Gabarito da P1 – E

1ª Questão) PHR no eixo da bomba:

A) $\text{Hest} = 20(\text{m}) = 27 - 5 + \dfrac{\text{Parcomp} + 0{,}6 \times 104}{1000}$

$\dfrac{\text{Parcomp}}{1000} = 20 - 28 = -8000(\text{kgf}/\text{m}^2)$

$\text{Parabs} = -8000 + 0{,}7 \times 13600 \Rightarrow \text{Parabs} = 2336(\text{kgf}/\text{m}^2)$

B) $\text{H}_\text{B} = \text{Hfinal} + \text{Hinicial} + \text{Hptotais} \Rightarrow 20 + \text{Hpt}$

No ponto de trabalho $\rightarrow \text{Q} = 16{,}2(\text{m}^3/\text{h})$
$\rightarrow \text{HB} = 41(\text{m})$

$41 = 20 + \text{Hpt} \Rightarrow \text{Hpt} = 21(\text{m})$

C) $21 = \text{f} \times \dfrac{140 + 28{,}2}{0{,}050} \times 16 \times \dfrac{\left(16{,}2/3600\right)^2}{(\pi \times 0{,}05^2)^2 \times 2 \times 9{,}8}$

$\text{f} \cong 2{,}33 \times 10^{-2}$

D) $\text{NB} = 0{,}328 \times 16{,}2^2 = 86{,}08032(\text{cv}) = \dfrac{1000 \times \left(16{,}2/3600\right) \times 41}{75 \times \eta_\text{B}}$

$\eta_\text{B} \cong 2{,}85\% \Rightarrow$ A bomba foi mal escolhida, portanto deve ser alterada, supondo que a vazão desejada é $14{,}5(\text{m}^3/\text{h})$, faça a nova escolha e as alterações desejáveis, considere $\text{Par} = -8000(\text{kgf}/\text{m}^2)$, tubulação de PVC e $\text{Pvapor}_{\text{H2O}} = 82{,}4(\text{kgf}/\text{m}^2)$

trabalhe com $\rightarrow \text{n} = 3500(\text{rpm})$
$\rightarrow \text{n} = 1750(\text{rpm})$

E) $\text{NPSH} = 0{,}0086 \times 16{,}2^2 - 0{,}0851 \times 16{,}2 + 1{,}8$

$\text{NPSH} = 2{,}68(\text{m})$

$2{,}68 = 5 + \dfrac{4336 - \text{Pvapor}}{1000} - 2{,}33 \times 10^{-2} \times \dfrac{(3 + 1{,}4) \times 16 \times \left(16{,}2/3600\right)^2}{0{,}050 \times 2 \times 9{,}8 \times (\pi \times 0{,}05^2)^2}$

$2{,}68 = 5 + 4{,}336 - \dfrac{\text{Pvapor}}{1000} - 0{,}55$

$\text{Pvapor} = 6106{,}5(\text{kgf}/\text{m}^2)$

2ª Questão) $\text{Sch}40 \Rightarrow 1{,}5'' \begin{cases} \rightarrow D\text{int} = 40{,}8(\text{mm}) \\ \rightarrow A = 13{,}1(\text{cm}^2) \end{cases} \Rightarrow$ aço galvanizado

fluido $H_2O \begin{cases} \rightarrow \gamma = 1000(\text{kgf}/\text{m}^3) \\ \rightarrow \nu = 10^{-6}(\text{m}^2/\text{s}) \end{cases}$

Dados da instalação $\begin{cases} \rightarrow L = 61(\text{m}) \\ \rightarrow \sum Le = 19{,}5(\text{m}) \end{cases}$

PHR no eixo da bomba

$$\text{Hinicial} = 4 - \frac{0{,}2 \times 10^4}{10^3} + 0 \Rightarrow \text{Hinicial} = 2(\text{m})$$

$$\text{Hfinal} = 36 + 0 + \frac{Q^2}{2 \times 9{,}8 \times (13{,}1 \times 10^{-4})^2} \Rightarrow \text{Hfinal} = 36 + 29730{,}4 \times Q^2$$

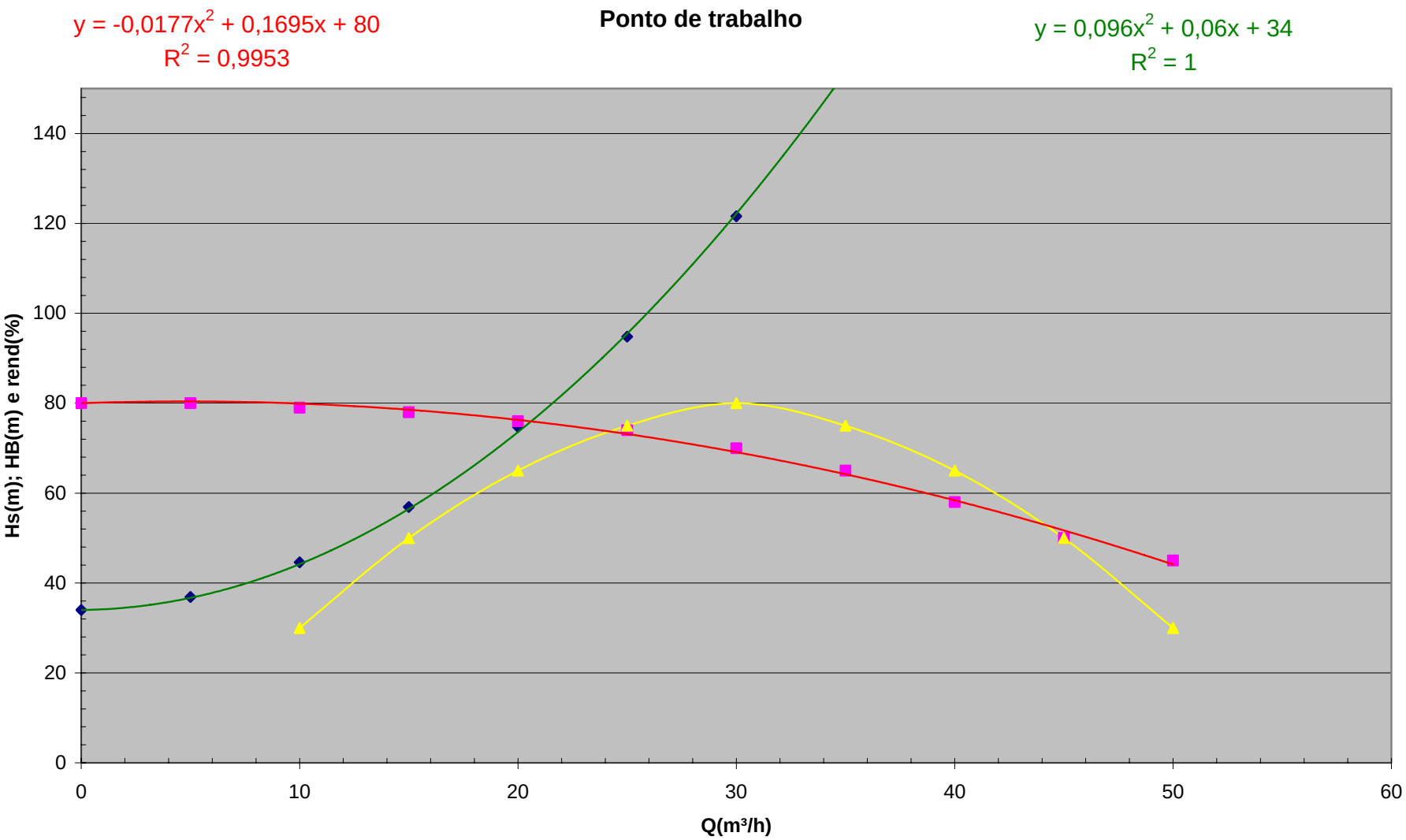
$$\text{Hpt} = f \times \frac{61 + 19{,}5}{0{,}0408} \times \frac{Q^2}{2 \times 9{,}8 \times (13{,}1 \times 10^{-4})^2}$$

$$\therefore \text{Hpt} = 58659324{,}1 \times f \times Q^2$$

$$2 + \text{Hs} = 36 + 29730{,}4 \times Q^2 + 58659324{,}1 \times f \times Q^2$$

$$\text{Hs} = 34 + 29730{,}4 \times Q^2 + 58659324{,}1 \times f \times Q^2$$

Q(m³/h)	Re	DH/K	f	Hs(m)	fnumérico	HB(m)	rend(%)
0	0	850	0	34	0	80	
5	43365	850	0,025	36,9	0,025	80	
10	86730	850	0,023	44,6	0,023	79	30
15	130095	850	0,022	56,9	0,0223	78	50
20	173459	850	0,022	74,7	0,0219	76	65
25	216824	850	0,021	94,8	0,0216	74	75
30	260189	850	0,021	121,6	0,0214	70	80
35	303554	850	0,021	153,2	0,0213	65	75
40	346919	850	0,021	189,8	0,0212	58	65
45	390284	850	0,021	231,1	0,0211	50	50
50	433648	850	0,021	277,4	0,021	45	30


y = -0,0177x2 + 0,1695x + 80
R2 = 0,9953
Ponto de trabalho
y = 0,096x2 + 0,06x + 34
R2 = 1
Hs(m); HB(m) e rend(%)
Q(m³/h)
0
20
40
60
80
100
120
140
0
10
20
30
40
50
60

$$-0{,}0177\times Q^2+0{,}1695\times Q+80=0{,}096\times Q^2+0{,}06\times Q+34$$

$$(0{,}096+0{,}0177)\times Q^2+(0{,}06-0{,}1695)\times Q+34-80=0$$

$$\therefore\ 0{,}1137\times Q^2-0{,}1095\times Q-46=0 \qquad \begin{array}{l}\rightarrow Q'=-19{,}64(m^3/h)\\ \rightarrow Q''=20{,}6(m^3/h)\end{array}$$

$0{,}096\times(20{,}6^2)+0{,}06\times 20{,}6+34\approx 76\,m$, portanto:

$$Q=20{,}6(m^3/h)$$

Ponto de trabalho: $HB\approx 76(m)$

$$\eta_B\approx 65\%$$

$$NB=\frac{1000\times\left(20{,}6/3600\right)\times 76}{75\times 0{,}65}\Rightarrow NB\cong 8{,}93(cv)$$

$$Nm_{REFER}=\frac{8{,}93}{0{,}9}\Rightarrow Nm_{REFER}=9{,}91(cv)$$

$$\therefore\ Nm=10(cv)$$

$$\eta_{m_{real}}=\frac{8{,}93}{10}\cong 89{,}3\Rightarrow \eta_{m_{real}}=89{,}3\%$$