

Name:ADM:Class:

School: **MARKING SCHEME**

Mathematics Paper 2

TIME: 2 ½ Hours

FEBRUARY 2022

BUNAMFAN FORM 4 EXAM2022

INSTRUCTIONS TO CANDIDATES

1. Write your name, Admissionnumber, class and school.
2. The paper contains two sections: Section I and II
3. Answer ALL questions in section I and ANY FIVE questions from section II.
4. All working and answers must be written on the question paper in the spaces provided below each question.
5. Marks may be awarded for correct working even if the answer is wrong.
6. Negligent and slovenly work will be penalized.
7. Non-programmable silent electronic calculators and mathematical tables are allowed for use.

FOR EXAMINERS USE ONLY

SECTION I

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

SECTION II

GRAND TOTAL

17	18	19	20	21	22	23	24	TOTAL

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This paper consists 14 of printed pages.

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

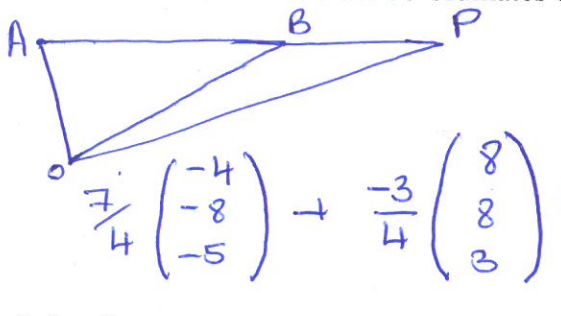
SECTION 1 (50marks)

(Answer all questions in this section)

1. The length and width of a rectangle were measured as 12.4cm and 5.0cm respectively. Find to 4 significant figures, the percentage error in calculating the area of the rectangle (3mks)

$$\begin{aligned}
 \text{W.A} &= 12.4 \times 5.0 = 62 \\
 \text{max A} &= 12.45 \times 5.05 = 62.8725 \\
 \text{min A} &= 12.35 \times 4.95 = 61.1325 \\
 \text{A.E} &= \frac{62.8725 - 61.1325}{2} = 0.87 \\
 &= \frac{0.87}{62} \times 100 = 1.403\%
 \end{aligned}$$

2. The co-ordinates of a point A is (2, 8, 3) and B is (-4, -8, -5). A point P divides AB externally in the ratio 7 : 3. Determine the co-ordinates of P (3mks)



$$\frac{7}{4} \begin{pmatrix} -4 \\ -8 \\ -5 \end{pmatrix} + \frac{-3}{4} \begin{pmatrix} 2 \\ 8 \\ 3 \end{pmatrix} = \begin{pmatrix} -7 \\ -14 \\ -35/4 \end{pmatrix} + \begin{pmatrix} -6 \\ -6 \\ -9/4 \end{pmatrix} = \begin{pmatrix} -13 \\ -20 \\ -11 \end{pmatrix}$$

$P = (-13, -20, -11)$

3. Solve for x:

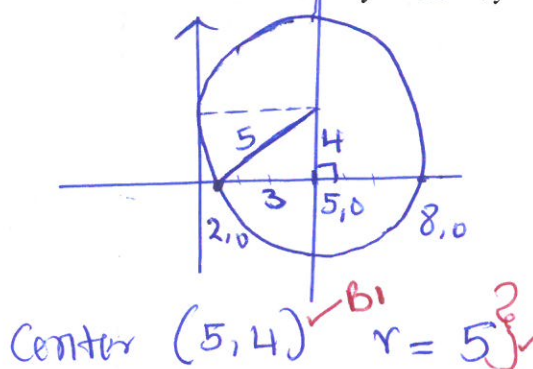
Solve for x: $(\log_3 x)^2 - \frac{1}{2} \log_3 x = \frac{3}{2}$ (3mks)

Let $\log_3 x$ be a.

$$\begin{aligned}
 a^2 - \frac{1}{2}a &= \frac{3}{2} \\
 2a^2 - a - 3 &= 0 \\
 (a+1)(2a-3) &= 0
 \end{aligned}$$

$a = -1$ or $a = \frac{3}{2}$
 $\log_3 x = -1$ or $\log_3 x = 1.5$
 $x = 3^{-1} = \frac{1}{3}$ or $x = 3^{1.5} = 5.196$

4. A circle is tangent to the y-axis and intersects the x-axis at (2,0) and (8,0). Obtain the equation of the circle in the form $x^2 + y^2 + ax + by + c = 0$, where a, b and c are integers (4mks)



$$\begin{aligned}
 (x-5)^2 + (y-4)^2 &= 5^2 \\
 x^2 - 10x + 25 + y^2 - 8y + 16 &= 25 \\
 x^2 + y^2 - 10x - 8y + 16 &= 0
 \end{aligned}$$

Center (5,4) $r = 5$

5. Solve for X in the equation:

$$2 \sin^2 x - 1 = \cos^2 x + \sin x, \text{ for } 0^\circ \leq x \leq 360^\circ$$

(3mks)

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

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

$$3 \sin^2 x - \sin x - 2 = 0 \quad \checkmark m_1$$

$$3a^2 - a - 2 = 0$$

$$(3a+2)(a-1) = 0$$

$$a = -\frac{2}{3} \text{ and } a = 1 \quad \checkmark A_1$$

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

$$\sin x = 1$$

$$\sin^{-1} \frac{2}{3} = 41.81^\circ$$

$$x = 90^\circ$$

$$x = 221.81, 318.19$$

$$x = 90^\circ, 221.81^\circ, 318.19^\circ \quad \checkmark B_1$$

6. Make P the subject of the formula

(3mks)

$$T = \sqrt[3]{\frac{P^2 + n}{m^2}} + R$$

$$[T-R]^3 = \sqrt[3]{\frac{P^2 + n}{m^2}}$$

$$\frac{P^2 + n}{m^2} = [T-R]^3 \quad \checkmark m_1$$

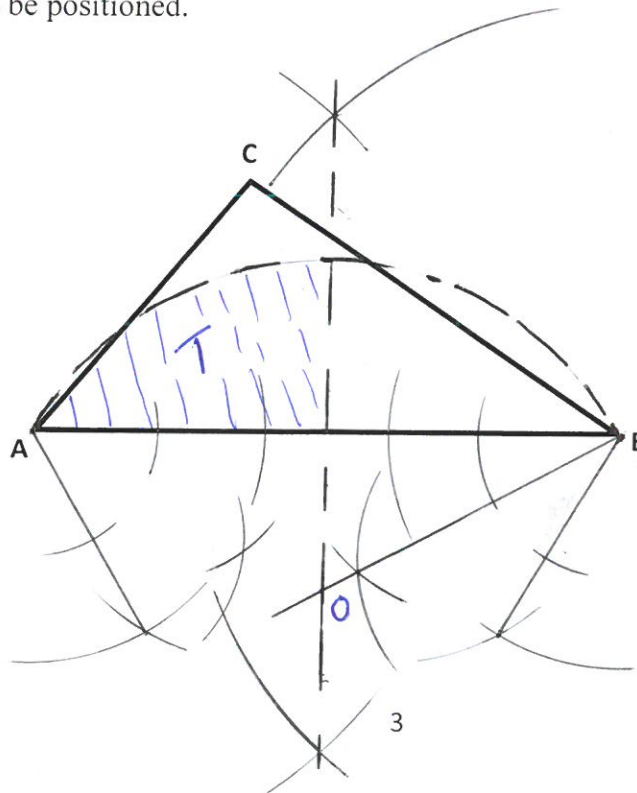
$$P^2 + n = m^2 [T-R]^3$$

$$P^2 = m^2 [T-R]^3 - n \quad \checkmark m_1$$

$$P = \sqrt{m^2 [T-R]^3 - n} \quad \checkmark A_1$$

7. The figure below represents a flower garden ABC. A tap T is to be placed inside the triangle such that it is nearer A than B and angle ATB is greater than 120° . By construction, show the region T where the tap can be positioned.

(4mks)



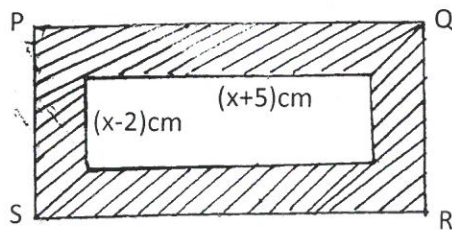
→ broken bisector of AB $\checkmark B_1$

→ center O located $\checkmark B_1$

→ Arc AB (dotted) $\checkmark B_1$

→ Region T identified $\checkmark B_1$

8. PQRS is a rectangle whose area 170cm^2 . The internal rectangle measures $(x+5)\text{cm}$ by $(x-2)\text{cm}$.



Determine the area of the shaded part if the thickness of this part is $0.1x$ cm (4mks)

$$1 \quad (1.2x+5)(1.2x-2) = 170 \quad \checkmark m_1$$

$$1.44x^2 + 3.6x - 180 = 0$$

$$2x^2 + 5x - 250 = 0$$

$$x = \frac{-5 \pm \sqrt{25 + 2000}}{4} \quad \checkmark m_1$$

$$x = -12.5, \quad x = 10$$

$$\therefore x = 10 \quad \checkmark A_1$$

$$(10+5)(10-2) = 120$$

Shaded Area

$$= 170 - 120$$

$$= 50 \text{ cm}^2 \quad \checkmark B_1$$

9. Find the length of an arc of a circle which subtends an angle of 0.8 radians at the center of the circle. The radius of the circle is 15 cm. (2mks)

$$\frac{l}{15} = 0.8 \quad \checkmark m_1$$

$$l = 12 \text{ cm} \quad \checkmark A_1$$

10. A map has a scale of $1:25\,000$. On this map a square piece of land is represented by an area of 2cm^2 . Calculate the actual area in hectares of the land. (2mks)

$$A.S.F = 1 : 25\,000^2$$

$$\text{Actual Area} = \frac{25\,000^2 \times 2}{10\,000}$$

$$= 125\,000 \text{ m}^2 \quad \checkmark B_1$$

$$\frac{125,000}{10,000}$$

$$12.5 \text{ Ha} \quad \checkmark B_1$$

11. A dealer has two types of grades of tea, A and B. Grade A costs shs.140 per kg while grade B costs shs.160 per kg. determine the ratio he should mix A and B so that he makes a 60% profit when he sells the mixture at shs.232 per kg. (3mks)

$$\text{COST} = \frac{232}{160} \times 100 = 145$$

$$\frac{140A + 160B}{A + B} = 145 \quad \checkmark m1$$

$$140A + 160B = 145A + 145B$$

$$15B = 5A \quad \checkmark m1$$

$$\frac{A}{B} = \frac{3}{1}$$

$$A : B$$

$$3 : 1 \quad \checkmark A1$$

ACCEPT

A : B

$$140 \quad 160$$

$$\begin{array}{c} 145 \\ \swarrow \quad \searrow \\ 15 \quad \checkmark B1 \quad 5 \quad \checkmark B1 \end{array}$$

$$3 : 1 \quad \checkmark B1$$

12. The data below shows marks scored by 8 form four students in Molo district mathematics contest 44, 32, 67, 52, 28, 39, 46, 64. Calculate the mean absolute deviation of the data. (3mks)

$$\bar{x} = \frac{44 + 32 + \dots + 64}{8} = 46.5$$

$$d = -2.5, -14.5, 20.5, 5.5, -18.5, -7.5, -0.5, 17.5 \quad \checkmark m1$$

$$\frac{\sum |d|}{N} = \frac{2.5 + 14.5 + \dots + 17.5}{8} \quad \checkmark m1$$

$$= 10.875 \quad \checkmark A1$$

13. A variable y varies as the square of x and inversely as the square root of z. Find the percentage change in y when x is changed in the ratio 5:4 and z reduced by 19% (3mks)

$$y \propto \frac{x^2}{\sqrt{z}}$$

$$y = \frac{kx^2}{\sqrt{z}}$$

$$x' = \frac{5}{4}x = 1.25x$$

$$z' = 0.81z$$

$$y' = \frac{k \cdot (1.25x)^2}{\sqrt{0.81z}} \quad \checkmark m1$$

$$= \frac{1.5625}{0.9} \frac{kx^2}{\sqrt{z}}$$

$$y' = 1.736111$$

$$\% = [1.736111 - 1] \times 100 = 73.61\%$$

$$z \text{ increases by } 73.61\% \quad \checkmark A1$$

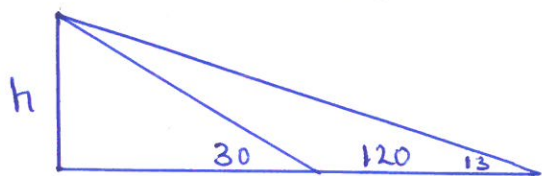
14. Simplify $\frac{2\sqrt{2}}{1+\sqrt{2}} - \frac{\sqrt{2}}{1-\sqrt{2}} = a+b\sqrt{c}$ leaving your answer in the form $a+b\sqrt{c}$, where a, b and c are rational numbers. (3mks)

$$\frac{2\sqrt{2}}{1+\sqrt{2}} - \frac{\sqrt{2}}{1-\sqrt{2}} = \frac{2\sqrt{2}[1-\sqrt{2}] - \sqrt{2}[1+\sqrt{2}]}{1^2 - [\sqrt{2}]^2} \quad \checkmark m1$$

$$\frac{2\sqrt{2} - 4 - \sqrt{2} - 2}{1 - 2} \quad \checkmark m1 \text{ denominator rational}$$

$$\frac{-6 + \sqrt{2}}{-1} = 6 - \sqrt{2} \quad \checkmark A1$$

15. When a man is standing at a point x, he observes that the angle of elevation of the top of a flag post is 13° , he walks 120 m towards the flag post and the angle of elevation is 30° . If the eyes of the man are 1.5m from the ground, find the height of the flag post. (4mks)



$$\tan 13 = \frac{h}{x}$$

$$\tan 30 = \frac{h}{x-120}$$

$$x \tan 13 = \tan 30 (x-120) \quad \checkmark m1$$

$$x = \frac{120 \tan 30}{\tan 30 - \tan 13}$$

$$= 199.96 \text{ m} \quad \checkmark A1$$

accept 199.97

$$h = 199.96 \tan 13 \quad \checkmark m1$$

$$h = 46.16 \text{ m}$$

$$\text{height} = 46.16 + 1.5$$

$$\underline{47.66 \text{ m}} \quad \checkmark A1$$

16. Find the value of x given that matrix T below has no inverse. (3mks)

$$T = \begin{bmatrix} x+1 & 2 \\ 4x & 2x \end{bmatrix}$$

$$2x[x+1] - 8x = 0 \quad \checkmark m1$$

$$2x^2 + 2x - 8x = 0$$

$$2x^2 - 6x = 0$$

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

$$x(x-3) = 0 \quad \checkmark m1$$

$$\therefore x = 0 \quad \text{OR} \quad x = 3 \quad \checkmark A1$$

SECTION II 50 marks

(Answer only five questions in this Section)

17. A tank has two water taps P and Q and another tap R. When empty the tank be filled by tap P alone in 5 hours or by tap Q in 3 hours. When full the tank can be emptied in 8 hours by tap R

a) The tank is initially empty. Find how long it would take to fill up the tank

- i) If tap R is closed and taps P and Q are opened at the same time.

(2mks)

$$\frac{1}{5} + \frac{1}{3} = \frac{8}{15} \quad \checkmark \text{ m1}$$
$$\text{Time} = \frac{15}{8} = 1\frac{7}{8} \text{ hours} \quad \checkmark \text{ A1}$$

Accept 1.875

- ii) If all the three taps are opened at the same time. Giving your answer to the nearest minute.

(2mks)

$$\frac{8}{15} - \frac{1}{8} = \frac{49}{120} \quad \checkmark \text{ m1}$$
$$2\frac{22}{49} \text{ hrs}$$

2 hours 27 mins \checkmark A1
or 147 mins

- b) Assume the tank initially empty and the three taps are opened as follows;

P at 8:00 am, Q at 9:00 am and R at 9:00 am

- i) Find the fraction of the tank that would be filled by 10:00 am.

(3mks)

$$\left[\frac{1}{5} \times 2\right] + \left[\frac{1}{3} \times 1\right] + \left[\frac{1}{8} \times 1\right] = \checkmark \text{ m1}$$
$$2\frac{1}{5} + \frac{1}{3} + \frac{1}{8} \quad \checkmark \text{ m1}$$
$$= \frac{73}{120} \quad \checkmark \text{ A1}$$

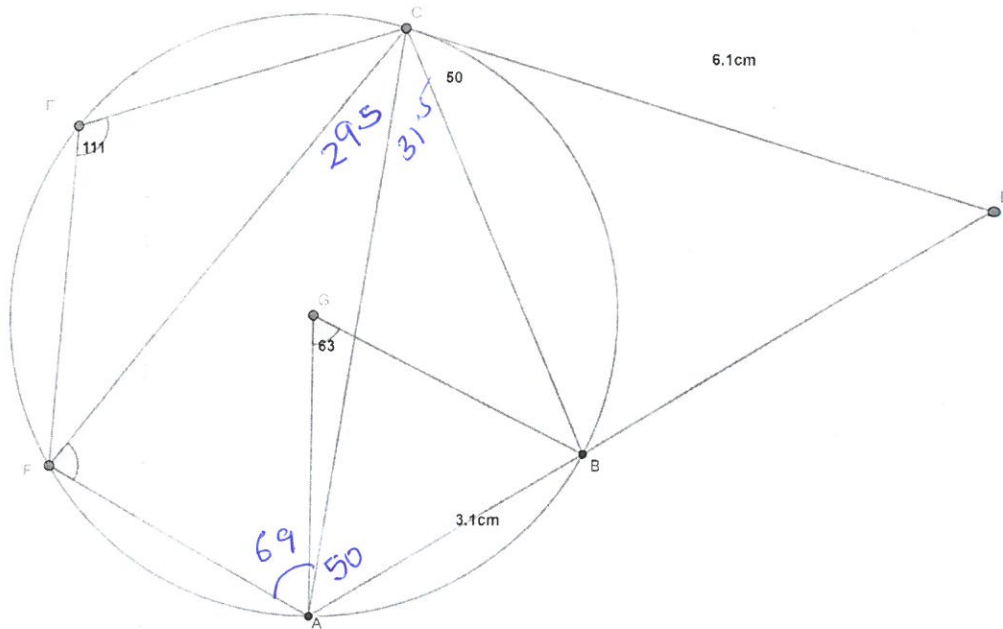
- ii) Find the time the tank would be fully filled up. Give your answer to the nearest minute.

(3mks)

$$\text{Remaining} = 1 - \frac{73}{120} = \frac{47}{120} \quad \checkmark \text{ m1}$$
$$1 \text{ hour} = \frac{49}{120}$$
$$x = \frac{47}{120}$$
$$x = \frac{47}{120} \times \frac{120}{49} \quad \checkmark \text{ A1}$$
$$\Rightarrow 57.55 \text{ mins}$$
$$\approx 58 \text{ mins}$$

10.58 am \checkmark B1

18. In the figure below, G is the center of the circle. $\angle DCB = 50^\circ$, $\angle AGB = 63^\circ$ and $\angle FEC = 111^\circ$



(a) Determine the size of the following angles

- i. $\angle FAC$ (1mk)

$$180 - 111$$

$$= \underline{69^\circ} \checkmark B1$$
- ii. $\angle BAC$ (1mk)

$$\angle DCB = \angle BAC$$

$$= \underline{50^\circ} \checkmark B1$$
- iii. $\angle ACB$ (1mk)

$$\angle ACB = \frac{1}{2} \angle AGB$$

$$= \frac{1}{2} \times 63 = \underline{31.5^\circ} \checkmark B1$$
- iv. $\angle ACF$ (1mk)

$$\angle ACB = 180 - (69 + 50) = 61$$

$$\angle ACF = 61 - 31.5$$

$$= \underline{29.5^\circ} \checkmark B1$$
- v. $\angle AFC$ (1mk)

$$180 - (69 + 29.5) = \underline{81.5^\circ} \checkmark B1$$

(b) DC is a tangent to the circle at C and its length is 6cm. AD is a straight line and chord AB is 3.1cm. Determine

(i) The length of BD

$$x(3.1 + x) = 6.1^2 \checkmark m1$$

$$x^2 + 3.1x = 37.21$$

$$x^2 + 3.1x - 37.21 = 0$$

$$\frac{-3.1 \pm \sqrt{9.61 + 148.84}}{2}$$

$$\frac{-3.1 \pm 12.59}{2} \quad (2\text{mks})$$

$$x = -7.845 \quad \cancel{x} = 4.745$$

$$\therefore BD = 4.745 \checkmark A1$$

(ii) Area of triangle ABC

(3mks)

$$\frac{3.1}{\sin 31.5} = \frac{BC}{\sin 50} \checkmark m1$$

$$BC = \frac{3.1 \sin 50}{\sin 31.5}$$

$$= 4.545 \checkmark A1$$

$$A = \frac{1}{2} \times 4.545 \times 3.1 \sin 98.5$$

$$= 6.967 \checkmark B1$$

19. The table below shows the income tax rates in a certain year.

Annual taxable income in Kenya shillings	Tax rate in %
0-144000	0%
144 001 -300 000	10
300 001 - 468 000	15
468 001 -648 000	20
648 001-840 000	25
Above 840 000	30

During that year Kurenta's annual gross tax in sixth band was Shs 108 000.

(a) Determine Kurenta's annual gross tax. (3mks)

$$\begin{array}{l}
 \text{1st band} = 0 \\
 \text{2nd } \frac{10}{100} \times 156,000 = 15,600 \\
 \text{3rd } \frac{15}{100} \times 168,000 = 25,200 \\
 \text{4th } \frac{20}{100} \times 180,000 = 36,000 \\
 \text{5th } \frac{25}{100} \times 192,000 = 48,000 \\
 \text{6th} = 108,000
 \end{array}
 \left. \vphantom{\begin{array}{l} \\ \\ \\ \\ \\ \\ \end{array}} \right\} \text{mi}$$

$$\begin{array}{r}
 15,600 + 25,200 + 36,000 \\
 + 48,000 + 108,000 \\
 \hline
 = 232,800 \quad \checkmark \text{ A1}
 \end{array}$$

(b) If he enjoyed annual relief of Shs. 21 000, determine his monthly net tax (P.A.Y.E)(2mks)

$$= \frac{232,800 - 21,000}{12} \quad \checkmark \text{mi}$$

$$= 17,650 \quad \checkmark \text{A1}$$

(c) Kurenta had a basic salary of Shs X Shs p.a. and enjoyed **non-taxable** allowances that is equivalent to 45% of basic salary. Determine Kurenta's gross salary p.m. (3mks)

$$\begin{array}{l}
 \text{6th band} = \frac{30}{100} \times x = 108,000 \quad \checkmark \text{B1} \\
 x = 360,000 \\
 \text{Taxable Income} = 360,000 + 840,000 \\
 = 1,200,000 \quad \checkmark \text{B1}
 \end{array}
 \left. \vphantom{\begin{array}{l} \\ \\ \end{array}} \right\} \text{mi}$$

$$\begin{array}{r}
 \frac{145}{100} \times 1,200,000 \\
 \hline
 1,740,000 \\
 \hline
 145,000 = \checkmark \text{B1}
 \end{array}$$

(d) The following deductions were also made from Kurenta's salary every month: Co-operative shares 8 000, Co-operative loans 12 000, Pension scheme 4 000, Union dues 2000. (2mks)

Determine Kurenta's monthly net salary during that year.

$$\text{Net Salary } 145,000 - [17,650 + 8,000 + 12,000 + 4,000 + 2,000] \quad \checkmark \text{mi}$$

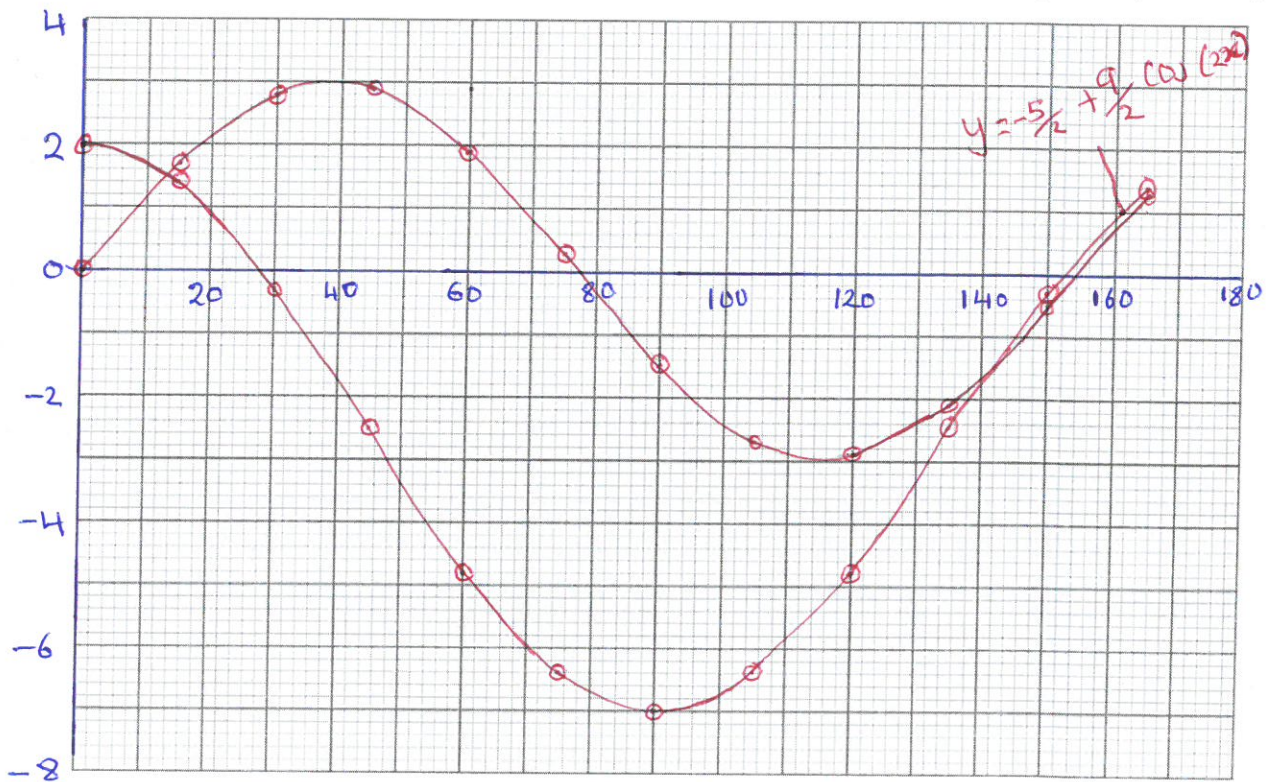
$$= 101,350 \quad \checkmark \text{A1}$$

20. (a) Complete the table below for the functions $y = -\frac{5}{2} + \frac{9}{2}\cos(2x)$ and $y = 3\sin\left(\frac{7x}{3}\right)$ to 1 d.p for $0^\circ \leq x \leq 165^\circ$ (2mks)

x	0	15	30	45	60	75	90	105	120	135	150	165
$y = -\frac{5}{2} + \frac{9}{2}\cos(2x)$	2	1.4	-0.3	-2.5	-4.8	-6.4	-7	-6.4	-4.8	-2.5	-0.3	1.4
$y = 3\sin\left(\frac{7x}{3}\right)$	0	1.7	2.8	2.9	1.9	0.3	-1.5	-2.7	-2.9	-2.1	-0.5	1.3

- (b) Draw the graphs of $y = -\frac{5}{2} + \frac{9}{2}\cos(2x)$ and $y = 3\sin\left(\frac{7x}{3}\right)$ on the same grid.

(use a scale of 1cm to rep 10° on the x-axis and 1cm to rep 1 unit on the y-axis.) (5mks)



- (c) Use your graph to solve $9\cos(2x) - 6\sin\left(\frac{7x}{3}\right) = 5$ (3mks)

$$9\cos 2x - 6\sin \frac{7x}{3} = 5$$

$$-5 + 9\cos 2x = 6\sin \frac{7x}{3}$$

$$-\frac{5}{2} + \frac{9}{2}\cos 2x = \frac{6}{2}\sin \frac{7x}{3} \quad \checkmark \quad m_1$$

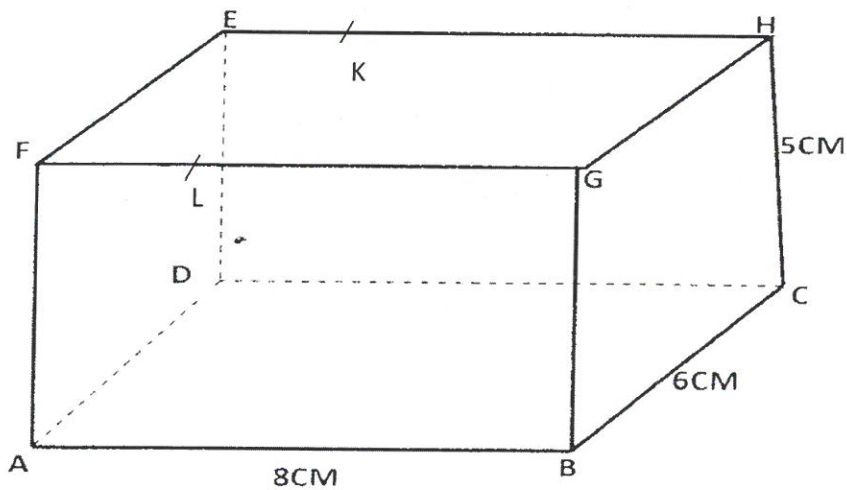
$$-\frac{5}{2} + \frac{9}{2}\cos 2x = 3\sin \frac{7x}{3}$$

$$x = 130^\circ \quad \checkmark \quad B_1$$

$$x = 142^\circ \quad \checkmark \quad B_1$$

21. The figure below shows a cuboid ABCDEFGH with AB = 8cm, BC = 6cm and CH = 5cm.

21. The figure below shows a cuboid ABCDEFGH with AB = 8cm, BC = 6cm and CH = 5cm.



Calculate to 1 d.p

(a) The length BE

(2mks)

$$BD = \sqrt{8^2 + 6^2} \checkmark$$

$$= 10 \text{ cm} \checkmark \text{ B1}$$

$$BE = \sqrt{10^2 + 5^2} = 11.18$$

$$= 11.2 \checkmark \text{ B1}$$

(b) The angle between BE and plane ABCD

(1mk)

$$\tan \theta = \frac{5}{10}$$

$$\theta = 26.57^\circ$$

$$\theta = 26.6^\circ \checkmark \text{ B1}$$

(c) The angle between lines FH and BC.

(2mks)

Translate BC to GH

$$\tan \theta = \frac{8}{6} = \frac{4}{3} \text{ M1}$$

$$\theta = 53.13^\circ$$

$$\theta = 53.1^\circ \checkmark \text{ A1}$$

(d) The acute angle between lines FH and BD

(1mks)

$$\sin \frac{1}{2} \theta = \frac{3}{5}$$

$$\frac{1}{2} \theta = \sin^{-1} \frac{3}{5} = 36.87$$

$$\theta = 36.87 \times 2 \\ = 73.74^\circ$$

$$\theta = 73.7^\circ \checkmark B_1$$

(e) The angle between plane AGHD and planes ABCD

(2mks)

$$\tan \theta = \frac{5}{8} \checkmark m_1$$

$$\theta = \tan^{-1} \frac{5}{8}$$

$$\theta = 32.01^\circ$$

$$\theta = 32.0^\circ \checkmark A_1$$

(f) Point K and L divides EH and FG respectively in the ratio 1:3. Determine the angle between planes ADKL and BCKL

(2mks)

$$\left. \begin{aligned} \tan \theta_1 &= \frac{2}{5} \\ \tan \theta_2 &= \frac{6}{5} \end{aligned} \right\} \text{Any one } m_1$$

$$21.80 + 50.19$$

$$71.99^\circ$$

$$72.0^\circ \checkmark A_1$$

22. Juice type Q is 60% tangerine and the rest is water. Juice type P is 30% water and the rest is pineapple.

(a) Jane mixes 8 litres of Q with 12 litres of P to produce a blend juice B. Find the percentage of water in blend B (2mks)

$$\text{Total Mixture} = 12 + 8 = 20 \text{ ml}$$

$$\text{Water} = \left[\frac{40}{100} \times 8 + \frac{30}{100} \times 12 \right] = 6.8$$

$$\frac{6.8}{20} \times 100 = 34\% \quad \checkmark \text{ A1}$$

(b) Janet makes 8L of a blend juice R that is 36% water by mixing juice Q and P. Determine the amount of juice Q and P that she uses. (4mks)

$$\frac{40\% Q + 30\% P}{Q + P} = 36\% \quad \checkmark \text{ M1}$$

$$40Q + 30P = 36Q + 36P$$

$$4Q = 6P$$

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

$$Q:P = 3:2 \quad \checkmark \text{ A1}$$

$$Q = \frac{3}{5} \times 8 = 4.8 \text{ L} \quad \checkmark \text{ B1}$$

$$P = \frac{2}{5} \times 8 = 3.2 \text{ L} \quad \checkmark \text{ B1}$$

(c) 5L of B is now mixed with 3L of Q to produce blend W. Find the concentration of tangerine in blend W. (4mks)

$$\begin{array}{cc} 5\text{L} & 3\text{L} \\ \text{B} & \text{Q} \end{array}$$

$$\text{Tangerine in Q} = \frac{60}{100} \times 3 = 1.8 \text{ L} \quad \checkmark \text{ B1}$$

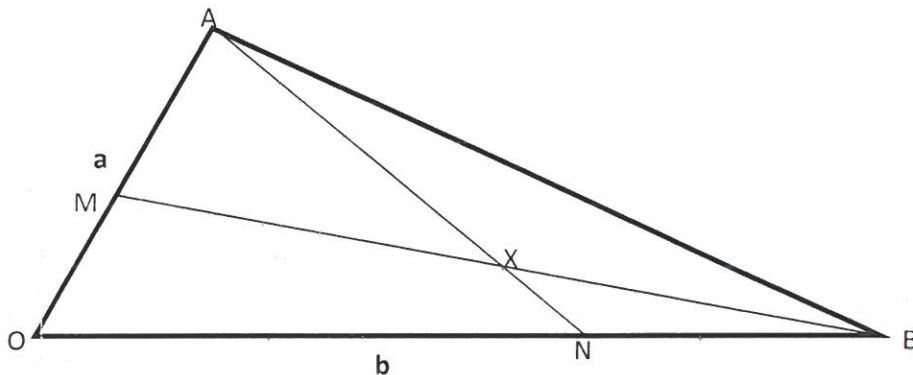
$$\% \text{ of Tangerine in B} = \frac{0.6 \times 8}{20} \times 100 = 24\%$$

$$\text{Tangerine in 5L of B} = \frac{24}{100} \times 5 = 1.2 \text{ L} \quad \checkmark \text{ B1}$$

$$\frac{1.8 + 1.2}{8} \times 100 \quad \checkmark \text{ M1}$$

$$37.5\% \quad \checkmark \text{ A1}$$

23. In triangle OAB below $\vec{OA} = \mathbf{a}$, $\vec{OB} = \mathbf{b}$ point M lies on ON such that $\vec{OM} : \vec{MA} = 2:3$ and point N lies on OB such that $\vec{ON} : \vec{NB} = 5:1$ line AN intersect line MB at X.



(a) Express in terms of \mathbf{a} and \mathbf{b}

(i) $\vec{AN} = \vec{AO} + \vec{ON}$ (1mk)

$$= -\mathbf{a} + \frac{5}{6}\mathbf{b}$$

(ii) $\vec{BM} = \vec{BO} + \vec{OM}$ (1mk)

$$= -\mathbf{b} + \frac{2}{5}\mathbf{a}$$

b) Given that $\vec{AX} = k\vec{AN}$ and $\vec{BX} = r\vec{BM}$ where k and r are scalars.

i. write down two different expressions for \vec{OX} in terms of \mathbf{a} , \mathbf{b} , k and r .

$$\vec{OX} = \vec{OA} + \vec{AX} \quad \left| \quad \vec{OX} = \vec{OB} + \vec{BX} \quad (2\text{mks})$$

$$= \mathbf{a} + k\left(-\mathbf{a} + \frac{5}{6}\mathbf{b}\right) \quad \left| \quad = \mathbf{b} + r\left(-\mathbf{b} + \frac{2}{5}\mathbf{a}\right)$$

$$= (1-k)\mathbf{a} + \frac{5}{6}k\mathbf{b} \quad \left| \quad = (1-r)\mathbf{b} + \frac{2}{5}r\mathbf{a}$$

ii. Find the value of k and r . (4mks)

$$(1-k)\mathbf{a} + \frac{5}{6}k\mathbf{b} = (1-r)\mathbf{b} + \frac{2}{5}r\mathbf{a} \quad \left| \quad \frac{5}{6}(1 - \frac{2}{5}r) = 1-r \quad \checkmark m_1$$

$$1-k = \frac{2}{5}r \quad \left. \begin{array}{l} \\ \end{array} \right\} m_1$$

$$\frac{5}{6}k = 1-r$$

$$k = 1 - \frac{2}{5}r$$

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

$$k = 1 - \frac{2}{5} \times \frac{1}{4}$$

$$k = \frac{9}{10}$$

$$r = \frac{1}{4} \quad \checkmark k = \frac{9}{10} \quad \checkmark B_1$$

iii. Determine the ratio in which x divides line MB. (2mks)

$$1-r : r$$

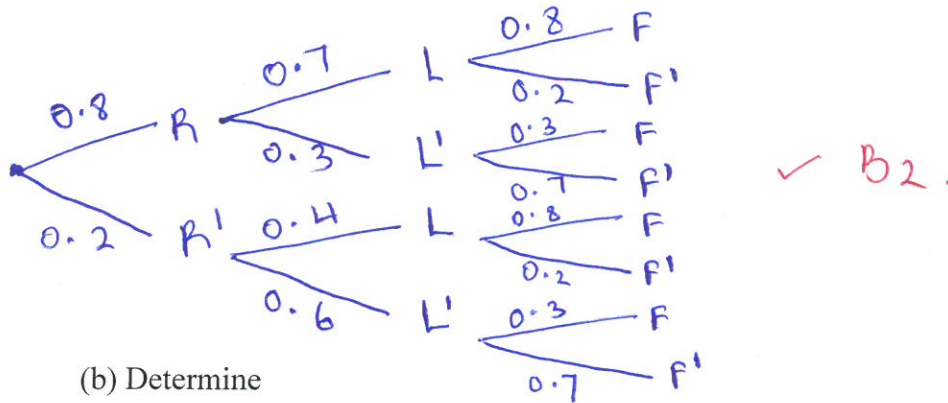
$$\frac{3}{4} : \frac{1}{4} \quad \checkmark m_1$$

$$3 : 1 \quad \checkmark A_1$$

24. The probability that it rains on a certain day is 0.8. if it rains the probability that Onguti comes to school late is 0.7 but otherwise it is 0.4. if he comes to school late, the probability that he fails an exercise is 0.8 but if he comes early the probability of failing an exercise is 0.3

(a) Draw a tree diagram to represent this information

(2mks)



(b) Determine

(i) The probability that it rains, he comes to schools early and he fails the exercise (2mks)

$$P(R L' F)$$

$$0.8 \times 0.3 \times 0.3 \quad \checkmark \text{ m1}$$

$$0.072 \quad \checkmark \text{ A1}$$

(ii) The probability that he passes his exercise

(2mks)

$$P(R L F') \text{ OR } P(R L' F') \text{ OR } P(R' L F') \text{ OR } P(R' L' F')$$

$$(0.8 \times 0.7 \times 0.2) + (0.8 \times 0.3 \times 0.7) + (0.2 \times 0.4 \times 0.2) + (0.2 \times 0.6 \times 0.7) \quad \checkmark \text{ m1}$$

$$= 0.38 \quad \checkmark \text{ A1}$$

(iii) The probability that he comes to school late

(2mks)

$$P(R L) \text{ OR } P(R' L)$$

$$= (0.8 \times 0.7) + (0.2 \times 0.4) \quad \checkmark \text{ m1}$$

$$= 0.64 \quad \checkmark \text{ A1}$$

(iv) The probability that he comes to schools late and he passes his exercise

(2mks)

$$P(R L F') \text{ OR } P(R' L F')$$

$$(0.8 \times 0.7 \times 0.2) + (0.2 \times 0.4 \times 0.2) \quad \checkmark \text{ m1}$$

$$= 0.128 \quad \checkmark \text{ A1}$$