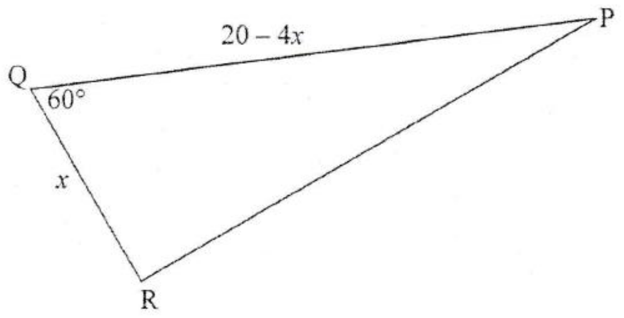
QUESTION 7

7.1 In the diagram below, ΔPQR is drawn with $PQ = 20 - 4x$, $RQ = x$ and $\hat{Q} = 60°$.

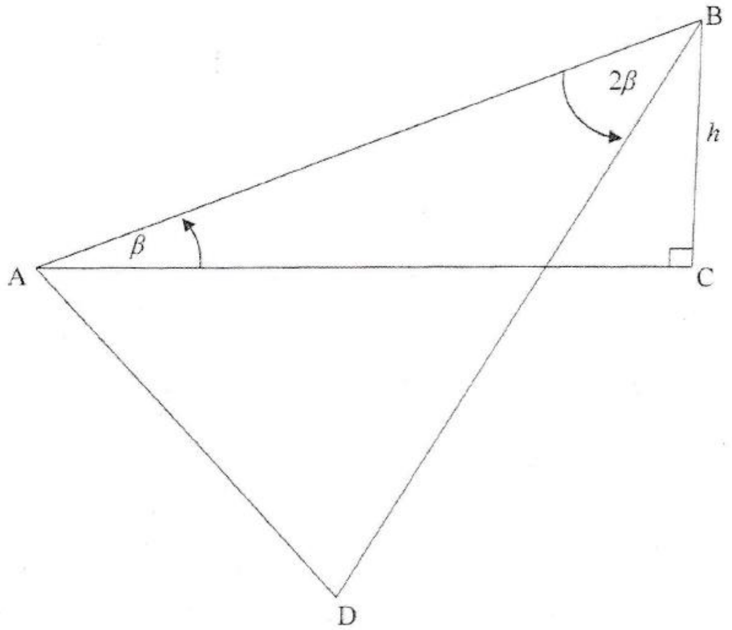


7.1.1 Show that the area of $\Delta PQR = 5\sqrt{3}x - \sqrt{3}x^2$. (2)

7.1.2 Determine the value of x for which the area of ΔPQR will be a maximum. (3)

7.1.3 Calculate the length of PR if the area of ΔPQR is a maximum. (3)

7.2 In the diagram below, BC is a pole anchored by two cables at A and D. A, D and C are in the same horizontal plane. The height of the pole is h and the angle of elevation from A to the top of the pole, B, is β. $A\hat{B}D = 2\beta$ and $BA = BD$.



Determine the distance AD between the two anchors in terms of h. (7)

[15]

QUESTION/*VRAAG* 7

7.1.1	Area of/*Oppervlakte van* $\Delta PQR = \frac{1}{2}PQ.QR.\sin\hat{Q}$ $= \frac{1}{2}x(20-4x)(\sin 60°)$ $= 10x - 2x^2\left(\frac{\sqrt{3}}{2}\right)$ $= 5\sqrt{3}x - \sqrt{3}x^2$	✓subst into area rule/ *subst in opp-reël* ✓subst & simpl/ *subst en vereenv* (2)
7.1.2	For maximum area/*Vir maksimum opp:* $(\text{Area } \Delta PQR)' = 0$ $5\sqrt{3} - 2\sqrt{3}x = 0$ $2\sqrt{3}x = 5\sqrt{3}$ $\therefore\ x_{max} = \frac{5}{2}$ or $2\frac{1}{2}$ or/*of* 2,5	✓$(\text{Area } \Delta PQR)' = 0$ ✓$5\sqrt{3} - 2\sqrt{3}x$ ✓answ/*antw* (3)
	OR/*OF* $x_{max} = -\frac{b}{2a}$ $= -\frac{5\sqrt{3}}{2(-\sqrt{3})} = \frac{5}{2}$ or $2\frac{1}{2}$ or 2,5	✓formula/*e* ✓ subst ✓answ/*antw* (3)
	OR/*OF* $5\sqrt{3}x - \sqrt{3}x^2 = 0$ $\sqrt{3}x(5-x) = 0$ $\therefore x = 0$ or 5 $\therefore\ x_{max} = \frac{0+5}{2} = \frac{5}{2}$ or/*of* 2,5	✓x-intercepts/ *x-afsnitte* ✓subst ✓answ/*antw* (3)
7.1.3	$RP^2 = QP^2 + QR^2 - 2.QP.QR.\cos Q$ $= 10^2 + 2{,}5^2 - 2(10)(2{,}5)\cos 60°$ $= 81{,}25$ $\therefore RP = 9{,}01$	✓subst into cosine rule/*in cos-reël* ✓simpl/*vereenv* ✓answ/*antw* (3)

7.2	In ΔABC: $\sin\beta = \dfrac{h}{\text{AB}}$ $\therefore \text{AB} = \dfrac{h}{\sin\beta}$ In ΔABD: AB = BD and/*en* $\text{A}\hat{\text{D}}\text{B} = 90° - \beta$ [∠s of/*v* Δ = 180°] $\dfrac{\sin 2\beta}{\text{AD}} = \dfrac{\sin(90° - \beta)}{\text{AB}}$ $\text{AD} = \dfrac{\text{AB}.\sin 2\beta}{\sin(90° - \beta)}$ $= \dfrac{h}{\sin\beta} \times \dfrac{2\sin\beta.\cos\beta}{\cos\beta}$ $= 2h$	✓AB ito h and/*en* β ✓ $\text{A}\hat{\text{D}}\text{B} = 90° - \beta$ ✓correct subst into cosine rule/*subst korrek in cos-reël* ✓AD as subject/ *onderwerp* ✓expansion/*uitbrei* ✓sin (90°– β) = cos β ✓answer ito h (7)
	OR/*OF* In ΔABC: $\sin\beta = \dfrac{h}{\text{AB}}$ $\therefore \text{AB} = \dfrac{h}{\sin\beta}$ In ΔABD: AB = BD $\text{AD}^2 = \text{AB}^2 + \text{AB}^2 - 2\text{AB}.\text{AB}.\cos 2\beta$ $= \left(\dfrac{h}{\sin\beta}\right)^2 + \left(\dfrac{h}{\sin\beta}\right)^2 - 2\left(\dfrac{h}{\sin\beta}\right)^2.\cos 2\beta$ $= \left(\dfrac{h}{\sin\beta}\right)^2 + \left(\dfrac{h}{\sin\beta}\right)^2 - 2\left(\dfrac{h}{\sin\beta}\right)^2(1 - 2\sin^2\beta)$ $= \left(\dfrac{h}{\sin\beta}\right)^2 + \left(\dfrac{h}{\sin\beta}\right)^2 - 2\left(\dfrac{h}{\sin\beta}\right)^2 + 4h^2$ $= 4h^2$ $\therefore \text{AD} = 2h$	✓AB ito h and/*en* β ✓correct subst into cosine rule/*subst korrek in cos-reël* ✓expansion/*uitbrei* ✓multiplication/ *vermenigv* ✓simpl/*vereenv* ✓answer ito h (7)