



**NATIONAL
SENIOR CERTIFICATE**

GRADE 12

SEPTEMBER 2022

**TECHNICAL MATHEMATICS P2
(DEAF)**

MARKS: 150

TIME: 3 hours

This question has 16 pages, including a 2-page information sheet.

INSTRUCTIONS AND INFORMATION

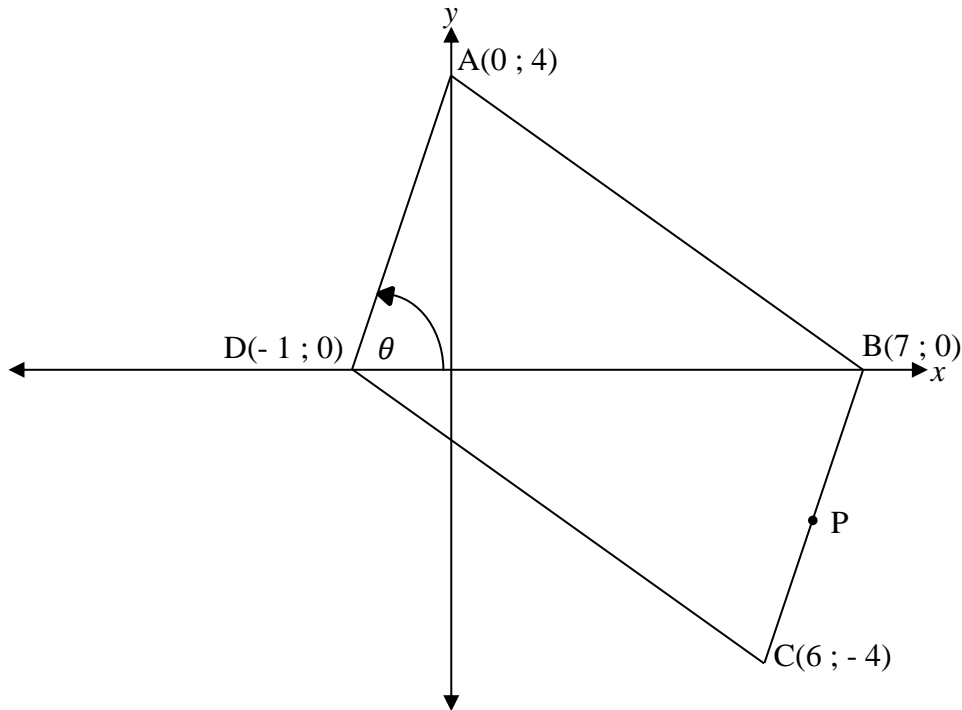
Read the instructions. Answer the questions.

1. This question paper has ELEVEN (11) questions.
2. Answer ALL the questions in the SPECIAL ANSWER BOOK provided.
3. Show ALL calculations, diagrams and graphs that you used to find your answers.
4. Answers only will NOT get full marks.
5. Use an approved scientific calculator (non-programmable and non-graphical). We will tell you if it is different.
6. Round off answers to TWO decimal places. We will tell you if it is different.
7. Diagrams are NOT drawn to scale.
8. Use the information sheet with formulae at the end of the question paper.
9. Write neatly.

QUESTION 1

Look at the diagram.

ABCD is a parallelogram with vertices $A(0 ; 4)$, $B(7 ; 0)$, $C(6 ; -4)$ and $D(-1 ; 0)$. θ is the inclination angle of line AD.

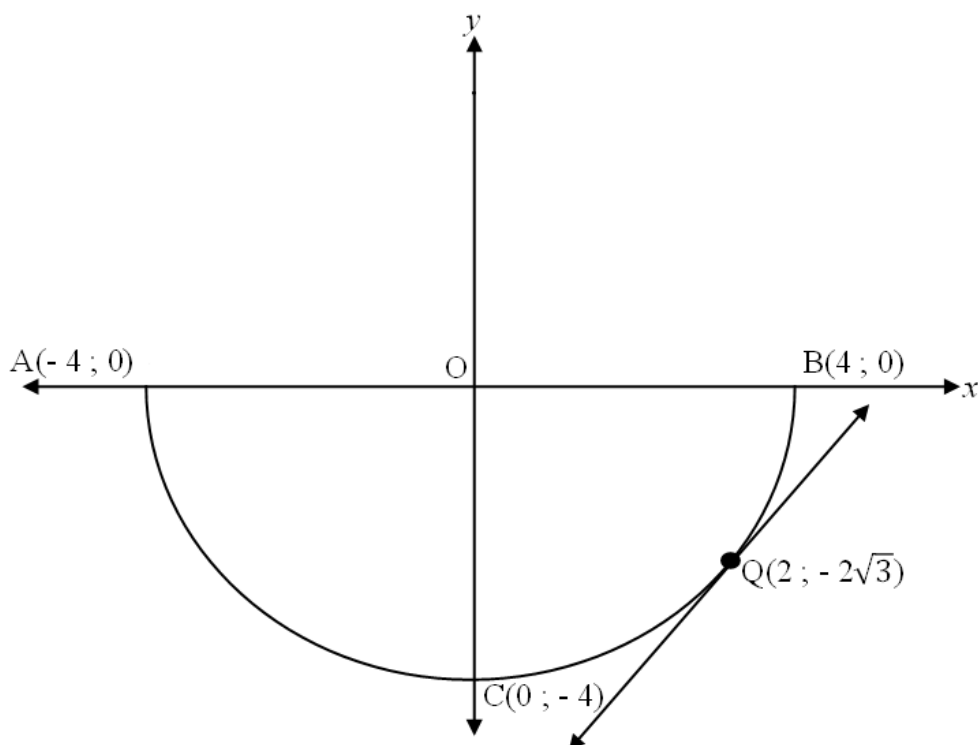


Determine:

- 1.1 The gradient of AD (2)
 - 1.2 The inclination angle, θ , (give your **answer to the nearest degree**) (3)
 - 1.3 The coordinates of P, the midpoint of BC (2)
 - 1.4 The length of AB (in **simplified surd form**) (2)
 - 1.5 The equation of the line perpendicular to BC and passing through the point P, in the form $y = \dots$ (3)
- [12]**

QUESTION 2

- 2.1 In the diagram below a semi-circle is sketched, with a tangent line touching at point Q.



2.1.1 **Determine**_(find out) the equation of the semi-circle. (3)

2.1.2 **Determine**_(find out) the **gradient** of OQ. (2)

2.1.3 **Determine**_(find out) the **equation** of the **tangent line** in the form $y = \dots$ if $P(0; -5)$ is point on the tangent line. (2)

2.2

Given: $\frac{x^2}{25} + \frac{y^2}{16} = 1$

2.2.1 **Sketch** the **given graph**, in your SPECIAL ANSWER BOOK, clearly **indicating all intercepts** with the axis. (3)

2.2.2 **Determine**_(find out) the **length** of the **major axis**. (1)

[11]

QUESTION 3

3.1 Given: $\hat{P} = 38,9^\circ$ and $\hat{S} = 153,2^\circ$

Determine(find out) the following:

3.1.1 $\sin P + \cos 2S$ (2)

3.1.2 $\sec\left(\frac{P}{3} + S\right)$ (3)

3.2 If $\tan 52^\circ = k$, **determine**(find out) the **following** in terms of k .

3.2.1 $\cos 52^\circ$ (3)

3.2.2 $\operatorname{cosec} 38^\circ$ (1)

3.2.3 $\sin 232^\circ$ (3)

3.3 Solve for θ , rounded off to ONE decimal digit, if $\theta \in (0^\circ; 90^\circ)$:

$\frac{1}{2} \operatorname{cosec} 2\theta = 0,814$ (4)

[16]

QUESTION 4

4.1 **Complete the identity:**

$$1 + \cot^2 \theta = \dots \quad (1)$$

4.2 **Simplify:**

$$\frac{\cos(180^\circ + \theta) \cdot \tan(360^\circ - \theta) \cdot \cos^2(360^\circ - \theta)}{\sin(180^\circ - \theta)} + \cos^2 \theta \quad (7)$$

4.3 **Prove that:**

$$\frac{\sec \theta + \operatorname{cosec} \theta}{\sin \theta + \cos \theta} = \tan \theta + \cot \theta \quad (8)$$

[16]

QUESTION 5

Given $f(x) = \sin x$ and $g(x) = \cos x + 1$, $x \in [0^\circ; 360^\circ]$

5.1 On the same axes, given in your SPECIAL ANSWER BOOK, **draw** the graphs of $f(x) = \sin x$ and $g(x) = \cos x + 1$. **Clearly show the intercepts with the axes, turning points and endpoints.** (7)

5.2 **Write down the range of g .** (2)

5.3 **Write down the period of f .** (1)

5.4 **Use your graphs to determine for which values of x is $g(x) = f(x)$** (2)
[12]

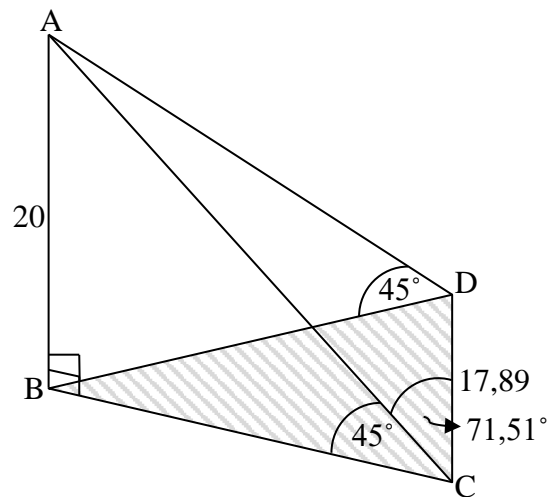
QUESTION 6

AB is a lamp pole anchored with steel cables at points C and D.
B, C and D are in the same horizontal plane.

AB = 20 units and CD = 17,89 units

$$\hat{ADB} = \hat{ACB} = 45^\circ$$

$$\hat{ACD} = 71,51^\circ$$



6.1 **Determine**(find out) the **length** of AC, one of the anchor cables. (2)

6.2 **Determine**(find out) the **area** of the $\triangle ACD$. (3)

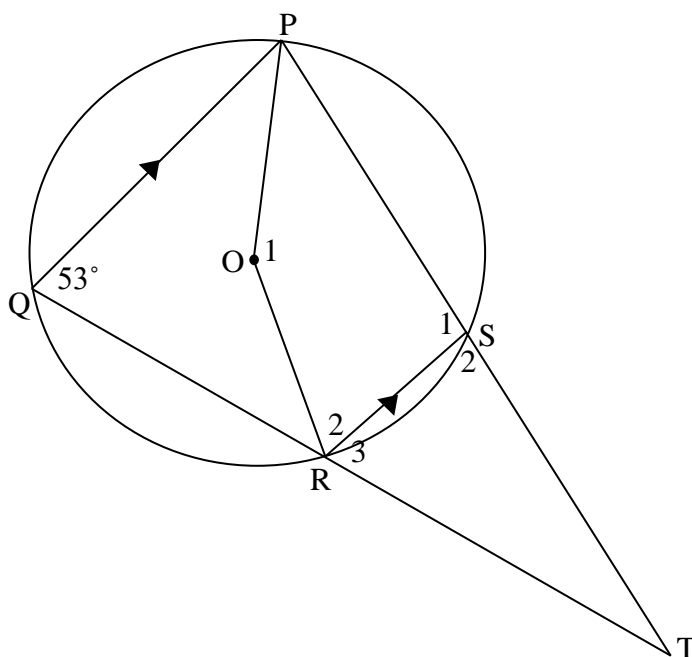
[5]

QUESTION 7

7.1 Fill in the **missing word(s)** in the following theorem statement:

“The angle subtended by an arc at the centre of the circle is ... the size of the angle subtended by the same arc at the circumference of the circle.” (1)

7.2 In the diagram below, O is the centre of the circle and PQRS is a cyclic quadrilateral $QP \parallel RS$.
PS and QR are produced to meet at T.
 $\hat{Q} = 53^\circ$



Write down the **sizes** of the **following angles** with **reasons**:

7.2.1 \hat{O}_1 (2)

7.2.2 \hat{S}_2 (2)

7.2.3 \hat{P} (2)

[7]

QUESTION 8

8.1 Fill in the **missing word(s)** in the **following** theorem statement:

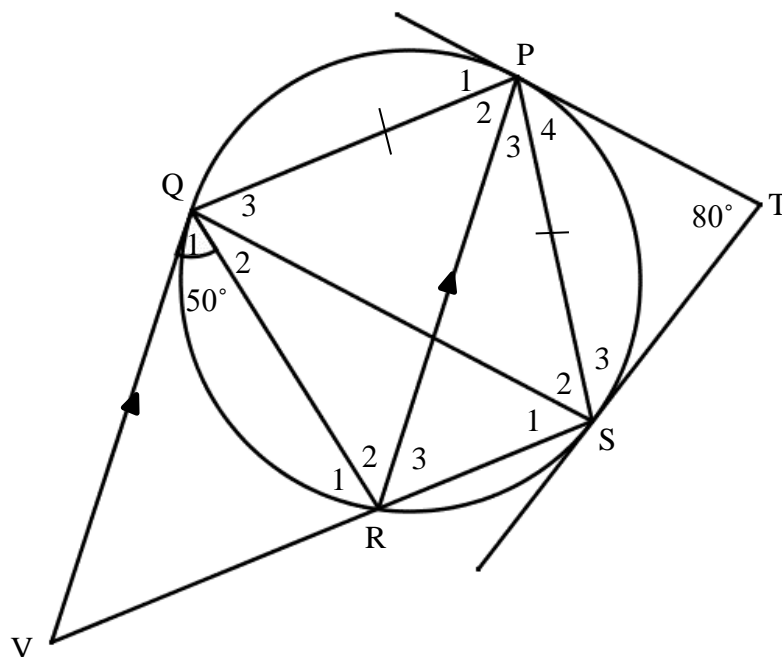
“The angle between the tangent to a circle and the chord drawn from the point of contact is ... to the angle in the alternate segment.” (1)

8.2 In the diagram below PQRS is a cyclic quadrilateral, with $PS = PQ$.

SR is produced to V, such that $QV \parallel PR$.

QV is a tangent to the circle at Q, with $\hat{Q}_1 = 50^\circ$

TP and TS are tangents from the same point T, with $\hat{T} = 80^\circ$



8.2.1 Give a reason why $TP = TS$. (1)

8.2.2 Calculate the size of \hat{P}_4 , with reasons. (4)

8.2.3 Calculate the size of the following angles, with reasons:

(a) \hat{P}_2 (2)

(b) \hat{S}_2 (2)

(c) \hat{R}_2 (2)

(d) \hat{V} (2)

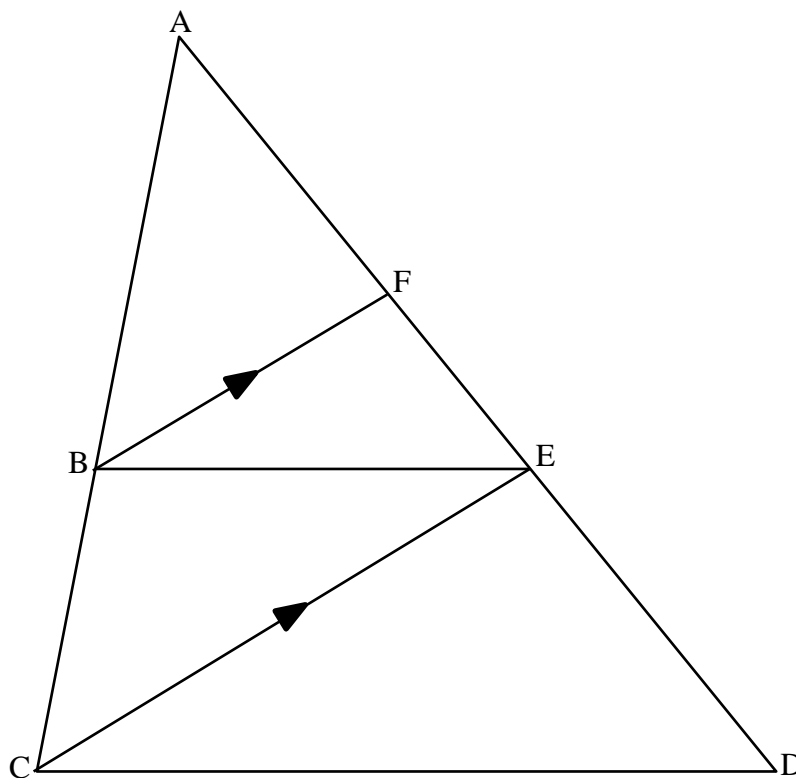
[14]

QUESTION 9

9.1 Fill in the **missing word(s)** in the following theorem statement:

“If a line divides two sides of a triangle in the same proportion, then the line is ... to the third side .” (1)

9.2 In the diagram below, $BF \parallel CE$; $AB : AC = 3 : 4$; $FE : ED = 3 : 4$ and $AE = 36$ cm.



Determine(find out):

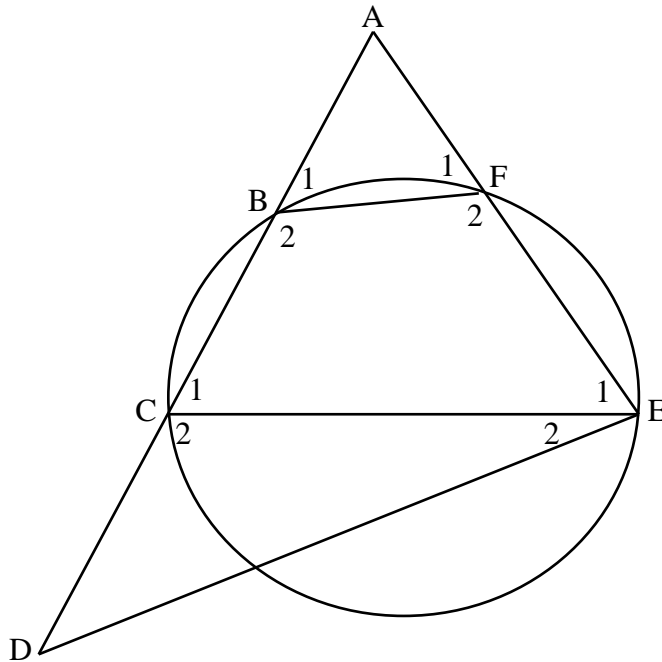
9.2.1 The length of AF (3)

9.2.2 The length of ED (3)

9.3 **Fill** in the **missing word(s)** in the following theorem statement:

“If the corresponding sides of two triangles are ..., then the triangles are equiangular.” (1)

9.4 In the diagram below, BFEC is a cyclic quadrilateral. Sides CB and EF are extended to meet at A. Triangle ECD is formed.



9.4.1 Prove that $\triangle ABF \parallel \triangle AEC$ (4)

9.4.2 Further if, $AB = 25$ cm; $AF = 20$ cm; $FE = 40$ cm and $CD = 27$ cm.

(a) **Determine**(find out) the length of BC. (3)

(b) **Show** that $BF \parallel DE$. (3)

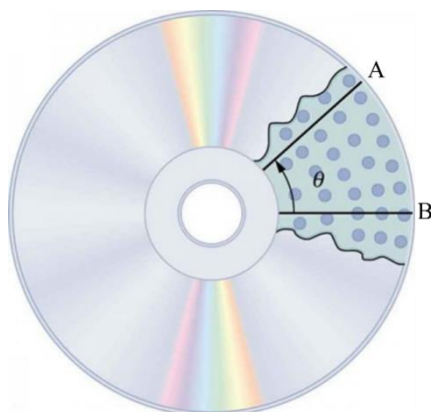
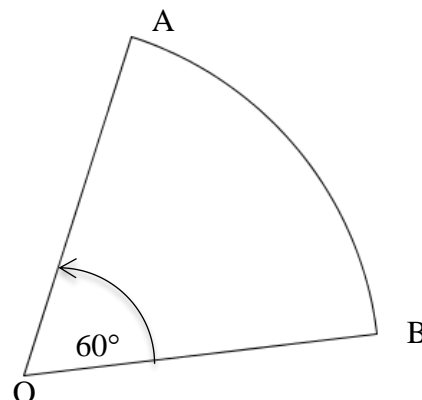
(c) **Prove** that $\triangle AEC \parallel \triangle ADE$. (3)

(d) **Determine**(find out) $DE : BF$. (2)

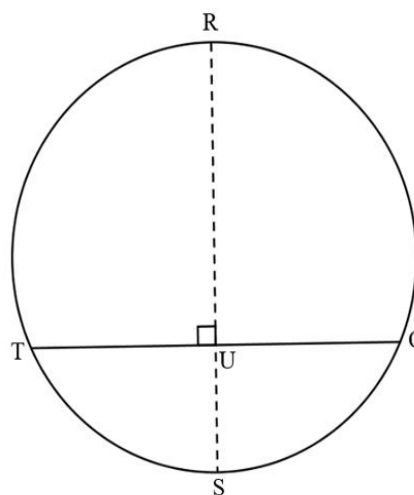
[23]

QUESTION 10

- 10.1 A crack on a music CD forms an angle of 60° as it moves on the track, from B to A. The radius of the CD is 5 cm. FIGURE 1 represent the crack.

**FIGURE 1**

- 10.1.1 Calculate the **arc length**, AB, that the **crack moved**. (4)
- 10.1.2 **Determine**(find out) the **area AOB**, formed by the crack. (3)
- 10.2 A tub in a washing machine, with diameter 420 mm, rotates at 1 800 revolutions per minute. In the diagram alongside, SR represent the diameter of the tub, with S and R points on the circumference and TQ represents a chord of the tub (circle) with $TQ \perp SR$ at U.



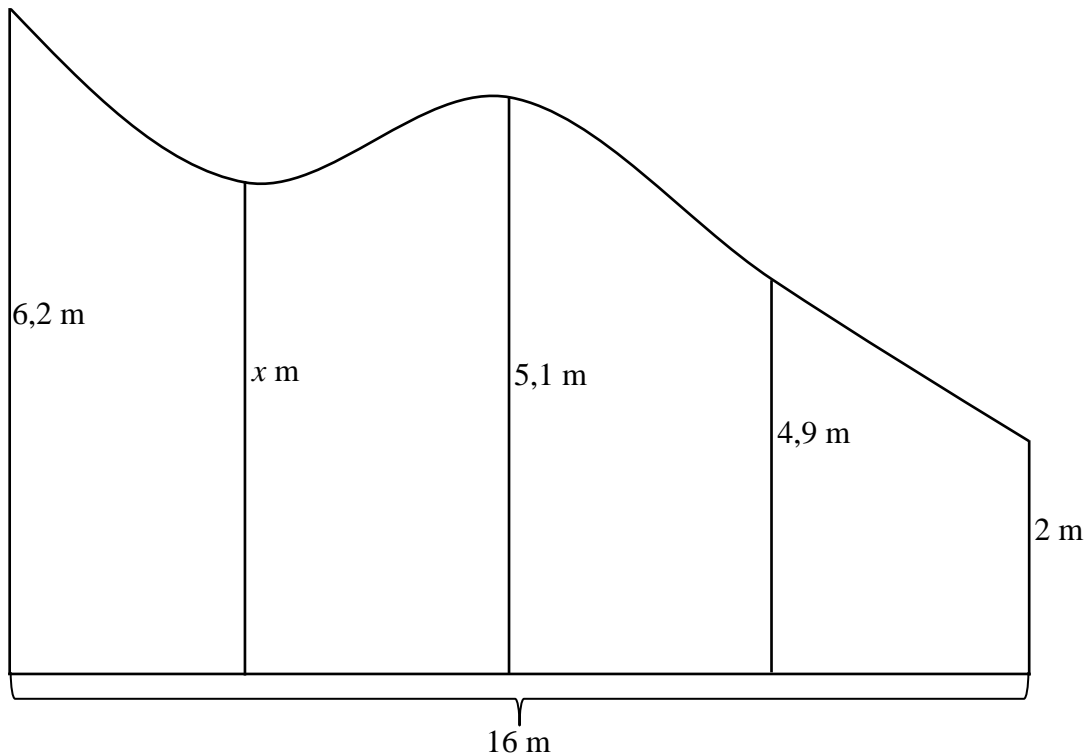
Calculate:

- 10.2.1 The **angular velocity**, of the tub, in **radians per second** (4)
- 10.2.2 The **circumferential velocity**, of the tub, in **meters per second** (4)
- 10.2.3 The **length** of **US**, if chord $TQ = 250$ mm. **Give your final** answer in cm (5)

[20]

QUESTION 11

- 11.1 The irregular shape below, with ordinates 6,2, x , 5,1, 4,9 and 2 m, has a TOTAL area of $73,6 \text{ m}^2$. One side has a length of 16 m and has been divided into four equal parts.



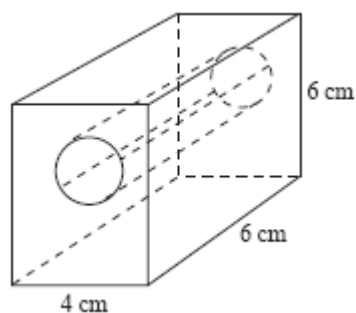
Calculate the value of x .

(5)

- 11.2 A block of wood has a cylinder cut out of it, through which an electrical cord needs to run. The cylinder has a diameter of 1,5 cm.

$$\text{Volume of cylinder} = \pi r^2 h$$

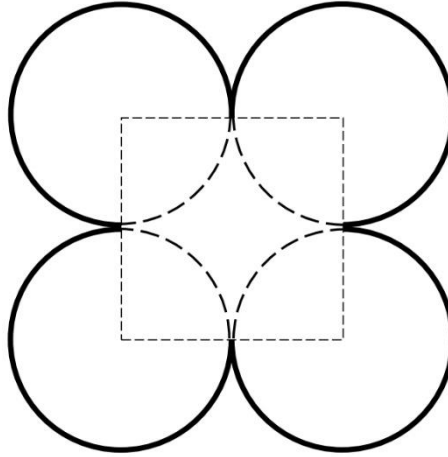
$$\text{Volume of rectangular prism} = l \times b \times h$$



Calculate the **volume** of the **remaining block of wood** after the **cylinder** has been cut out.

(4)

- 11.3 A poster is made up of 4 identical circles. The circles have a radius of 15 cm. The poster must be pasted on a wall that has a circular space with a circumference of 200 cm. The midpoints of the circles form the vertices of a square. The diagram below illustrates what the poster should look like.



Determine (find out) if the poster can be pasted in the space that is available on the wall.

(5)

[14]

TOTAL: 150

INFORMATION SHEET

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$x = -\frac{b}{2a}$$

$$y = \frac{4ac - b^2}{4a}$$

$$a^x = b \Leftrightarrow x = \log_a b, \quad a > 0, a \neq 1 \text{ and } b > 0$$

$$A = P(1 + ni)$$

$$A = P(1 - ni)$$

$$A = P(1 + i)^n$$

$$A = P(1 - i)^n$$

$$i_{eff} = \left(1 + \frac{i}{m}\right)^m - 1$$

$$f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$$

$$\int x^n dx = \frac{x^{n+1}}{n+1} + C, \quad n \neq -1$$

$$\int kx^n dx = k \cdot \frac{x^{n+1}}{n+1} + C, \quad n \neq -1$$

$$\int \frac{1}{x} dx = \ln(x) + C, \quad x > 0$$

$$\int \frac{k}{x} dx = k \cdot \ln(x) + C, \quad x > 0$$

$$\int a^x dx = \frac{a^x}{\ln a} + C, \quad a > 0$$

$$\int ka^{nx} dx = k \cdot \frac{a^{nx}}{n \ln a} + C, \quad a > 0$$

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$M\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$$

$$y = mx + c$$

$$y - y_1 = m(x - x_1)$$

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$m = \tan \theta$$

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

In $\triangle ABC$:

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc \cos A$$

$$\text{Area} = \frac{1}{2} ab \sin C$$

$$\sin^2 \theta + \cos^2 \theta = 1$$

$$1 + \tan^2 \theta = \sec^2 \theta$$

$$\cot^2 \theta = 1 + \operatorname{cosec}^2 \theta$$

$$\pi \text{ rad} = 180^\circ$$

$$\text{Angular velocity} = \omega = 2\pi n \quad \text{where } n = \text{rotation frequency}$$

$$\text{Angular velocity} = \omega = 360^\circ n \quad \text{where } n = \text{rotation frequency}$$

$$\text{Circumferential velocity} = v = \pi D n \quad \text{where } D = \text{diameter and } n = \text{rotation frequency}$$

$$\text{Circumferential velocity} = v = \omega r \quad \text{where } \omega = \text{Angular velocity and } r = \text{radius}$$

$$\text{Arc length } s = r\theta \quad \text{where } r = \text{radius and } \theta = \text{central angle in radians}$$

$$\text{Area of a sector} = \frac{rs}{2} \quad \text{where } r = \text{radius and } s = \text{arc length}$$

$$\text{Area of a sector} = \frac{r^2\theta}{2} \quad \text{where } r = \text{radius and } \theta = \text{central angle in radians}$$

$$4h^2 - 4dh + x^2 = 0 \quad \text{where } h = \text{height of segment, } d = \text{diameter of the circle and } x = \text{length of chord}$$

$$A_T = a(m_1 + m_2 + m_3 + \dots + m_{n-1}) \quad \text{where } a = \text{width of equal parts, } m_1 = \frac{o_1 + o_2}{2} \\ \text{and } n = \text{number of ordinates}$$

OR

$$A_T = a \left(\frac{o_1 + o_n}{2} + o_2 + o_3 + o_4 + \dots + o_{n-1} \right) \quad \text{where } a = \text{width of equal parts, } o_i = i^{\text{th}} \text{ ordinate and} \\ n = \text{number of ordinates}$$