THE KENYA NATIONAL EXAMINATIONS COUNCIL
Kenya Certificate of Secondary Education

121/2 — **MATHEMATICS** — **Paper 2**
ALT A
Apr. 2021 – 2½ hours

Name .... Index Number ....

Candidate's Signature .... Date ....

Instructions to candidates

(a) Write your name and index number in the spaces provided above.
(b) Sign and write the date of examination in the spaces provided above.
(c) This paper consists of **two** sections: **Section I** and **Section II**.
(d) Answer **all** the questions in **Section I** and only **five** questions from **Section II**.
(e) **Show all the steps in your calculations, giving your answers at each stage in the spaces provided below each question.**
(f) Marks may be given for correct working even if the answer is wrong.
(g) **Non-programmable** silent electronic calculators **and** KNEC Mathematical tables may be used, except where stated otherwise.
(h) **This paper consists of 19 printed pages.**
(i) **Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.**
(j) **Candidates should answer the questions in English.**

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Section I

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

Section II

17	18	19	20	21	22	23	24	Total

Grand Total

910189

Turn over

SECTION I (50 marks)

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

1. A flour milling company has two types of flour for making porridge; maize flour and millet flour. Maize flour costs Ksh 60 per kilogram and millet flour costs Ksh 90 per kilogram. The milling company makes a new brand of flour by mixing maize flour and millet flour. If the new brand costs ksh 85 per kilogram, determine the percentage of maize flour in the mixture.

(3 marks)

2. The sum of the first two terms of an increasing Geometric Progression (GP) is 20. The sum of the second term and the third term of the same GP is 30.

   Determine the common ratio of the GP.

(4 marks)

3. Given that $\sin 75° = \dfrac{\sqrt{6} + \sqrt{2}}{4}$, simplify $\dfrac{1}{\sin 75°}$.

(2 marks)

4. (a) Expand the expression $\left(1 - \frac{3}{10}x\right)^5$ in ascending powers of x, leaving coefficient as fractions in their lowest form. (2 marks)

(b) Use the first three terms of the expansion in part (a) above to estimate the value of $(0.97)^5$ (2 marks)

5. The figure below shows a cuboid labelled ABCDEFGH. Point O is the mid-point of BD, AB = 15 cm, BC = 8 cm and CF = 5 cm.
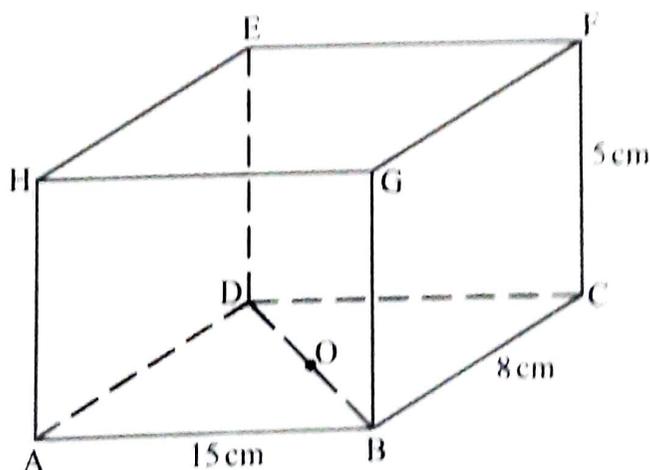
Calculate the angle between the lines OE and OF. (3 marks)

6. Two variables x and y are such that y varies directly as x^n where n is a constant.

   Given that $y = 320$ when $x = 16$ and $y = 2560$ when $x = 64$, find the value of n. (3 marks)

7. In the figure below, O is the centre of the circle and N is a point on the circumference.
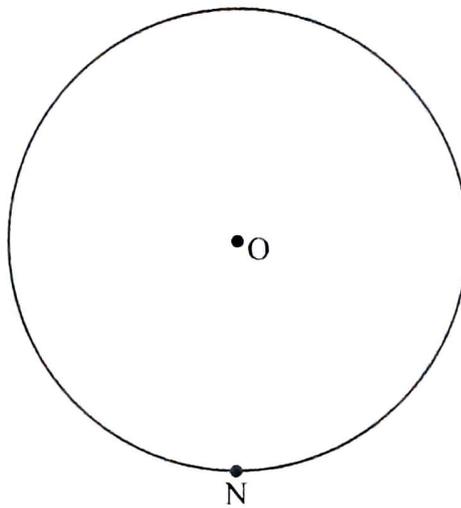
   Using a ruler and a pair of compasses only.

   Construct:

   (a)   a tangent, MN, to the circle at N. (1 mark)

   (b)   another tangent to the circle intersecting with MN at 60°. (2 marks)

8. Solve for x given that
$$\frac{1}{2}\log_2 9 + \log_2 (5x - 4) = 7.$$
(3 marks)

9. The figure ABCD below is a scale drawing representing a rectangular garden of length 60 m and width 30 m.
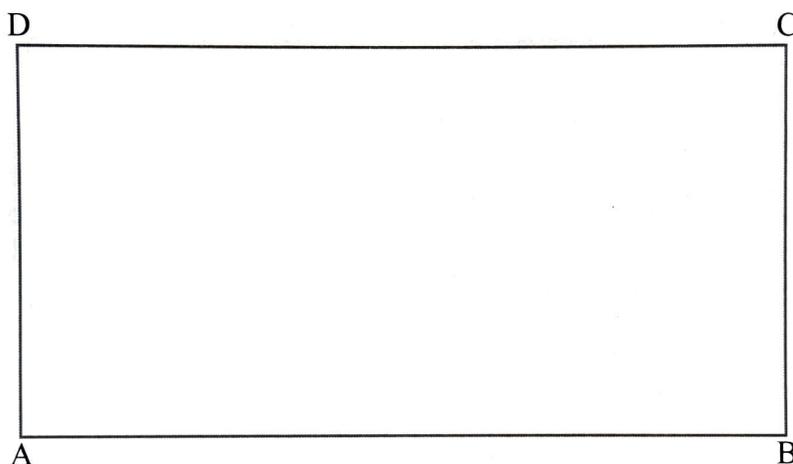
The owner intends to plant trees in the garden. Each tree, T, must be at least 21 m from the edge AB. In addition, angle ATB must be acute.

Show by shading the exact region where the trees can be planted. (3 marks)

10. A point P(x, y) is mapped onto P'(x_1, y_1) by successive transformations M = $\begin{pmatrix} 1 & -1 \\ 2 & 3 \end{pmatrix}$ followed by N = $\begin{pmatrix} 1 & 1 \\ -1 & 2 \end{pmatrix}$

Determine the single transformation matrix that would map P'(x_1, y_1) onto P(x, y). (3 marks)

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11. In an experiment involving two variables, time (*t*), hours and height, (*h*) cm; the following results were obtained.

Time(t) hours	0	0.7	1.5	2.1	2.8	3.2	3.6
Height(h) cm	100	82	64	46	32	18	10

(a) On the grid provided, plot (*t, h*) where *t* is time and *h* is the height. (1 mark)
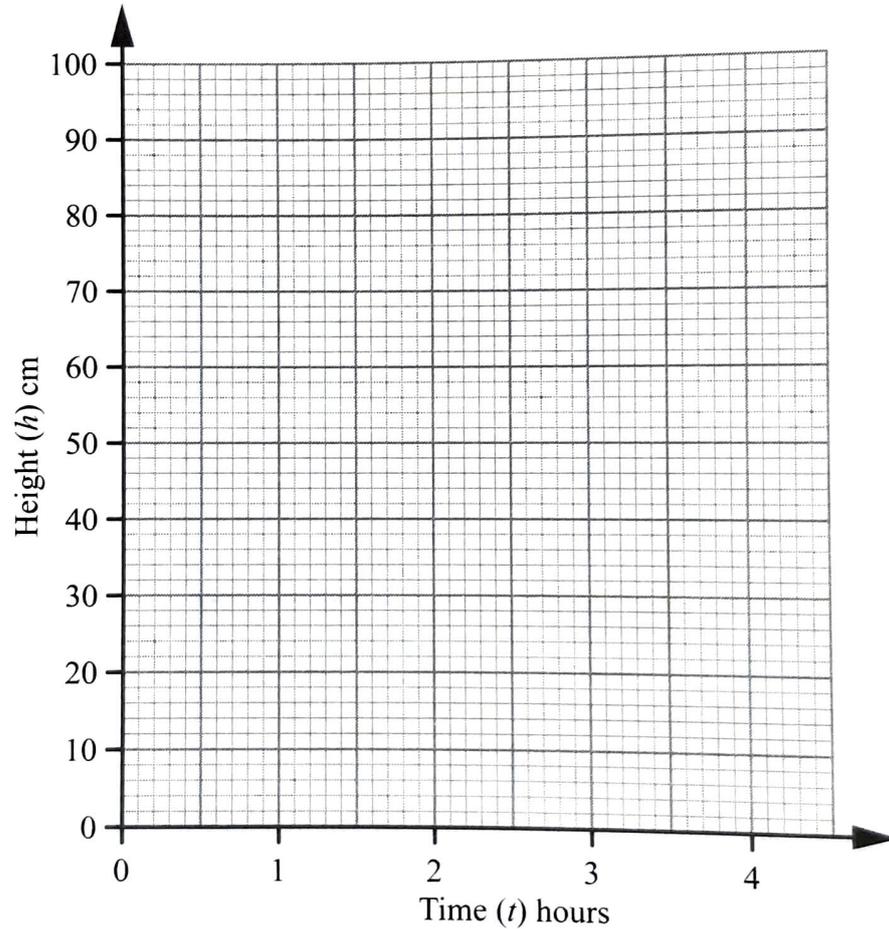
(b) Use the plotted points to draw the line of best fit for the data and hence determine the rate of change of height with time. (2 marks)

12. The mean of six numbers is calculated. The deviations of the numbers from the mean are:

$$-4, 5, -3, -2, d, 1.$$

Determine the value of d and hence find the exact variance of the numbers. (3 marks)

13. The cash price of a cooker is Ksh 27 500. A customer opts to buy the cooker on hire purchase terms by paying a deposit of Ksh 17 250. Determine the monthly rate of compound interest charged on the balance if the customer is required to repay by six equal monthly instalments of Ksh 2 100 each. (3 marks)

14. Solve the equation

$$\sin^2 \theta - \cos^2 \theta = -\frac{1}{2} \text{ for } 0° \leq \theta \leq 360°.$$ (4 marks)

15. The position vectors of points P, Q and R are $\begin{pmatrix} 1 \\ -1 \\ 3 \end{pmatrix}$, $\begin{pmatrix} 3 \\ 3 \\ 1 \end{pmatrix}$ and $\begin{pmatrix} 6 \\ 9 \\ -2 \end{pmatrix}$ respectively.

Show that points P, Q and R are collinear. (3 marks)

16. A particle moves in a straight line from a fixed point. The velocity V ms⁻¹ of the particle after t seconds is given by V = t² − 4t + 6.

Calculate the distance travelled by the particle in the first 4 seconds. (3 marks)

SECTION II (50 marks)

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

17. A farmer has two tractors P and Q. Tractor P, working alone, can plough a piece of land in 5 hours while tractor Q would take $1\frac{2}{3}$ hours less than tractor P.

    (a)   Determine the time the two tractors ploughing together, would take to complete the work.
    (3 marks)

    (b)   One day, the tractors started to plough the piece of land together. After 40 minutes, tractor P broke down but Q continued alone and completed the work.

          Calculate the total time taken to plough the piece of land that day.   (4 marks)

    (c)   In another season, the farmer hired an additional tractor R to assist P and Q which retained the same rate of working as before. The three tractors took 1 hour 12 minutes to plough the same piece of land. The owner of tractor R was paid some money proportional to the work done by the tractor.

          If the total work was valued at Ksh 20 000, find the amount of money paid to the owner of tractor R.   (3 marks)

18. The table below shows the income tax rates for a certain year.

Monthly taxable income in Ksh	Tax rate percentage (%) in each shilling
1 – 11 180	10
11 181 – 21 714	15
21 715 – 32 248	20
32 249 – 42 782	25
over 42 782	30

(a) During the year, Moraa's monthly income was as follows:

Basic salary   Ksh 40 000
House allowance   Ksh 11 090
Commuter allowance   Ksh 7 000

Calculate:

(i) Moraa's total monthly taxable income.   (1 mark)

(ii) total income tax charged on Moraa's monthly income.   (4 marks)

(b) Moraa's net monthly tax was Ksh 10 750.80.

Determine the monthly tax relief allowed.   (1 m)

(c)   A proposal to expand the size of the first income tax band by 50% while retaining the size of the next three bands was made. The tax rates would remain as before in each band.

Using the proposal, calculate:

(i)   the tax Moraa would pay in the first band.   (1 mark)

(ii)   the tax Moraa would pay in the last tax band.   (3 marks)

19. Kering purchased $(2x-1)$ identical pens for Ksh 180. Naraya purchased $(3x+1)$ identical pencils for Ksh 200.

   (a)   Write an expression for the:

      (i)   price of one pen;   (1 mark)

      (ii)   price of one pencil.   (1 mark)

   (b)   A pen costs Ksh 4 more than a pencil.

      Form an equation to represent the information above and hence solve for x.   (4 marks)

   (c)   Later the price of a pen went up by 25% while that of a pencil remained unchanged. A school spent the same amount of money on the purchase of pens as that spent on pencils. The total number of both pens and pencils bought was 46.

      Determine the number of pens bought by the school.   (4 marks)

20. An aircraft took off from point A($x°$N, $15°$E) at 0720h, local time. It flew due West to another point B($x°$N, $75°$W) a distance of 5005 km from A.

After a stopover of 1 hour 30 minutes at point B, the aircraft took off and flew for 3 hours 40 minutes due south to a point C. The aircraft maintained an average speed of 910 km/h for the journey from A to B and also from B to C.

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

(a)   Calculate the:

(i)   position of point B.   (3 marks)

(ii)   position of point C.   (3 marks)

(b)   Determine the local time at point C when the aircraft arrived.   (4 marks)

21. A road contractor has to transport 240 tonnes of hardcore. He will use two types of lorries, type A and type B. He has 3 type A lorries and 2 type B lorries. The capacity of each type A lorry is 8 tonnes while that of type B is 15 tonnes. All type A lorries must each make the same number of trips. Similarly all type B lorries must each make the same number of trips. The number of trips made by each type B lorry should be less than twice those made by each type A lorry. Each type A lorry must not make more than 6 trips.

(a) Take x to be the number of trips made by each type A lorry and y to represent the number of trips made by each type B lorry.

Form all the inequalities in x and y, to represent the above information. (3 marks)

(b) On the grid provided, draw all the inequalities and shade the unwanted region. Take 1 cm to represent 1 unit on each of the axes. (4 marks)
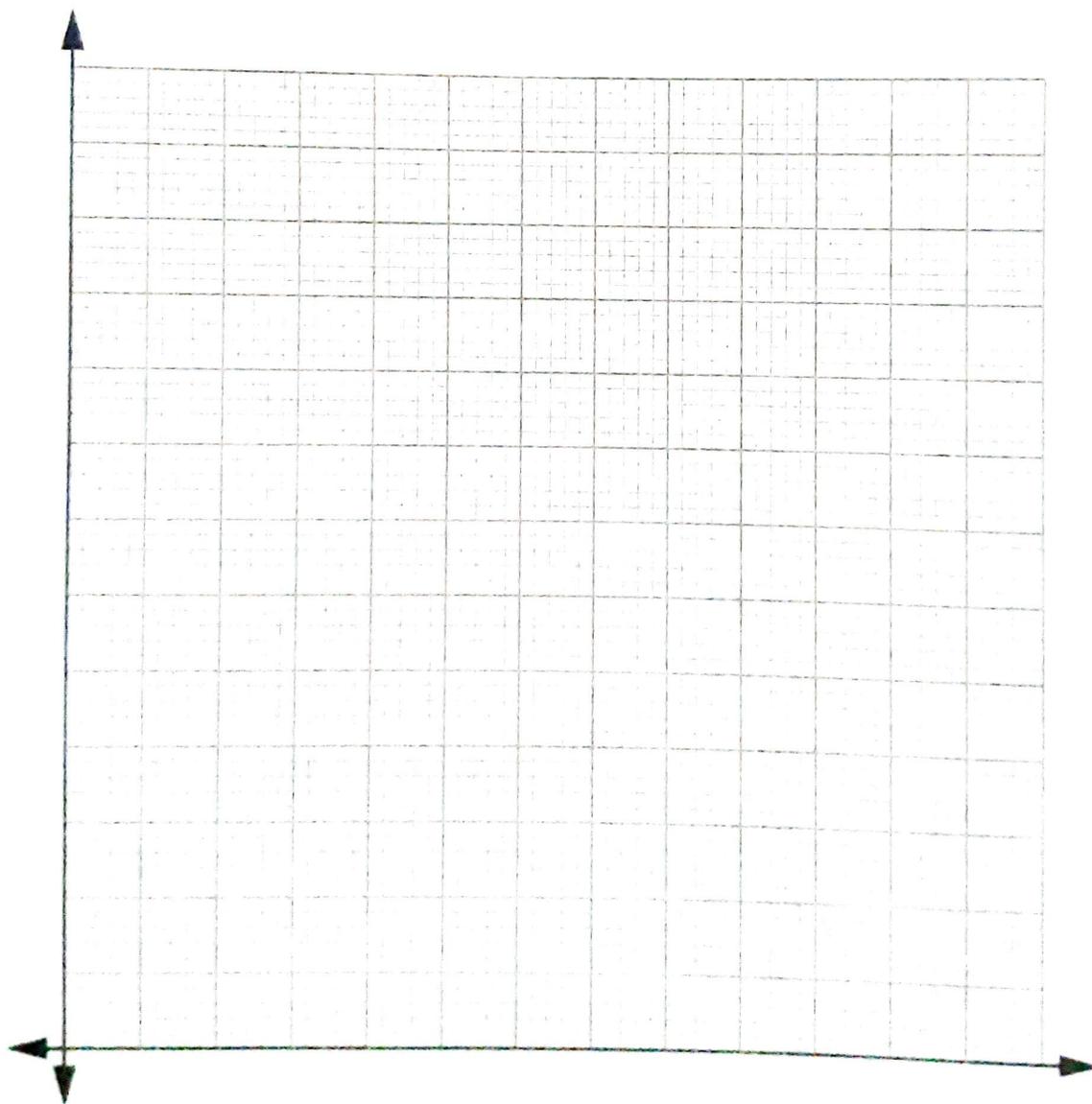
(c)   The cost of operating each type A lorry is Ksh 5 000 per trip while that of operating each type B lorry is Ksh 12 500 per trip.

Determine the number of trips each type of lorry should make in order to minimise the cost of transporting the hardcore. Hence calculate the minimum cost.   (3 marks)

22. The systolic blood pressure of 60 patients attending a clinic was recorded as follows:

Blood pressure	95 – 104	105 – 114	115 – 124	125 – 134	135 – 144	145 – 154	155 – 164
Number of patients	7	11	15	12	8	4	3

(a)   On the grid provided, draw an ogive that represents the above information.   (4 marks)
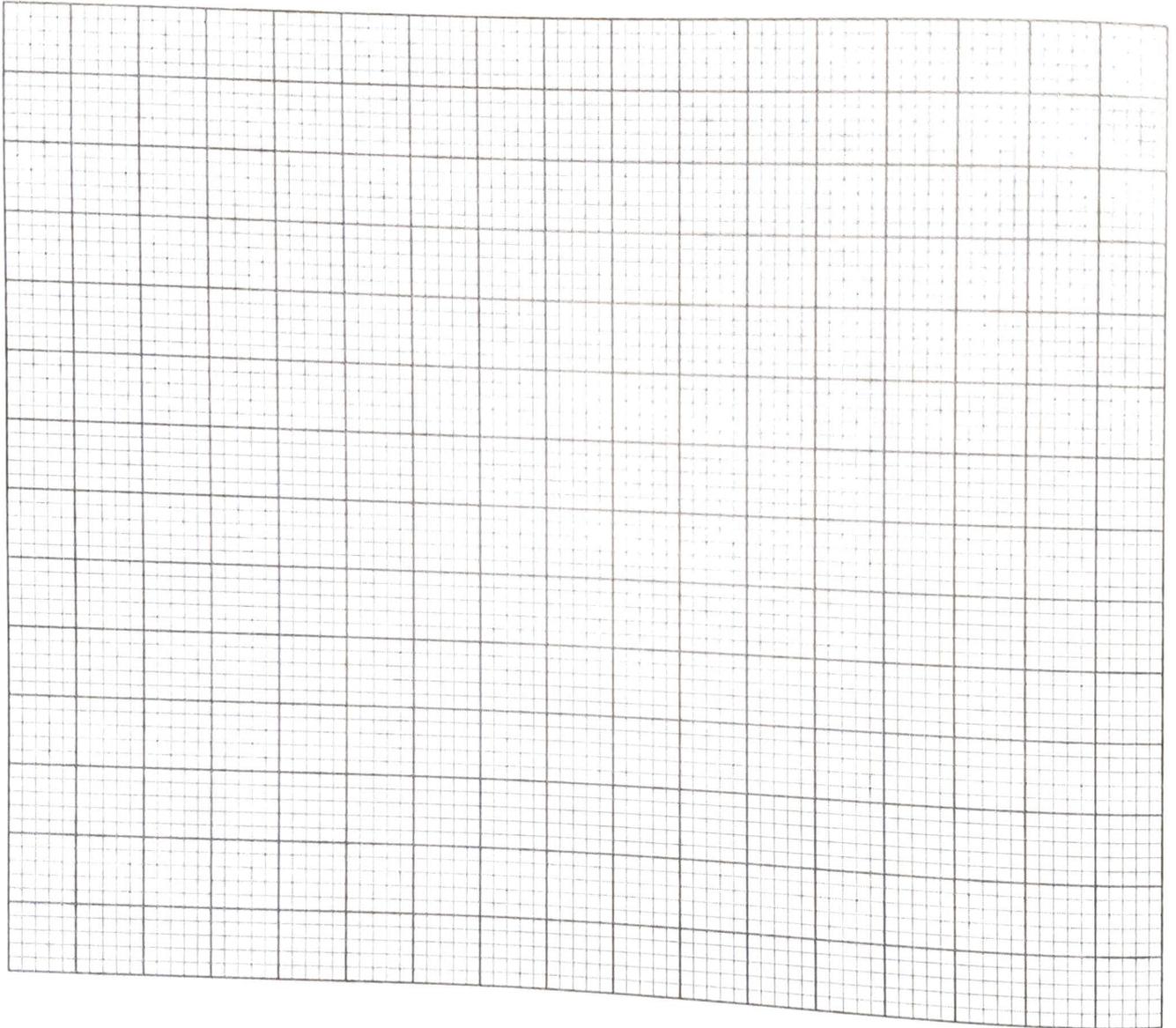
(b)   Use the graph to estimate the interquartile range of the blood pressures.   (3 marks)

(c)   Determine the percentage of patients whose blood pressure exceeds 150.   (3 marks)

23. In the figure below A, B, C and D are points on the circumference of the circle, centre O. A tangent to the circle at A intersects chord CD produced at E. Line AB is parallel to line EC. Angle AED = 45° and angle ABD = 40°.
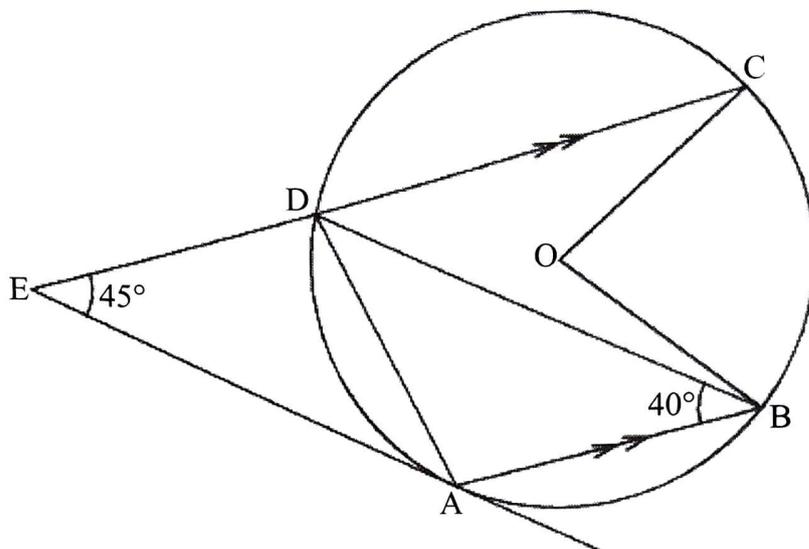
(a) Calculate the size of:

(i) ∠ADB. (3 marks)

(ii) ∠OCD. (3 marks)

(b) Given that ED = 3.5 cm and DC = 4.9 cm, calculate correct to 1 decimal place:

(i) the length of the tangent AE. (2 marks)

(ii) the radius of the circle. (2 marks)

24. The table below shows the number of students in each class in a school. The percentage (%) of the students in each class who wear glasses is also shown.

Class	Form 1	Form 2	Form 3	Form 4
Number of students	60	56	44	40
Percentage(%) with glasses	10%	12.5%	25%	17.5%

(a) A student is chosen at random from the school.

Determine the:

(i) probability that the student is in form 4. (2 marks)

(ii) probability that the student wears glasses. (2 marks)

(b) Two students are chosen at random from the school.

Determine the:

(i) probability that one of the two students is in form 1 while the other student is in form 4. (3 marks)

(ii) probability that one of the students is in form 1 while the other is in form 4 and both wear glasses. (3 marks)

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