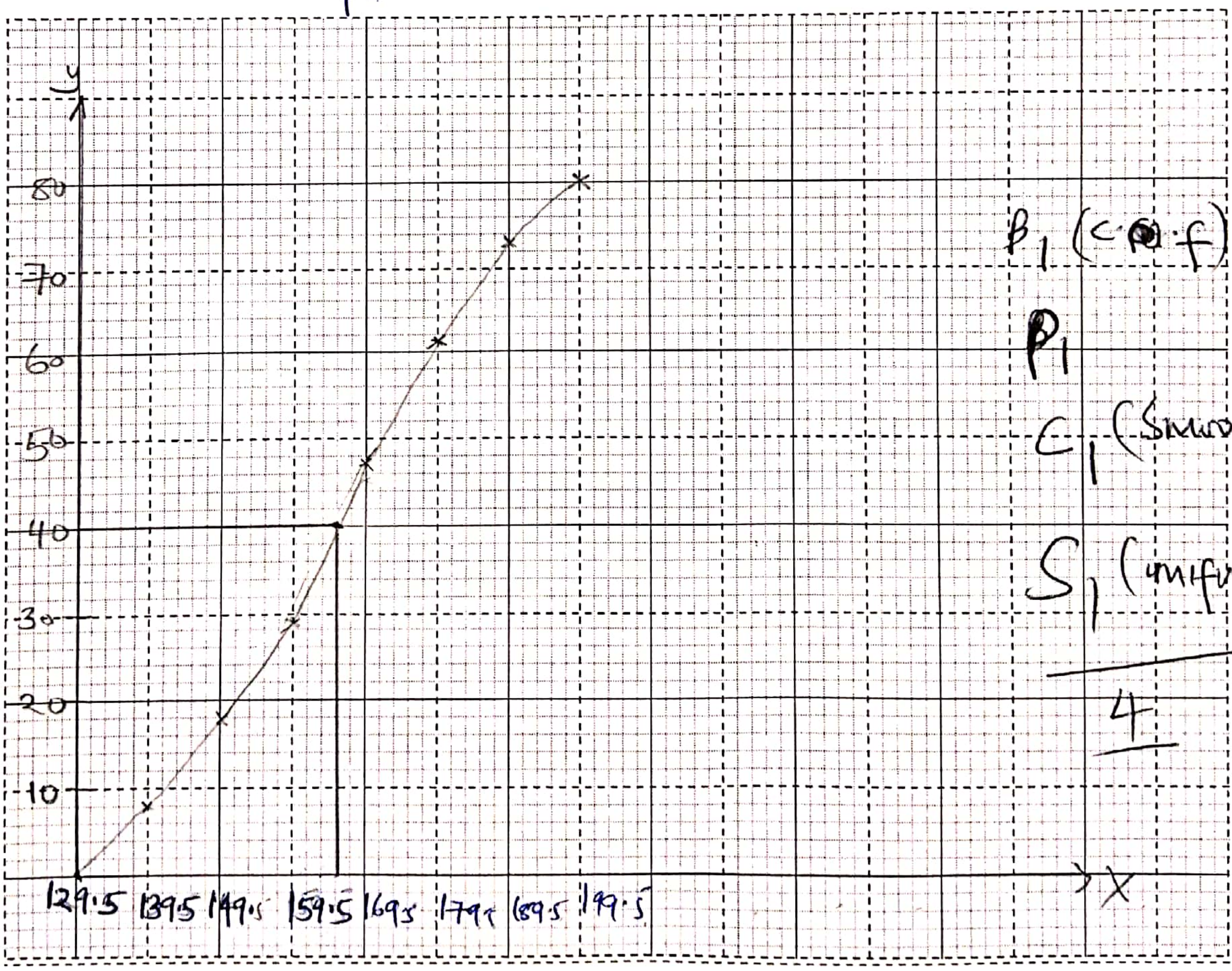
$$= 164.5 + \frac{40}{80} = \underline{165}$$

$$\text{Standard deviation} = \sqrt{\frac{\Sigma fd^2}{\Sigma f} - \left(\frac{\Sigma fd}{\Sigma f}\right)^2}$$

$$= \sqrt{\frac{24800}{80} - \left(\frac{40}{80}\right)^2} \quad B1$$

$$= \underline{17.60}$$

b) Draw a cumulative frequency curve on the grid provided and use it to estimate the median ~~c.f~~ (5 marks)



c.f

Upper class limits

B1 (c.f)

B1

C1 (Smooth

S1 (uniform)

4

1

$\text{Median} = \frac{1}{2} \times 80$

$= 40.$

From cumulative frequency curve, Median $= \underline{165.5}$ B1

10

19. P varies directly as the cube of Q and inversely as the square root of R

a) Given that P = 35 when Q = 8 and R = 144, find P when Q = 20 and R = 225

(5 marks)

$P \propto \frac{Q^3}{\sqrt{R}}$, $P = \frac{KQ^3}{\sqrt{R}}$.

$35 = \frac{K \times 8 \times 8 \times 8}{\sqrt{144}}$ M1

$35 = \frac{512K}{12}$.

$K = \frac{105}{128}$. M1

$P = \frac{105Q^3}{128\sqrt{R}}$. M1

$P = \frac{105 \times 20^3}{128 \times \sqrt{225}}$

$= \frac{105 \times 8000}{128 \times 15}$ M1

5

$= 437.5$ A1

b) If Q decreases by 24% and R increases by 40% find the percentage change in P.

(5 marks)

Original value of P

$= \frac{KQ^3}{\sqrt{R}}$.

New value =

$\frac{K \times (0.76Q)^3}{\sqrt{1.4R}}$. M1

$= \frac{0.438976KQ^3}{1.1832\sqrt{R}}$.

$= 0.3710 \frac{KQ^3}{\sqrt{R}}$. M1

Change $= (0.3710 - 1)\frac{KQ^3}{\sqrt{R}}$

$= -0.6290 \frac{KQ^3}{\sqrt{R}}$ M1

% change $= \frac{-0.6290}{1} \times 100$ M1

5

$= -62.90\%$

P has decreased by 62.90% A1

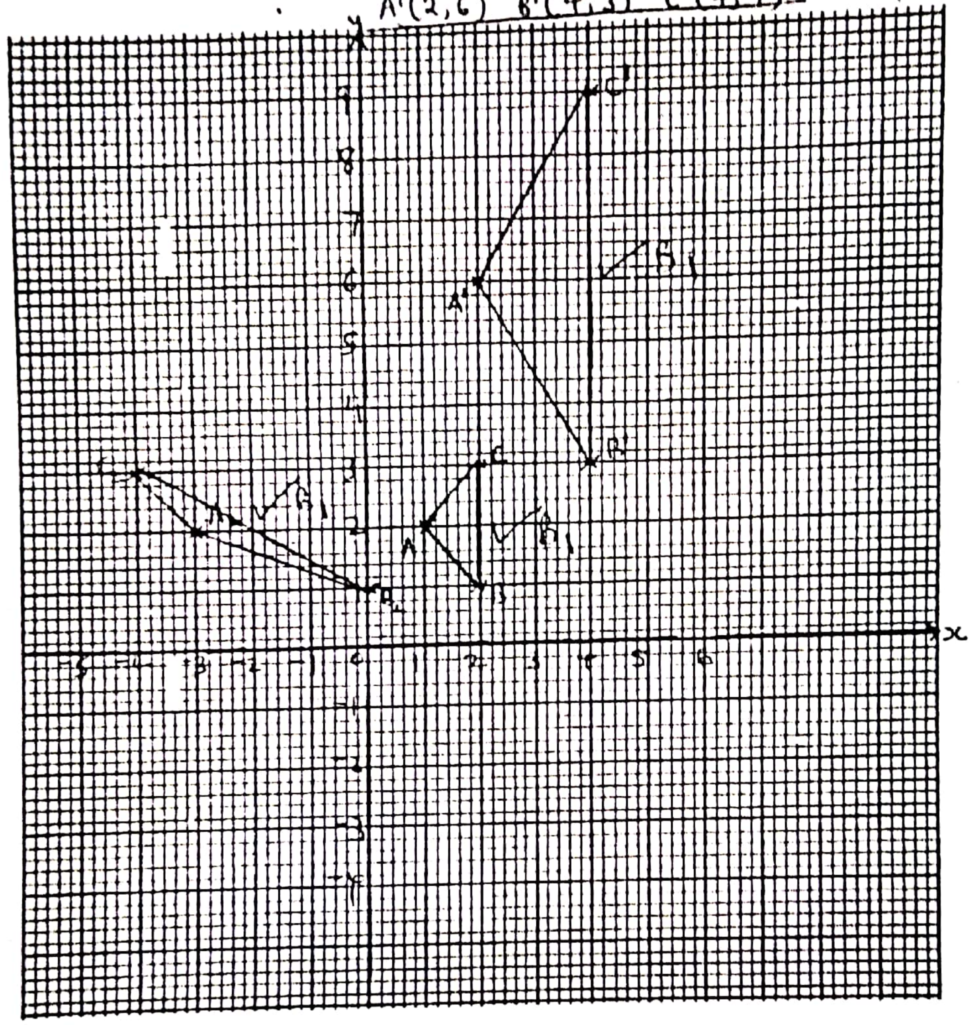
10

20. The triangle ABC has vertices A(1,2), B(2,1) and C(2,3) $A_1B_1C_1$ is the image of ABC under the transformation given by the matrix $\begin{pmatrix} 2 & 0 \\ 0 & 3 \end{pmatrix}$

$$\begin{pmatrix} 2 & 0 \\ 0 & 3 \end{pmatrix}\begin{array}{c} \begin{array}{ccc} A & B & C \end{array} \\ \begin{pmatrix} 1 & 2 & 2 \\ 2 & 1 & 3 \end{pmatrix} \end{array} = \begin{array}{c} \begin{array}{ccc} A' & B' & C' \end{array} \\ \begin{pmatrix} 2 & 4 & 4 \\ 6 & 3 & 9 \end{pmatrix} \end{array}$$

a) What are the co-ordinates of $A_1B_1C_1$? Plot ABC and $A_1B_1C_1$ on the same axis (3 marks)

$A'(2,6)$ $B'(4,3)$ $C'(4,9)$ ✓B_1



b) State the ratio of the areas of the two triangles and use the area of ABC to calculate the area of $A_1B_1C_1$ (3 marks)

Ratio of the areas of 2 triangles = determinant of matrix
$= (2\times3) - (0\times0) = 6$
Thus ratio $= \underline{6:1}$ ✓B_1 (Accept 6 or $\frac{1}{6}$ or 1:6)
Area of $\triangle ABC = \frac{1}{2}\times2\times1 = 1$ square unit ✓B_1
Area of $\triangle A_1B_1C_1 = 1\times6 = 6$ square units ✓B_1

c) If $A_2B_2C_2$ is the image ABC under the transformation given by the matrix $\begin{pmatrix} 1 & -2 \\ 0 & 1 \end{pmatrix}$

Find the co-ordinates of $A_2B_2C_2$ Plot $A_2B_2C_2$ and describe the transformation fully. (4 marks)

10

$$\begin{pmatrix} 1 & -2 \\ 0 & 1 \end{pmatrix}\begin{array}{c} \begin{array}{ccc} A & B & C \end{array} \\ \begin{pmatrix} 1 & 2 & 2 \\ 2 & 1 & 3 \end{pmatrix} \end{array} = \begin{array}{c} \begin{array}{ccc} A_2 & B_2 & C_2 \end{array} \\ \begin{pmatrix} -3 & 0 & -4 \\ 2 & 1 & 3 \end{pmatrix} \end{array}$$

$A_2(-3,2)$ $B_2(0,1)$ $C_2(-4,3)$ ✓B_1

(B_1 – Shear with x axis invariant
B_1 – A point not on invariant line and its image)

The transformation is a shear parallel to the x axis with the x axis invariant, shear factor −2. The image of A(1,2) is $A_2(-3,2)$ ✓B_1 ✓B_1

N/B Shear factor not a must!

N/B A shear is described fully by giving
(i) Invariant line
(ii) A point not on the invariant line and its image

21. a) An industrialist has 460 litres of a chemical which is 75% pure. She mixes it with a chemical of the same type but 90% pure so as to obtain a mixture which is 78% pure. Find the amount of the 90% pure chemical used. (3 marks)

$\frac{75}{100} \times 460 = 345$ litres

Let 90% pure chemical use be x

$345 + \frac{90}{100}x = \frac{78}{100}(460+x)$ M1

$345 + 0.9x = 358.8 + 0.78x$ M1

$0.12x = 13.8$

$x = 115$ litres A1

3

b) Three machines A, B and C are set to work together. A working alone takes 6 hours to complete the work; B takes 8 hours while C takes 12 hours. All the three machines started working at the same time. 40 minutes later machine A broke down. B and C continued for another 1 hour before B ran out of fuel and therefore stopped working for 20 minutes while C continued. If B resumed working after 20 minutes, calculate the:

(i) Fraction of the work left after machine A broke down. (2 marks)

In 1hr $\frac{1}{6} + \frac{1}{8} + \frac{1}{12} = \frac{3}{8}$

In 40 minutes $= \frac{40}{60} \times \frac{3}{8} = \frac{1}{4}$ M1

Fraction left

$= 1 - \frac{1}{4} = \frac{3}{4}$ A1

2

(ii) Fraction of the work done by C working alone for 20 minutes (2 marks)

1hr $= \frac{1}{12}$

20 min ?

$\frac{20}{60} \times \frac{1}{12} = \frac{1}{36}$ M1 A1

2

(iii) Total time taken for the work to be completed. (3 marks)

In 1hr B & C $= \frac{1}{8} + \frac{1}{12} = \frac{5}{24}$

$\frac{3}{4} - \frac{5}{24} = \frac{13}{24}$, $\frac{13}{24} - \frac{1}{36} = \frac{37}{72}$ M1

$\frac{5}{24} = 1$hr.

$\frac{37}{72} = \frac{37}{72} \times \frac{24}{5} = 2\frac{7}{15}$ hrs. M1

Time =

40min + 1hr 20min

+ 2hrs 28min

= 4hrs 28min A1

3

10

22. The table below shows taxation rates in Kenya

Monthly taxable income (kshs p.m)	Tax rate %
1-9680	10
9681-18800	15
18801-27920	20
27921-37040	25
37041 and above	30

A civil servant is provided with a house and pays a nominal rent of sh 6260 per month. In addition the government gives him taxable allowances amounting to sh 16000 per month. He is entitled to a personal relief of sh 1520 per month. He has a life insurance policy for which he pays sh 1200 per month and claims insurance relief at the rate of sh 3 per k£. The civil servant's PAYE is sh 6900.Apart from PAYE and insurance his other monthly deductions are WCPS 2% of basic salary, HELB loan sh 4000 and cooperative shares sh 600. Calculate his:

a) Taxable income per month. (6 marks)

Gross Tax = Net tax + Relief = 6900 + 1520 + $\left(\frac{3}{20} \times 1200\right)$ = sh. 8600 M1

9680×0.1 = sh. 968
9120×0.15 = sh. 1368 +
9120×0.20 = sh. 1824
9120×0.25 = sh. 2280
sh. 6440 M1

8600 − 6440 = sh. 2160 M1

6

$y \times 0.30 = 2160$
y = sh. 7200

~~Taxable income = 7200 + 9680 + 18800 + 27920~~

Taxable income = $7200 + (9120 \times 3) + 9680$ M1
= sh. 44,240 A1

b) Basic salary per month (2 marks)

Taxable income = (1.15 B.S) + Allowances − NR

$44240 = 1.15x + 16000 - 6260$ M1

$1.15x = 34{,}500$ x = sh. 30,000 A1

2

c) Net monthly pay. (2 marks)

Total deductions = $6900 + 1200 + \left(\frac{12}{100} \times 30{,}000\right) + 4000 + 600$
= sh. 13,300

Net monthly pay = $44{,}240 - (0.15 \times 30{,}000) - 13{,}300$ M1
= sh. 26,440 A1

2

10.

23. The probability of James, Tyson and David passing an examination are $\frac{4}{5}$, $\frac{3}{4}$ and $\frac{2}{3}$ respectively. Find the probability that in one attempt:

(a) only one passes the examination. (2 marks)

$$\left(\frac{1}{3}\times\frac{4}{5}\times\frac{1}{4}\right)+\left(\frac{3}{4}\times\frac{1}{5}\times\frac{1}{3}\right)+\left(\frac{2}{3}\times\frac{1}{5}\times\frac{1}{4}\right) \quad M_1$$

$$=\frac{1}{15}+\frac{1}{20}+\frac{1}{30}=\frac{3}{20} \quad A_1 \quad 2$$

(b) All the three passes the examination. (2 marks)

$$\frac{4}{5}\times\frac{3}{4}\times\frac{2}{3} \; M_1 =\frac{2}{5} \quad A_1 \quad 2$$

(c) Two pass the examination. (2 marks)

$$\left(\frac{4}{5}\times\frac{3}{4}\times\frac{1}{3}\right)+\left(\frac{3}{4}\times\frac{2}{3}\times\frac{1}{5}\right) M_1 +\left(\frac{4}{5}\times\frac{2}{3}\times\frac{1}{4}\right)$$

$$=\frac{1}{5}+\frac{1}{10}+\frac{2}{15}=\frac{13}{20} \quad A_1 \quad 2$$

(d) None passes the examination. (2 marks)

$$\frac{1}{5}\times\frac{1}{4}\times\frac{1}{3} \; M_1 =\frac{1}{60} \quad A_1 \quad 2$$

(e) At least one passes the examination. (2 marks)

$$1-\frac{1}{60} \; M_1 =\frac{59}{60} \quad A_1 \quad 2$$

10

24. An aero plane left town P ($65^0N, 15^0E$) to another town Q ($65^0N, 165^0W$) at a speed of 200 knots using the shortest route. Take $\pi = \frac{22}{7}$ and radius of the earth R= 6370 km.

a) (i) Calculate the distance travelled in nautical miles. (2 marks)

$\theta = 180° - (65+65) = 50°$

$D = 60 \times 50 \overset{M1}{=} \underline{3000nm}$ A1 2

(ii) Calculate the time taken to travel from P to Q in hours. (2 marks) 2

$Time = \frac{D}{S} = \frac{3000nm}{200 knots}$ M1 $= \underline{15 \text{ hours}}$ A1

b) Another plane left P at 1.30 pm local time and travelled to T ($65^0N, 60^0E$) along a parallel of latitude. Calculate the:

(i) Distance between P and T to the nearest km (3 marks)

Longitude difference $= 60 - 15 = 45°$ M1

Distance (km) $= \frac{\theta}{360} 2\pi R\cos\alpha$.

$\frac{45}{360} \times 2 \times \frac{22}{7} \times 6370 \times \cos 65$ M1

$= \underline{2115 \text{ km}}$ A1 3

(ii) Local time of arrival at town T if the plane flew at the speed of 470 km/h (3 marks)

$Time = \frac{2115.2}{470} = 4 hrs \ 30 \ minutes$ M1

$\frac{45 \times 4}{60} = 3 hrs.$ 3

Time at T = 1:30pm $\overset{M1}{+}$ $4\frac{1}{2}$ + 3 hrs.

$= \underline{9.00pm}$ A1

10