4.2   MATHEMATICS ALTERNATIVE B (122)

4.2.1   Mathematics Alt.B Paper 1 (122/1)

SECTION I (50 marks)

*Answer **all** the questions in this section in the spaces provided.*

1. Without using a calculator or mathematical tables, evaluate $\dfrac{0.0042 \times 1.23}{0.41 \times 0.056}$ expressing the answer as a fraction in its simplest form.   (3 marks)

2. The floor of a square room is covered by four square carpets of equal size. The area of each carpet is $3\dfrac{22}{49}\,\text{m}^2$. Calculate the length of one side of the room in metres.   (3 marks)

3. Simplify $\dfrac{2x+3}{4} - \dfrac{x-6}{6} + \dfrac{x-4}{2}$.   (3 marks)

4. Use factor method to solve $2x^2 - x - 3 = 0$.   (3 marks)

5. In a certain function, $\dfrac{3}{5}$ of the people who attended were women, $\dfrac{1}{4}$ of the remainder were men and the rest were children. If there were 80 men in the function, calculate the number of children who attended.   (3 marks)

6. Solve the inequality $x + 1 > 2x - 1 \le 4x + 1$ giving the answer as a combined inequality.   (3 marks)

7. The length of a rectangle is 30 cm and the width is 20 cm. Each side of the rectangle is increased by 10% to form a new rectangle. Calculate the percentage increase in the area.   (3 marks)

8. The base of a rectangular container measures 16 cm by 10 cm. It contains water up to a height of 12 cm. When a spherical ball is dropped into the container, the water level rises to a height of 15 cm. Calculate the radius, correct to 1 decimal place, of the spherical ball.   (3 marks)

9. A triangular flower garden measures 5 m by 8 m by 11 m. Using Hero's formula, calculate the area of the garden, correct to 2 decimal places.   (3 marks)

10. The number of patients who visited a certain health centre in six days were as follows; Monday 114, Tuesday 153, Wednesday 198. On Thursday the number was 19 less than those who visited on Wednesday. Equal number of patients visited the centre on Friday and Saturday. The total number of patients who visited the health centre in the six days was 1092. Calculate the number of patients who visited the health centre on Friday.   (3 marks)

11. The vertices of a triangle ABC are A(2, 3), B(4, 1), C(1, 1) and that of its image A′B′C′ are A′(−2, 3), B′(− 4, 1), C′(−1, 1).

(a) On the grid provided, draw triangle ABC and its image A′B′C′.   (2 marks)
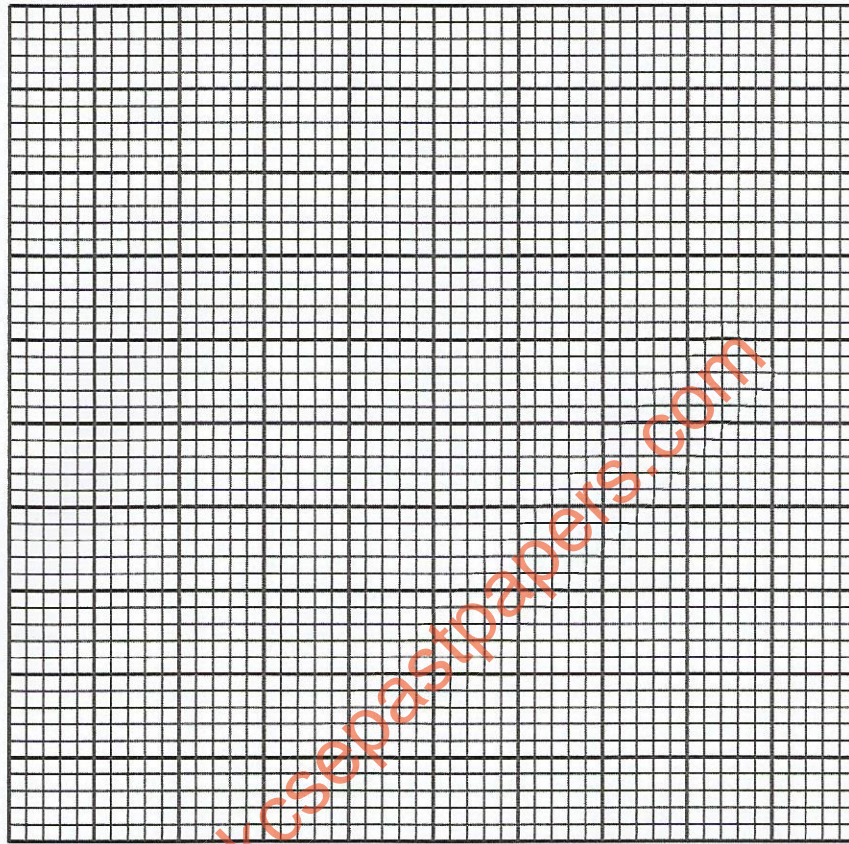

(b) Describe the transformation that maps triangle ABC onto triangle A′B′C′.   (2 marks)

12. The volumes of two similar solid cylinders are 2052 cm^3 and 608 cm^3. The area of the curved surface of the smaller cylinder is 176 cm^2. Find the area of the curved surface of the larger cylinder.   (4 marks)

13. The area of a right-angled triangular plot is 120 m^2. The length of the shortest side is 10 m. Determine the length of the longest side.   (3 marks)

14. By construction, divide the line AB below into five equal parts.   (3 marks)

A   B
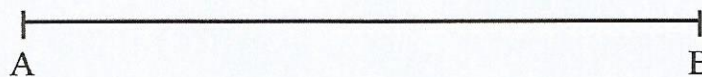
15. Given that sin x = 0.9063, where x is an acute angle, find, correct to 4 decimal places, the value of 2 tan x + cos x.   (3 marks)

16. An agent sold five plots for Ksh 250 000 each. She charged a 5% commission for the sale and paid 15% of the commission to her workers. Determine the amount of money she remained with.   (3 marks)

SECTION II (50 marks)

Answer only five questions from this section in the spaces provided.

17. A bus operating along a highway carried 60 passengers to a certain town. The ratio of men to women in the bus was 4:5 and that of women to children was 5:3. The bus charges Ksh 200 for adults and Ksh 100 for children.

On the return journey, the number of men remained the same while the number of children reduced by 20% and that of women increased by 40%. The bus charges remained the same.

Calculate:

(a)   the ratio of children to men who were travelling to town;   (1 mark)

(b)   the number of women who boarded the bus to town;   (2 marks)

(c)   the total amount of money collected on the way to town;   (3 marks)

(d)   the difference between the money collected on the way to town and on the return journey.   (4 marks)

18. A straight line L_1 passes through the point (2, 3) and cuts the y-axis at (0, 5).

(a)   Find the equation of L_1 in the form $y = mx + c$, where m and c are constants.   (3 marks)

(b)   Another line L_2 is perpendicular to L_1 and passes through the point (2, 3).

Determine the equation of L_2 in the form $ax + by + c = 0$, where, a, b, and c are constants.   (3 marks)

(c)   Given that another line L_3 is parallel to L_1 and passes through the point (1, 2), find the x – intercept of L_3.   (4 marks)

19. (a)   Using a ruler and a pair of compasses only:

(i)   Construct triangle ABC on line AB given below such that BC = 6.5 cm and AC = 5.7 cm.   (1 mark)

A |——| B

(ii)   Drop a perpendicular from C to meet AB at E. Measure CE.   (2 marks)

(iii)   Bisect angle ABC and let the bisector meet line CE at F.   (1 mark)

(iv)   Draw a line parallel to BF passing through C.   (1 mark)

(v)   At point B, construct a perpendicular line to meet the parallel line at D. Measure BD.   (2 marks)

(b)   Determine the area of CEBD.   (3 marks)

20.   The cost of a short and 3 skirts in certain shop was Ksh 900 while the cost of 3 shorts and 2 shirts was Ksh 1 300.

(a)   By letting Ksh x be the cost of a short and Ksh y be the cost of a shirt:

(i)   form two linear equations to represent the above information;   (2 marks)

(ii)   find the cost of a short and that of a shirt.   (3 marks)

(b)   A customer bought 3 shorts and 4 shirts and was given a discount of 5% for the shorts and 10% for the shirts. Calculate:

(i)   the total amount of money paid;   (3 marks)

(ii)   the amount of discount given.   (2 marks)

21.   In the figure below, AOD is a diameter of the circle, AC = CD and $\angle ADE = 32°$.
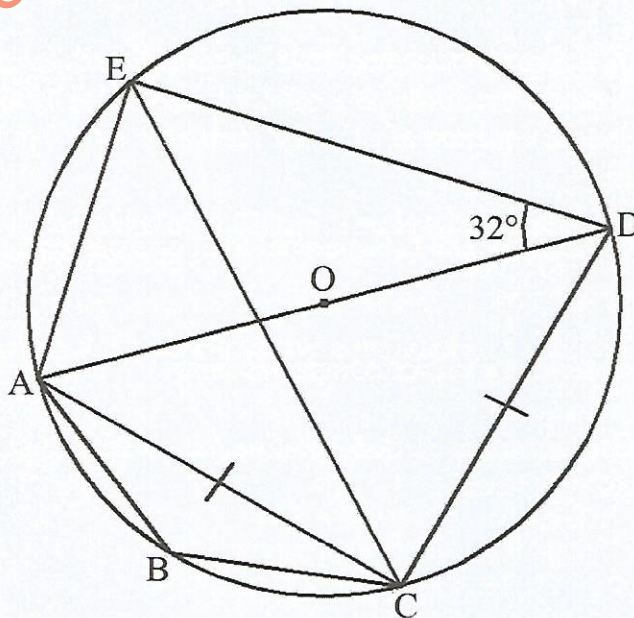
Giving reasons, find the size of the following angles:

(a) $\angle AED$;   (2 marks)

(b)   ∠ECA: (2 marks)

(c)   ∠ADC: (2 marks)

(d)   ∠CAE: (2 marks)

(e)   ∠ABC.   (2 marks)

22.   The figure below shows a solid made up of a cylinder mounted on a hemisphere. The height of the cylindrical part is 12 cm and its radius is 7 cm. The height of the solid 33 cm.
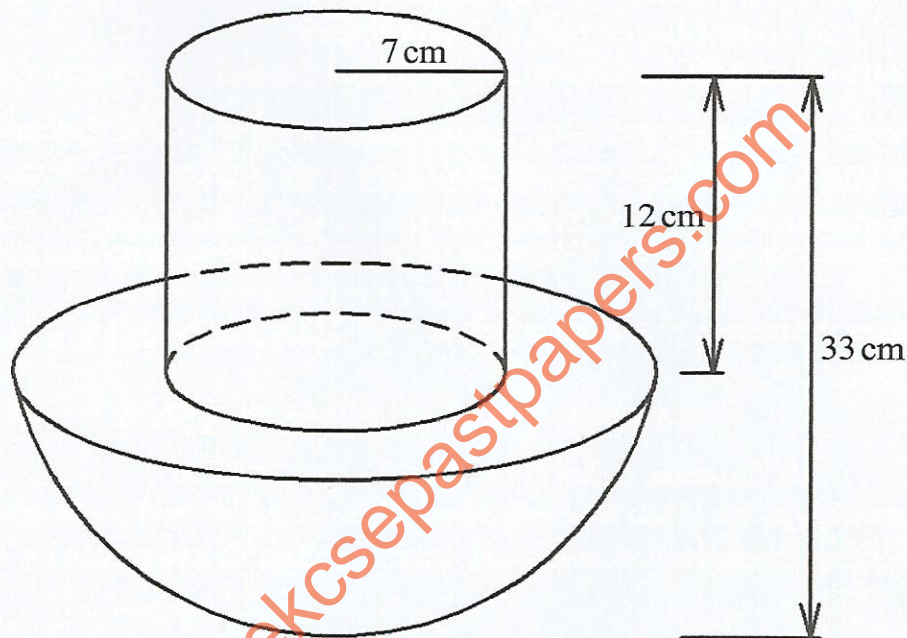
Taking $\pi = \frac{22}{7}$, calculate:

(a)   the area of the circular top of the cylinder;   (1 mark)

(b)   the area of the circular top of the hemisphere not in contact with the base of the cylinder;   (3 marks)

(c)   the area of the curved hemispherical part;   (2 marks)

(d)   the area of the curved part of the cylinder;   (2 marks)

(e)   the total surface area of the solid.   (2 marks)

119

23. A Kenyan business person bought goods worth 46 000 UAE Dirhams in Dubai. On arrival in Kenya, he paid custom duty of 35% on the value of the goods. Given the exchange rates were:

	Buying (Ksh)	Selling (Ksh)
1 UAE Dirham	27.76	27.85

(a)   Calculate:

   (i)   the amount of money, in Kenya shillings, that he used to buy the goods;
                                                                                    (2 marks)

   (ii)   the custom duty he paid, in Kenya shillings.   (2 marks)

(b)   The business person sold all the goods, making a profit of 40%. Determine the total amount of money he got from the sale of the goods, in Kenya Shillings.   (3 marks)

(c)   The business person sent 60% of the profit made to his son who was studying in Canada.

   The exchange rate was as given below:

	Buying (Ksh)	Selling (Ksh)
1 Canadian Dollar	76.60	76.76

   Calculate the amount of money, in Canadian dollars, that he sent to his son.   (3 marks)

24. John left town Q for town R at 8.15 a.m and travelled at an average speed of 90 km/hr. Oluoch left town R for town Q at 9.00 a.m and travelled at an average speed of 120 km/hr. The two met at a place 180 km from Q.

Calculate:

(a)   the distance John had travelled before Oluoch started his journey;   (2 marks)

(b)   the time when the two met;   (3 marks)

(c)   the distance travelled by Oluoch by the time the two met;   (2 marks)

(d)   the time John arrived at town R.   (3 marks)

SECTION I (50 marks)

*Answer **all** the questions in this section in the spaces provided.*

1.   Express each of the numbers in the expression below correct to 2 significant figures $\dfrac{44.08}{179.06 - 19.54}$, hence evaluate the expression.   (3 marks)

2.   A business lady deposited Ksh 305 000 in a fixed deposit account in a bank that paid compound interest at a rate of 5% per annum. The money was compounded quarterly for 2 years.

   Calculate the amount of money she had in the bank at the end of the 2 years to the nearest shilling.   (3 marks)

3.   The cost of yellow maize in a certain market was Ksh 45 per kg and that of white maize was Ksh 65 per kg. A trader mixed the two types of maize and sold the mixture at Ksh 60 per kg making a profit of 20%. Calculate:

   (a)   the cost of 1 kg of the mixture;   (1 mark)

   (b)   the ratio of yellow maize to white maize in the mixture.   (3 marks)

4.   In the figure below, O is the centre of the circle. Points X and Y are on the circumference of the circle.
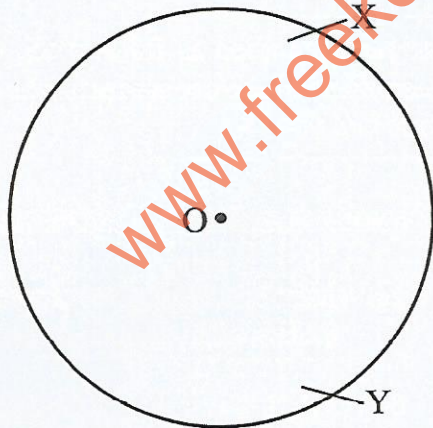
   Using a ruler and a pair of compasses only, construct tangents to the circle at points X and Y and let them meet at point Z. Measure YZ   (3 marks)

5.   Make t the subject in, $at = \sqrt{\dfrac{t^2 + p}{s^2}}$.   (3 marks)

6.   Two points A and B lie on the same longitude on the earth surface. The location of A is $(42°\,N, 40°\,E)$ and point B is due south of A. Given that the distance between points A and B is $7007\,km$, find the location of B.

(Take the radius of the earth to be $6370\,km$ and $\pi = \dfrac{22}{7}$).   (4 marks)

7.   Use the method of completing the square to solve for x in $2x^2 + 5x + 2 = 0$.   (3 marks)

8.   (a)   Complete the table below for the function $y = x^2 + x - 3$

x	-1	-0.5	0	0.5	1	1.5	2
y			-3		-1		3

(2 marks)

(b)   Using the trapezium rule with 7 ordinates, estimate the area bounded by the curve $y = x^2 + x - 3$, the x-axis and the lines $x = -1$ and $x = 2$.   (2 marks)

9.   A triangular plot PQR is such that $PQ = 26\,m$, $PR = 54\,m$ and $\angle QPR = 88°$. Calculate the length RQ.   (2 marks)

10. The nth term of an arithmetic sequence is given by $2n + 3$. Determine the first three terms of the sequence. Hence find the common difference.   (3 marks)

11. The masses, in kilograms, of six students in a class were recorded as follows 55, 45, 50, 47, x and y. Given that y is 5 kg more than x, and the mean mass of the six students was $52\,kg$, find the value of y.   (3 marks)

12. The probability that teams A, B and C qualify for quarter finals in a soccer tournament are $\dfrac{2}{5}, \dfrac{4}{7}$ and $\dfrac{1}{3}$ respectively. Find:

(a)   the probability that either B or C qualifies;   (2 marks)

(b)   the probability that A and C do not qualify for the quarter finals.   (2 marks)

13. A trader bought 5 television sets and 4 radio sets for Ksh 168 000. Another trader bought 2 television sets and 3 radio sets from the same dealer for Ksh 84 000. Take the cost of a television set to be x and that of a radio set to be y.

(a)   Form two equations in x and y to represent the above information.   (1 mark)

(b)   Use matrix method to find the cost of a television set and that of a radio.   (3 marks)

14. Given that $p = i + 3j$ and $q = 3i + j$, find $2p - q$. (2 marks)

15. The vertices of a triangle ABC are given as A$(-2, -3)$, B$(-2, 1)$ and C $(-4, -1)$.

    The triangle is transformed by matrix $P = \begin{pmatrix} 3 & -2 \\ 1 & -2 \end{pmatrix}$. Determine the coordinates of the image. (2 marks)

16. The marks obtained in an oral examination in a certain class were as follows: 3, 5, 9, 4, 7, 6.

    Determine the standard deviation. (3 marks)

SECTION II (50 marks)

*Answer only **five** questions in this section in the spaces provided.*

17. The monthly tax rates in Kenya for a certain year were as shown in the table below.

Income in Kenya Shilling (Ksh)	Tax Rate (%)
0 – 12 298	10
12 299 – 23 885	15
23 886 – 35 472	20
35 473 – 47 059	25
47 060 and above	30

A tax relief of Ksh 1408 was allowed.

An employee earned a monthly basic salary of Ksh 39 000. The employee was also paid the following monthly allowances.

House Allowance   Ksh 14 000
Medical Allowance   Ksh 4 000
Commuter Allowance   Ksh 5 000

(a) Calculate the employee's:

    (i) monthly taxable income; (2 marks)

    (ii) net tax per month to the nearest shilling. (5 marks)

(b)   The following deductions were also made on the employee's salary in that month.

Co-operative loan   Ksh 5 000
Union dues   Ksh 780
Sacco shares   Ksh 2 000

Determine the employee's net monthly salary.   (3 marks)

18.   The vertices of triangle ABC are A(2, 3), B(4, 2) and C(3, 4). Under a transformation matrix $\mathbf{M} = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$, the triangle is mapped into triangle A′ B′ C′ with A′(-1, 3), B′(-5, 5) and C′(-3, 1).

(a)   On the grid provided draw triangle ABC and its image A′ B′ C′.   (2 marks)
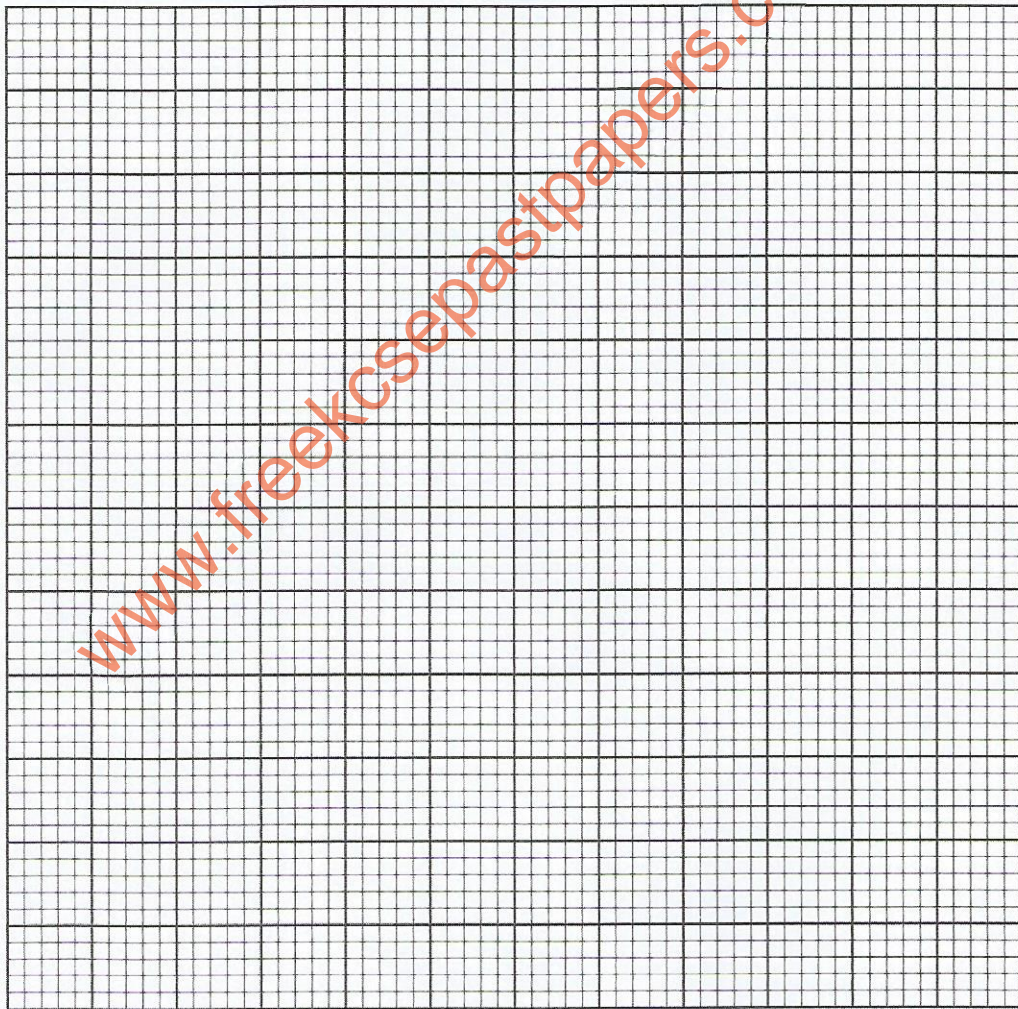
(b)   Determine the matrix $\mathbf{M}$.   (4 marks)

(c)   Matrix $\mathbf{P} = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$ maps triangle A′B′C′ onto triangle A″B″C″.

     (i)   Draw triangle A″B″C″.   (3 marks)

     (ii)   Describe the transformation fully.   (1 mark)

19.   (a)   The third and eleventh term of an Arithmetic Progression (A.P.) are 10 and 34 respectively. Find:

     (i)   the first term and common difference of the Arithmetic Progression; .   (3 marks)

     (ii)   the sum of the first 27 terms of the A.P.   (2 marks)

   (b)   On employment, Mr Kizito earned a monthly salary of Ksh 25 600. He was also entitled to an annual increment of Ksh 520 per month. Determine:

     (i)   the monthly salary in the 8th year of employment;   (2 marks)

     (ii)   the total amount earned in 5 years.   (3 marks)

20.   The vertices of a triangle PQR are P(-1, 1), Q(1, 3) and R(2, 1).

   (a)   Find:

     (i)   **PQ**;   (1 mark)

     (ii)   **QR**.   (1 mark)

   (b)   M and N are the mid points of PQ and QR respectively. Find:

     (i)   **MN**;   (3 marks)

     (ii)   the magnitude of **MN**.   (2 marks)

   (c)   Given that Q′(3, 2) is the image of Q under a translation, find the image of P under the translation.   (3 marks)

21.   A veterinary officer visited a dairy farm for a routine check up of the calves and recorded the mass of the calves, to the nearest kilogram, as shown in the table below.

39	42	45	44	35	52	46	54	42
40	46	41	45	43	46	50	38	45
47	39	42	48	37	46	33	43	51
50	46	45	48	56	39	47	36	45

   (a)   Starting with the class 30–34, make a frequency table for the data.   (3 marks)

(b)   Calculate the mean mass of the calves.   (4 marks)

(c)   Determine the median mass.   (3 marks)

22.   Three quantities M, N and P are such that M varies directly as the cube root of N and inversely as the square of P.

    (a)   When M = 0.625, N = 8 and P = 4.

        (i)   Determine the equation connecting M, N and P.   (4 marks)

        (ii)   Find N when M = 0.8 and P = 5.   (2 marks)

    (b)   If N is increased by 33.1% and P is decreased by 5%, find the percentage change in M.   (4 marks)

23.   (a)   Complete the table below for the curves $y = \cos x$ and $y = 2 \sin x$ for $0° \leq x \leq 360°$.   (2 marks)

$x°$	0	30	60	90	120	150	180	210	240	270	300	330	360
$\cos x$	1.0			0.0	−0.5	−0.9		−0.9	−0.5	0.0		0.9	
$2 \sin x$		1.0	1.7	2.0			0.0	−1.0	−1.7	−2.0			0.0

    (b)   On the grid provided, draw the graphs of $y = \cos x$ and $y = 2 \sin x$ for $0° \leq x \leq 360°$ on the same axis.   (5 marks)
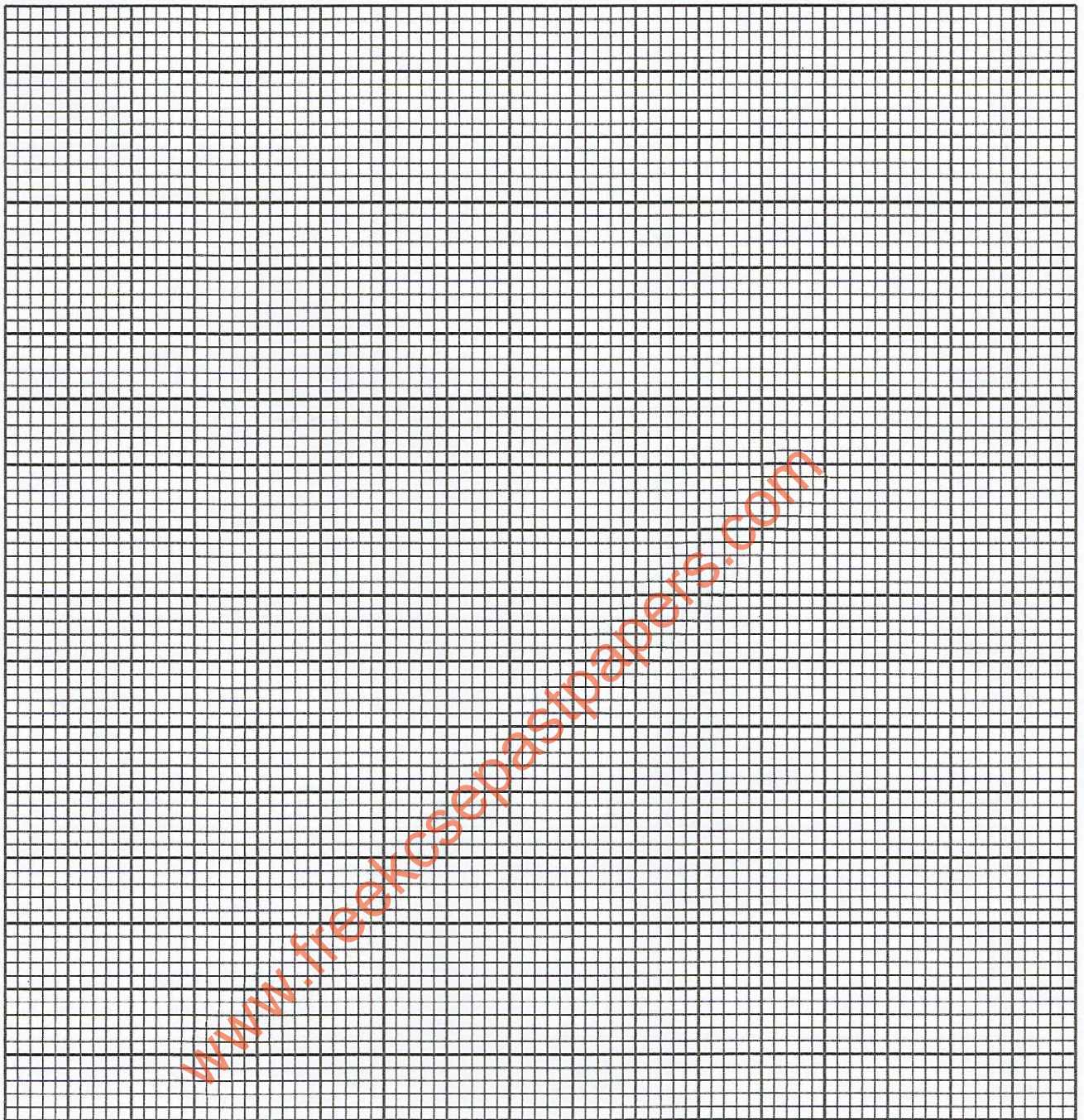
(c)   From the graphs, estimate the solution to the equation $\cos x - 2\sin x = 0$.   (2 marks)

(d)   Find the values of x when $y = 1.5$.   (1 mark)

24. Three towns P(0°, 62°E), Q(0°, 35°W) and R(60°N, 35°W) are located on the earth's surface. An aircraft A, flew from town P to Q at a speed of 670 km/h. Another aircraft B took off from town R towards Q $1\frac{1}{2}$ hours later.

(Take the radius of the earth to be 6370 km and $\pi = \frac{22}{7}$).

Calculate:

(a) the distance between towns P and Q correct to 1 decimal place;   (3 marks)

(b) the time taken by the aircraft A to fly from P to Q;   (2 marks)

(c) the speed, to the nearest whole number, at which aircraft B needs to fly in order to arrive in town Q at the same time with aircraft A.   (5 marks)

128