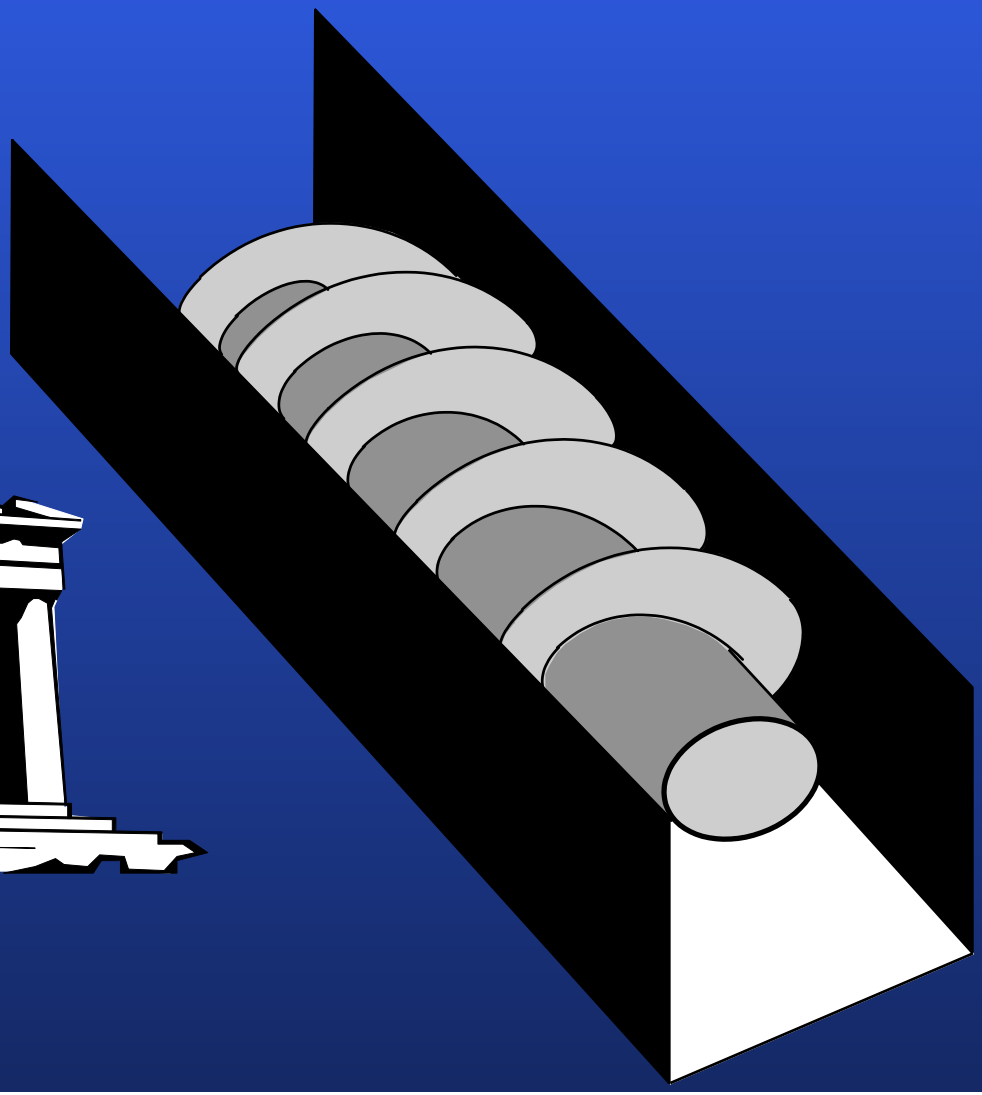
HIDRAULICA BASICA

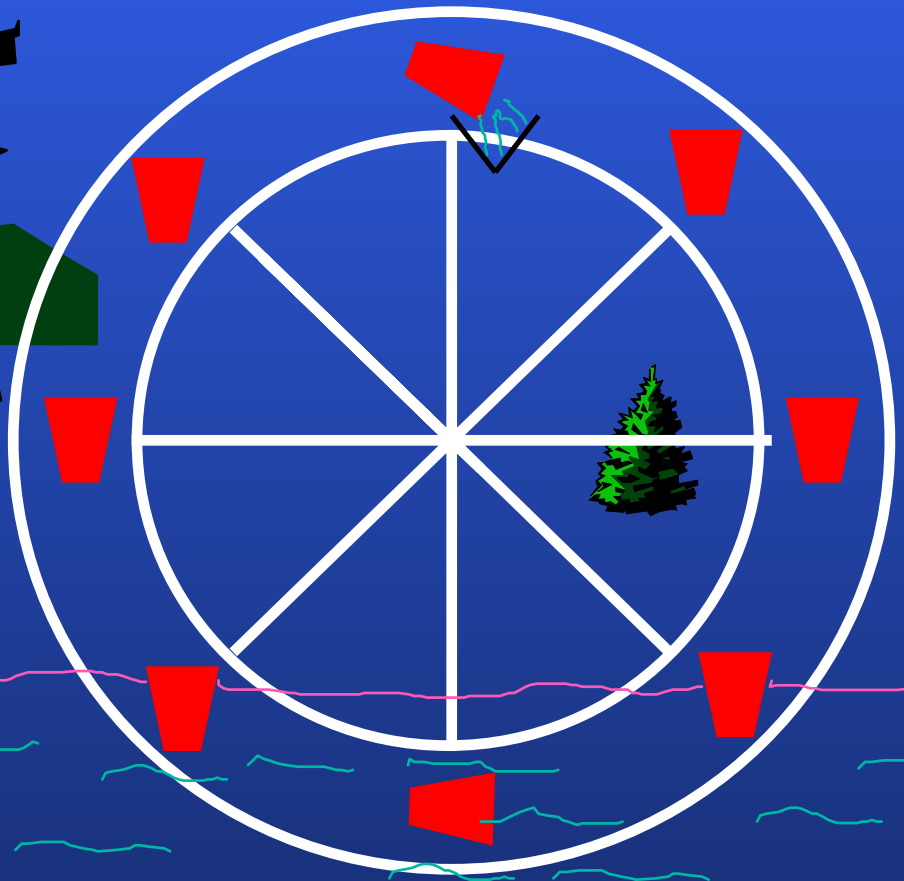
AGENDA

- Historia de las Bombas
- Clasificación de las Bombas
- Terminos Hidraulicos / Definición
- Curvas de Bombas
- Resolviendo Problemas de Altura & NPSH
- Curva de Altura del Sistema
- Operación a Velocidad Reducida
- Corrección por Viscosidad

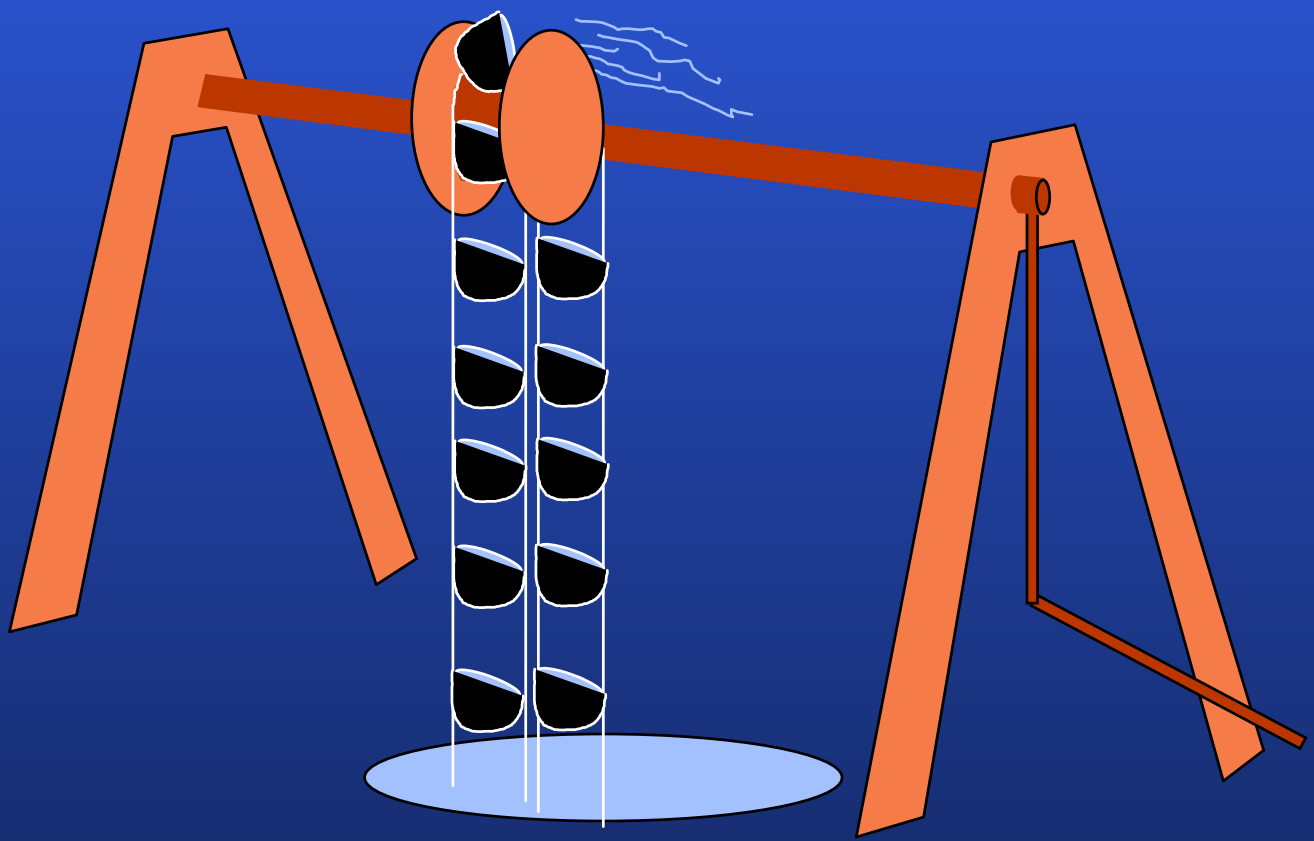
TORNILLO SIN FIN



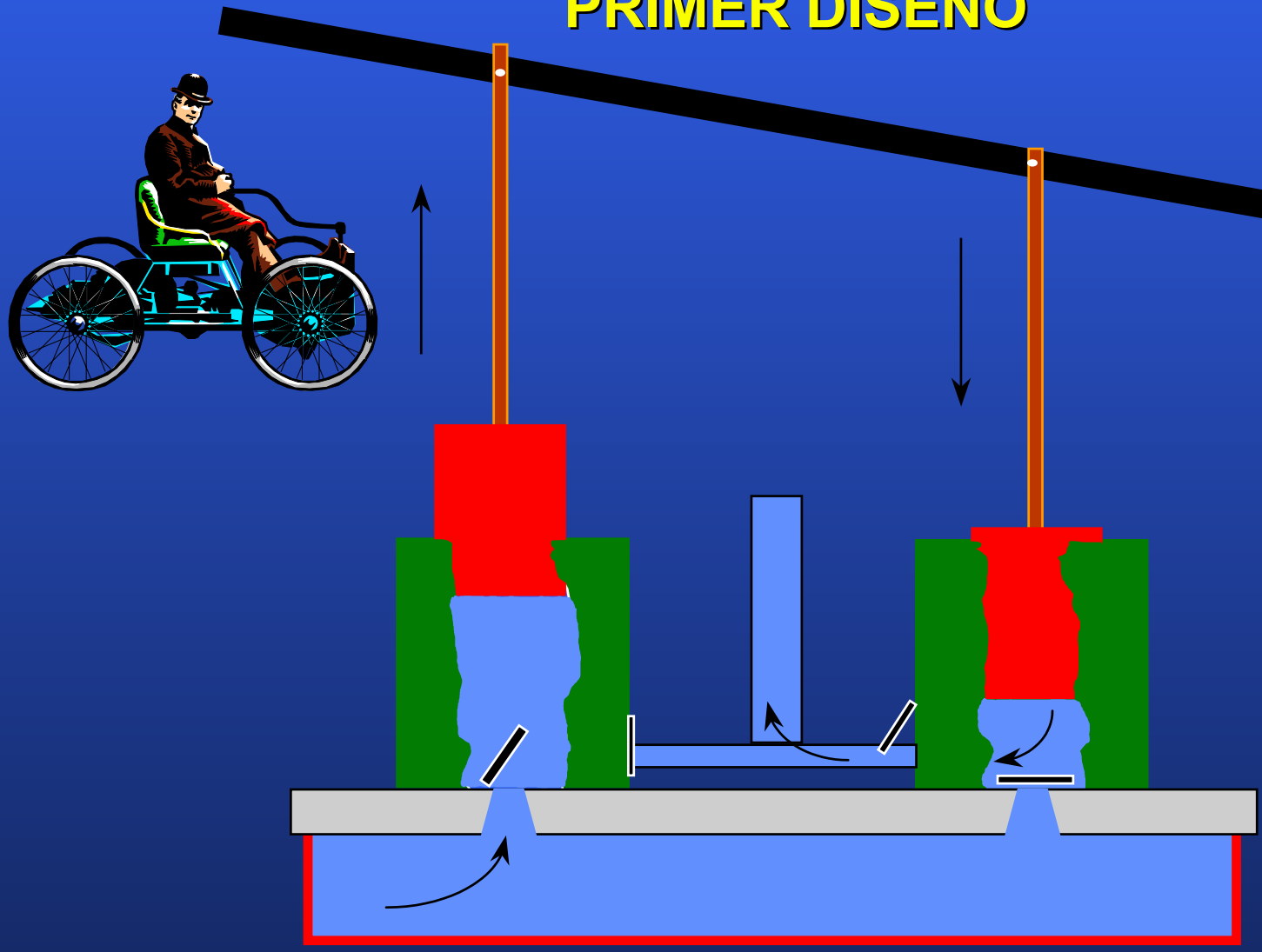
NORIA



CADENA de ENVASES

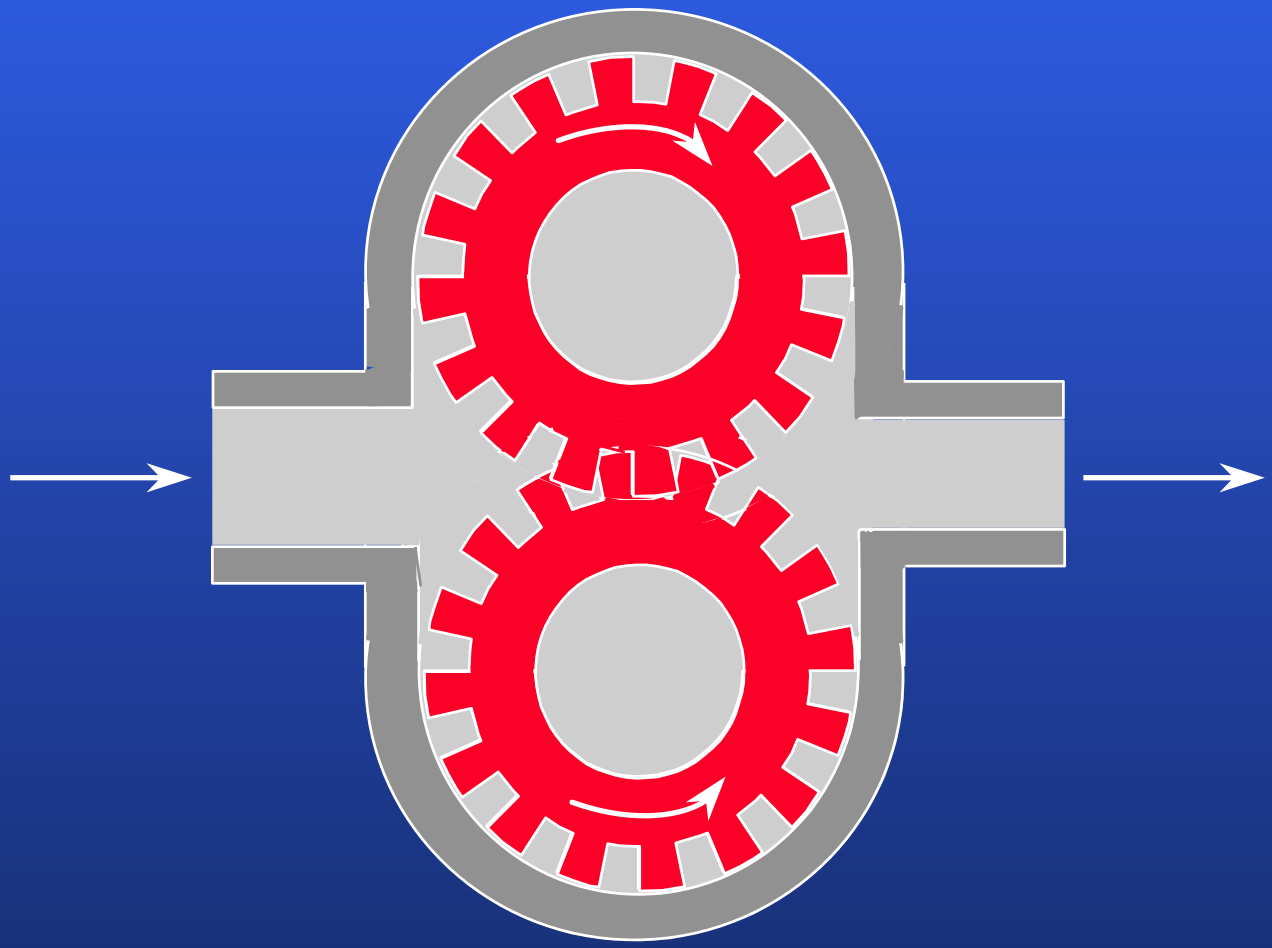


BOMBA DE DESPLAZAMIENTO POSITIVO
PRIMER DISEÑO




BOMBA
DESPLAZAMIENTO POSITIVO
RECIPROCANTE
ROTATIVA
CINETICA
CENTRIFUGA
REGENERATIVA
EFECTO ESPECIAL

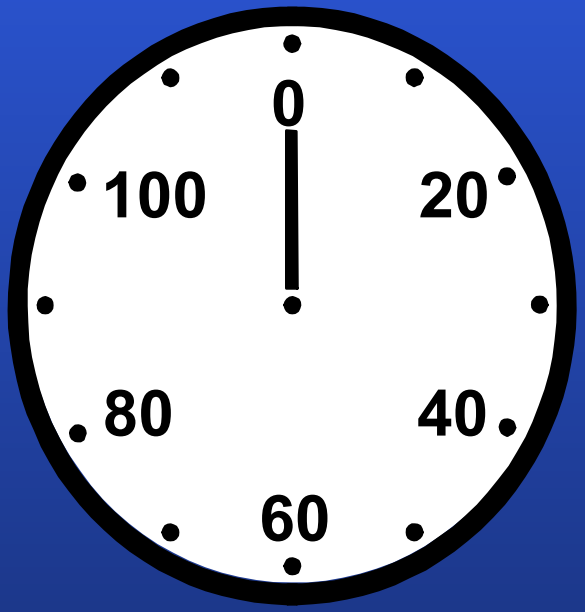

DESPLAZAMIENTO POSITIVO
RECIPROCANTE
PISTON
BALANCIN
DIAFRAGMA
ROTATIVA
ENGRANAJE
LOBULO
TORNILLO
ALABE
CAVIDAD PROGRESIVA




CINETICA
CENTRIFUGA
IMPULSOR EN VOLADIZO
IMPULSOR ENTRE RODAMIENTOS
TIPO TURBINA
EFECTO ESPECIAL
CENTRIFUGA REVERSIBLE
CARCAZA ROTATIVA
TURBINA REGENERATIVA
IMPULSOR EN VOLADIZO
IMPULSOR ENTRE RODAMIENTOS

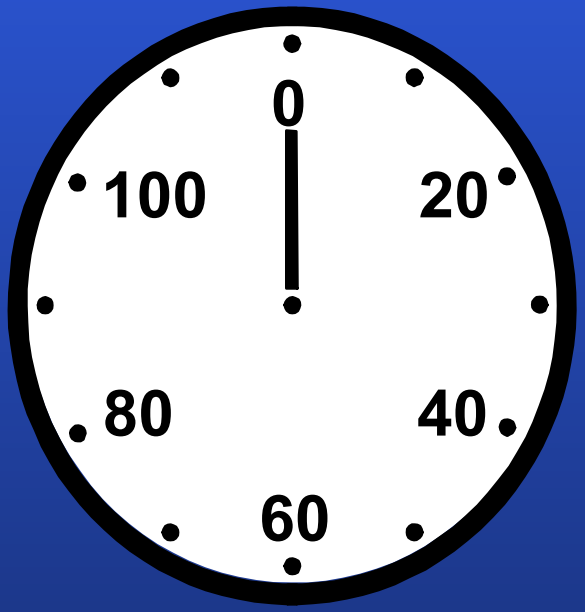
PRESION ATMOSFERICA

MEDIDOR DE PRESION



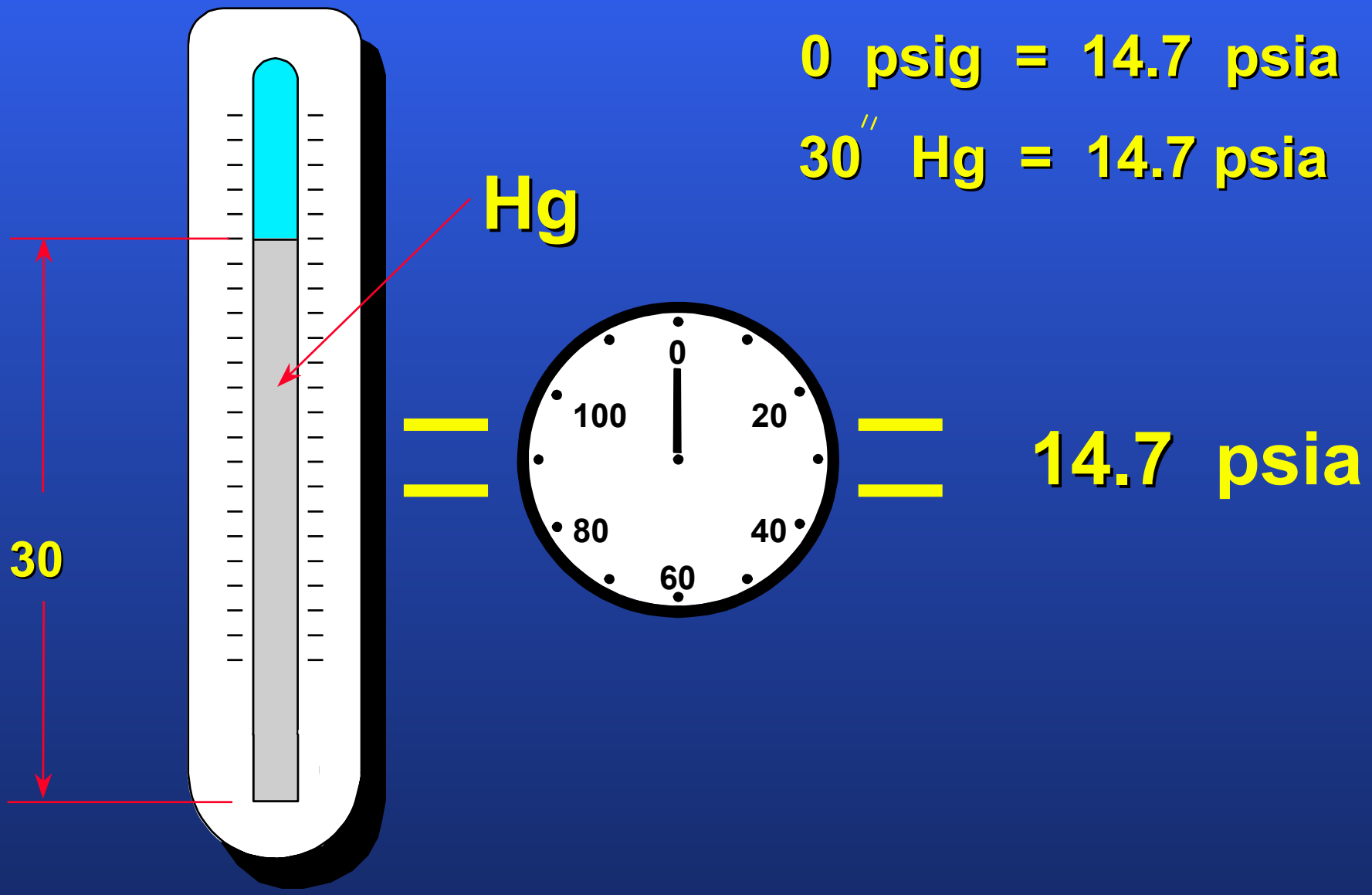
0 psig

MEDIDOR DE PRESION

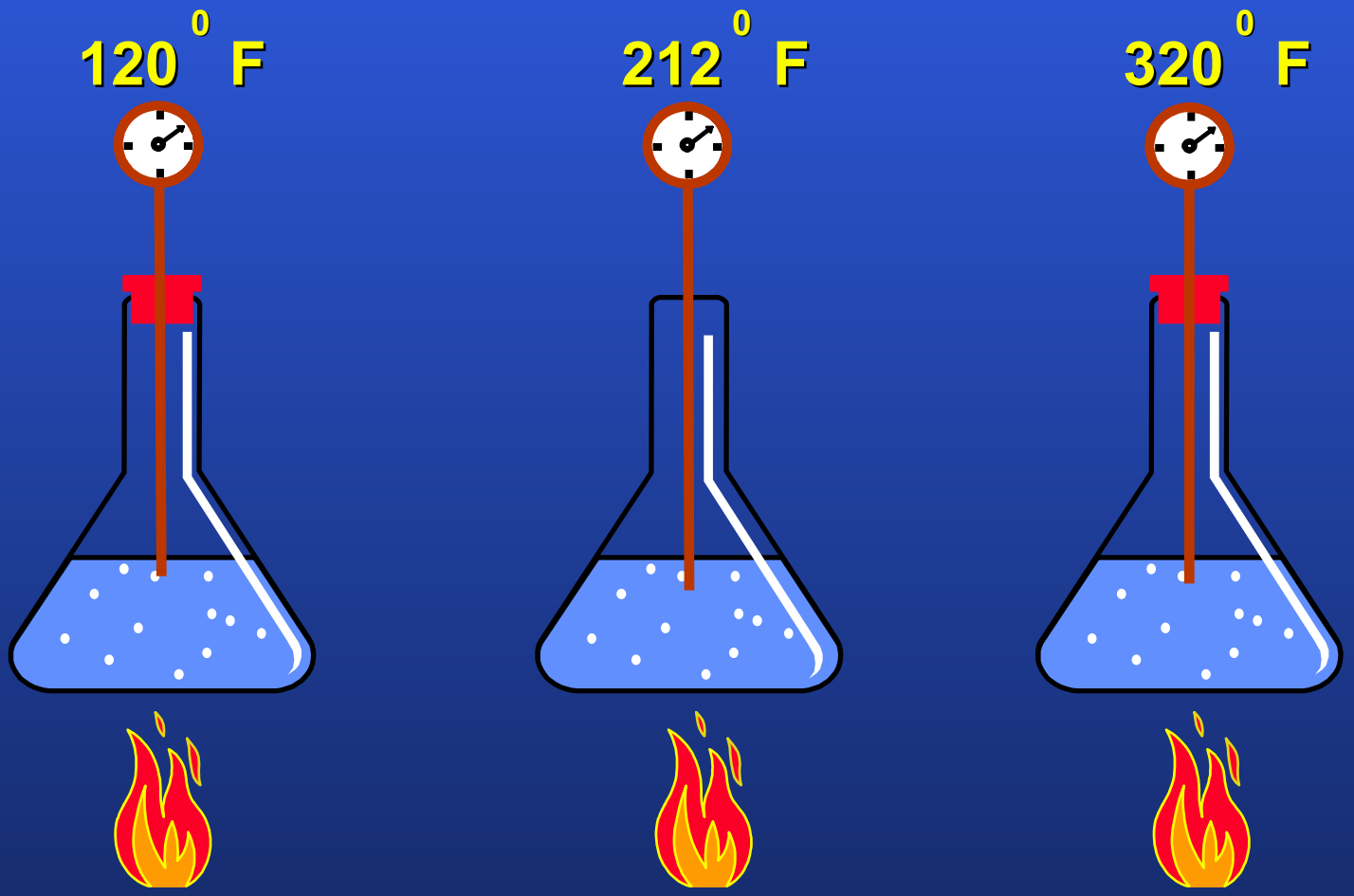


0 psig

= 14.7 psia

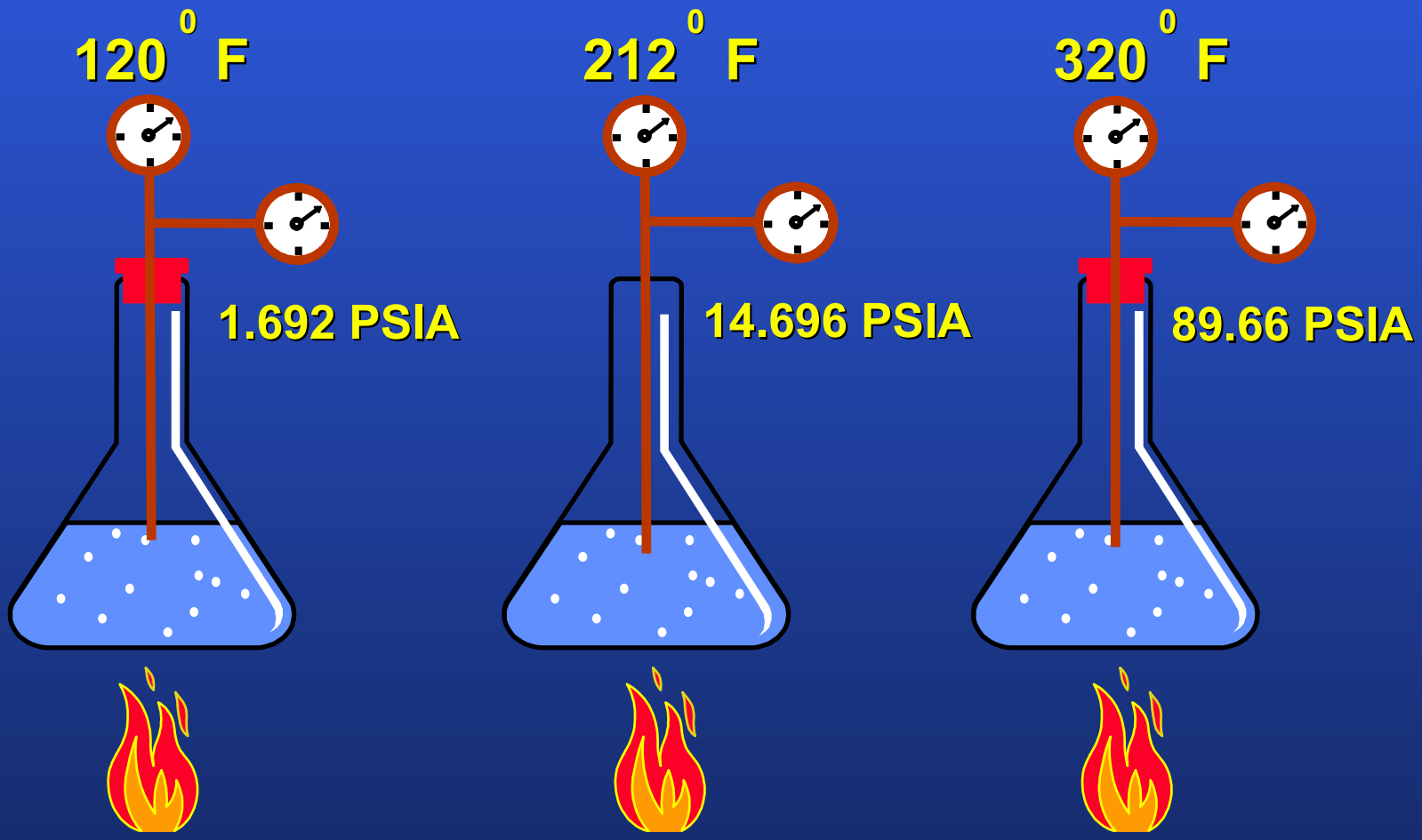

0 psig = 14.7 psia
30″ Hg = 14.7 psia
Hg
30
0
20
40
60
80
100
14.7 psia

PRESION DE VAPOR
AGUA



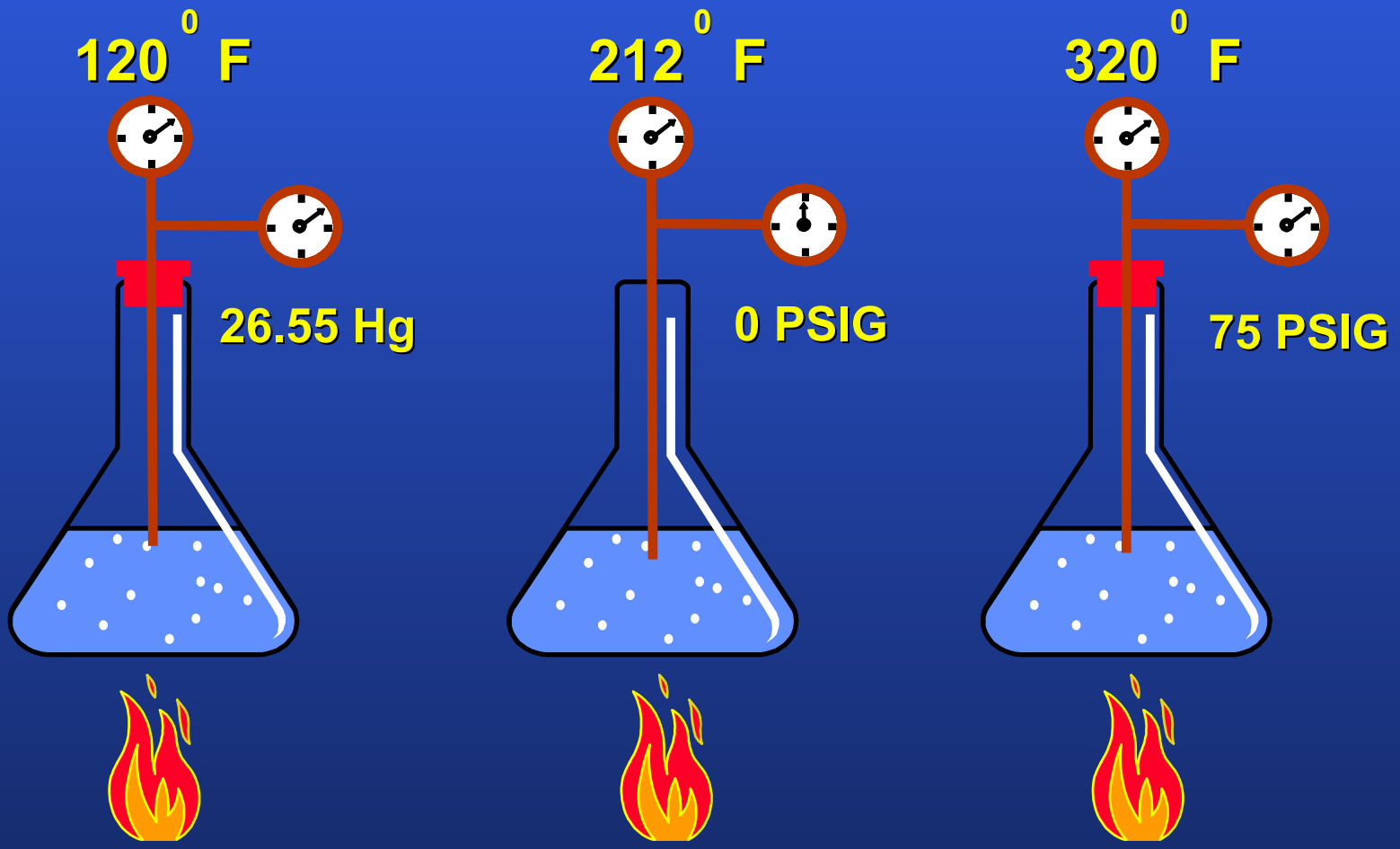
PRESION DE VAPOR

AGUA

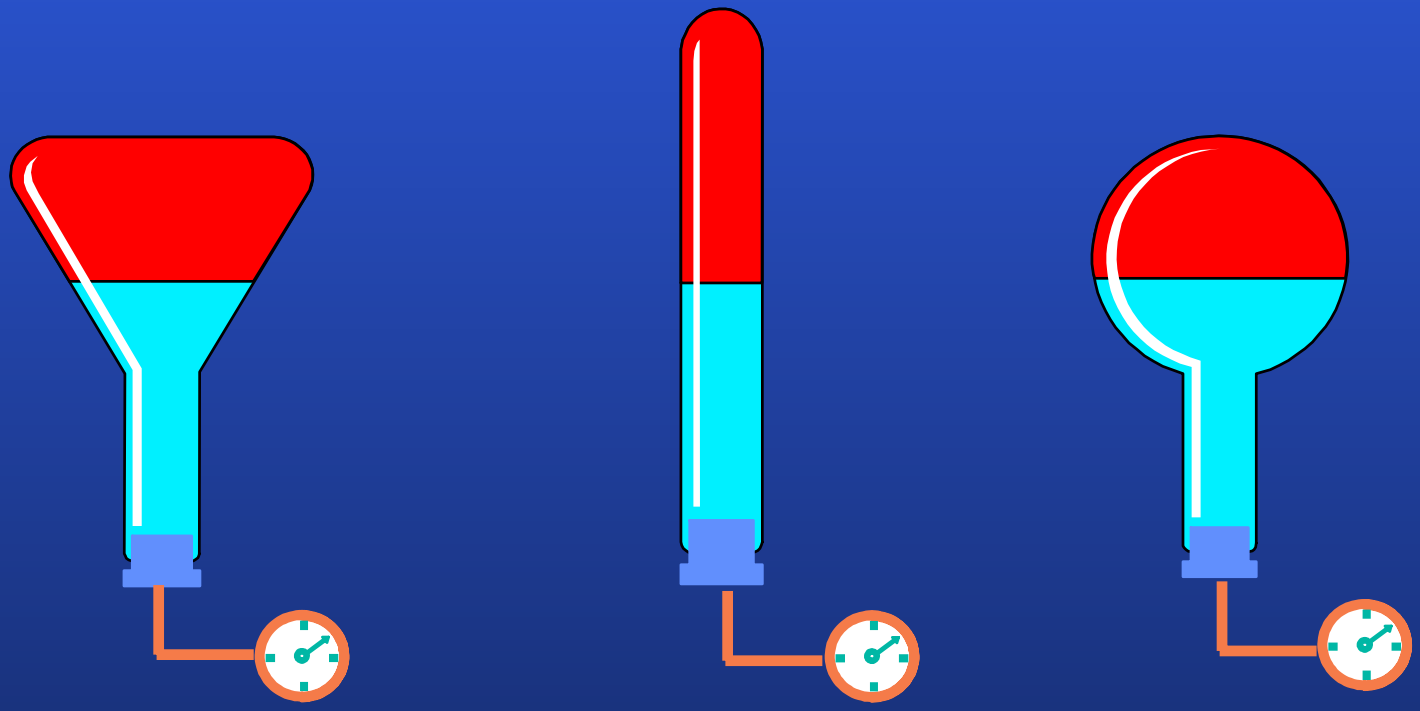


PRESION DE VAPOR

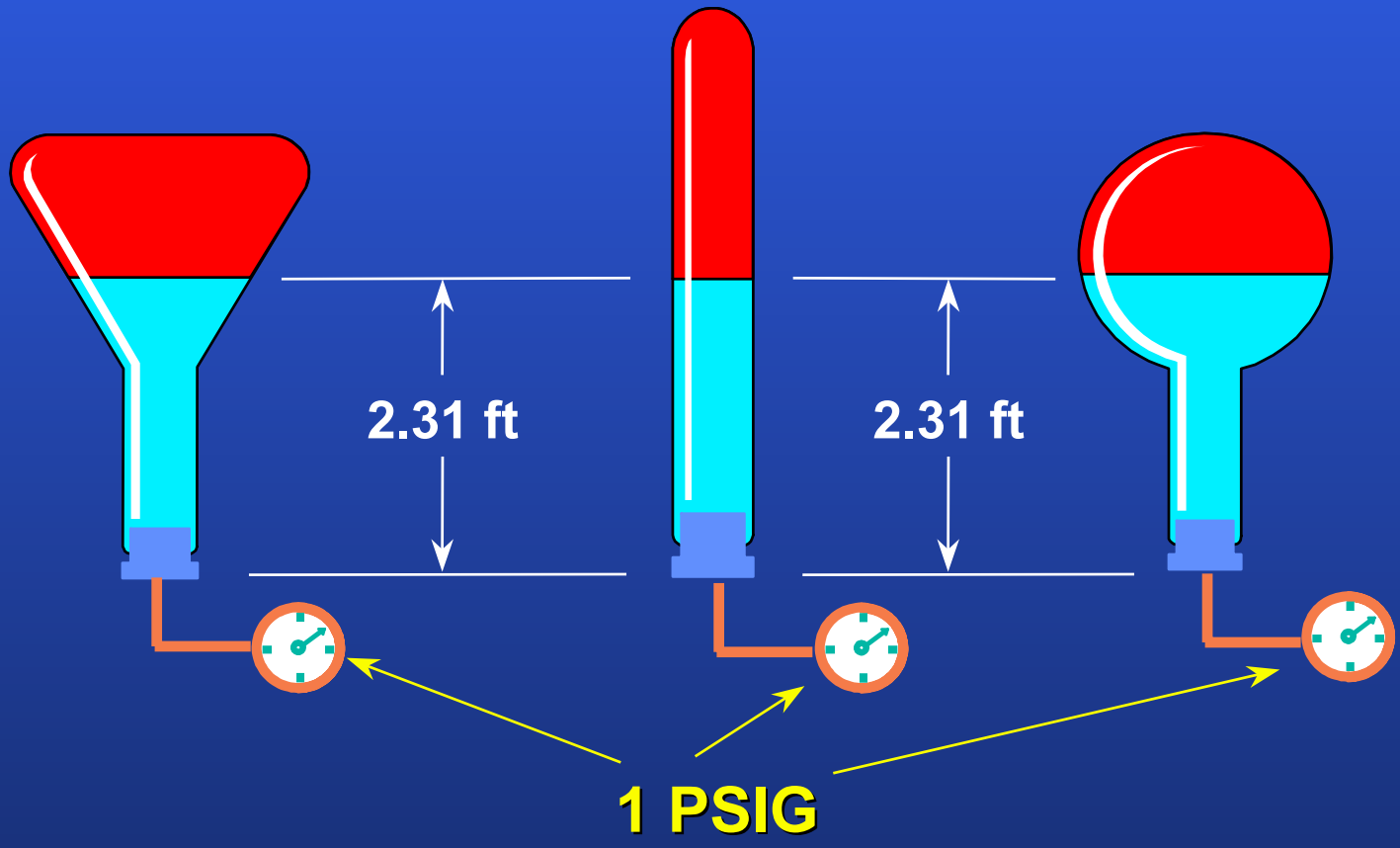
AGUA



FLUIDO EN RECIPIENTE = AGUA
GRAVEDAD ESPECIFICA = 1.0



FLUIDO EN RECIPIENTE = AGUA
GRAVEDAD ESPECIFICA = 1.0



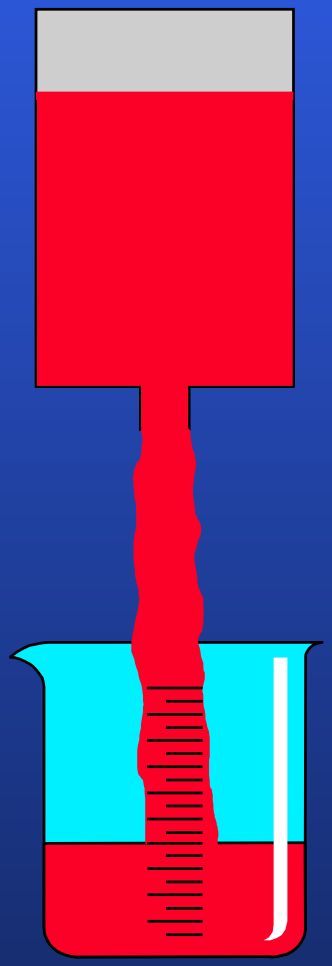
LA GRAVEDAD ESPECIFICA Y LA ALTURA AFECTAN LA PRESION
EL TAMAÑO Y FORMA DEL CONDUCTO NO LA AFECTA

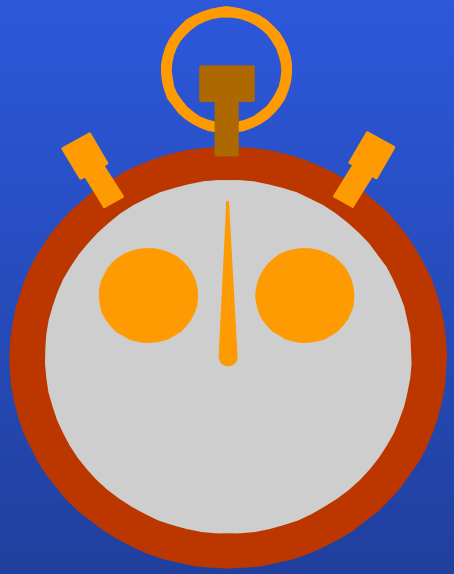
GRAVEDAD ESPECIFICA

0.70 S.G.
GASOLINA

1.0 S.G.
AGUA

VISCOSIDAD

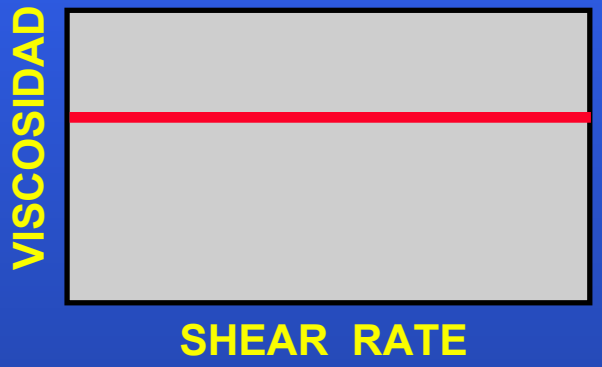




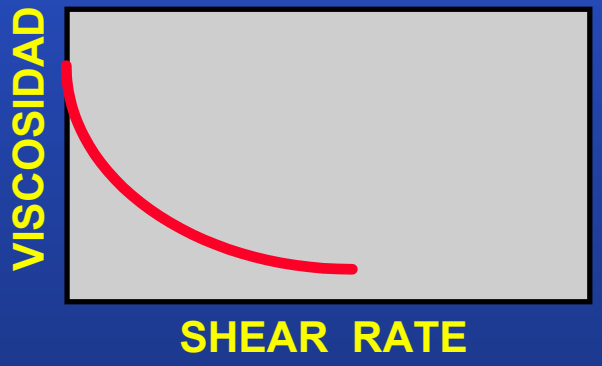
SAYBOLT SECONDS UNIVERSAL
AGUA A 60 °F ES 31 SSU

VISCOSIDAD

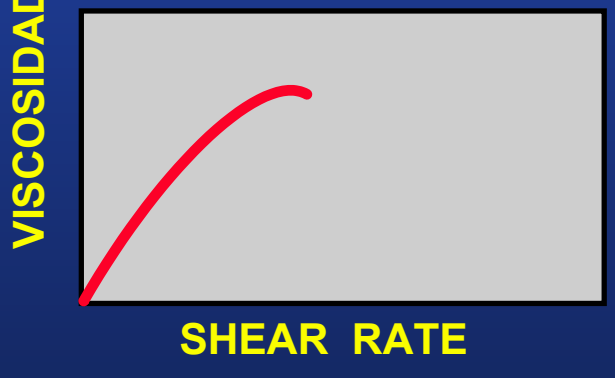
NEWTONIANO



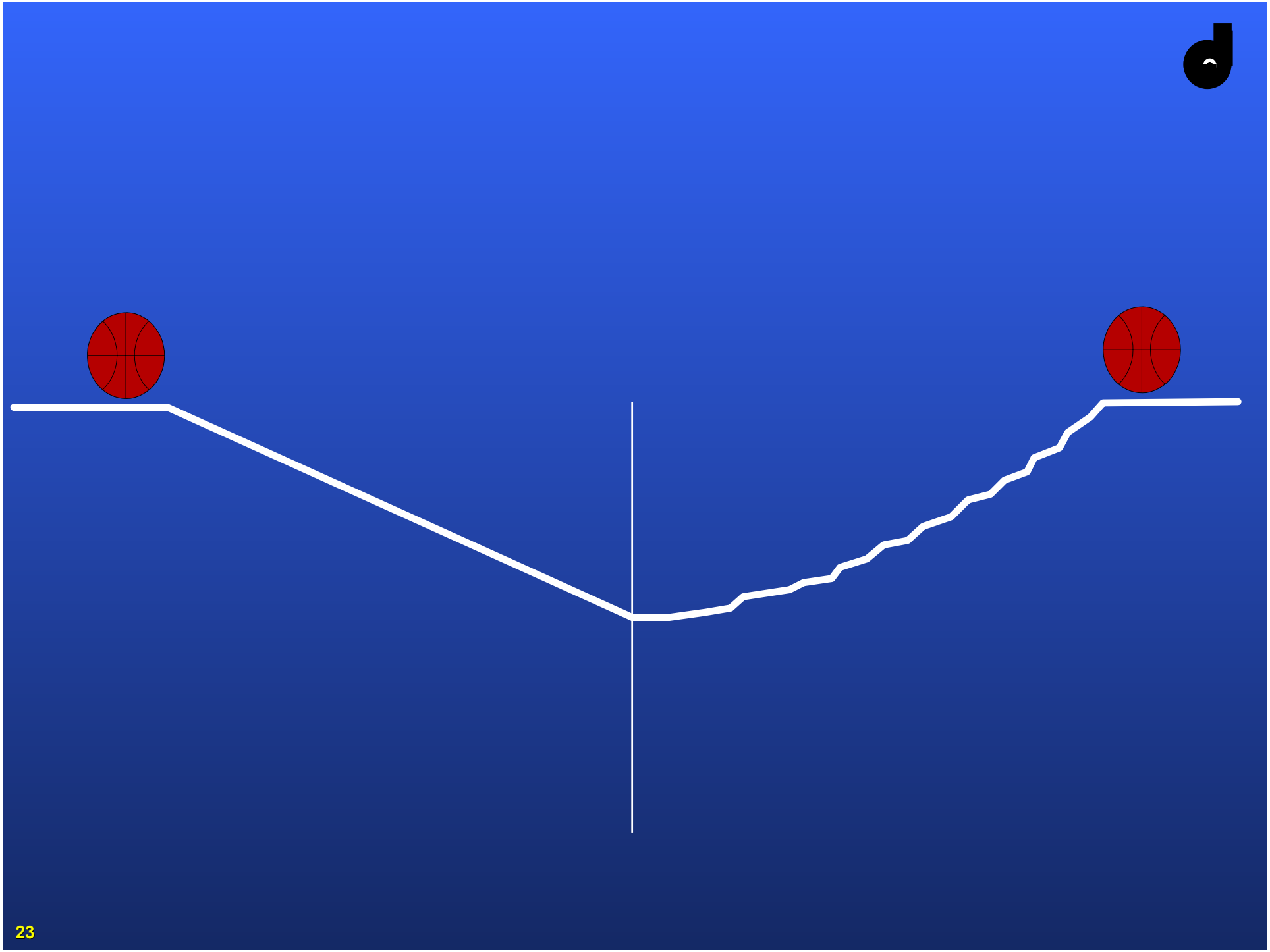
THIXOTROPIC



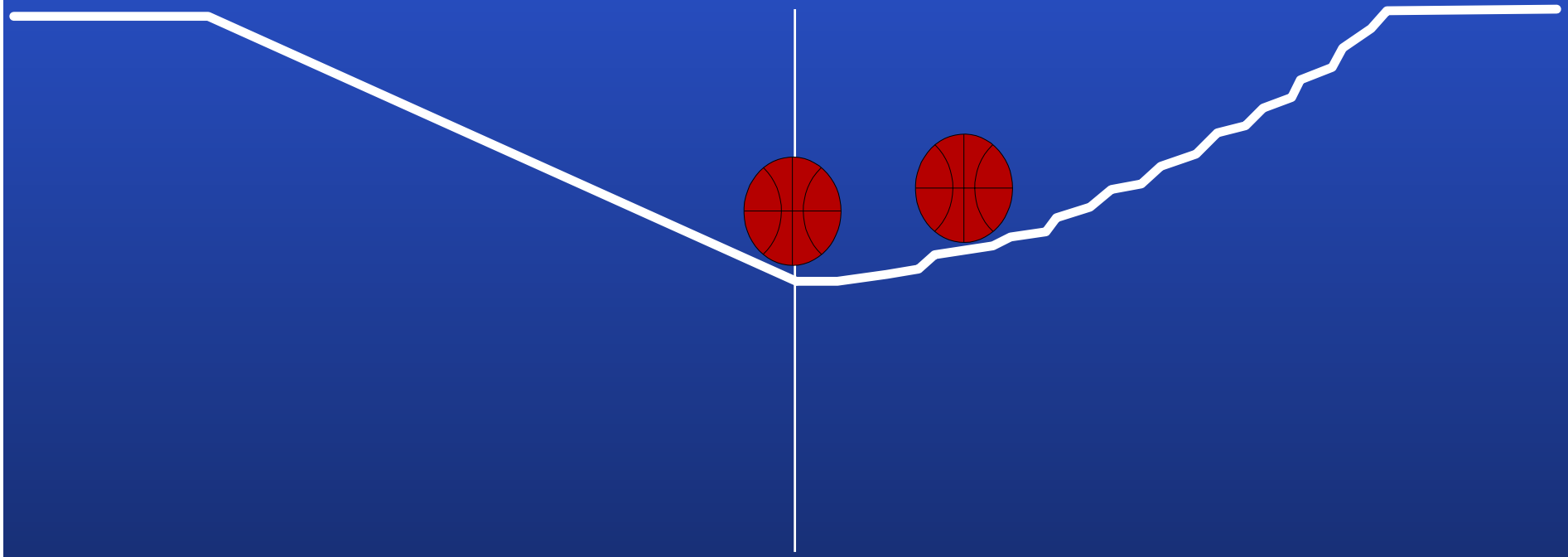
DILATANTE

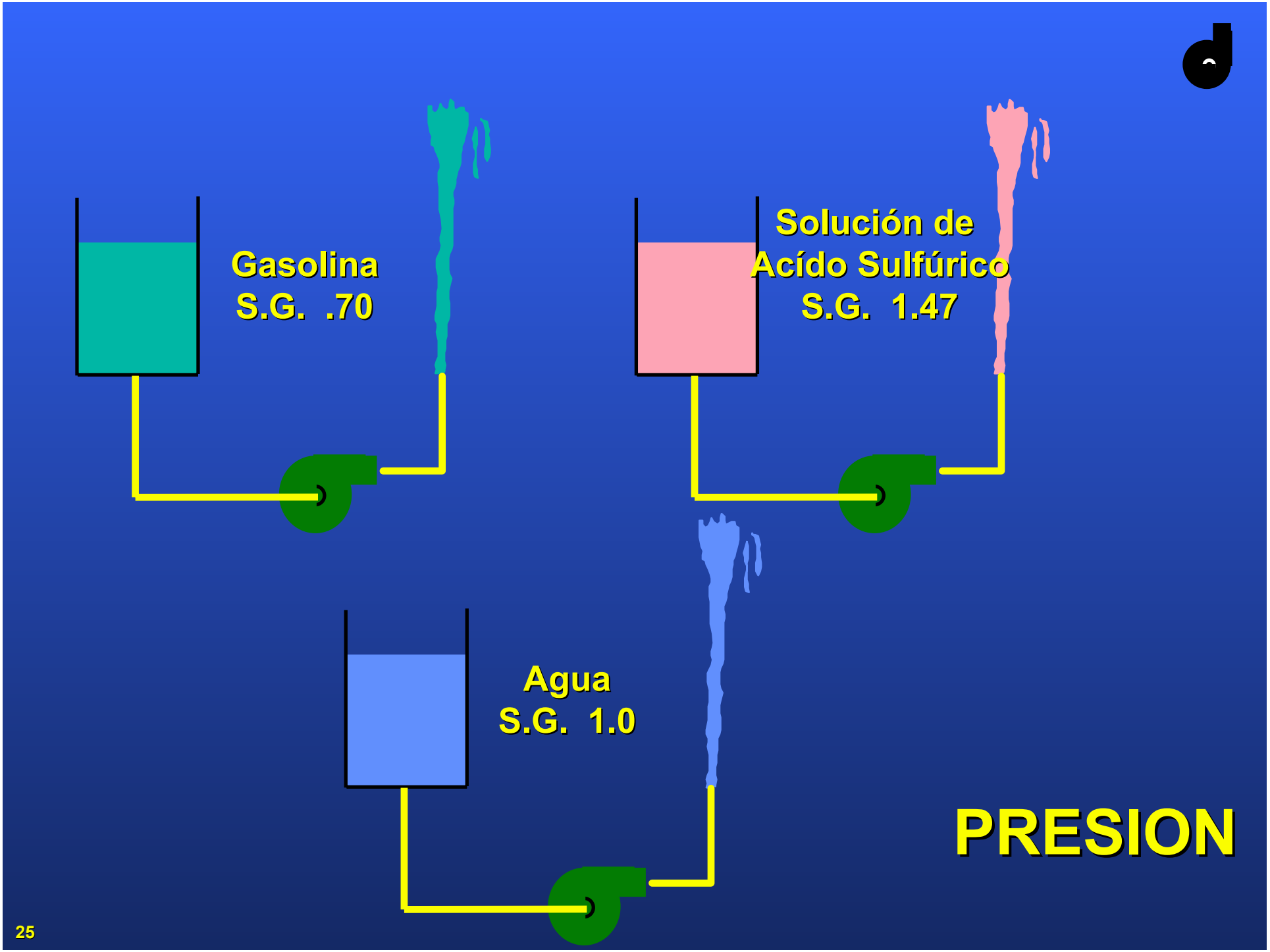


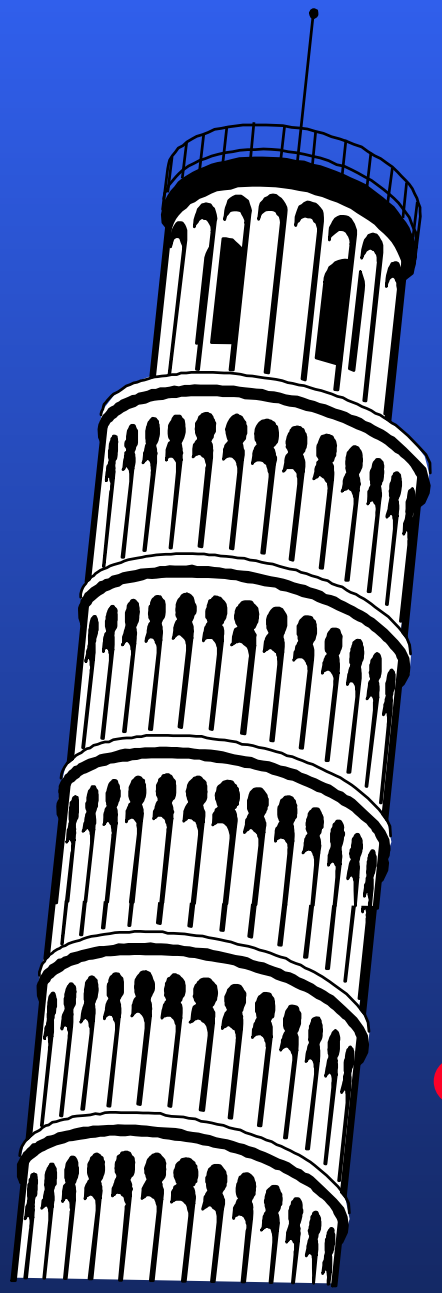
d



PERDIDAS POR FRICCION



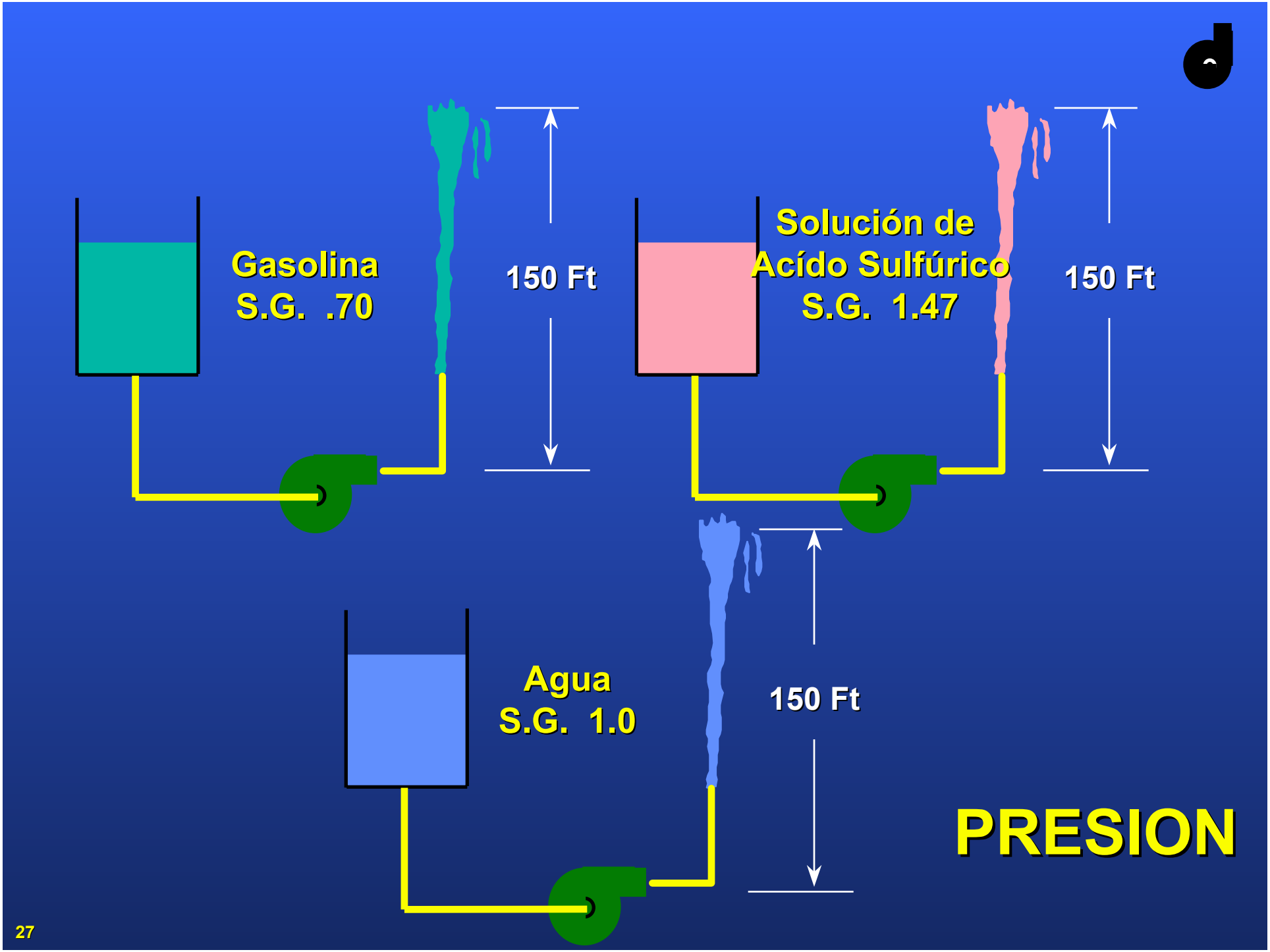

Gasolina
S.G. .70
Solución de
Acído Sulfúrico
S.G. 1.47
Agua
S.G. 1.0
PRESION

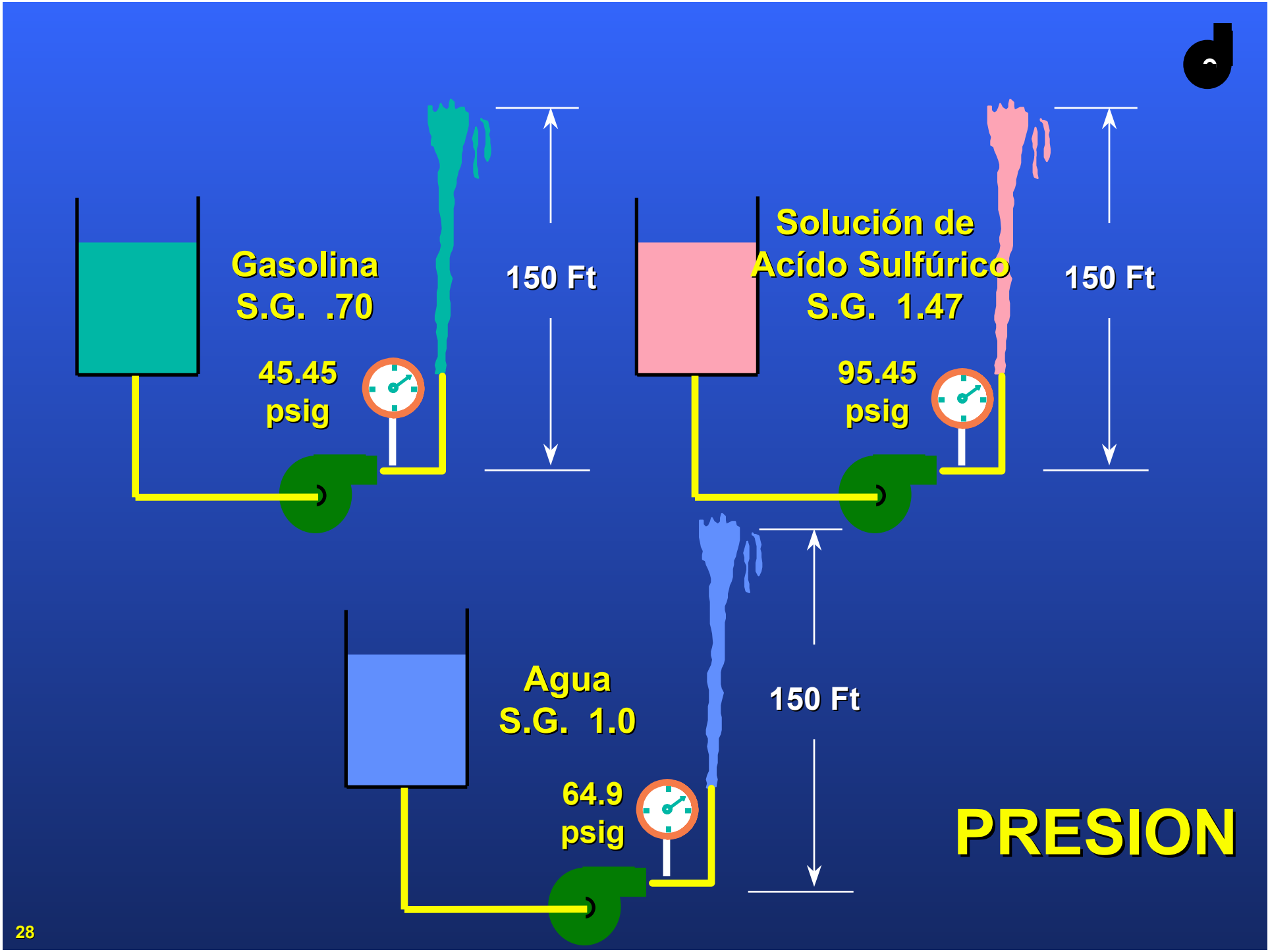


Aceleración de la gravedad es 9.81 m/s^2

1 lb

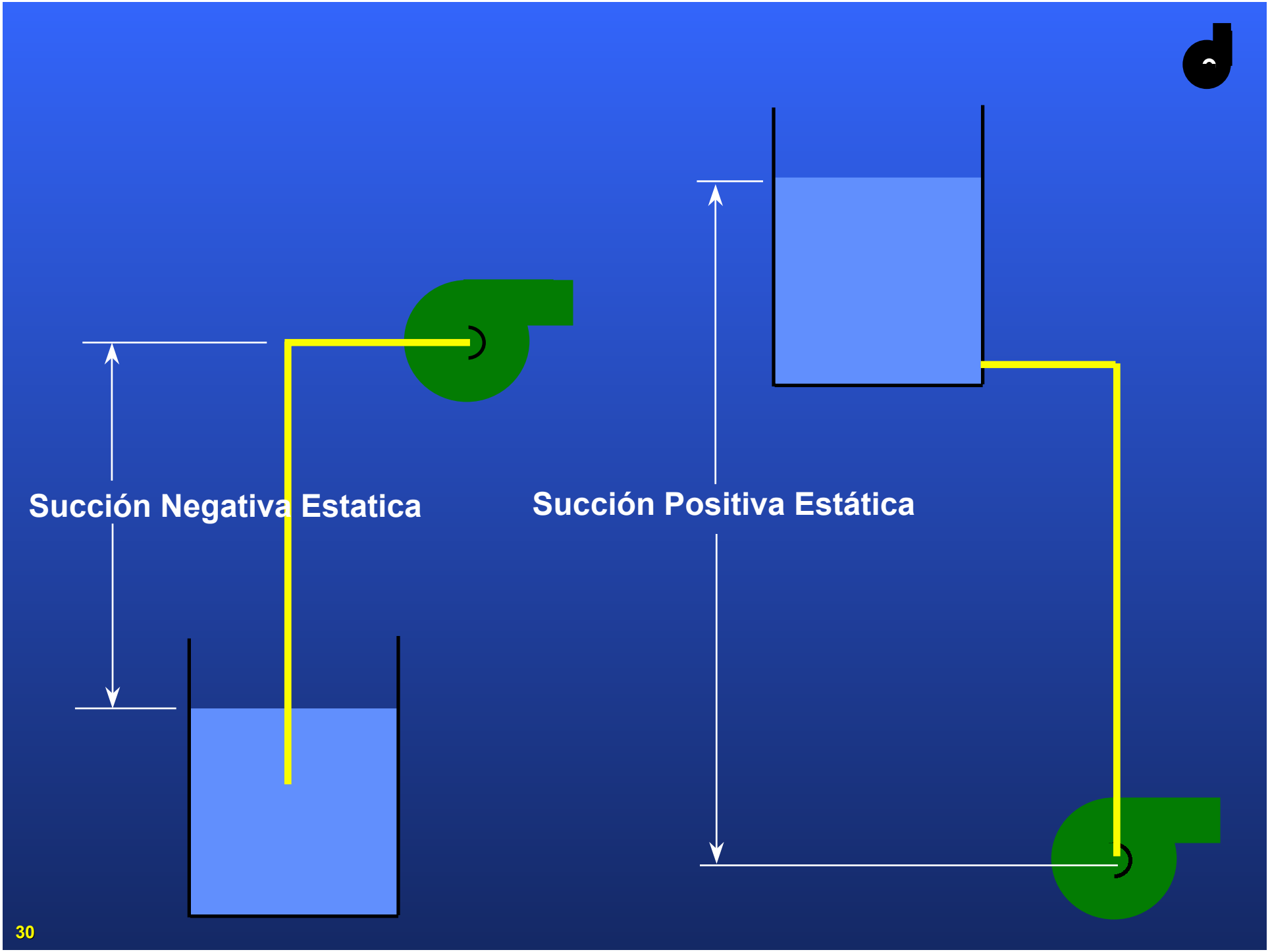
5 lbs.

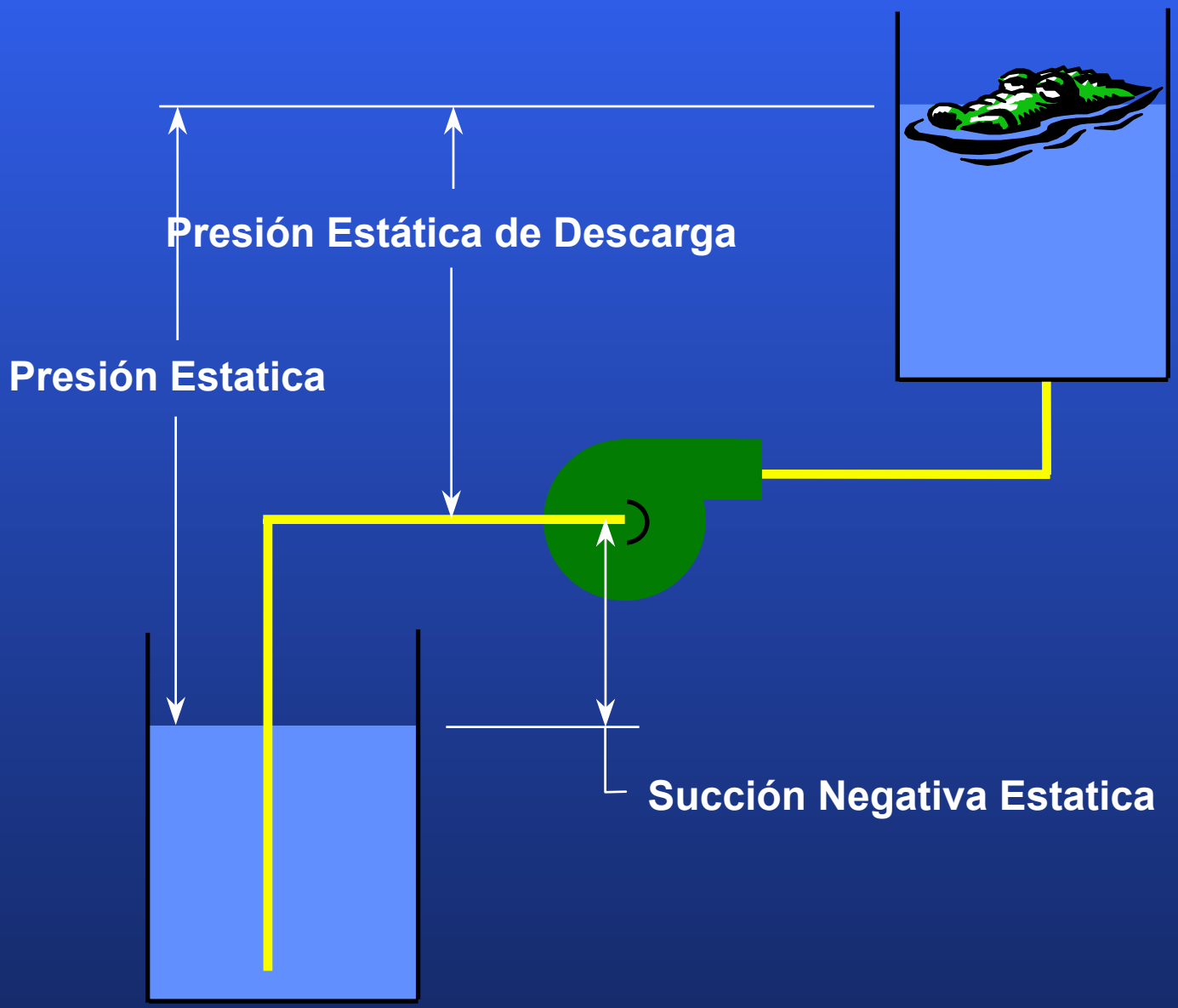

Gasolina
S.G. .70
150 Ft
Solución de
Acído Sulfúrico
S.G. 1.47
150 Ft
Agua
S.G. 1.0
150 Ft
PRESION

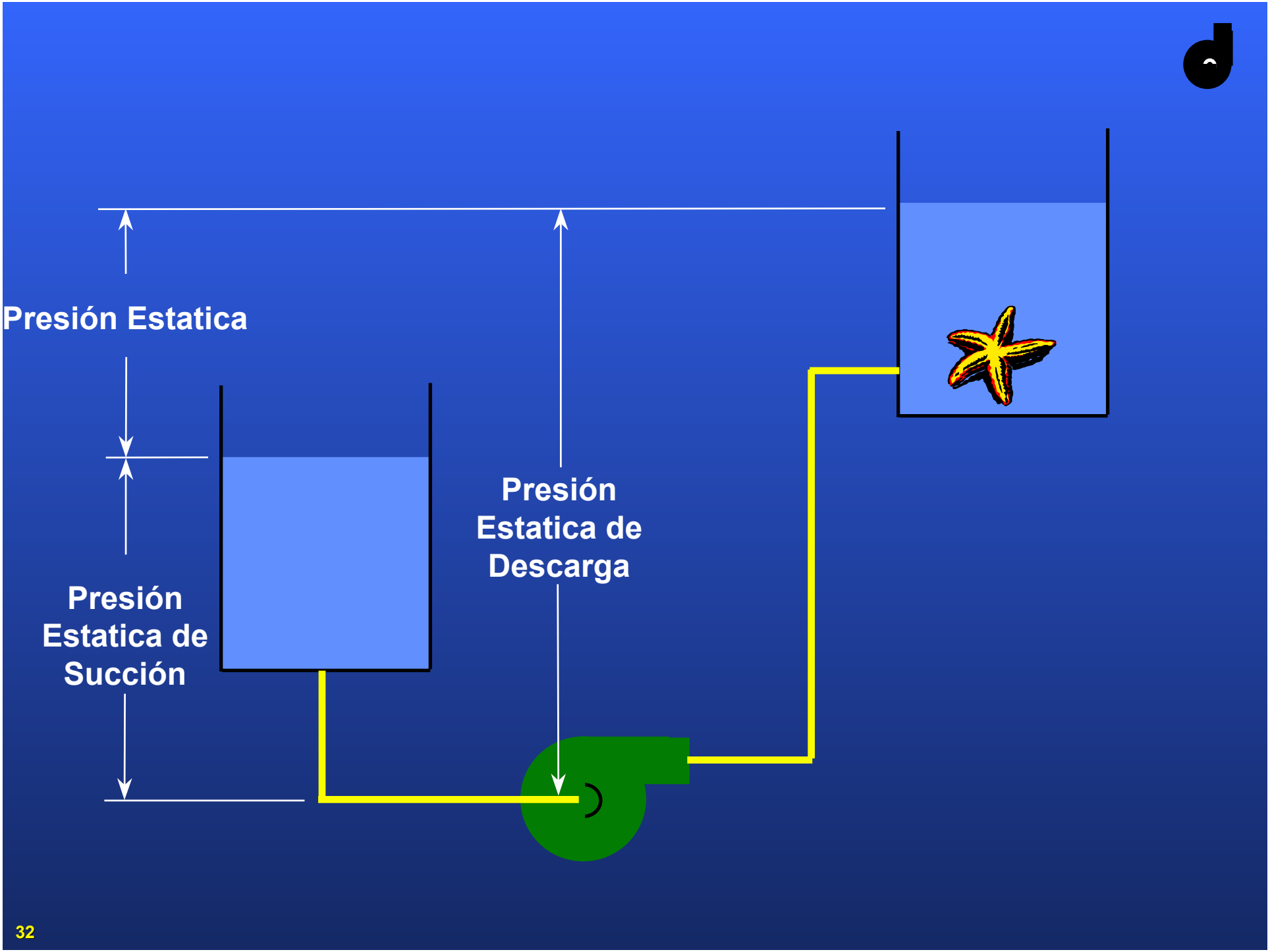

Gasolina
S.G. .70
45.45
psig
150 Ft
Solución de
Acído Sulfúrico
S.G. 1.47
95.45
psig
150 Ft
Agua
S.G. 1.0
64.9
psig
150 Ft
PRESION

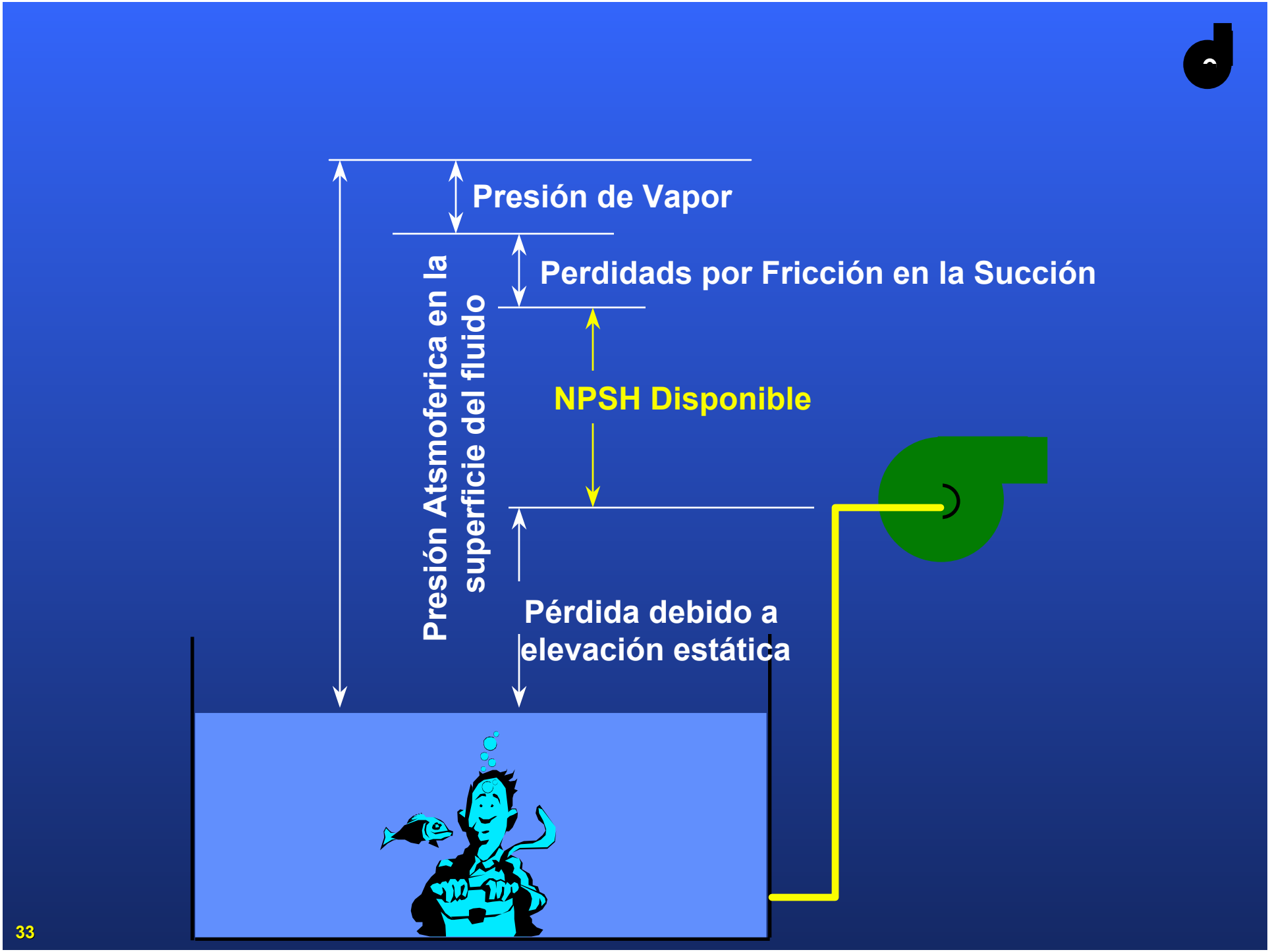
$$\text{Presión (ft)} = \frac{\text{PSIG} \times 2.31}{\text{S.G.}}$$

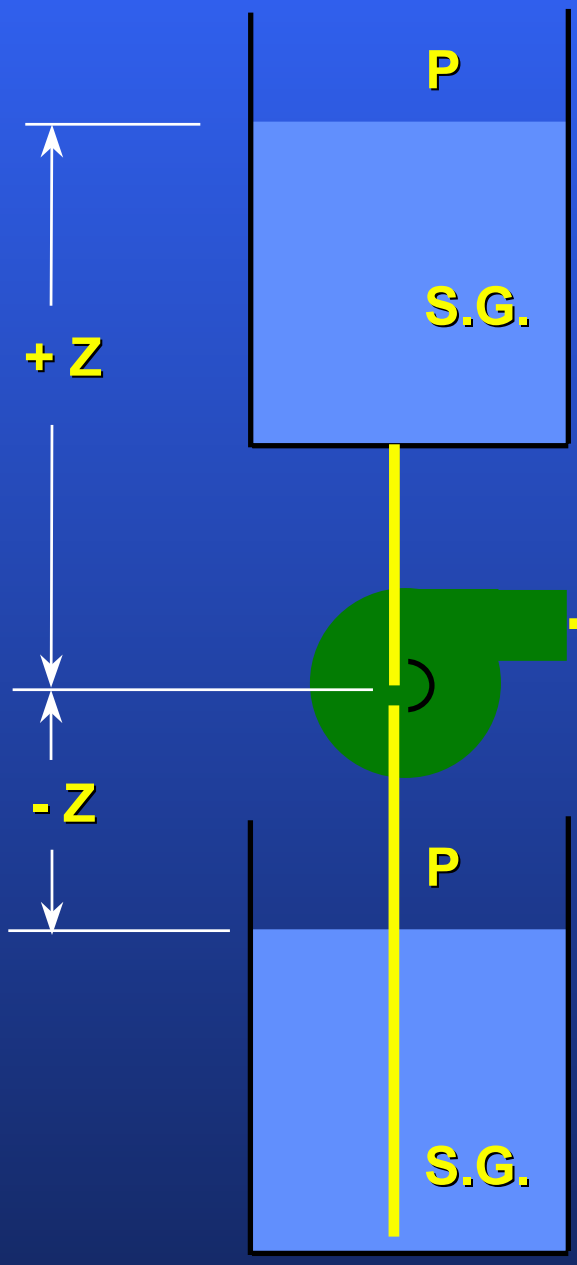
$$\text{PSIG} = \frac{\text{Presión (ft)} \times \text{S.G.}}{2.31}$$


Succión Negativa Estatica
Succión Positiva Estática


Presión Estática de Descarga
Presión Estatica
Succión Negativa Estatica


Presión Estatica
Presión Estatica de Succión
Presión Estatica de Descarga


Presión de Vapor
Perdidads por Fricción en la Succión
Presión Atsmoferica en la superficie del fluido
NPSH Disponible
Pérdida debido a elevación estática



P = Presión en la Superficie del Fluido

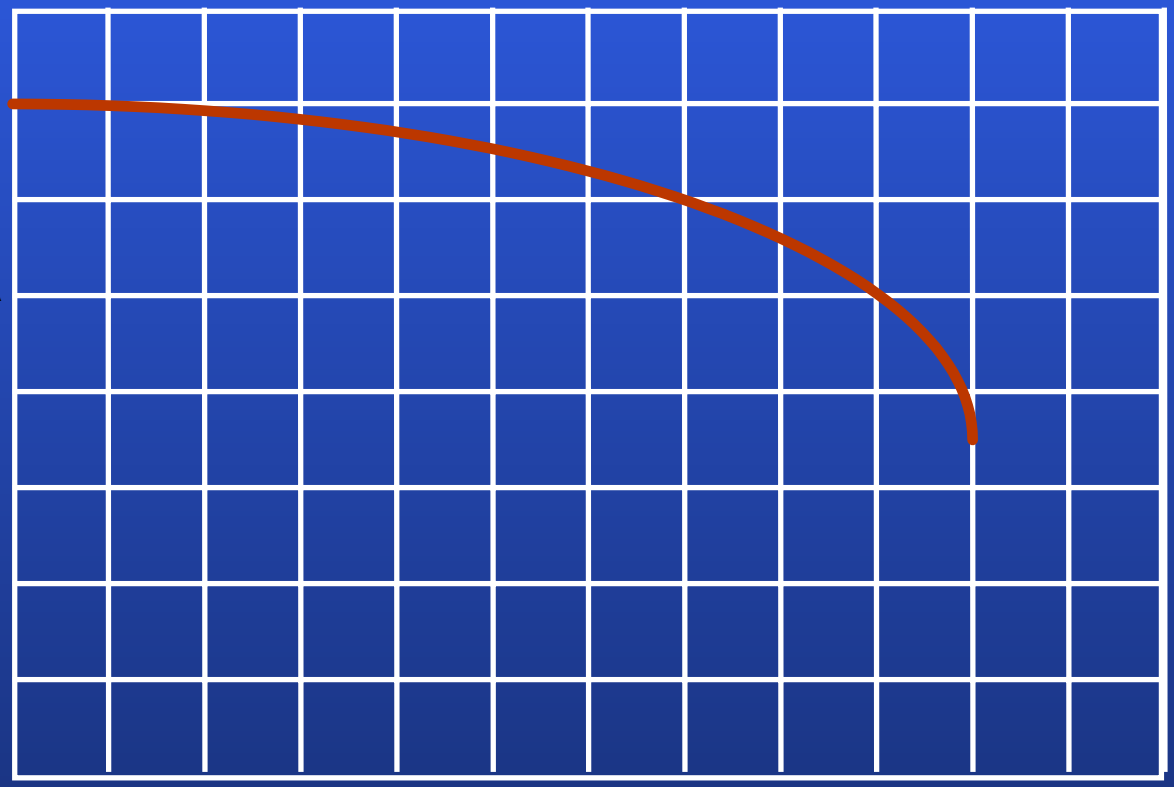
VP = Presión de Vapor del Fluido

S.G. = Gravedad Específica

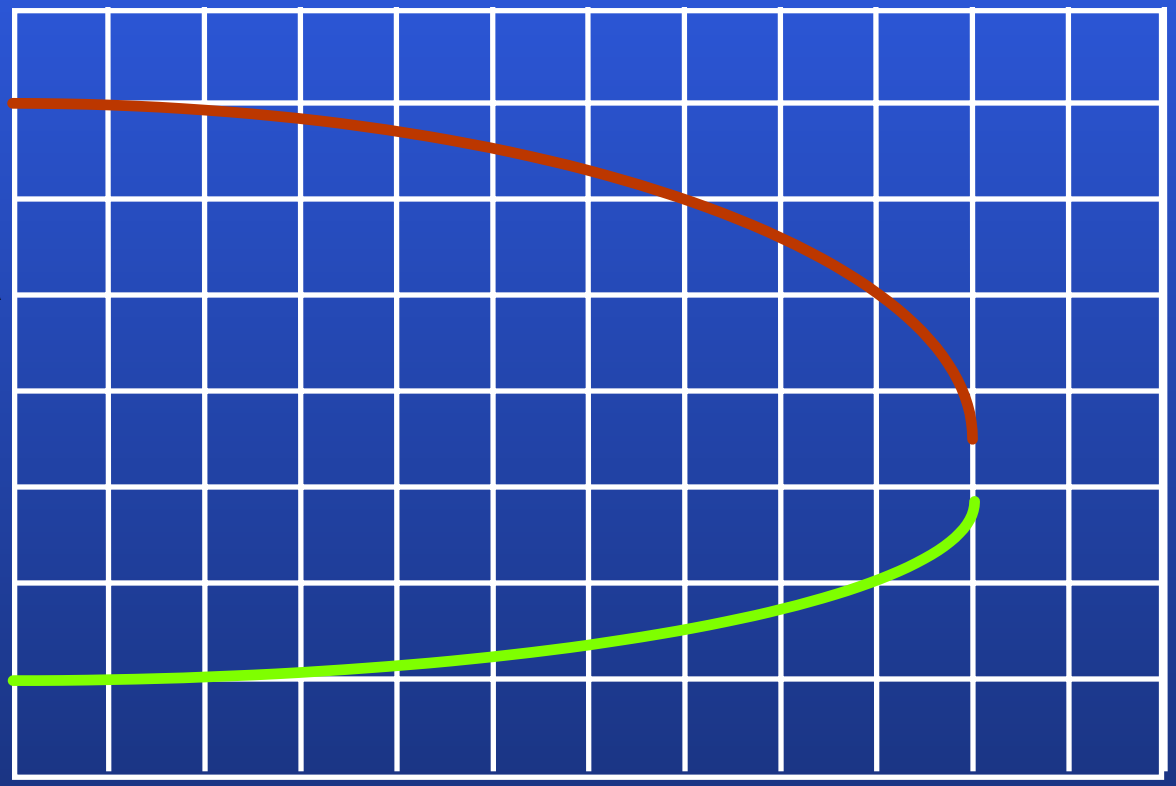
L = Pérdidas por Fricción

$$NPSHA = \frac{(P - VP)\ 2.31}{S.G.} \pm Z - L$$

PRESIÓN - CAUDAL



PRESIÓN - CAUDAL

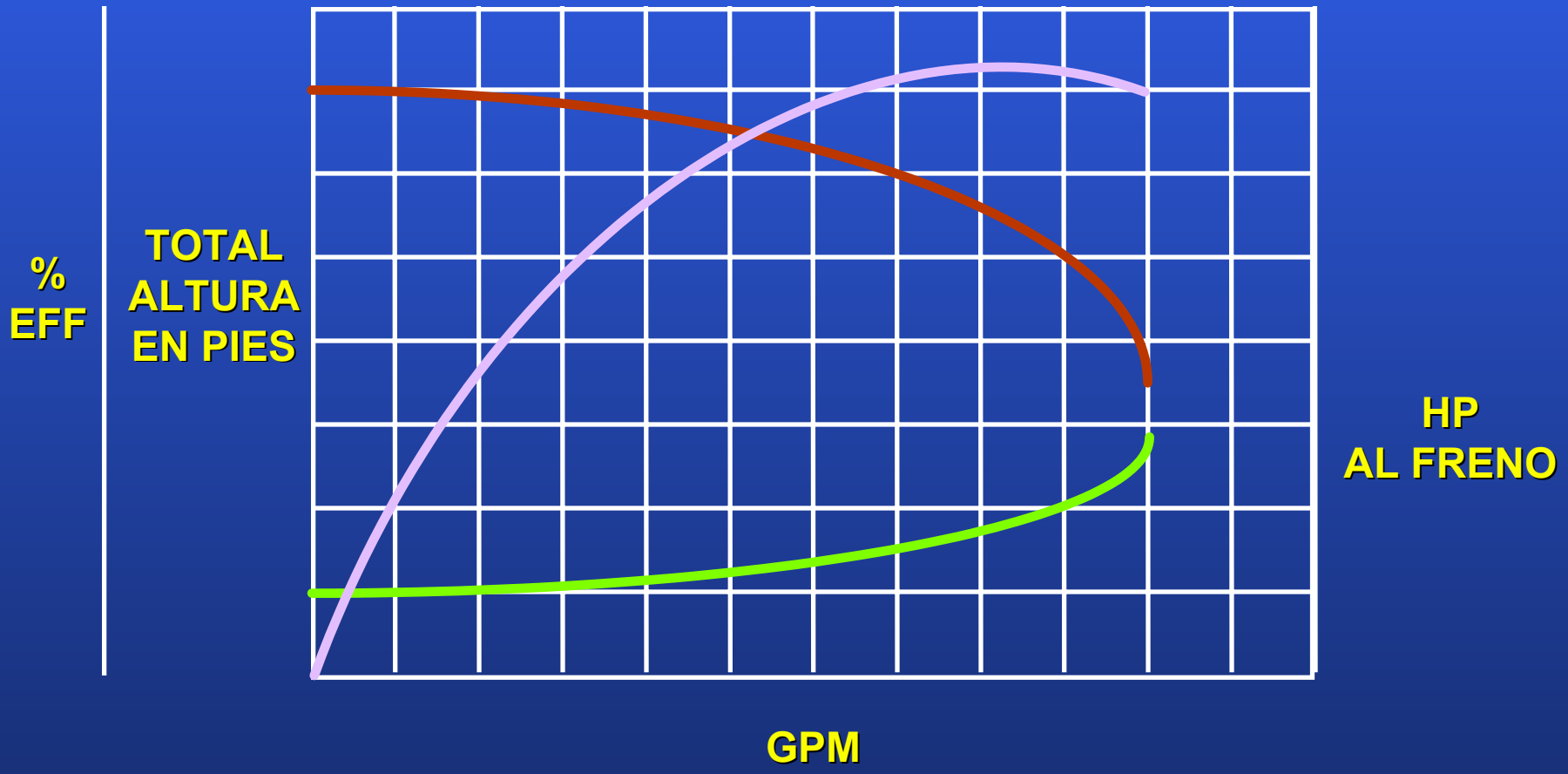


TRES TIPOS DE CABALLOS DE FUERZA (HP)

$$BHP = \frac{GPM \times Presión \times S.G.}{3960 \times Eff}$$

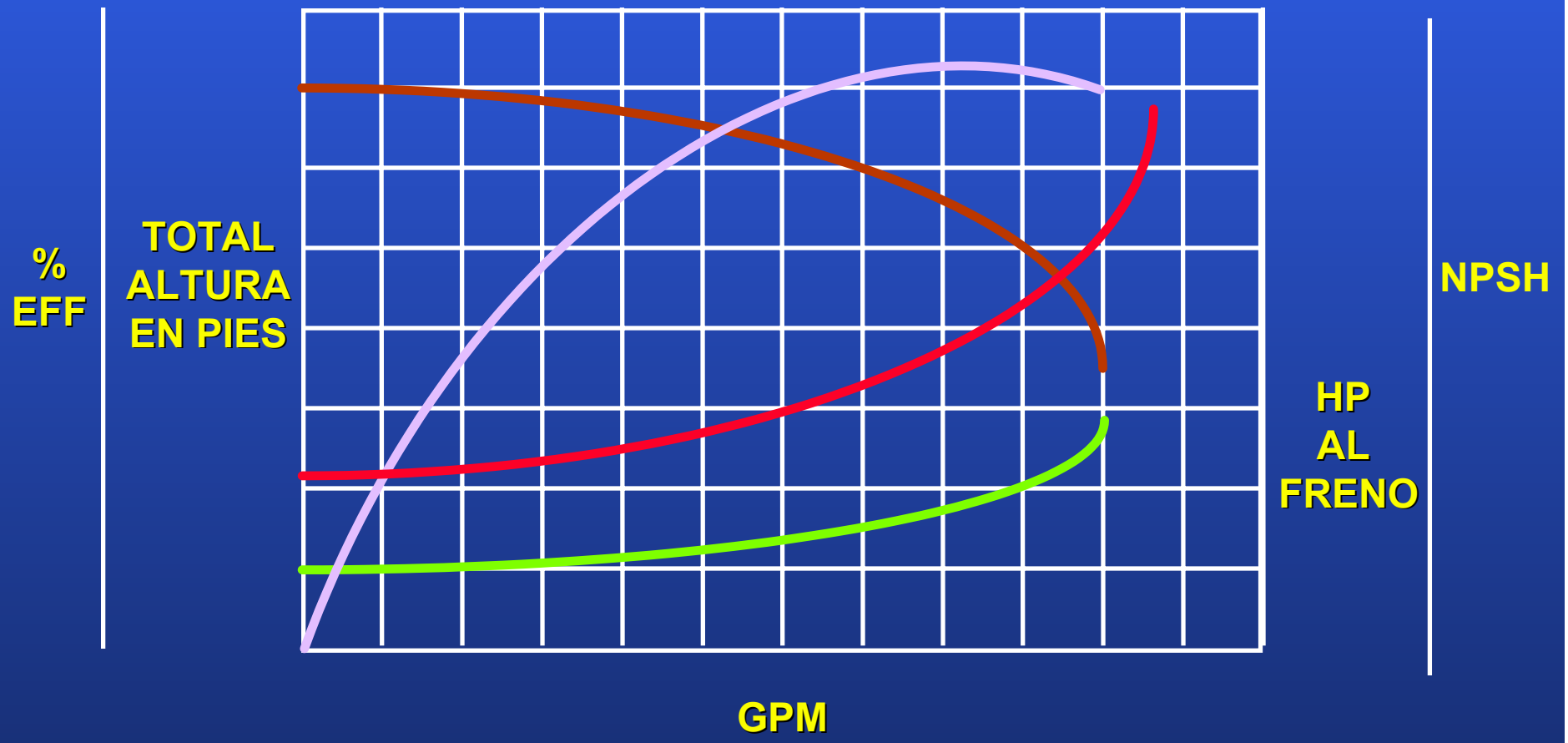
$$BHP = \frac{GPM \times PSI}{1714 \times Eff}$$

PRESION - CAUDAL

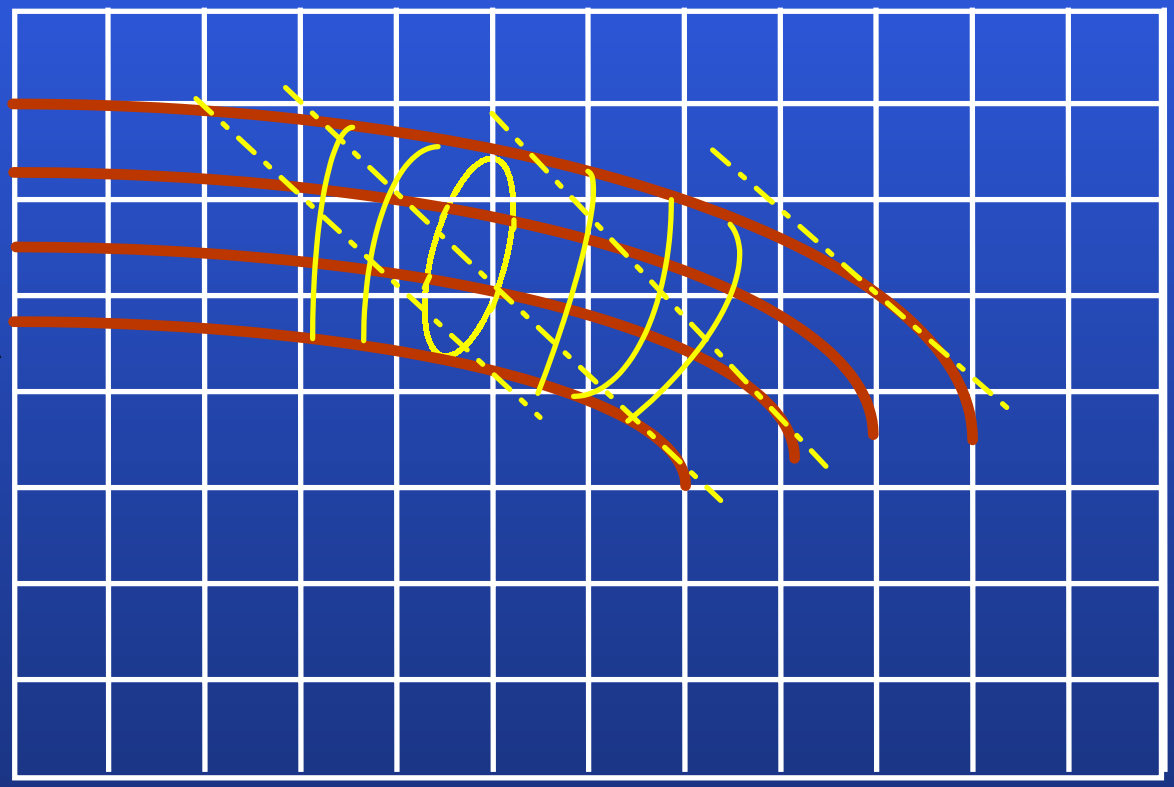


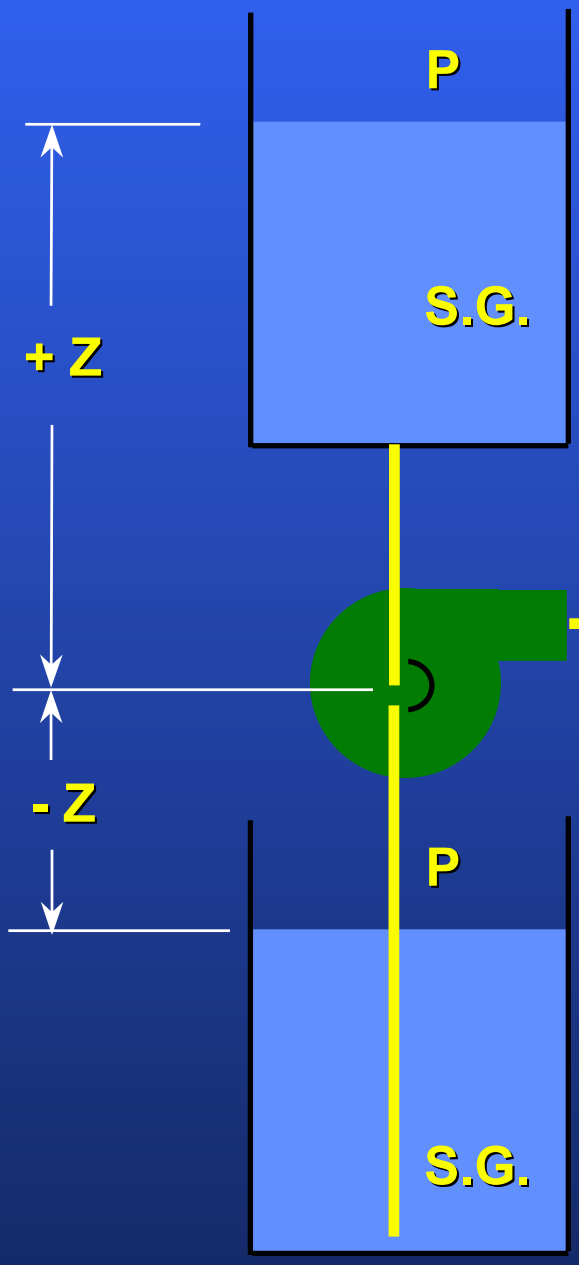
$$\text{Eficiencia} = \frac{\text{Altura(ft) x Capacidad x S.G.}}{\text{3960 x HP}}$$

PRESION - CAUDAL



PRESION - CAUDAL





P = Presión sobre la superficie del fluido

VP = Presión de Vapor de fluido

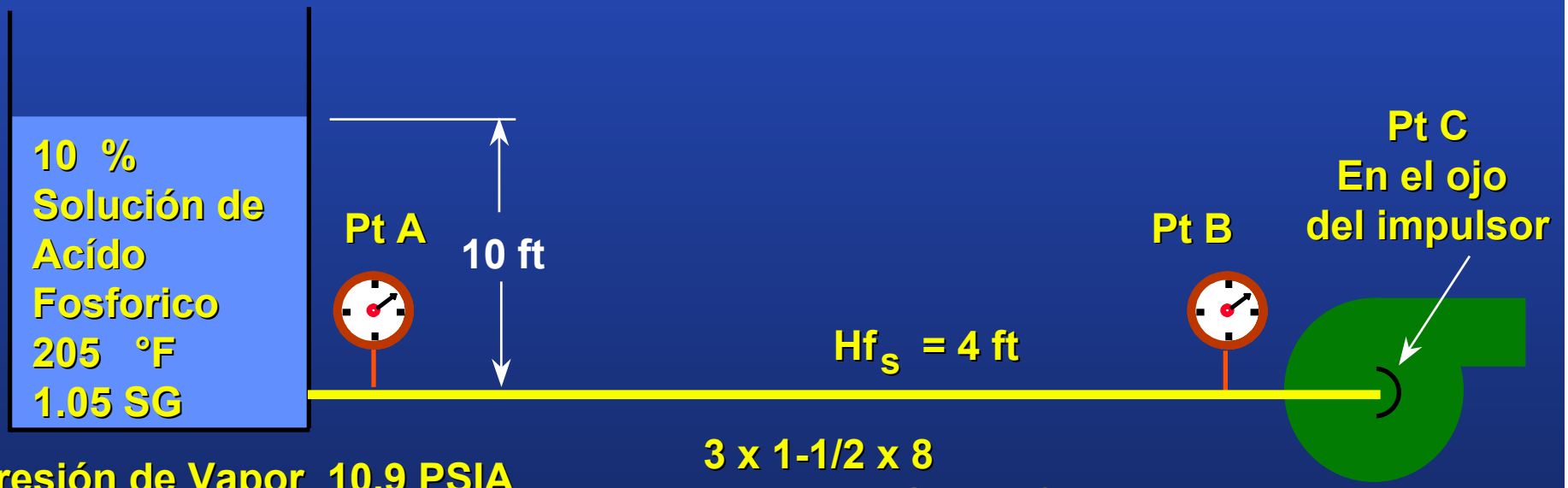
S.G. = Gravedad Especifica

L = Perdida por fricción

$$NPSHA = \frac{(P - VP)\ 2.31}{S.G.} \pm Z - L$$

NPSHr OBSERVADO COMO UNA PERDIDA

(Este ejercicio trata al NPSHr como una perdida)

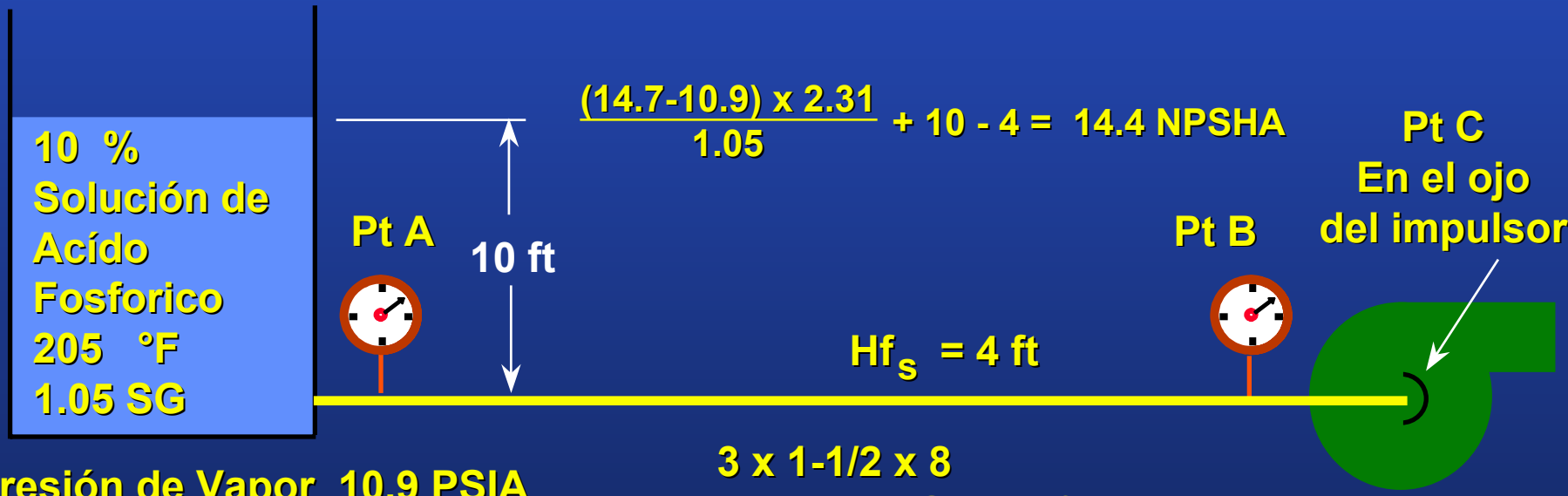


Presión de Vapor 10.9 PSIA

3 x 1-1/2 x 8
150 gpm @ 225 ft
3550 RPM 10 ft NPSHr

NPSHr OBSERVADO COMO UNA PERDIDA

(Este ejercicio trata al NPSHr como una perdida)



$$\frac{(14.7-10.9) \times 2.31}{1.05} + 10 - 4 = 14.4 \text{ NPSHA}$$

Oresión de Vapor 10.9 PSIA

3 x 1-1/2 x 8
150 gpm @ 225 ft
3550 RPM 10 ft NPSHr

NPSHr OBSERVADO COMO UNA PERDIDA

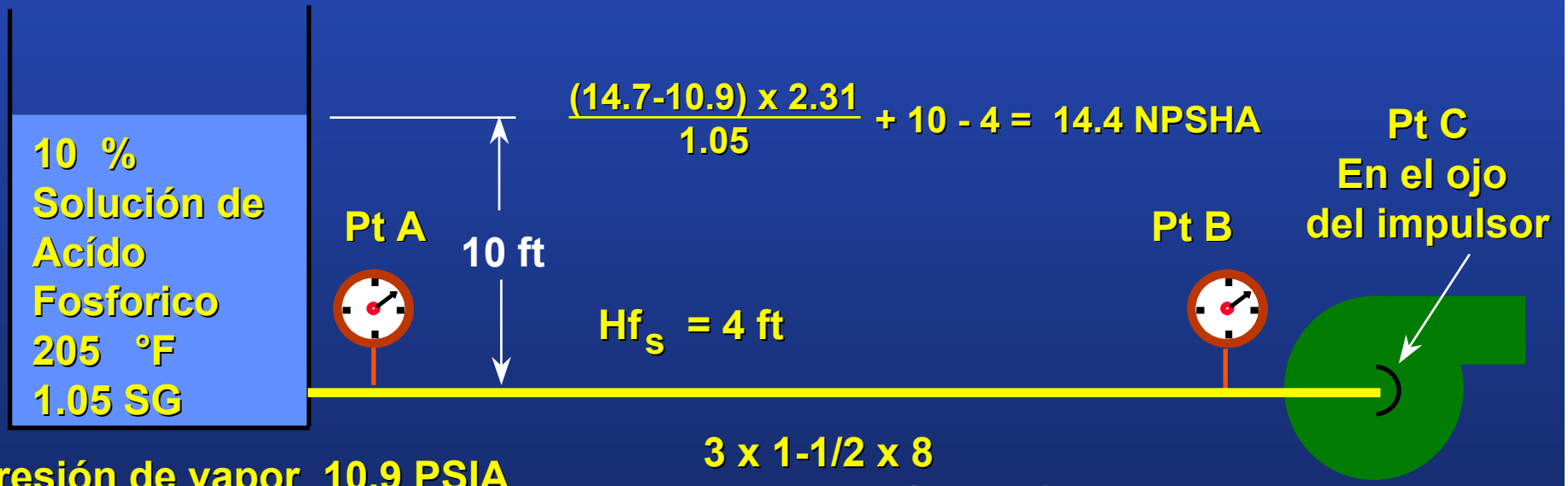
(Este ejercicio trata al NPSHr como una perdida)

Pt A

$$\frac{10 \times 1.05}{2.31} = 4.5 \text{ psig}$$

+ 14.7 psia

19.2 psia



$$\frac{(14.7-10.9) \times 2.31}{1.05} + 10 - 4 = 14.4 \text{ NPSHA}$$

Presión de vapor 10.9 PSIA

3 x 1-1/2 x 8
150 gpm @ 225 ft
3550 RPM 10 ft NPSHr

NPSHr OBSERVADO COMO UNA PERDIDA

(Este ejercicio trata al NPSHr como una perdida)

Pt A

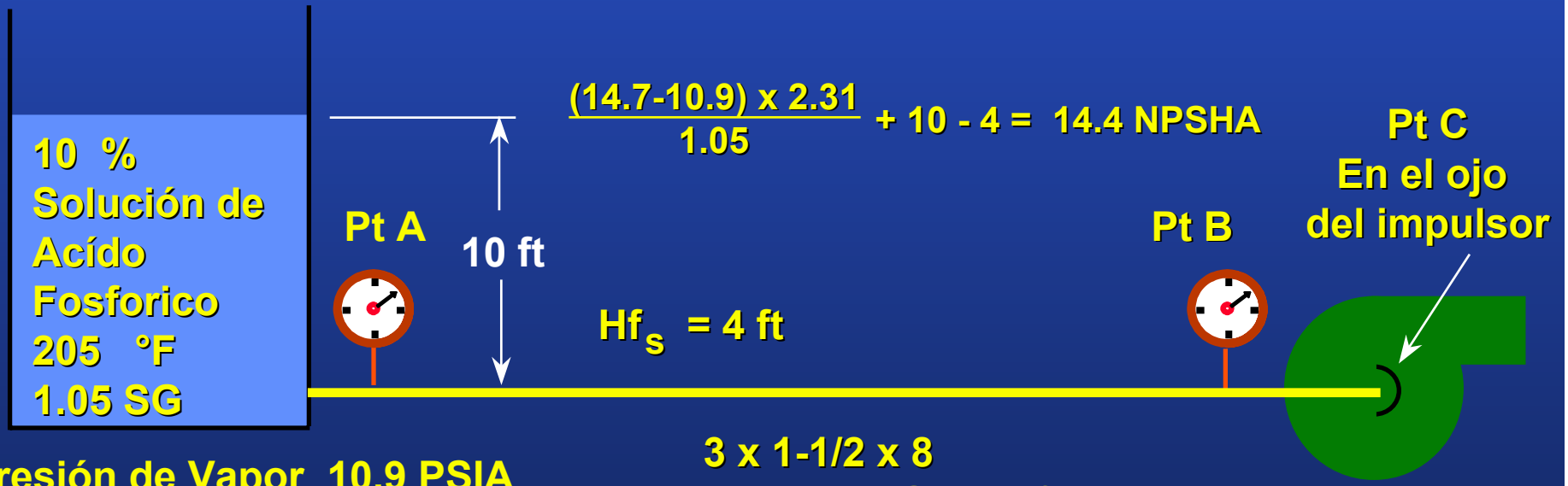
$$\frac{10 \times 1.05}{2.31} = 4.5 \text{ psig}$$

$$4.5 \text{ psig} + 14.7 \text{ psia} = 19.2 \text{ psia}$$

Pt B

$$\frac{(10 - 4) \times 1.05}{2.31} = 2.7 \text{ psig}$$

$$2.7 \text{ psig} + 14.7 \text{ psia} = 17.4 \text{ psia}$$



$$\frac{(14.7-10.9) \times 2.31}{1.05} + 10 - 4 = 14.4 \text{ NPSHA}$$

Presión de Vapor 10.9 PSIA

3 x 1-1/2 x 8
150 gpm @ 225 ft
3550 RPM 10 ft NPSHr

NPSHr OBSERVADO COMO UNA PERDIDA

(Este ejercicio trata al NPSHr como una perdida)

Pt A

$$\frac{10 \times 1.05}{2.31} = 4.5 \text{ psig}$$

$$4.5 \text{ psig} + 14.7 \text{ psia} = 19.2 \text{ psia}$$

Pt B

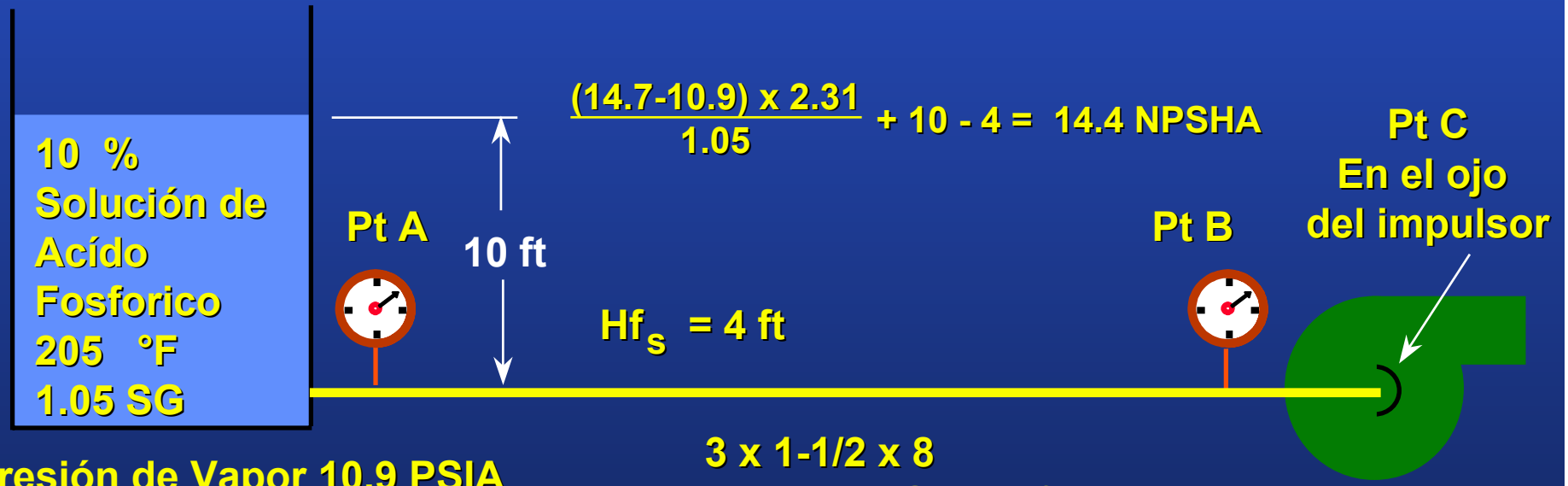
$$\frac{(10 - 4) \times 1.05}{2.31} = 2.7 \text{ psig}$$

$$2.7 \text{ psig} + 14.7 \text{ psia} = 17.4 \text{ psia}$$

Pt C

$$\frac{(10 - 4 - 10) \times 1.05}{2.31} = -1.8 \text{ psig}$$

$$-1.8 \text{ psig} + 14.7 \text{ psia} = 12.9 \text{ psia}$$



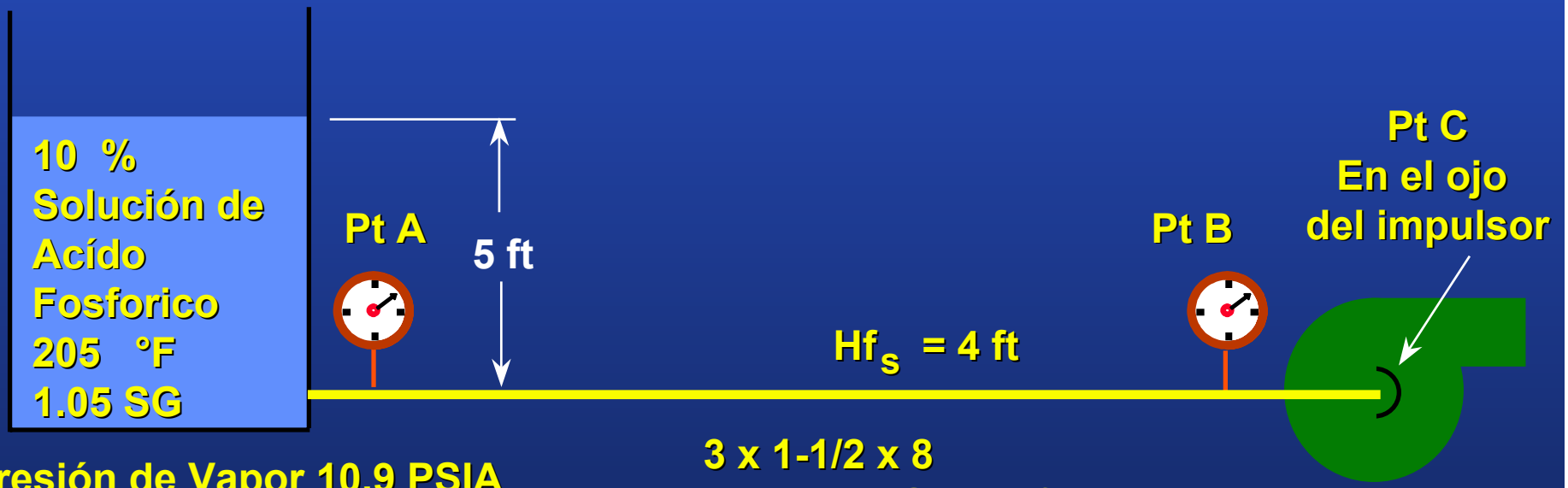
$$\frac{(14.7 - 10.9) \times 2.31}{1.05} + 10 - 4 = 14.4 \text{ NPSHA}$$

Presión de Vapor 10.9 PSIA

3 x 1-1/2 x 8
150 gpm @ 225 ft
3550 RPM 10 ft NPSHr

NPSHr OBSERVADO COMO UNA PERDIDA

(Este ejercicio trata al NPSHr como una perdida)

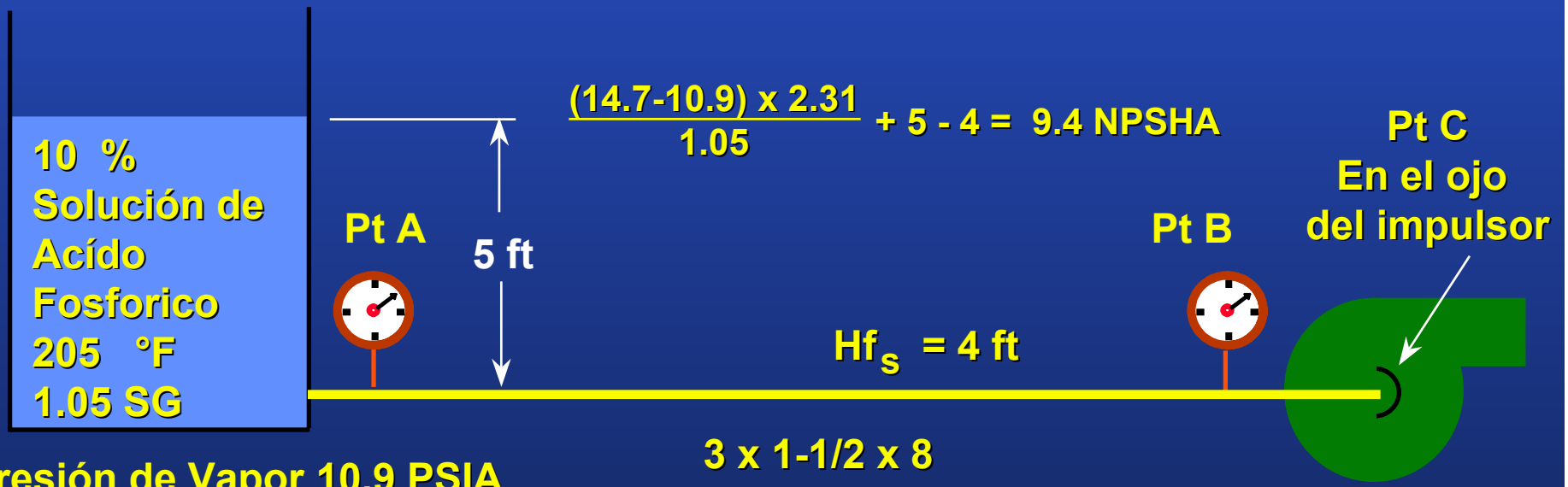


Presión de Vapor 10.9 PSIA

3 x 1-1/2 x 8
150 gpm @ 225 ft
3550 RPM 10 ft NPSHr

NPSHr OBSERVADO COMO UNA PERDIDA

(Este ejercicio trata al NPSHR como una perdida)



$$\frac{(14.7-10.9) \times 2.31}{1.05} + 5 - 4 = 9.4 \text{ NPSHA}$$

Presión de Vapor 10.9 PSIA

3 x 1-1/2 x 8
150 gpm @ 225 ft
3550 RPM 10 ft NPSHr

NPSHr OBSERVADO COMO UNA PERDIDA

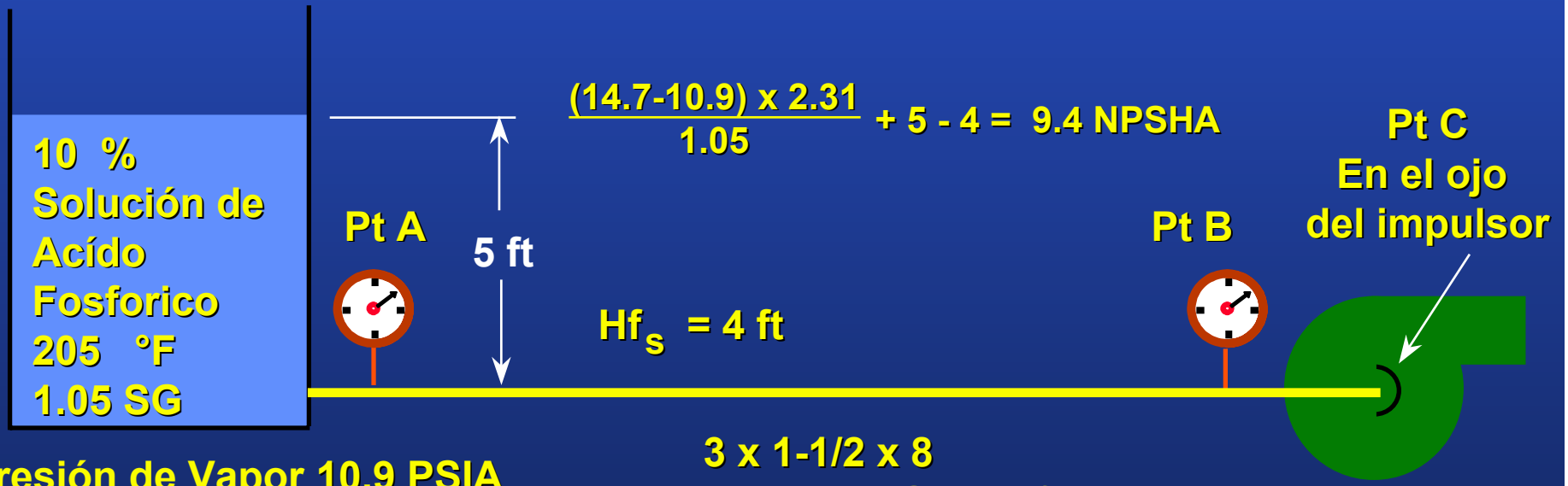
(Este ejercicio trata al NPSHR como una perdida)

Pt A

$$\frac{5 \times 1.05}{2.31} = 2.3 \text{ psig}$$

+ 14.7 psia

17.0 psia



$$\frac{(14.7-10.9) \times 2.31}{1.05} + 5 - 4 = 9.4 \text{ NPSHA}$$

Presión de Vapor 10.9 PSIA

3 x 1-1/2 x 8
150 gpm @ 225 ft
3550 RPM 10 ft NPSHr

NPSHr OBSERVADO COMO UNA PERDIDA

(Este ejercicio trata al NPSHR como una perdida)

Pt A

$$\frac{5 \times 1.05}{2.31} = 2.3 \text{ psig}$$

$$+ 14.7 \text{ psia}$$

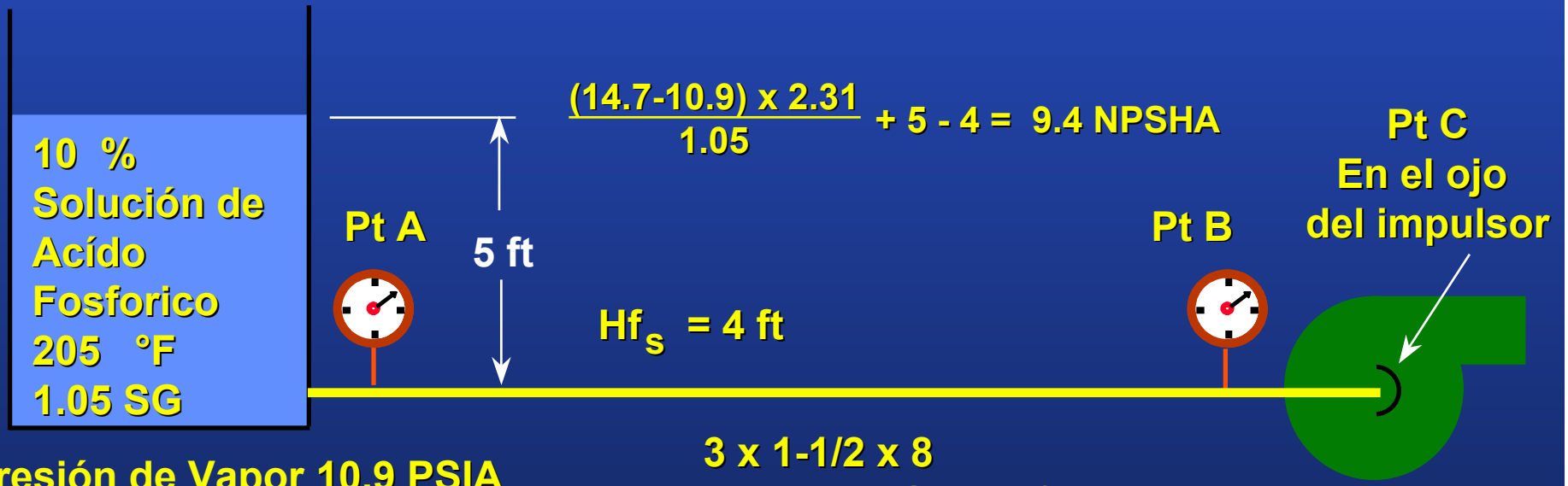
$$17.0 \text{ psia}$$

Pt B

$$\frac{(5 - 4) \times 1.05}{2.31} = .5 \text{ psig}$$

$$+ 14.7 \text{ psia}$$

$$15.2 \text{ psia}$$



$$\frac{(14.7-10.9) \times 2.31}{1.05} + 5 - 4 = 9.4 \text{ NPSHA}$$

Presión de Vapor 10.9 PSIA

3 x 1-1/2 x 8
150 gpm @ 225 ft
3550 RPM 10 ft NPSHr

NPSHr OBSERVADO COMO UNA PERDIDA

(Este ejercicio trata al NPSHR como una perdida)

Pt A

$$\frac{5 \times 1.05}{2.31} = 2.3 \text{ psig}$$

$$2.3 \text{ psig} + 14.7 \text{ psia} = 17.0 \text{ psia}$$

Pt B

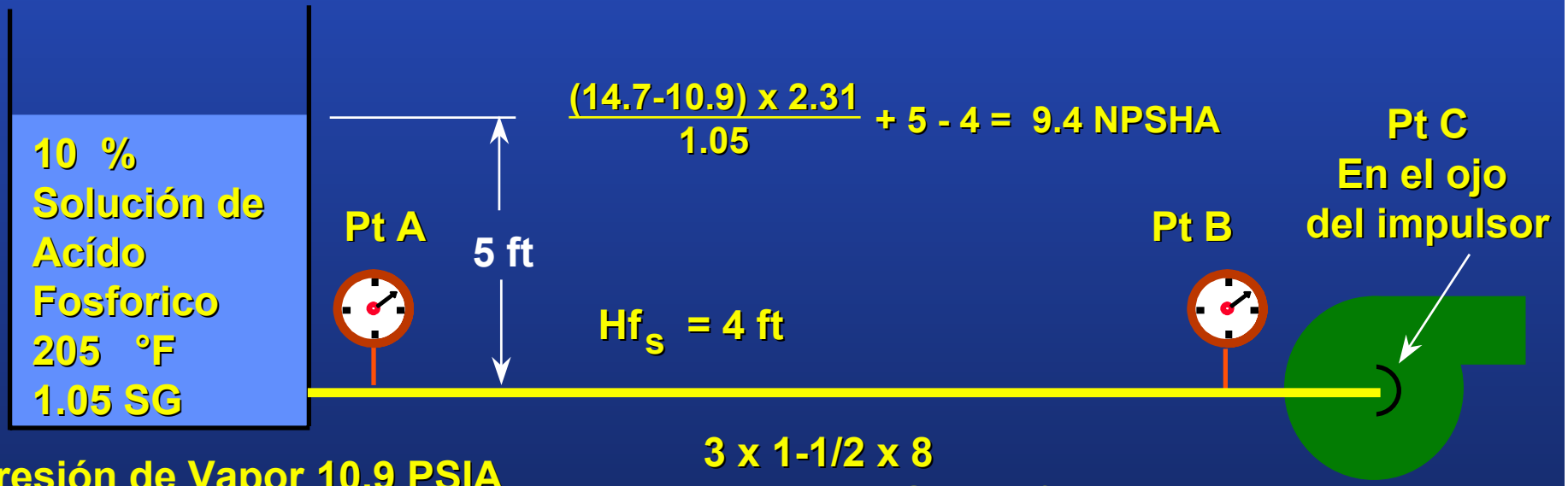
$$\frac{(5 - 4) \times 1.05}{2.31} = .5 \text{ psig}$$

$$.5 \text{ psig} + 14.7 \text{ psia} = 15.2 \text{ psia}$$

Pt C

$$\frac{(5 - 4 - 10) \times 1.05}{2.31} = -4.1 \text{ psig}$$

$$-4.1 \text{ psig} + 14.7 \text{ psia} = 10.6 \text{ psia}$$



$$\frac{(14.7 - 10.9) \times 2.31}{1.05} + 5 - 4 = 9.4 \text{ NPSHA}$$

Presión de Vapor 10.9 PSIA

3 x 1-1/2 x 8
150 gpm @ 225 ft
3550 RPM 10 ft NPSHr

BHP CALCULOS

1. 500 GPM @ 120 Ft Altura 76 % Eficiencia 1.0 S.G.

2. 1200 GPM @ 200 Ft Altura 83 % Eficiencia 0.95 S.G.

BHP CALCULOS

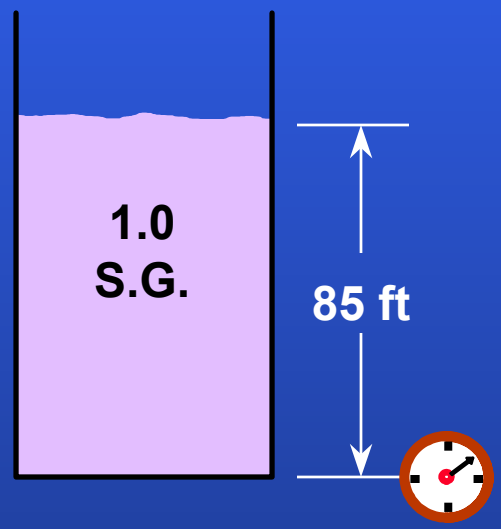
$$BHP = \frac{GPM \times HEAD \times S.G.}{3960 \times Eff}$$

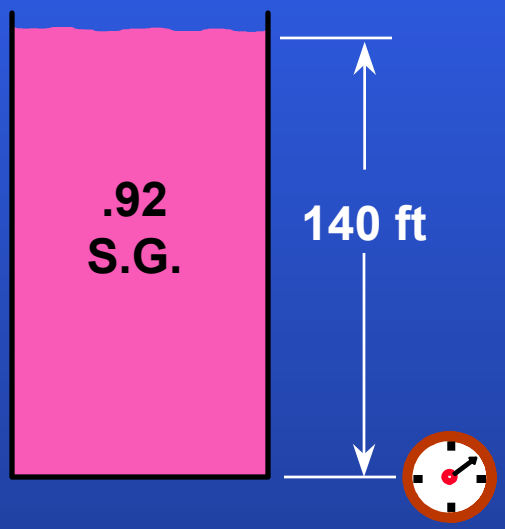
1. 500 GPM @ 120 Ft Altura 76 % Eficiencia 1.0 S.G.

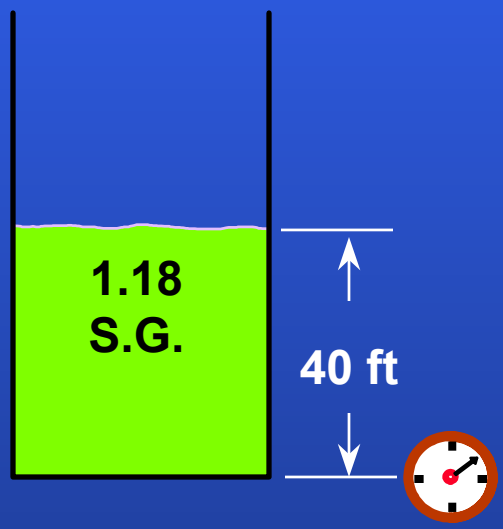
$$\frac{500 \times 120 \times 1.0}{3960 \times .76} = 19.94$$

2. 1200 GPM @ 200 Ft Altura 83 % Eficiencia 0.95 S.G.

$$\frac{1200 \times 200 \times 0.95}{3960 \times .83} = 69.37$$





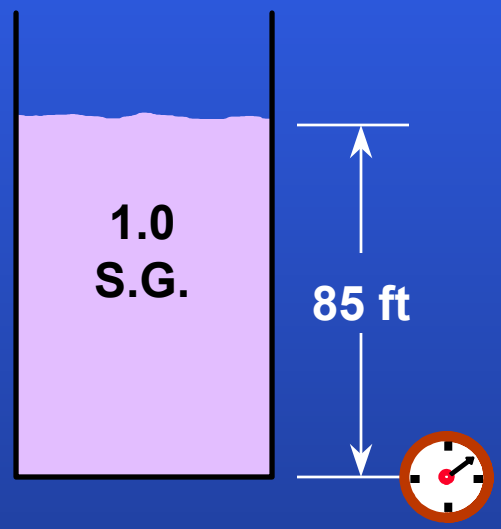


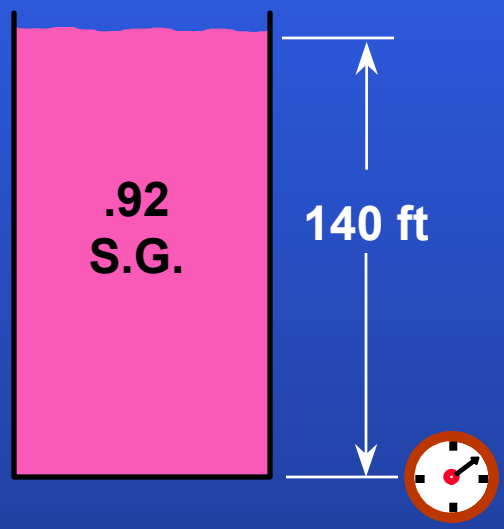
_____ psig

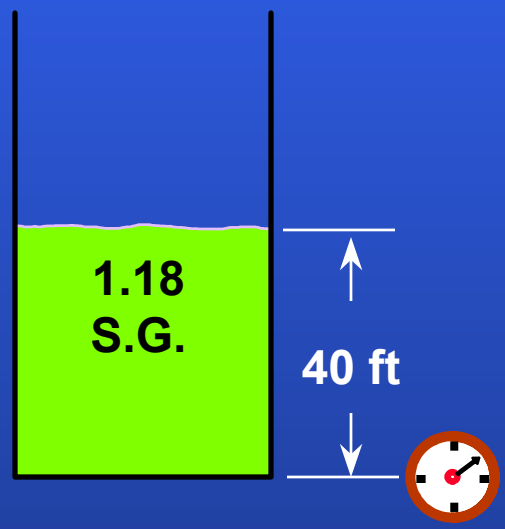
_____ psig

_____ psig

CALCULE LA MEDIDA DE LA PRESION





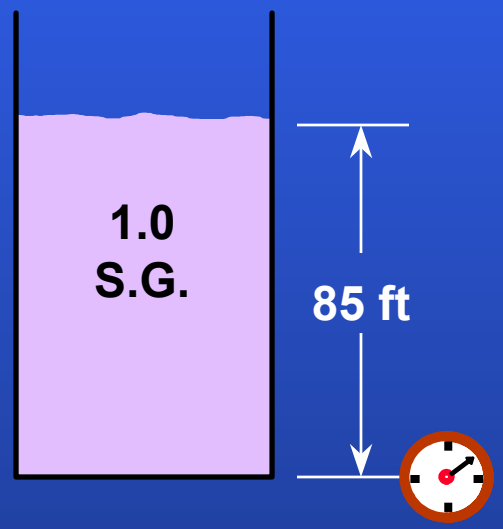


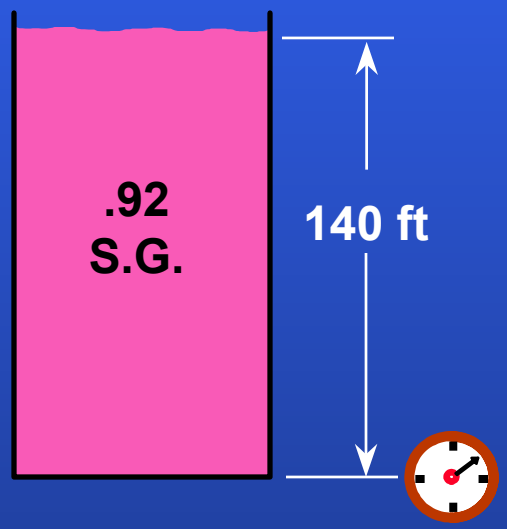
36.8 psig

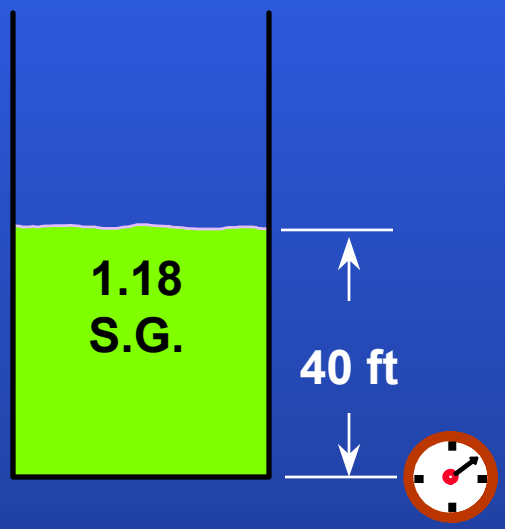
_____ psig

_____ psig

$$\frac{85 \times 1.0}{2.31} = 36.796$$





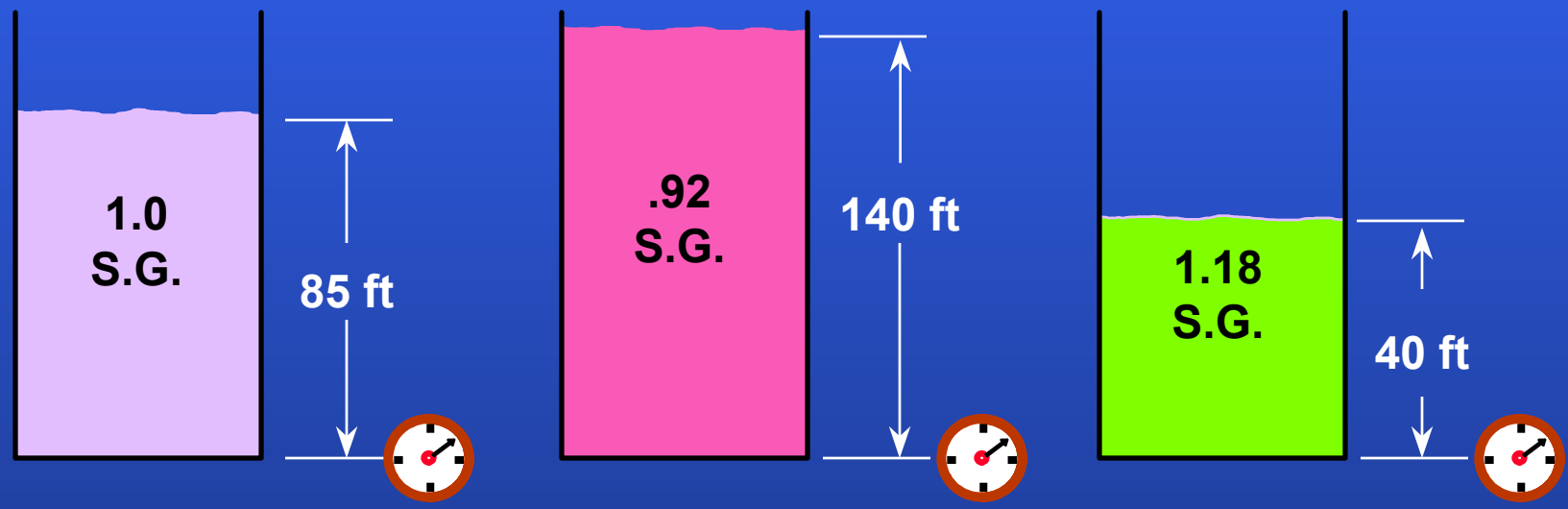


36.8 psig

55.8 psig

____ psig

$$\frac{140 \times .92}{2.31} = 55.757$$

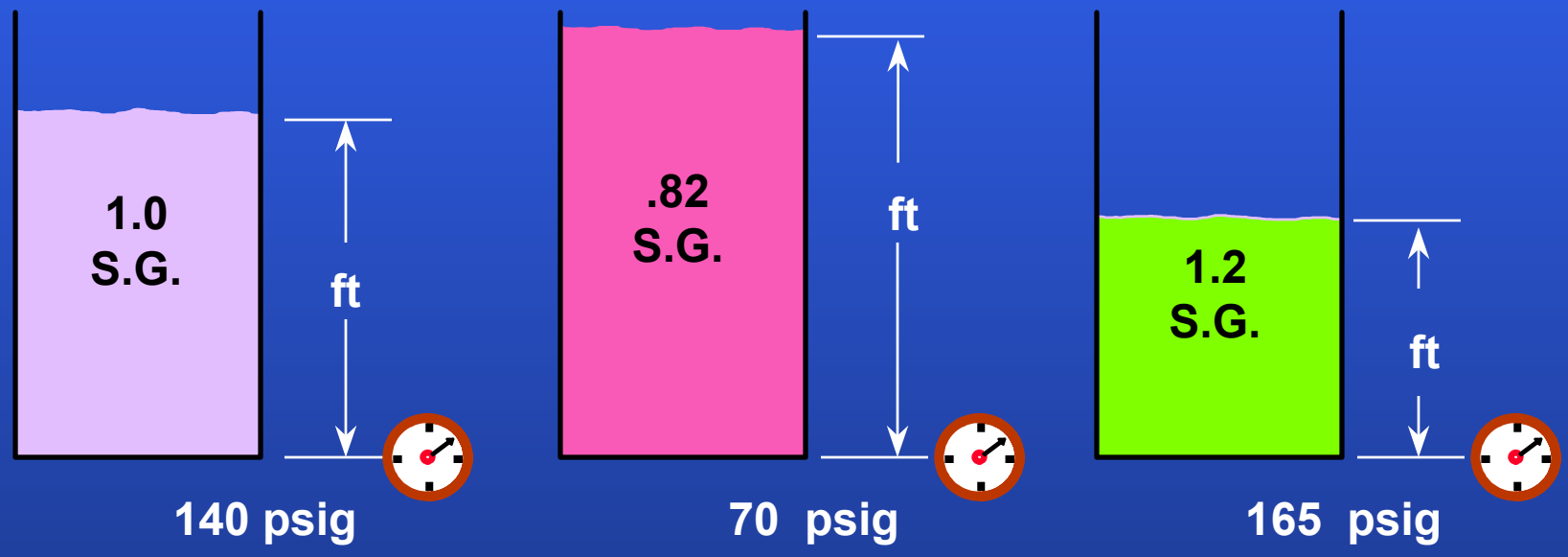


36.8 psig

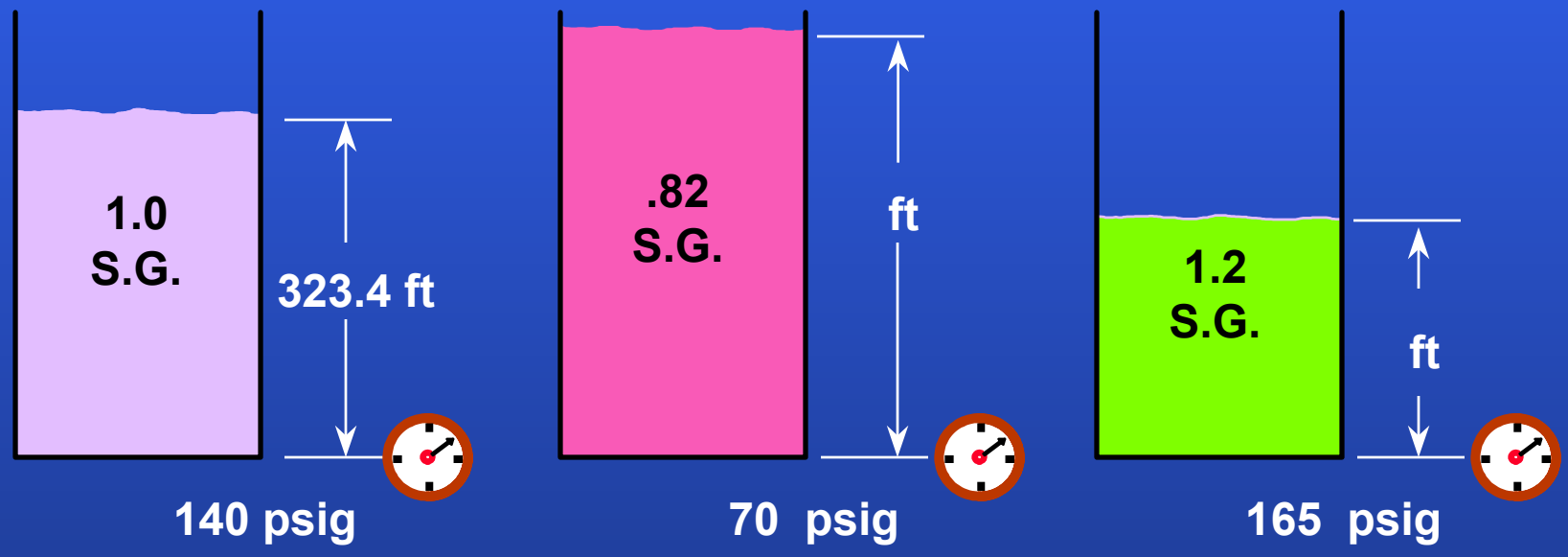
55.8 psig

20.4 psig

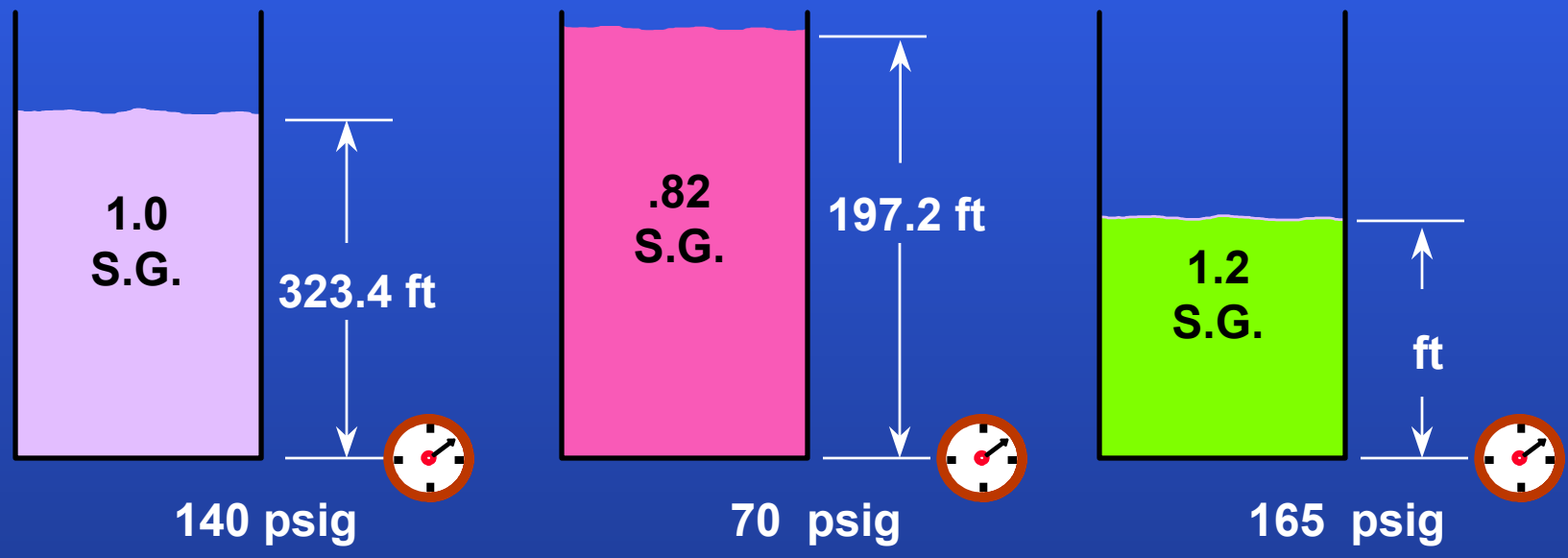
$$\frac{40 \times 1.18}{2.31} = 20.432$$



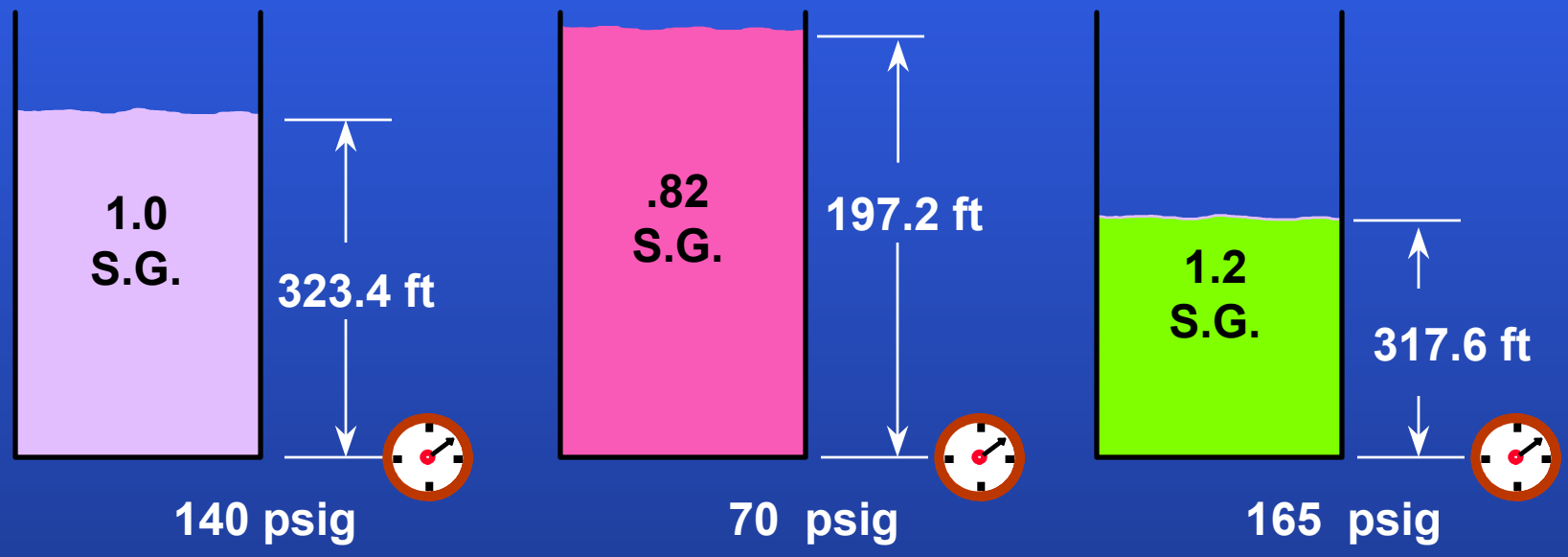
CALCULE EL NIVEL DEL LIQUIDO DENTRO DEL TANQUE



$$\frac{140 \times 2.31}{1.0} = 323.4$$

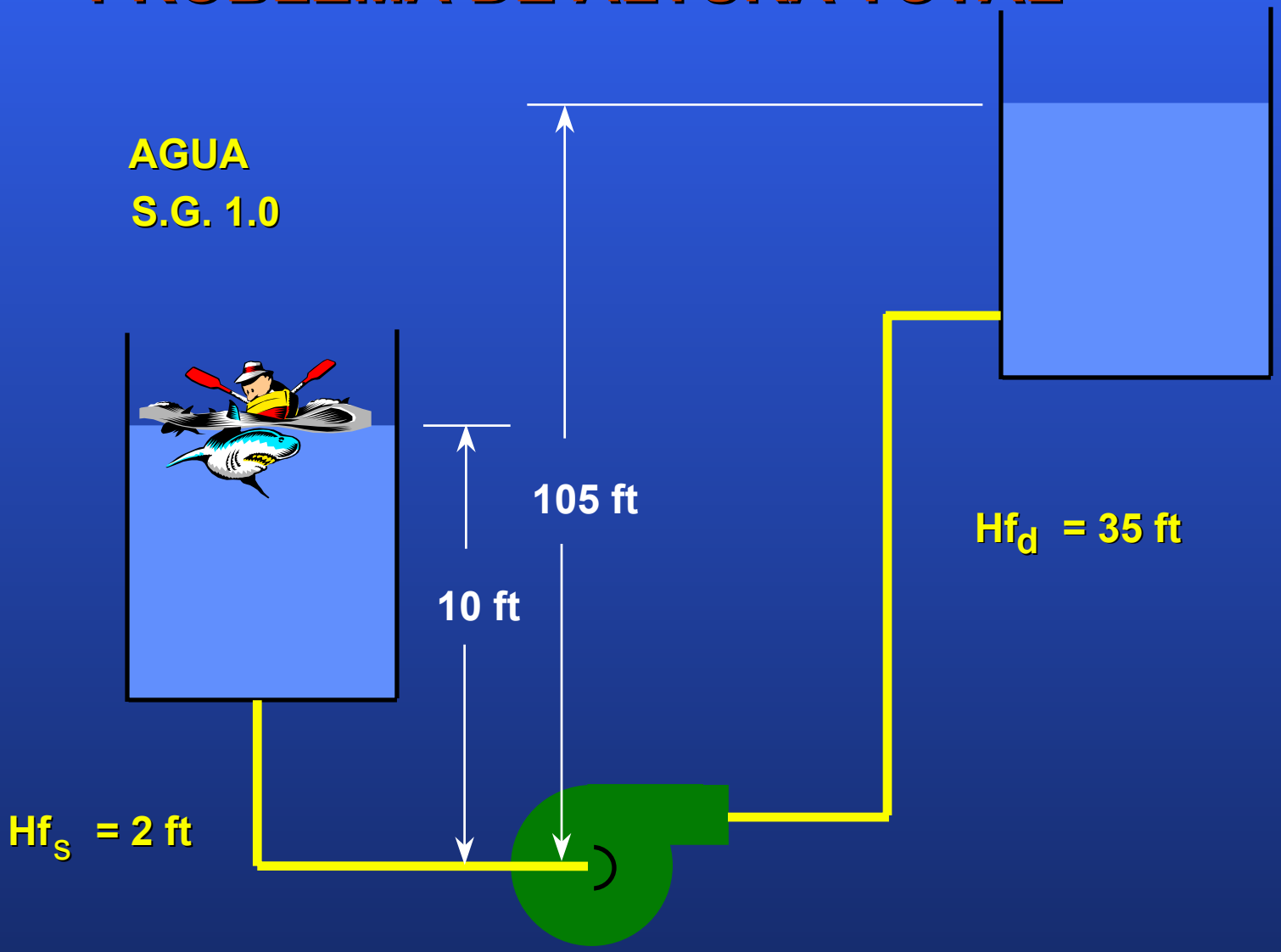


$$\frac{70 \times 2.31}{.82} = 197.19$$

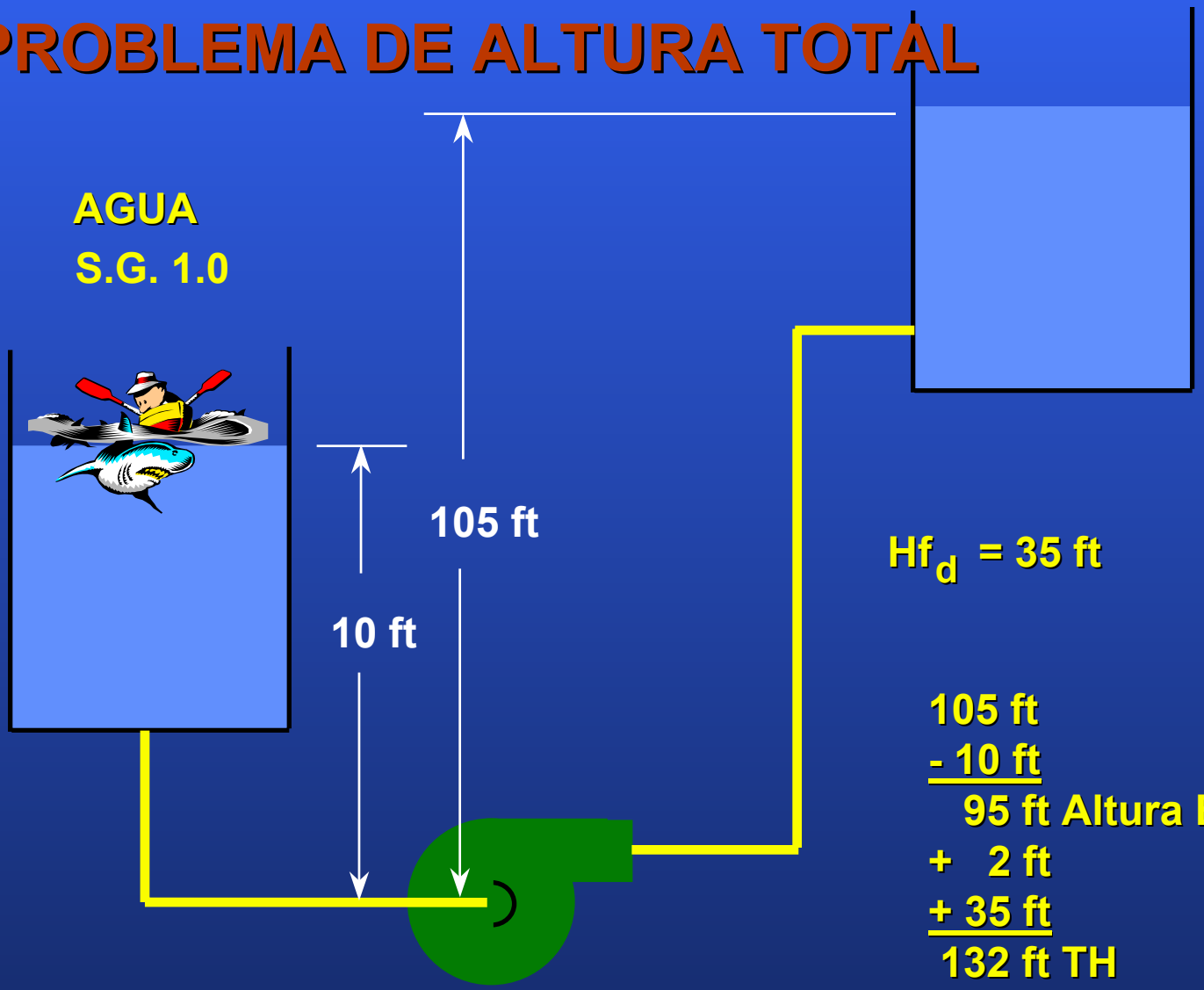


$$\frac{165 \times 2.31}{1.2} = 317.62$$

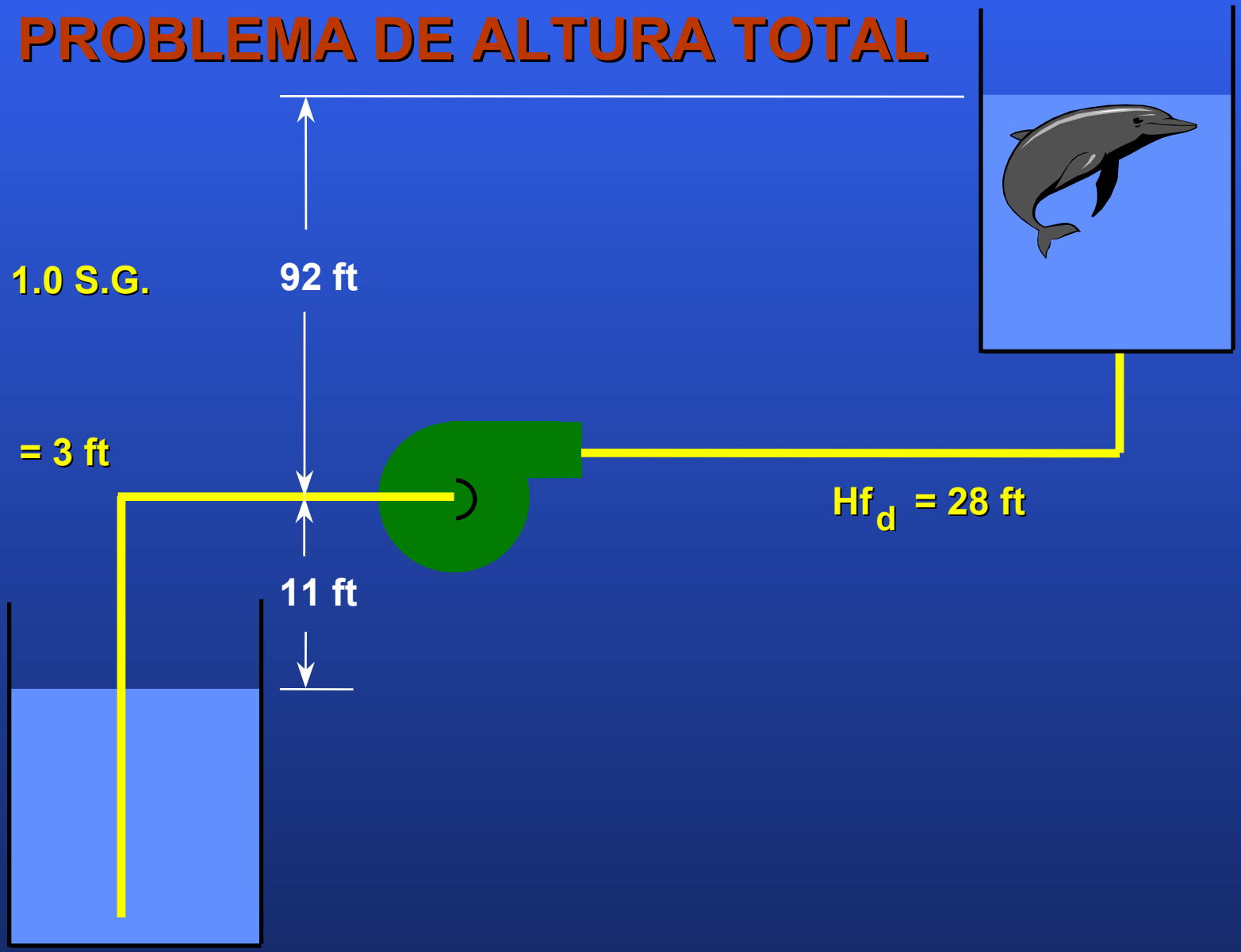
PROBLEMA DE ALTURA TOTAL



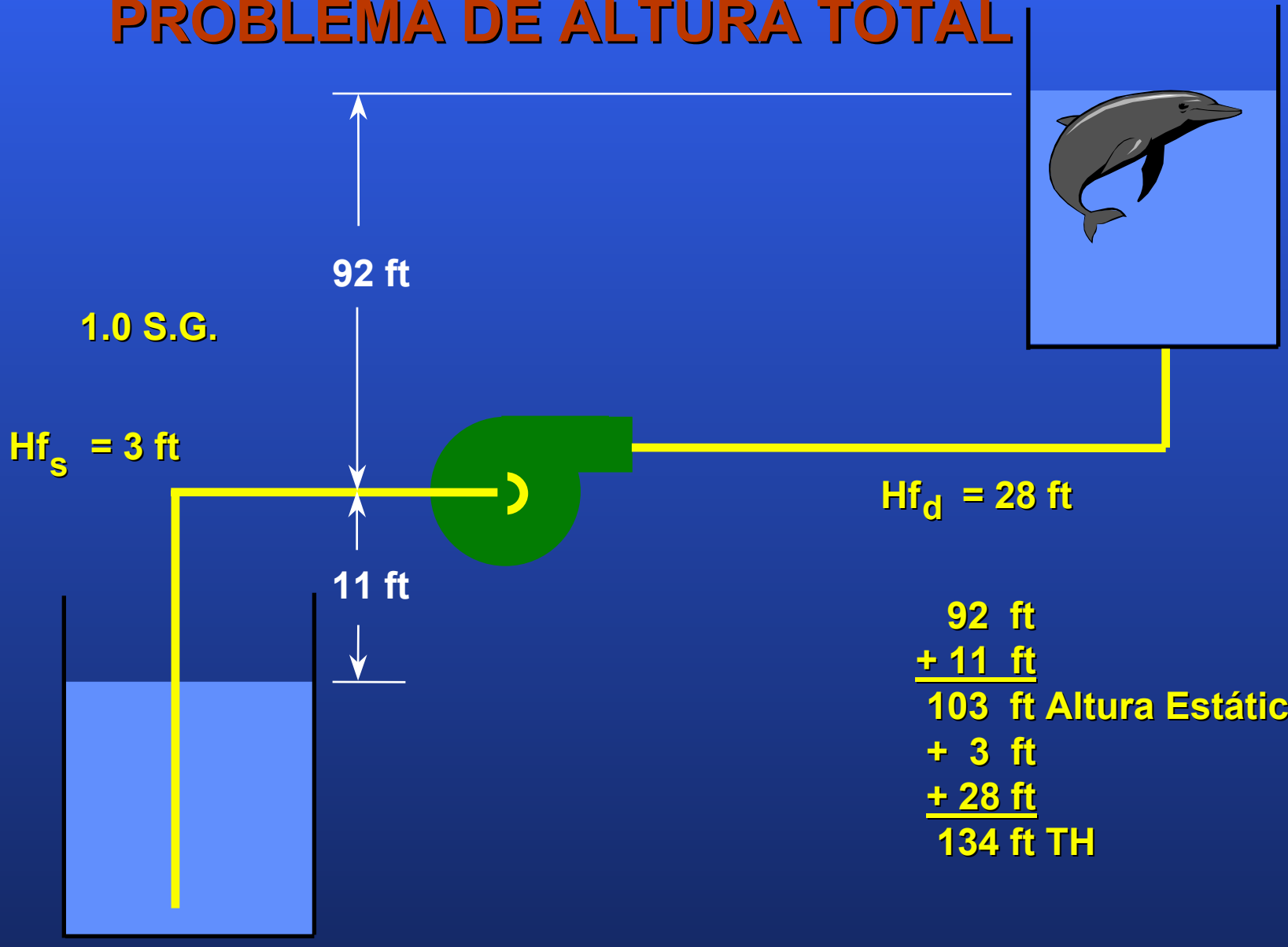
PROBLEMA DE ALTURA TOTAL



PROBLEMA DE ALTURA TOTAL

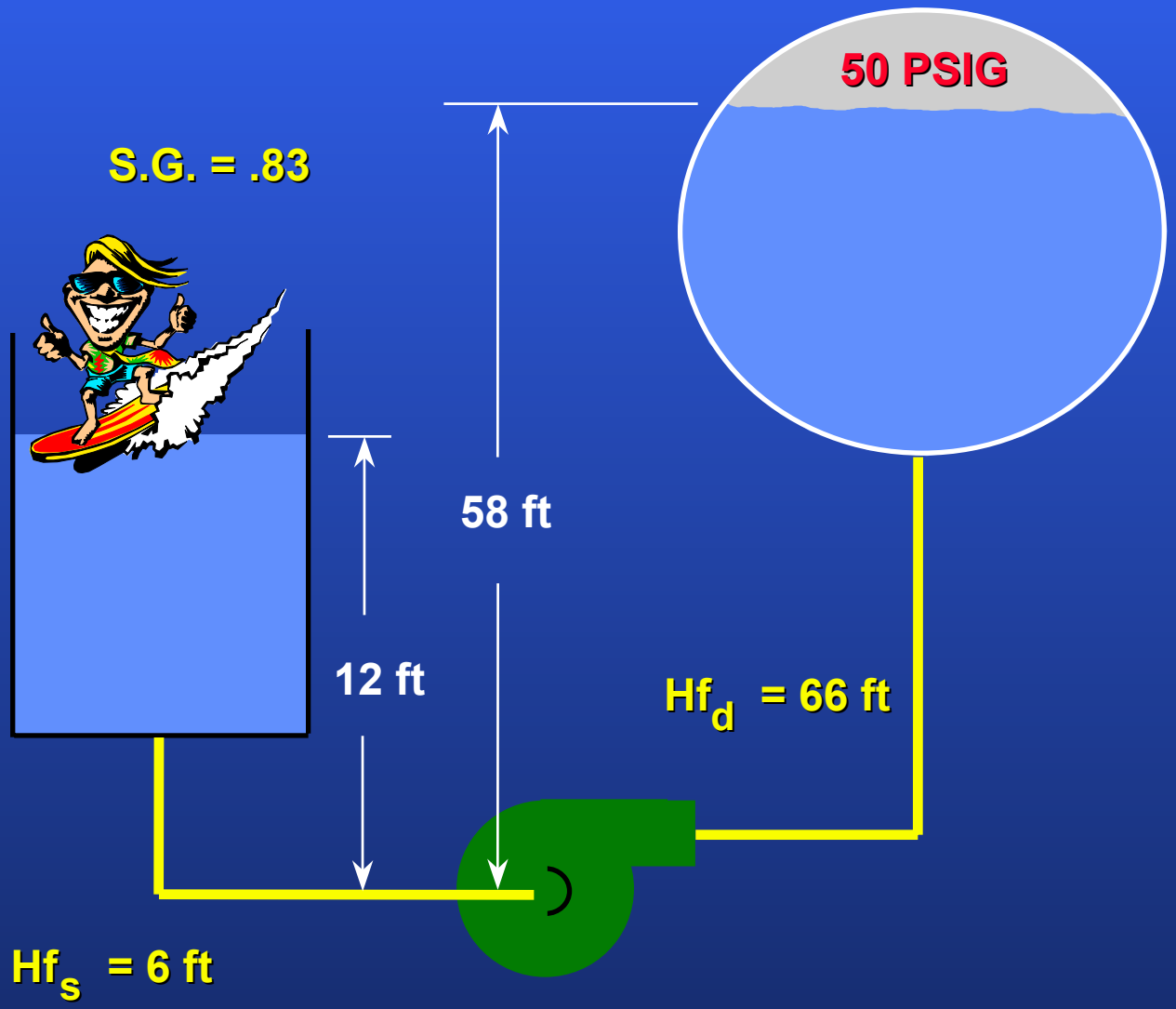


PROBLEMA DE ALTURA TOTAL

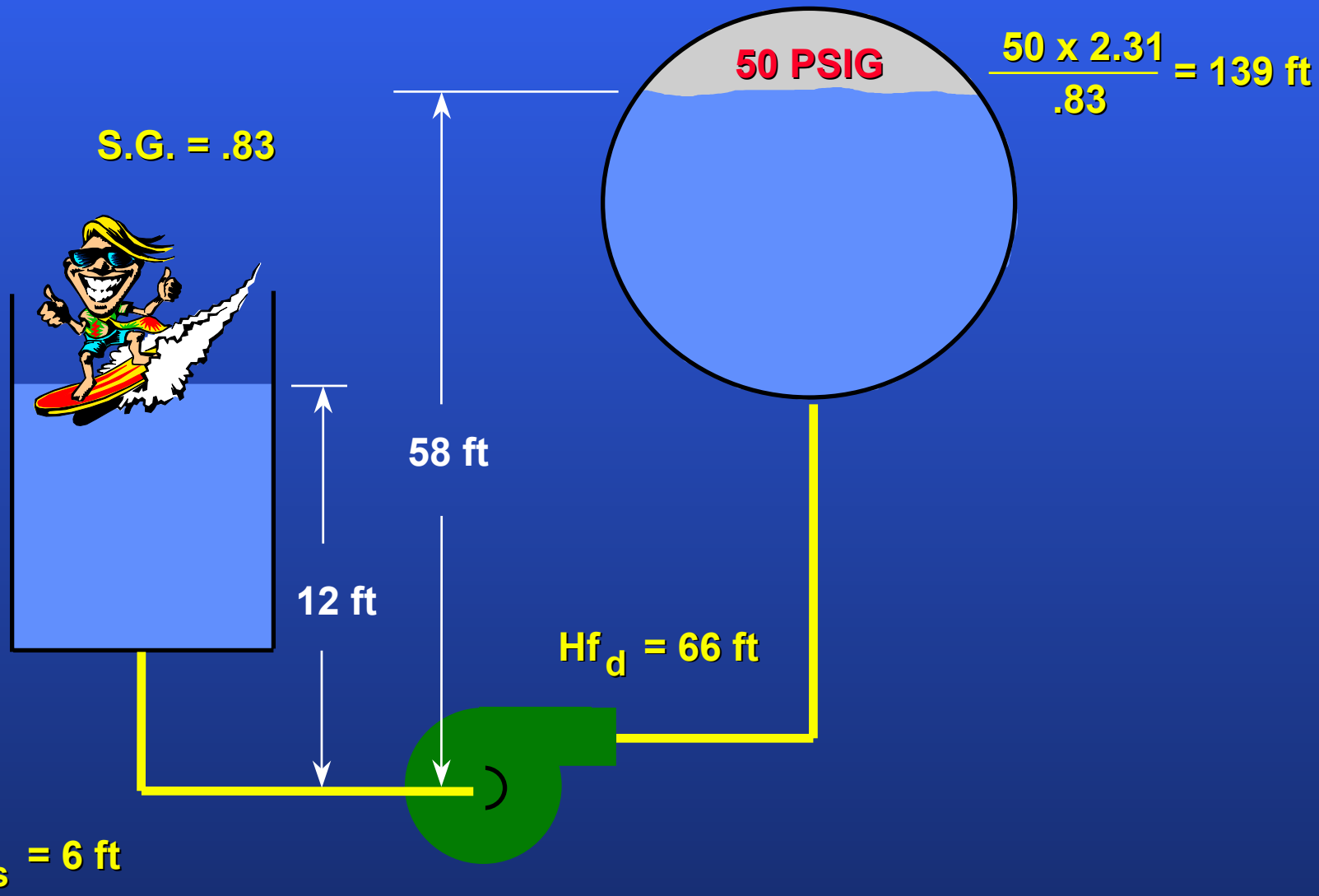


92 ft
+ 11 ft
103 ft Altura Estática
+ 3 ft
+ 28 ft
134 ft TH

PROBLEMA DE ALTURA TOTAL



PROBLEMA DE ALTURA TOTAL



PROBLEMA DE ALTURA TOTAL

S.G. = .83

50 PSIG

$$\frac{50 \times 2.31}{.83} = 139 \text{ ft}$$

58 ft

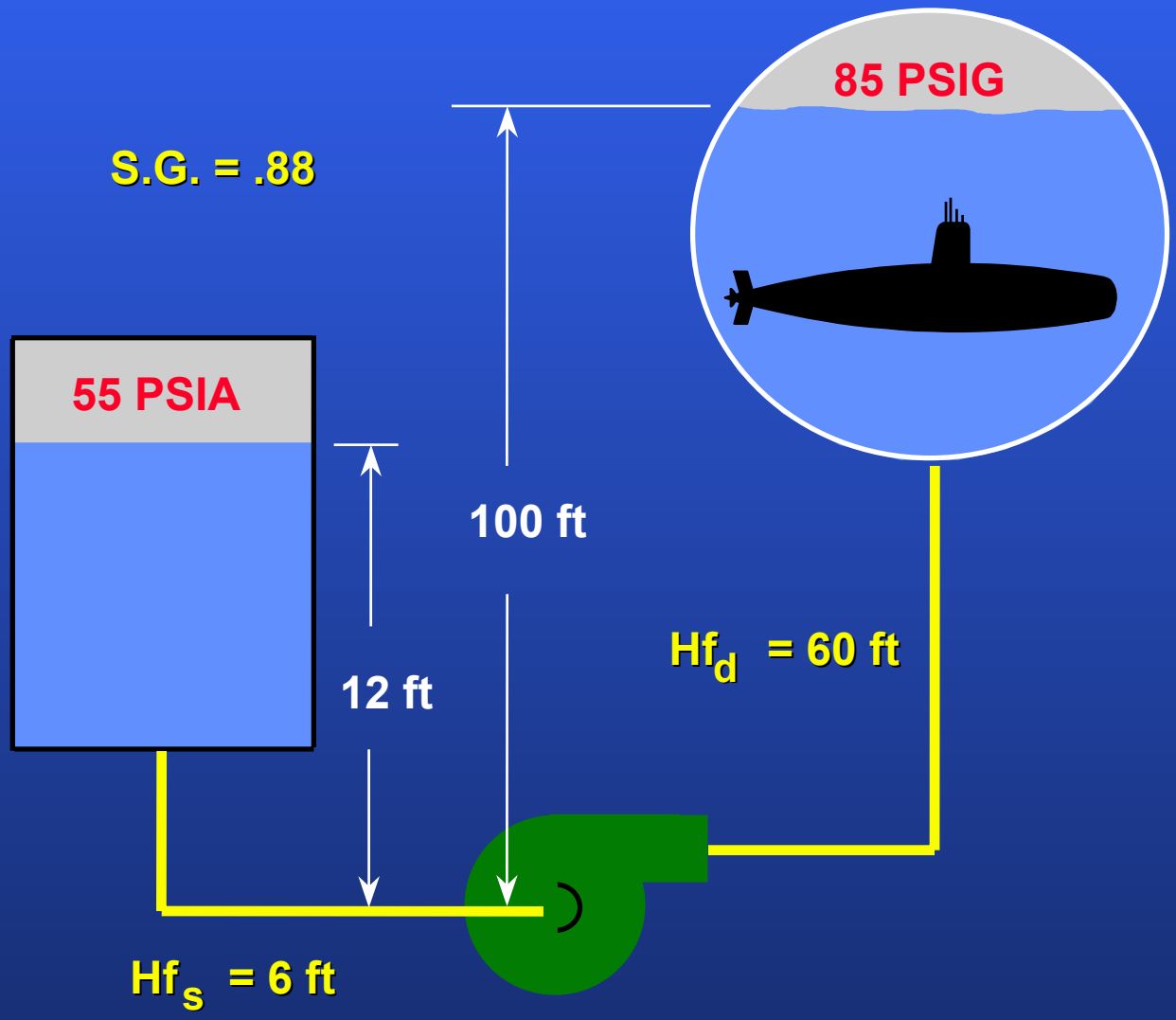
12 ft

Hf_d = 66 ft

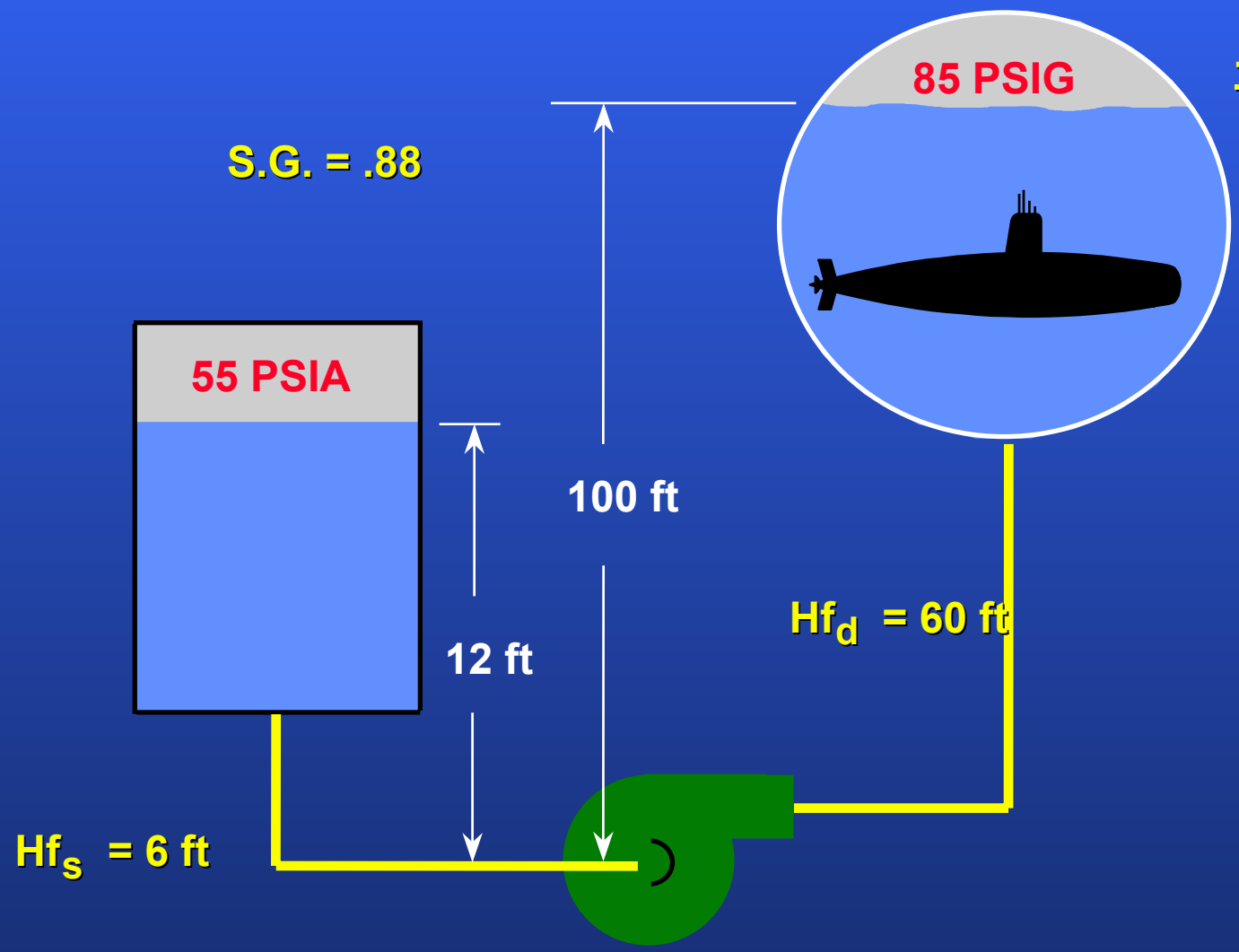
Hf_s = 6 ft

58 ft
- 12 ft
46 ft Altura Estática
+ 139 ft
185 ft Total Altura Estática
+ 6 ft
+ 66 ft
257 ft TH

PROBLEMA DE ALTURA TOTAL

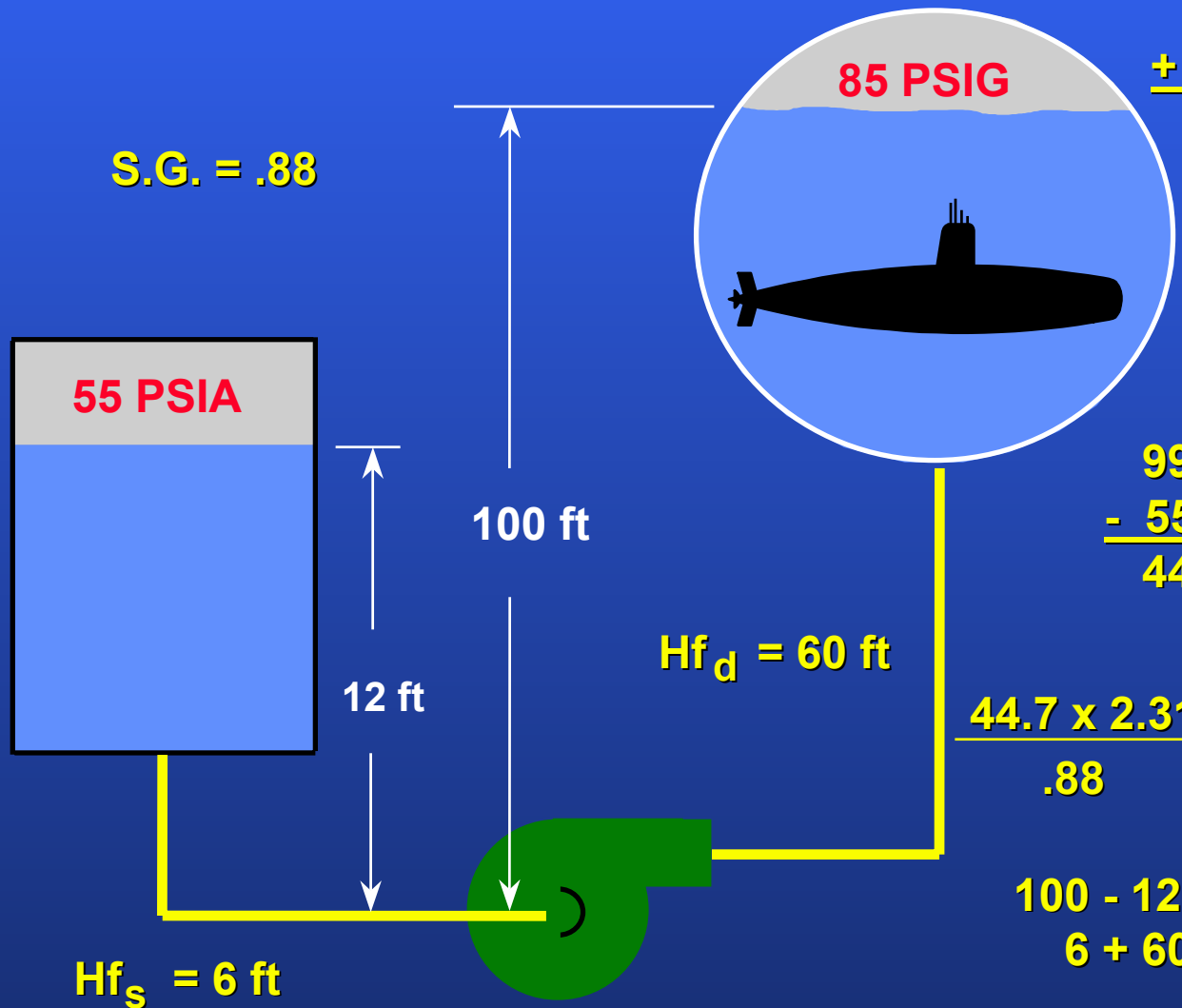


PROBLEMA DE ALTURA TOTAL



85 PSIG
+ 14.7
99.7 PSIA

PROBLEMA DE ALTURA TOTAL



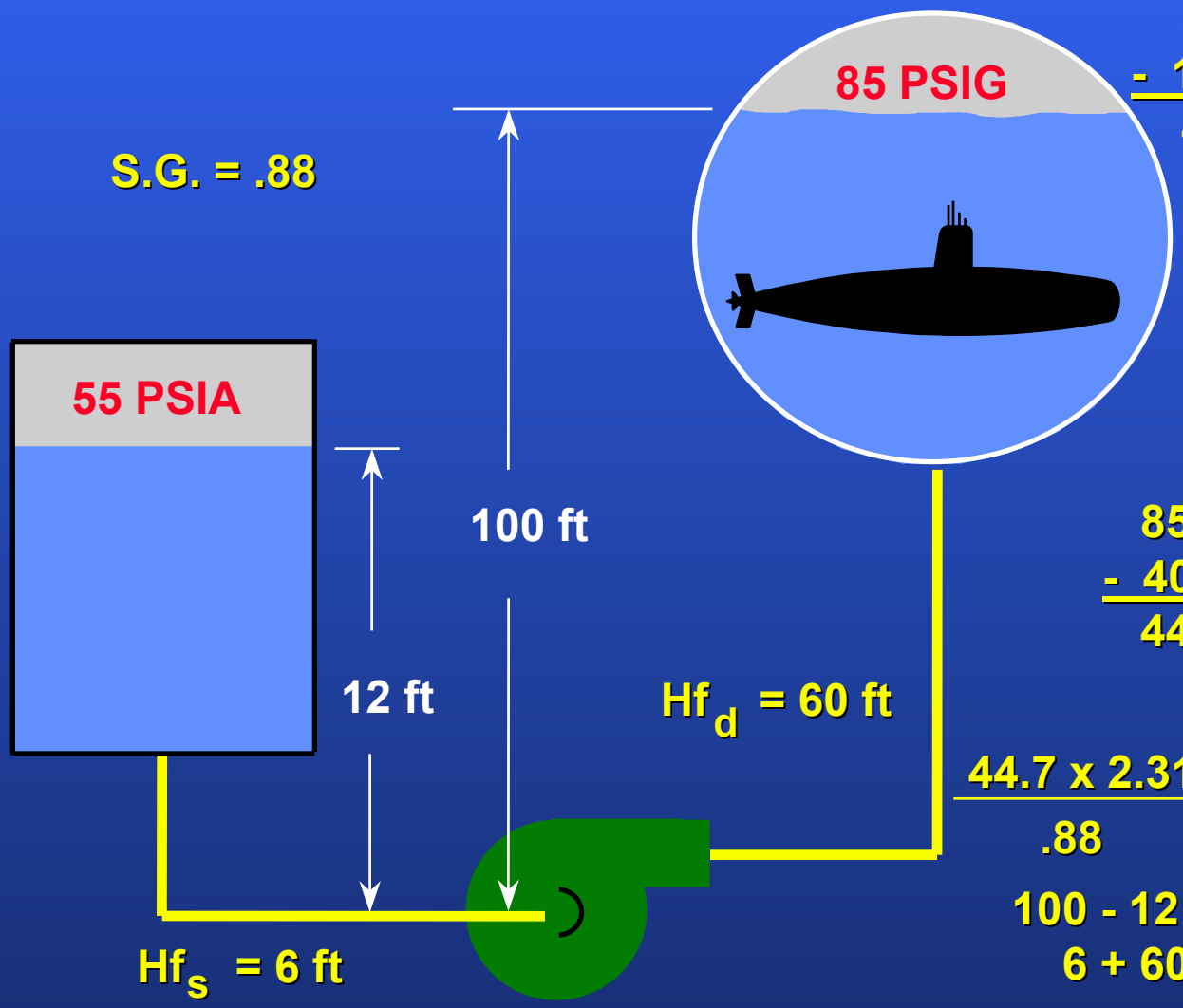
85 PSIG
+ 14.7
99.7 PSIA

99.7 PSIA
- 55 PSIA
44.7 PSIA

$\frac{44.7 \times 2.31}{.88}$ = 117.3 ft

100 - 12 = 88 ft
6 + 60 = 66 ft
217.3 ft

PROBLEMA DE ALTURA TOTAL



55 PSIA
- 14.7
40.3 PSIG

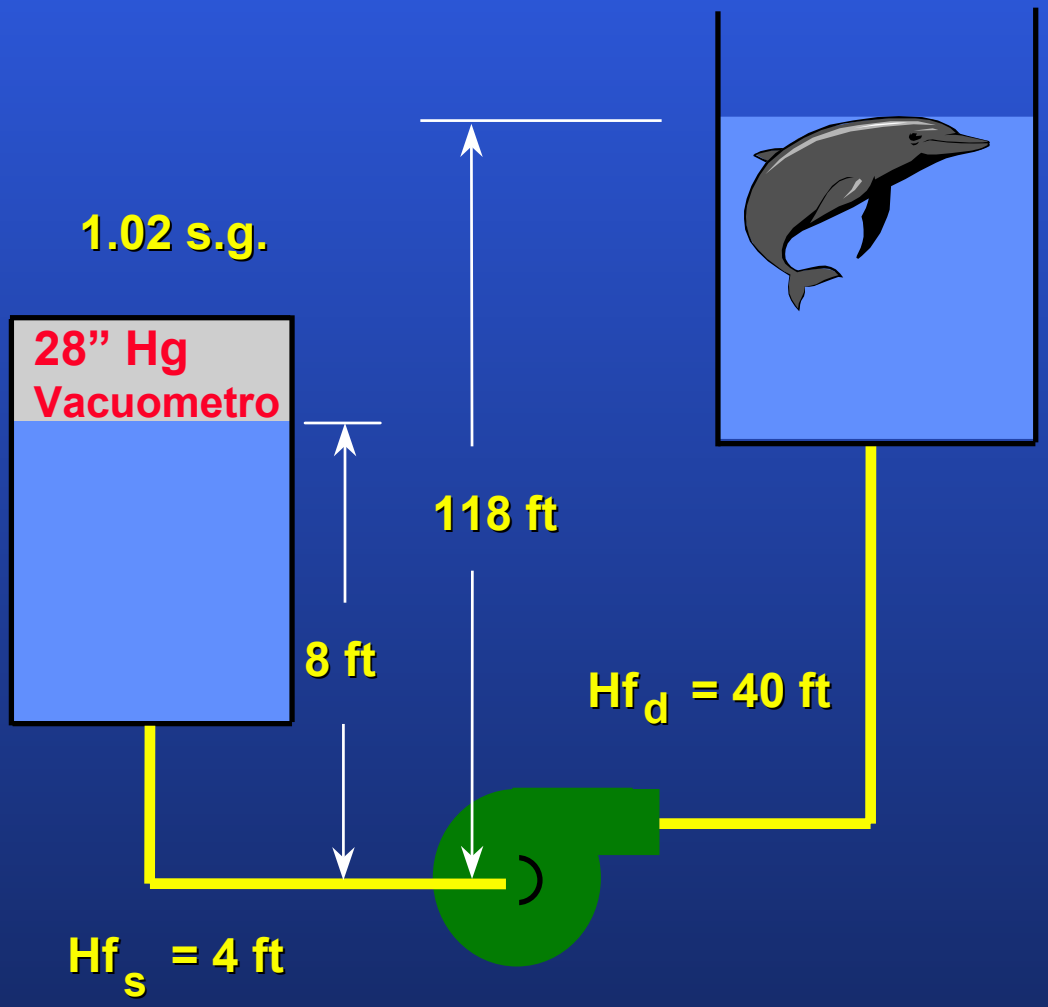
85 PSIG
- 40.3 PSIG
44.7 PSIG

$$\frac{44.7 \times 2.31}{.88} = 117.3 \text{ ft}$$

100 - 12 = 88 ft
6 + 60 = 66 ft

217.3 ft

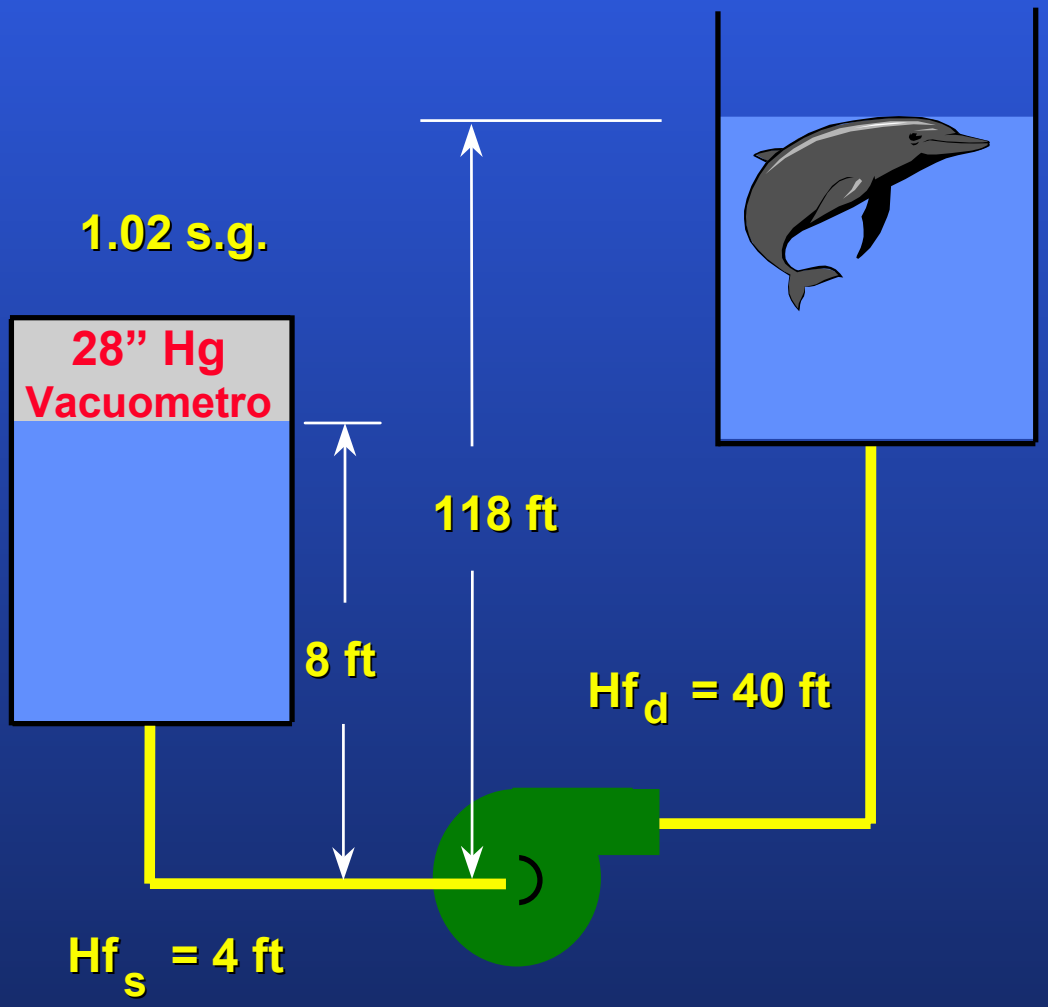
PROBLEMA DE ALTURA TOTAL



PROBLEMA DE ALTURA TOTAL

30”Hg - 28”HG = 2” Hg

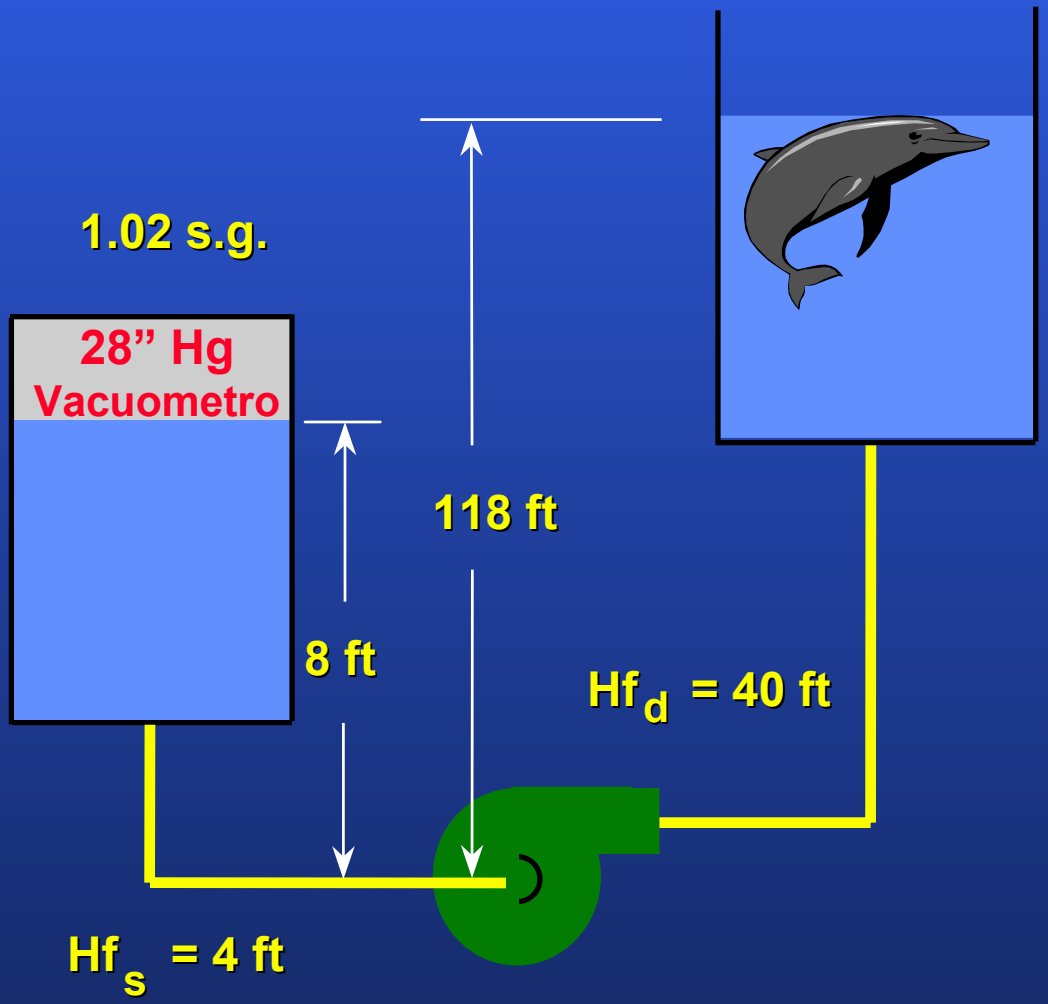
$\frac{2}{30}$ $\frac{x}{14.7}$ = .98 PSIA



PROBLEMA DE ALTURA TOTAL

30”Hg - 28”HG = 2” Hg

$\frac{2}{30}$ $\frac{x}{14.7}$ = .98 PSIA



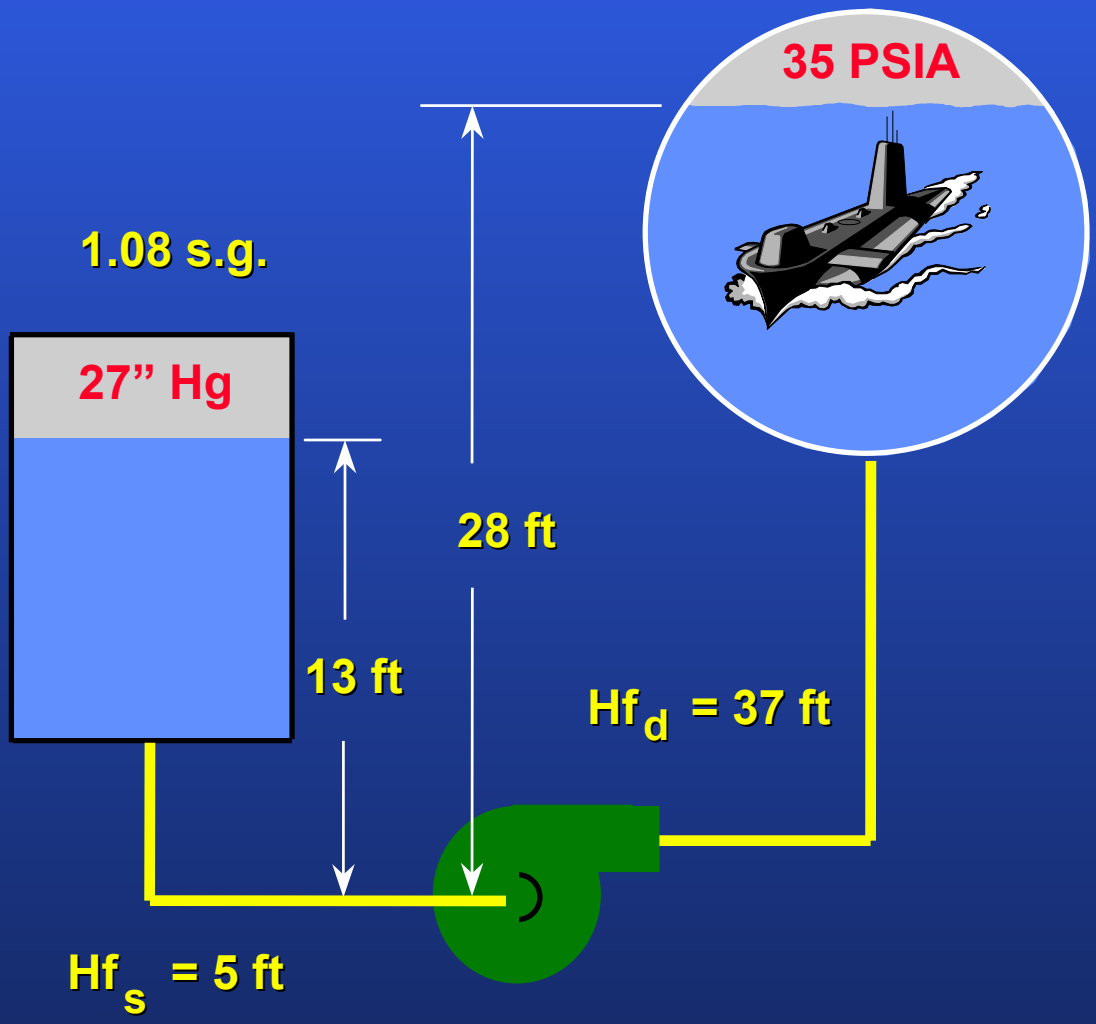
$\frac{(14.7 - .98) \times 2.31}{1.02}$ = 31.1 ft

118 - 8 = 110 ft

4 + 40 = 44 ft

185.1 ft TH

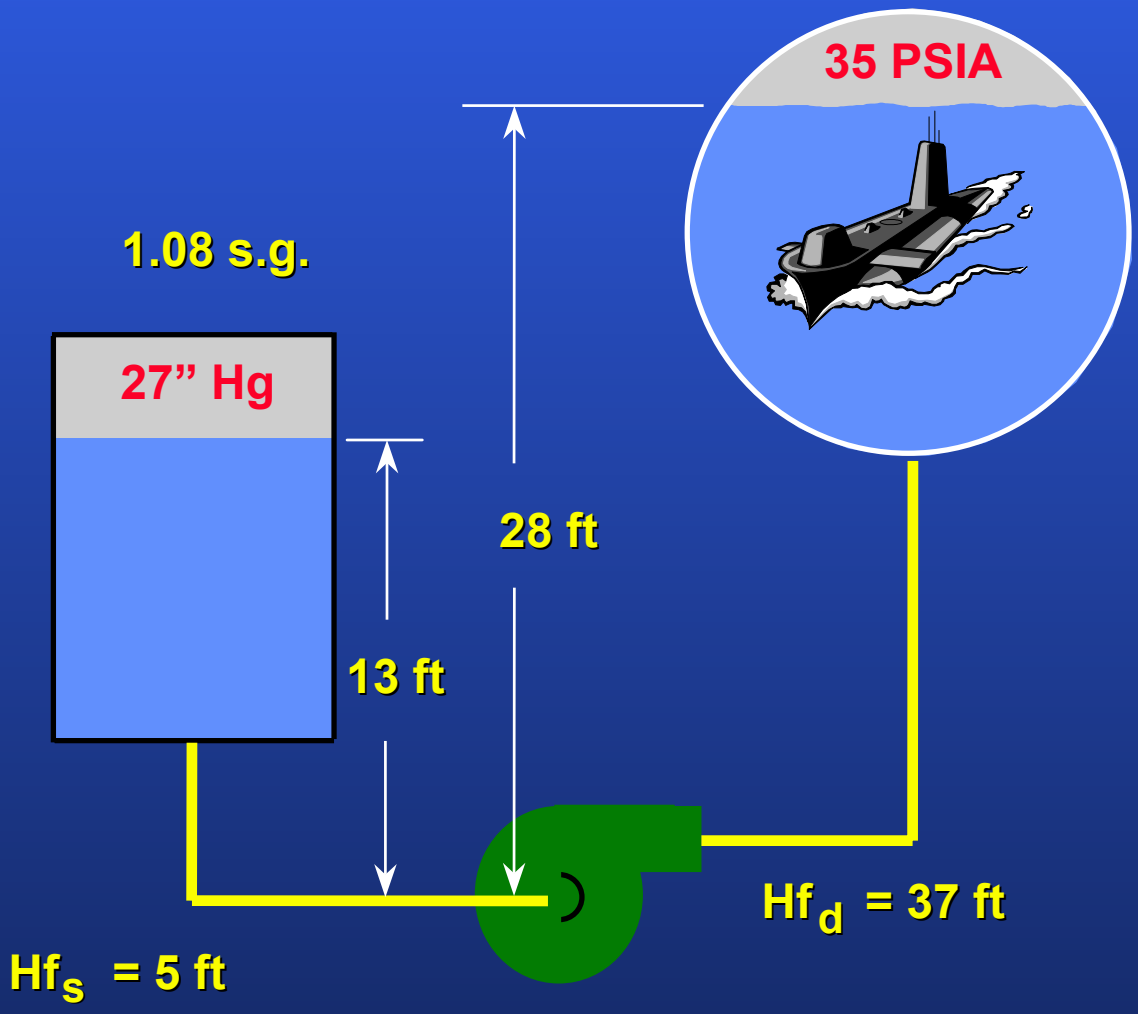
PROBLEMA DE ALTURA TOTAL



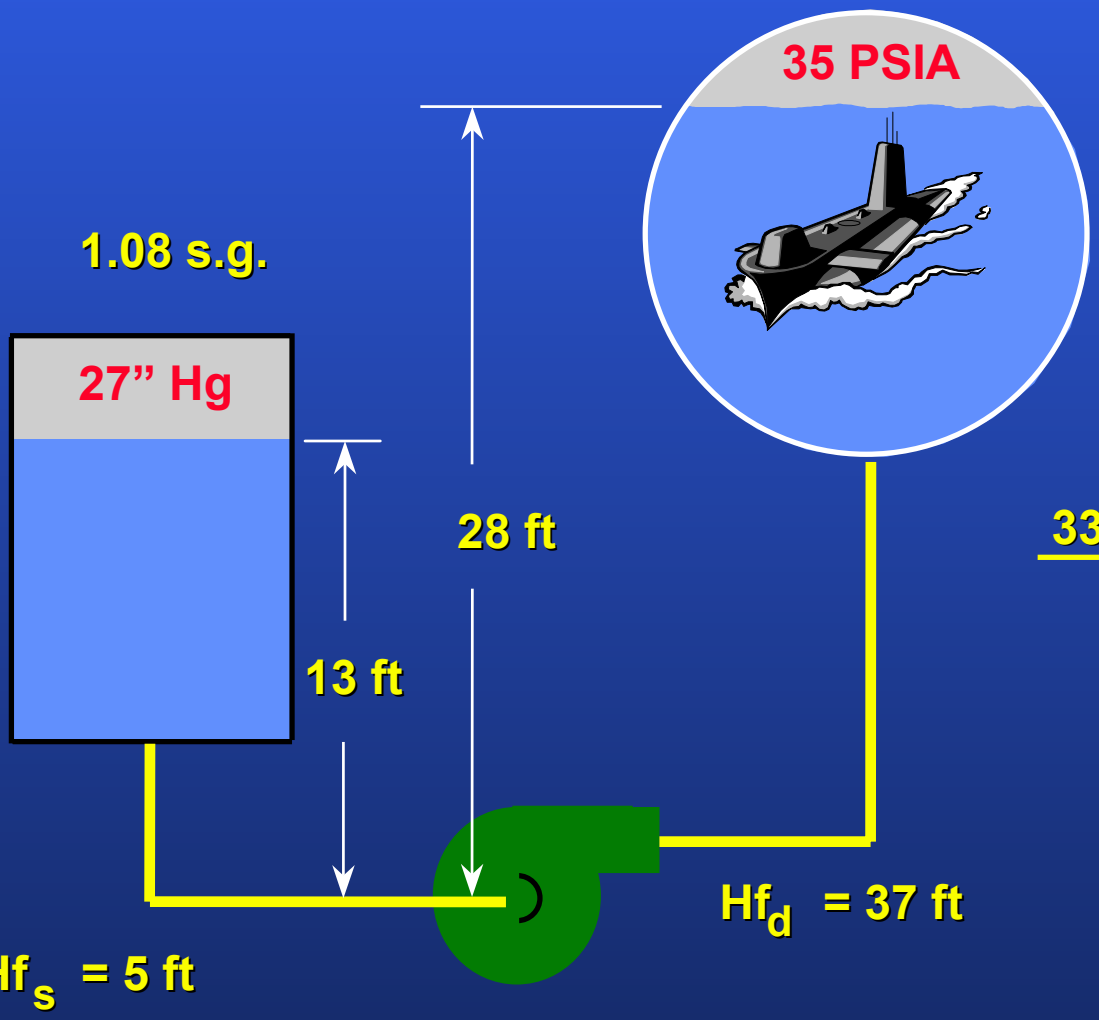
PROBLEMA DE ALTURA TOTAL

30”Hg - 27”HG = 3” Hg

$\frac{3}{30} \times \frac{x}{14.7} = 1.47$ PSIA



PROBLEMA DE ALTURA TOTAL



30"Hg - 27"HG = 3" Hg

$$\frac{3}{30} \times \frac{x}{14.7} = 1.47 \text{ PSIA}$$

$$\begin{array}{r} 35 \text{ PSIA} \\ -\ 1.47 \text{ PSIA} \\ \hline 33.53 \text{ PSIA} \end{array}$$

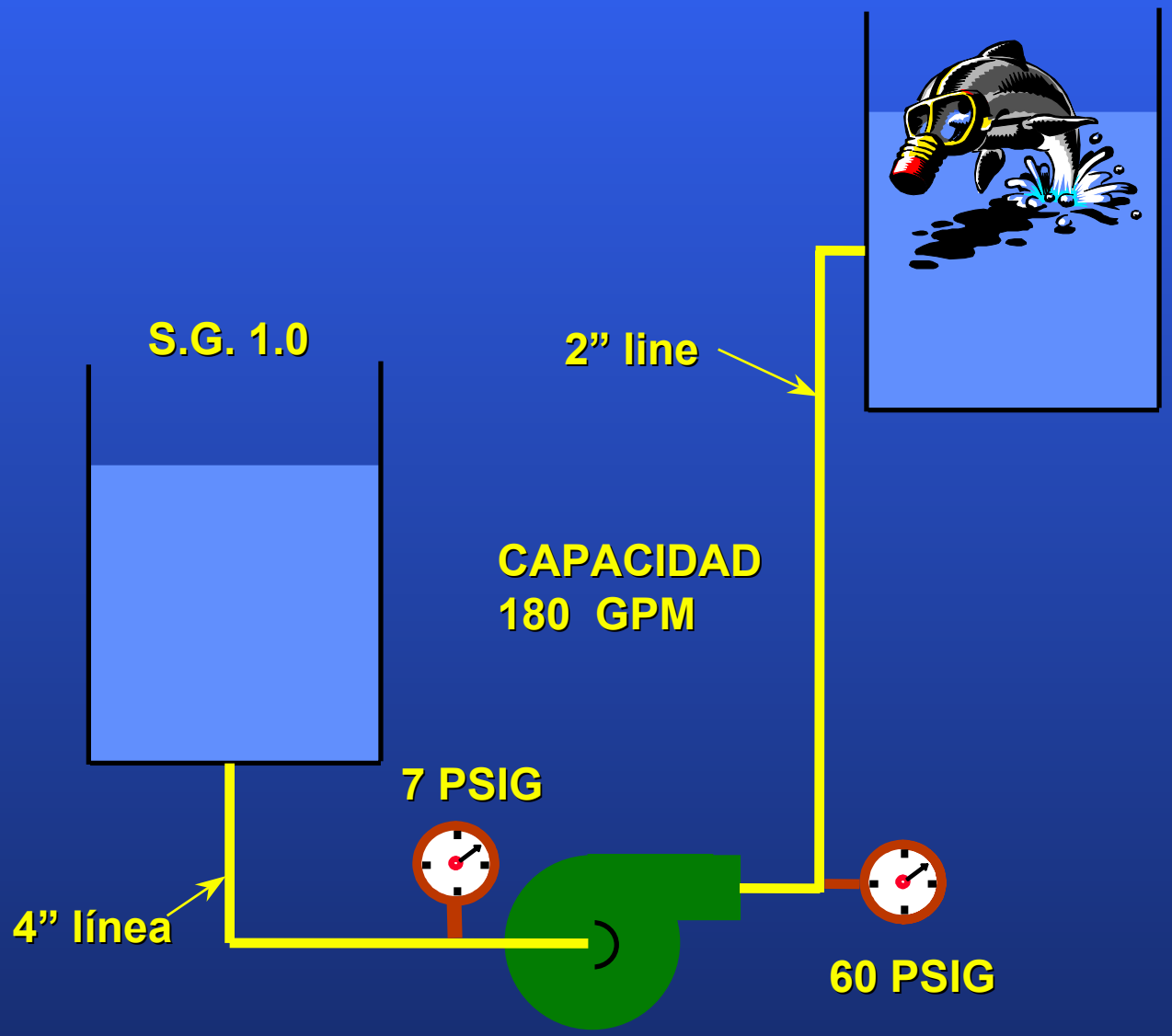
$$\frac{33.53 \times 2.31}{1.08} = 71.7 \text{ ft}$$

28 ft - 13 ft = 15 ft

5 + 37 = 42 ft

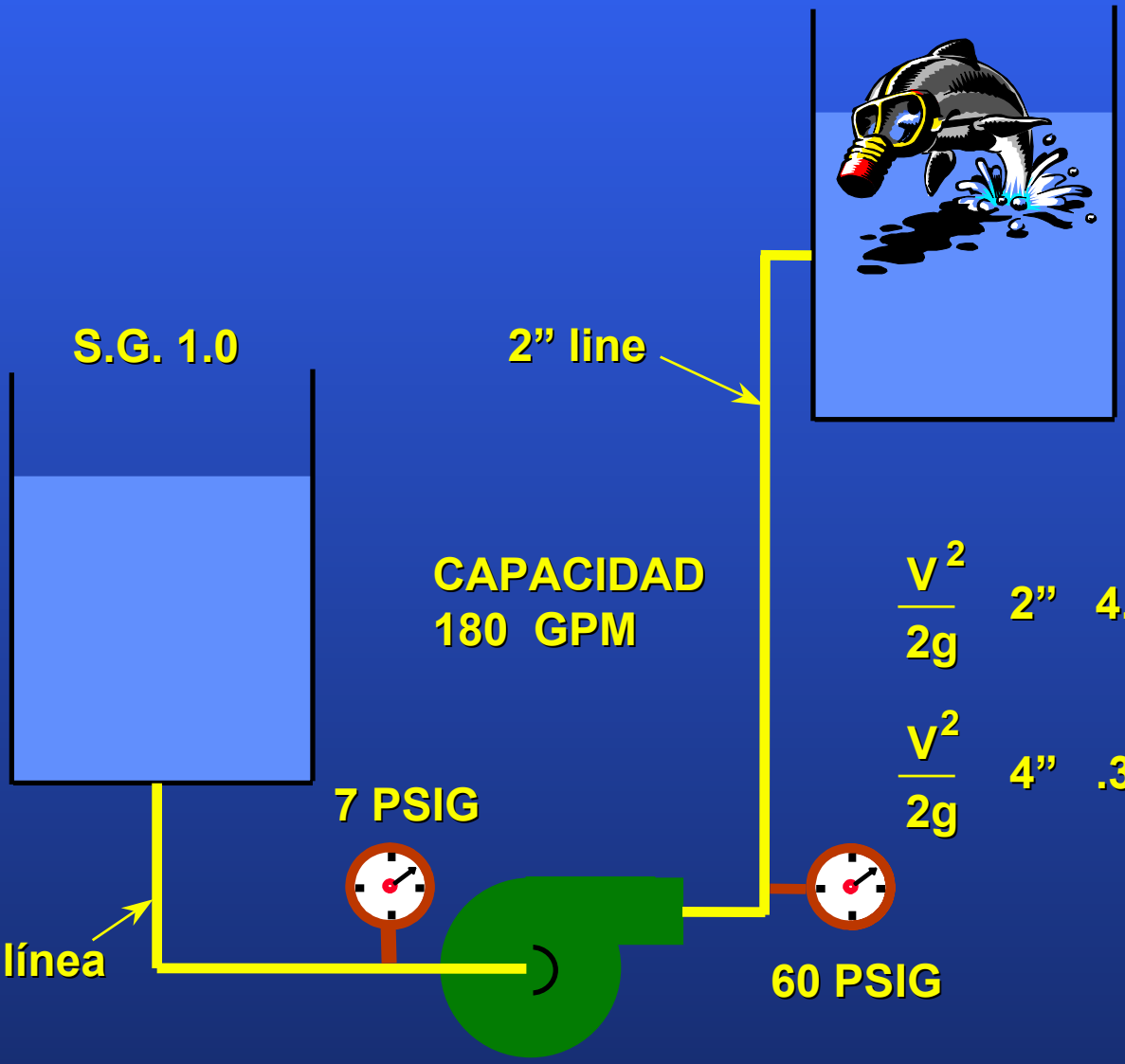
128.7 ft TH

PROBLEMA DE ALTURA TOTAL



Tuberias en schedule 40

PROBLEMA DE ALTURA TOTAL



60 PSIG
- 7 PSIG
53 PSIG

$\frac{53 \times 2.31}{1.0}$ = 122.4 ft
4.28 ft
126 .68 TH

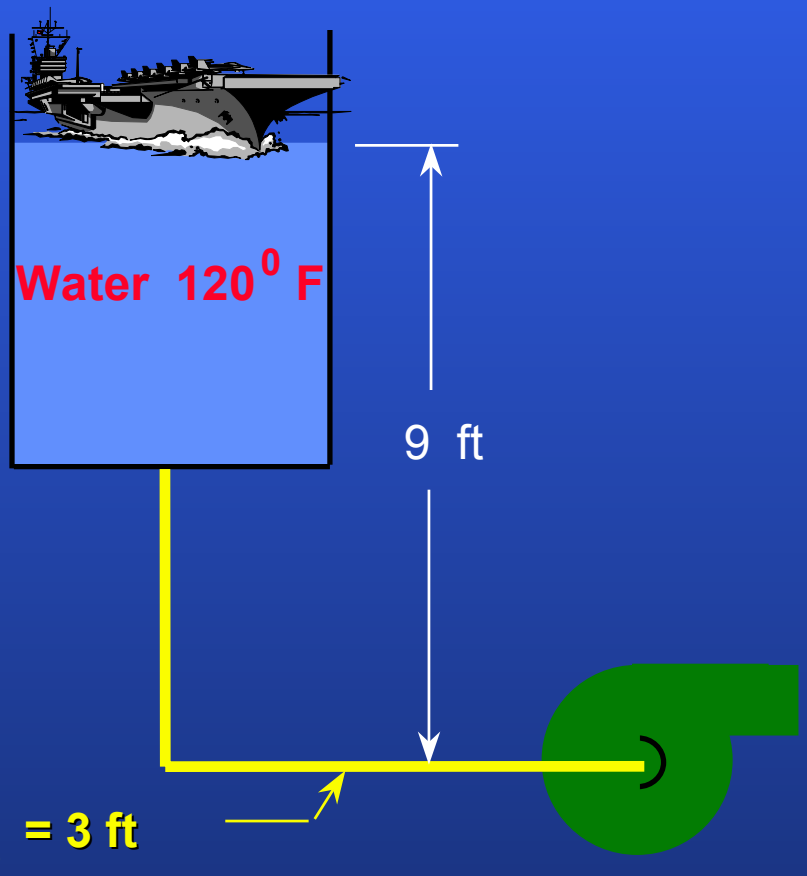
$\frac{V^2}{2g}$ 2” 4.6 ft

$\frac{V^2}{2g}$ 4” .32 ft

4.6 ft
- .32 ft
4.28 ft

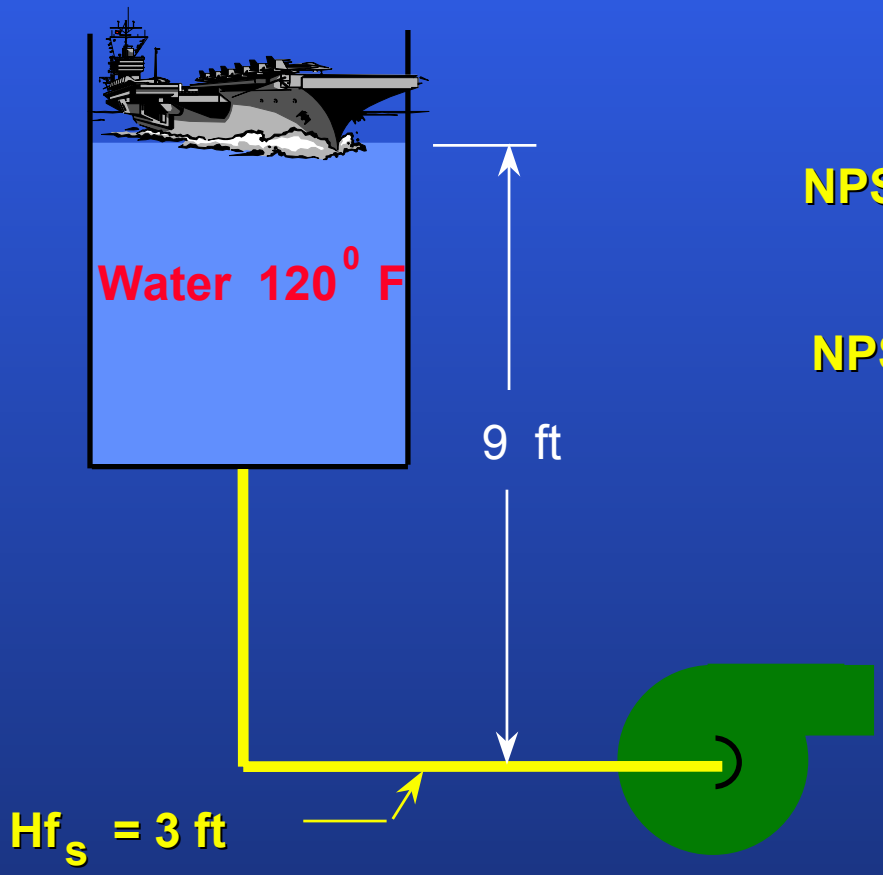
Tuberias en schedule 40

PROBLEMA NPSHd



Presión de Vapor 120 °F agua = 1.692 PSIA
Gravedad Especifica 120 °F agua = 0.99

PROBLEMA NPSHd

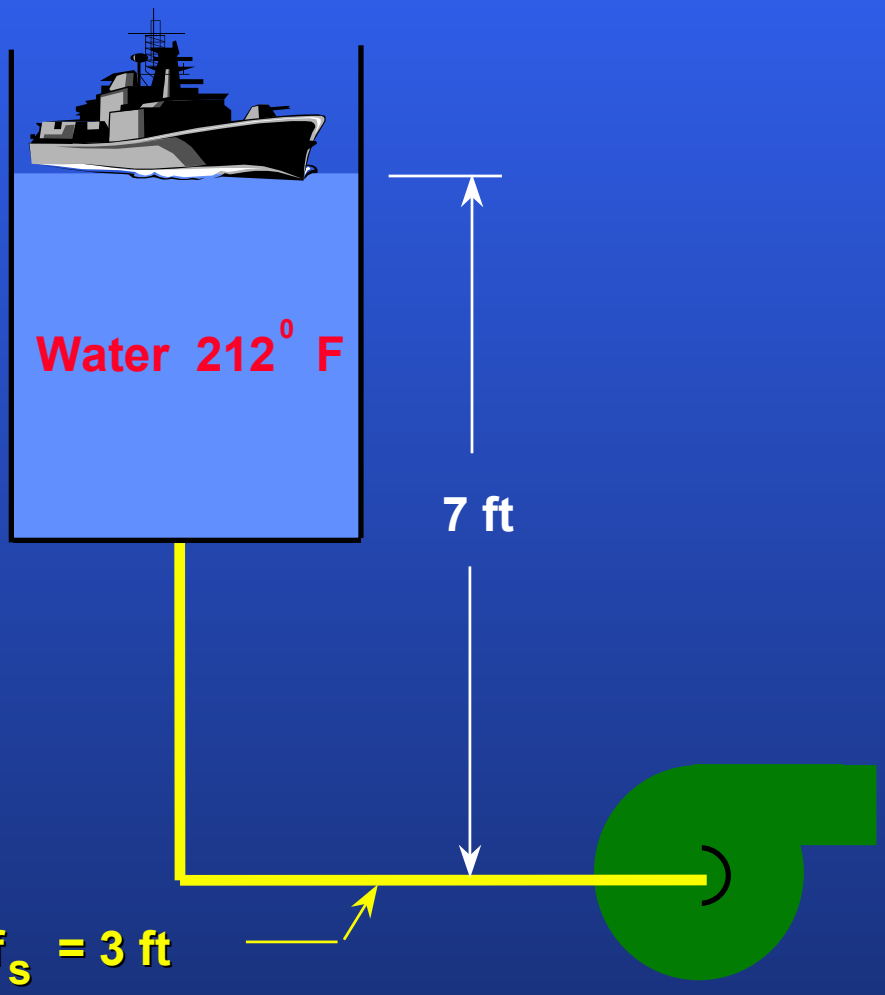


$$NPSHd = \frac{(14.7 - 1.692)\ 2.31}{.99} + 9 - 3$$

$$NPSHd = 30.4 + 6 = 36.4 \text{ ft}$$

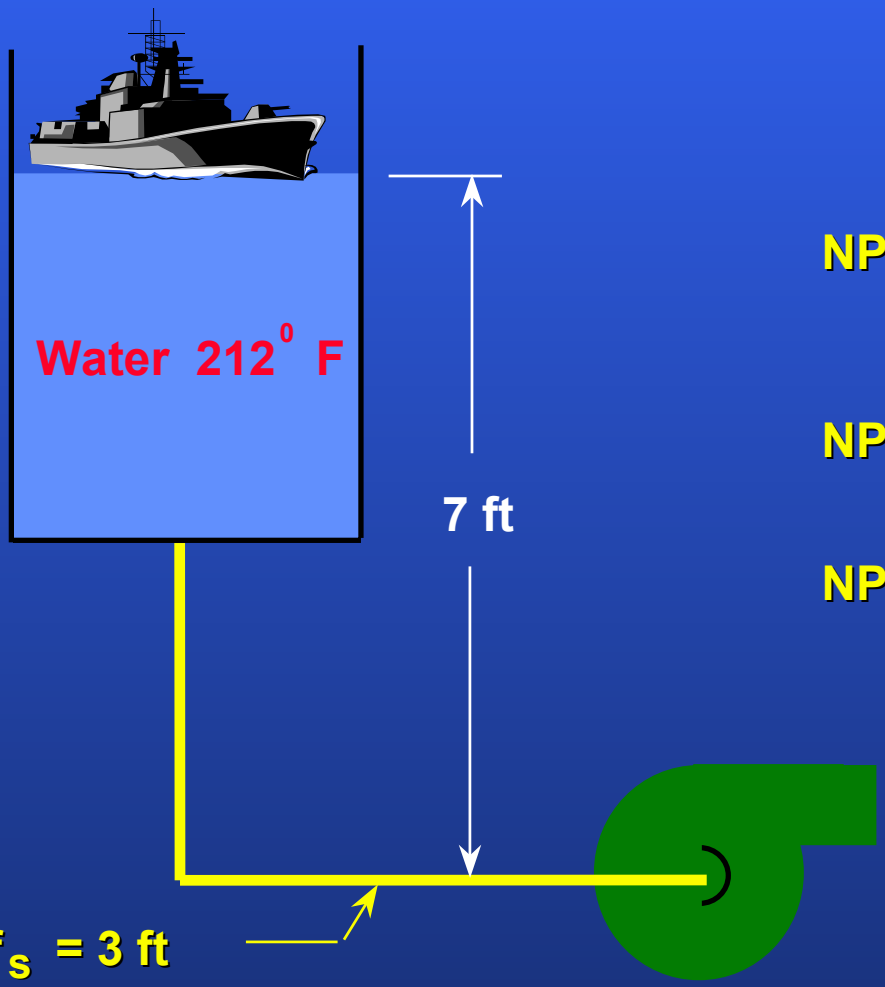
Presión de Vapor 120 °F agua = 1.692 PSIA
Gravedad Especifica 120 °F agua = 0.99

PROBLEMA NPSHd



Presión de Vapor 212 °F agua = 14.7 PSIA
Gravedad Especifica 212 °F agua = 0.959

PROBLEMA NPSHd



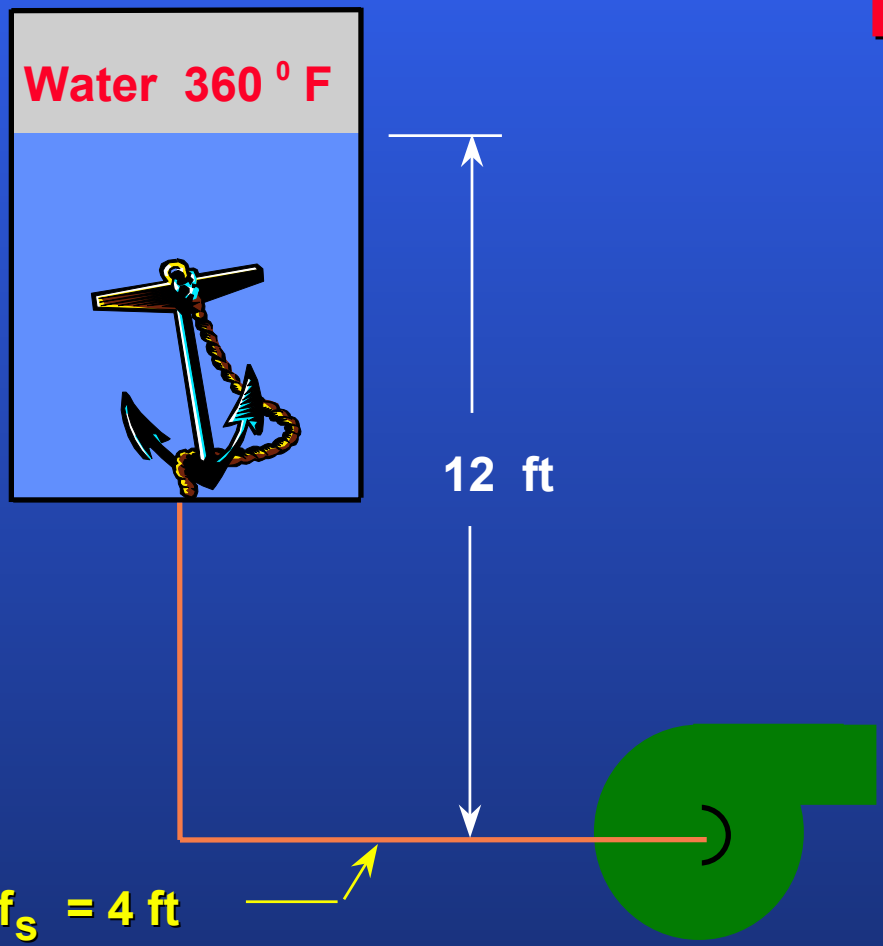
$$NPSHd = \frac{(14.7 - 14.7)\ 2.31}{.959} + 7 - 3$$

$$NPSHd = \frac{(14.7 - 14.7)\ 2.31}{.959} + 7 - 3$$

$$NPSHd = 7 - 3 = 4\ ft$$

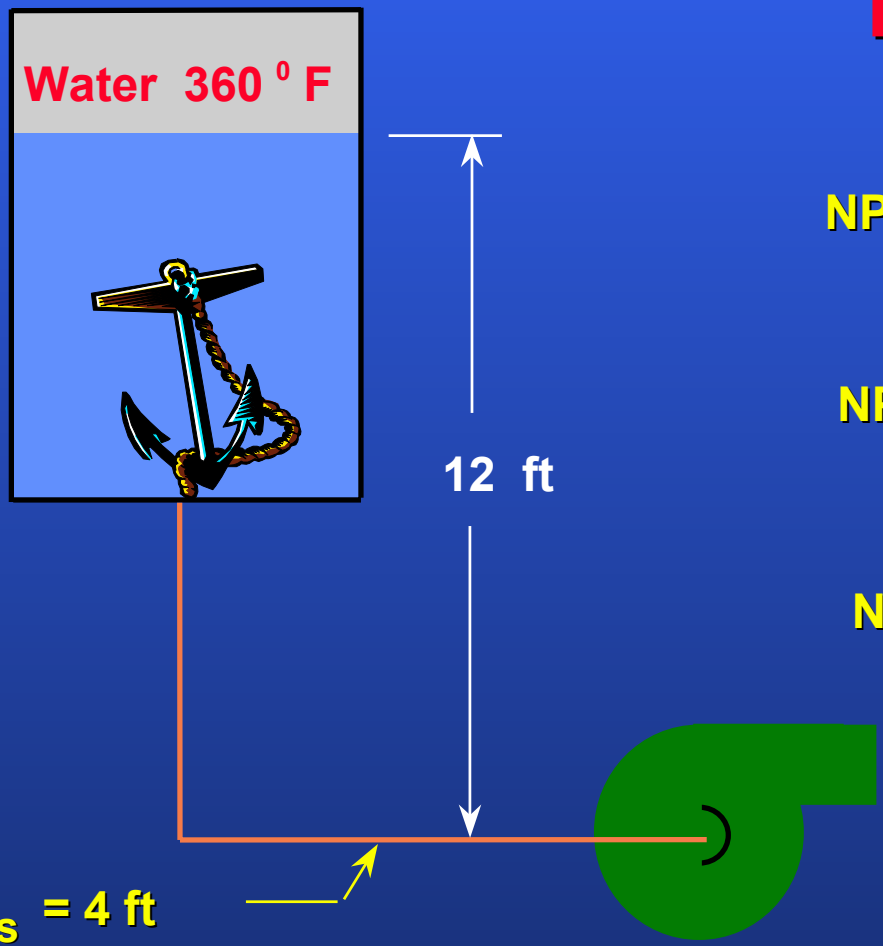
Presión de Vapor 212 °F agua = 14.7 PSIA
Gravedad Especifica 212 °F agua = 0.959

PROBLEMA NPSHd



Presion de Vapor 360 °F agua = 153.04 PSIA
Gravedad Especifica 360 °F agua = 0.886

PROBLEMA NPSHd



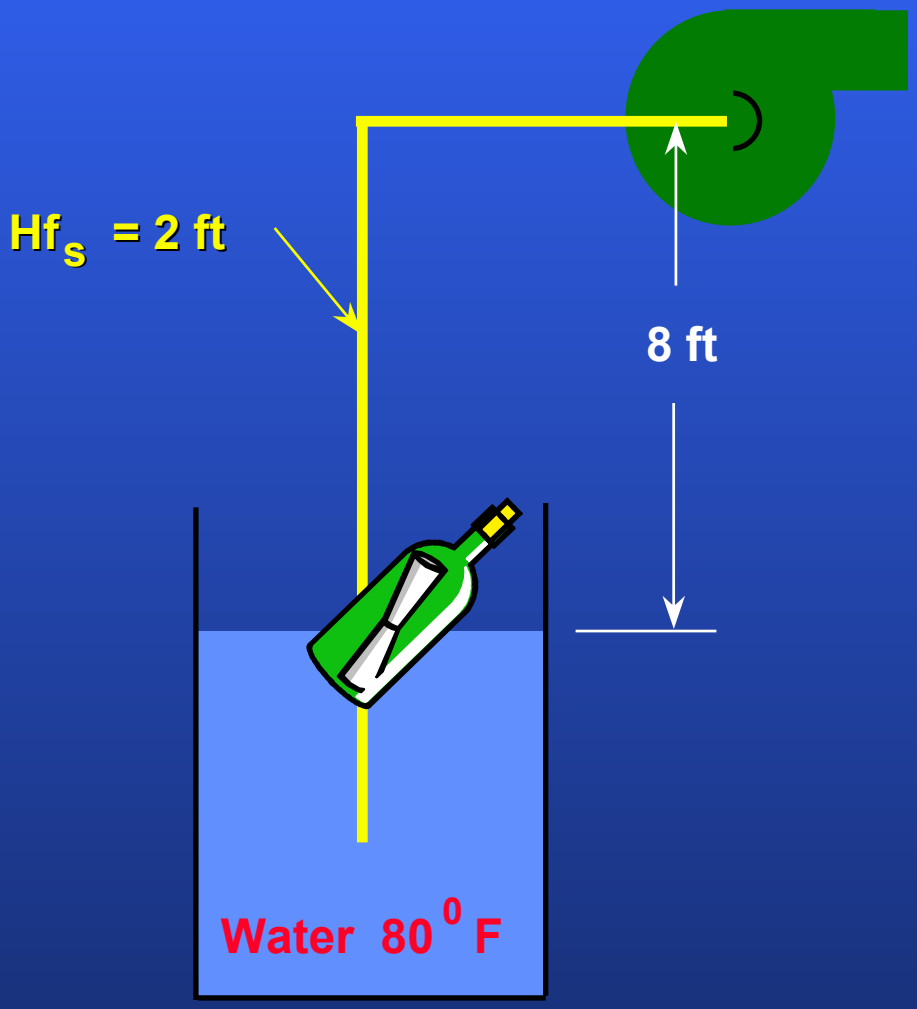
$$NPSHd = \frac{(153.04 - 153.04)\ 2.31}{.886} + 12 - 4$$

$$NPSHd = \frac{(153.04 - 153.04)\ 2.31}{.886} + 12 - 4$$

NPSHd = 12 - 4 = 8 ft

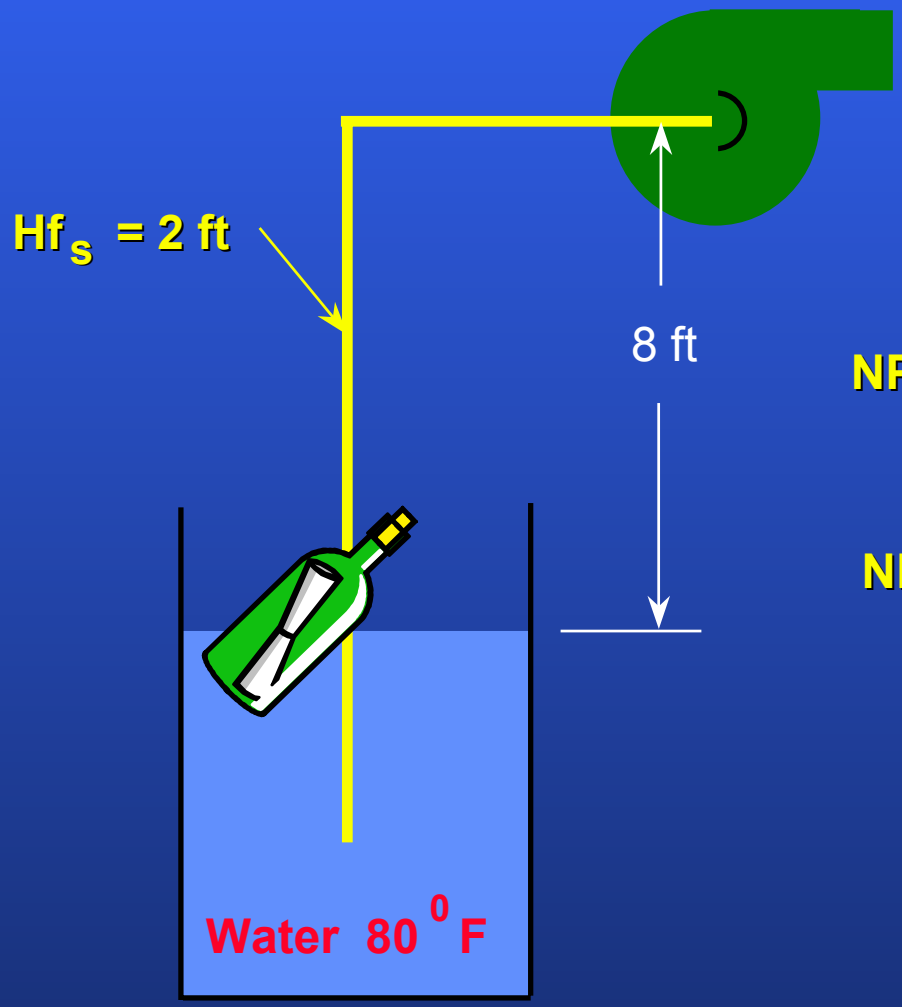
Presion de Vapor 360 °F agua = 153.04 PSIA
Gravedad Especifica 360 °F agua = 0.886

PROBLEMA NPSHd



Presión de Vapor 80 °F agua = .5069 PSIA
Gravedad Especifica 80 °F agua = 0.998

PROBLEMA NPSHd

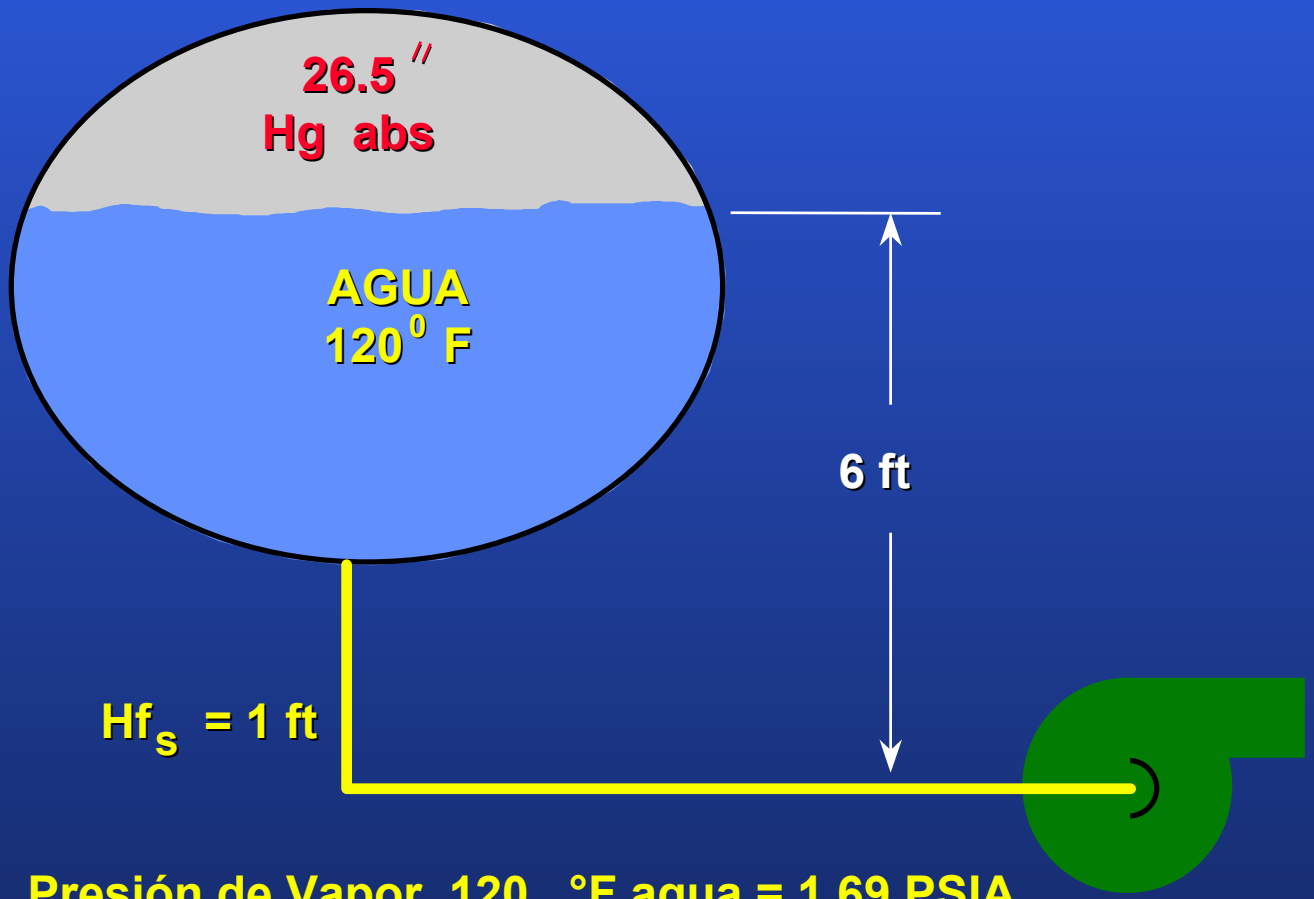


$$NPSHd = \frac{(14.7 - .5069)\ 2.31}{.998} - (8 + 2)$$

NPSHd = 32.85 - 10 = 22.85 ft

Presión de Vapor 80 °F agua = .5069 PSIA
Gravedad Especifica 80 °F agua = 0.998

PROBLEMA NPSHd

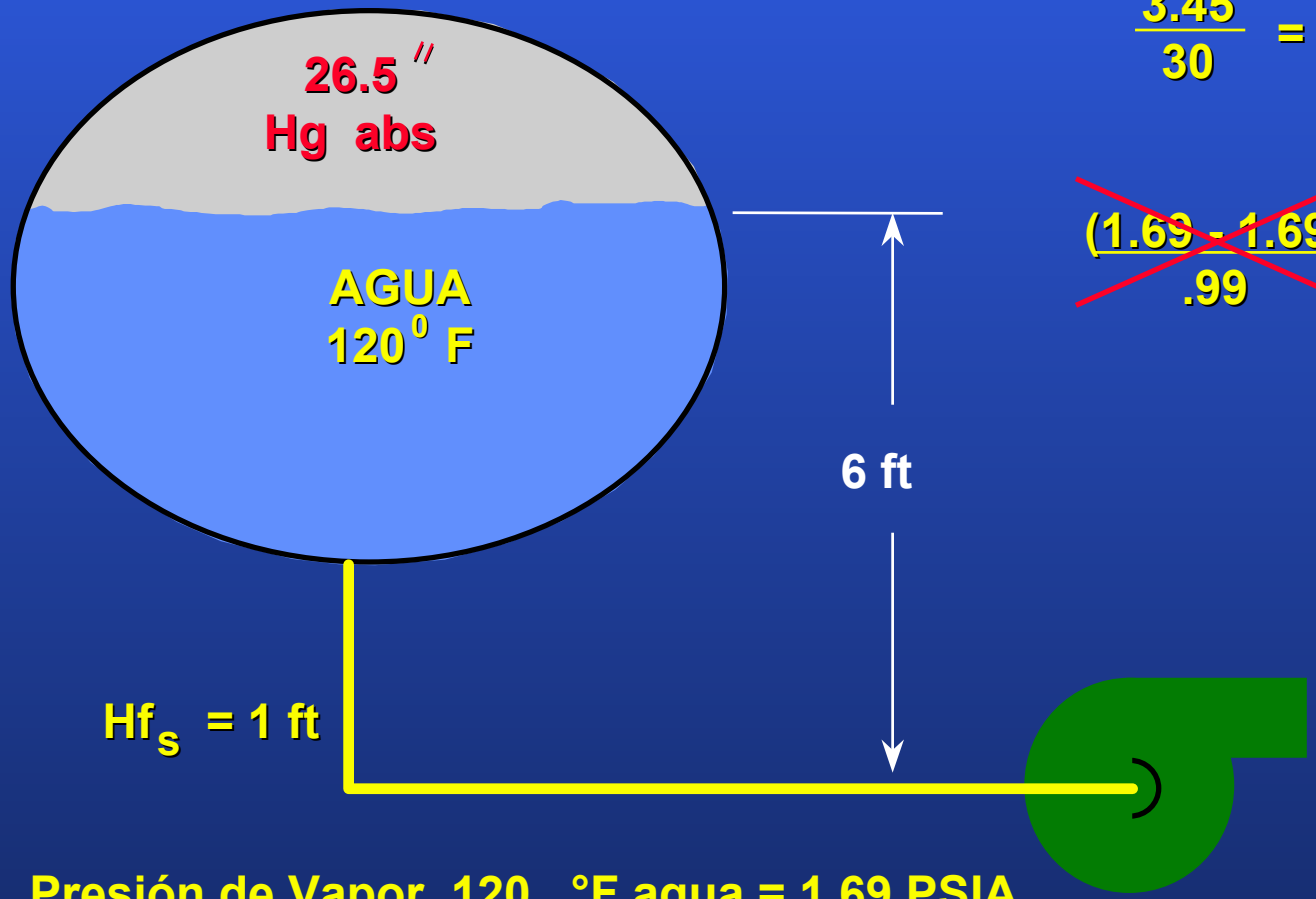


Presión de Vapor 120 °F agua = 1.69 PSIA
Gravedad Especifica 120 °F agua = 0.99

PROBLEMA NPSHd

30 - 26.5 = 3.45 Hg abs

$$\frac{3.45}{30} = \frac{X}{14.7} \qquad X = 1.69 \text{ PSIA}$$

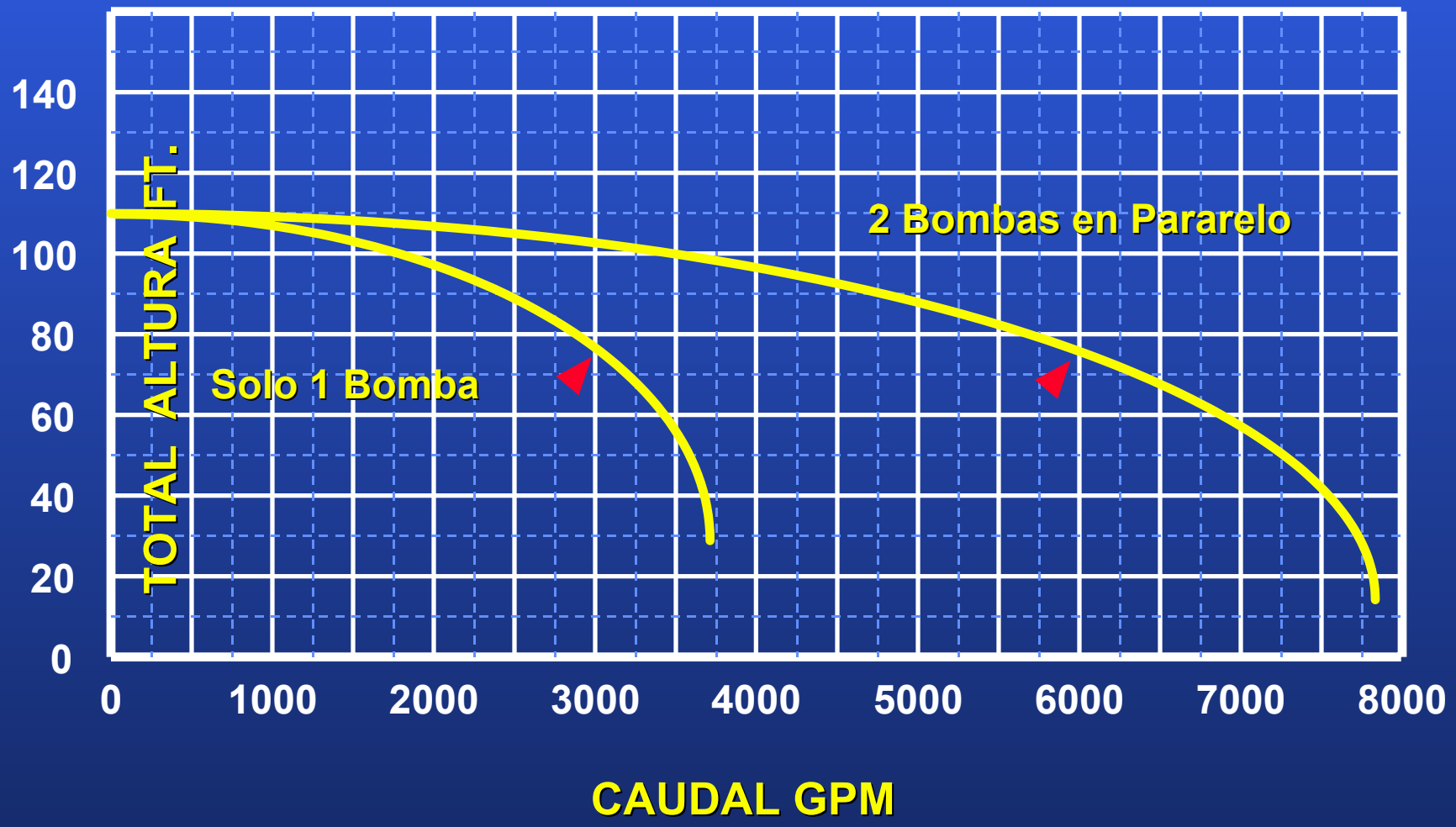


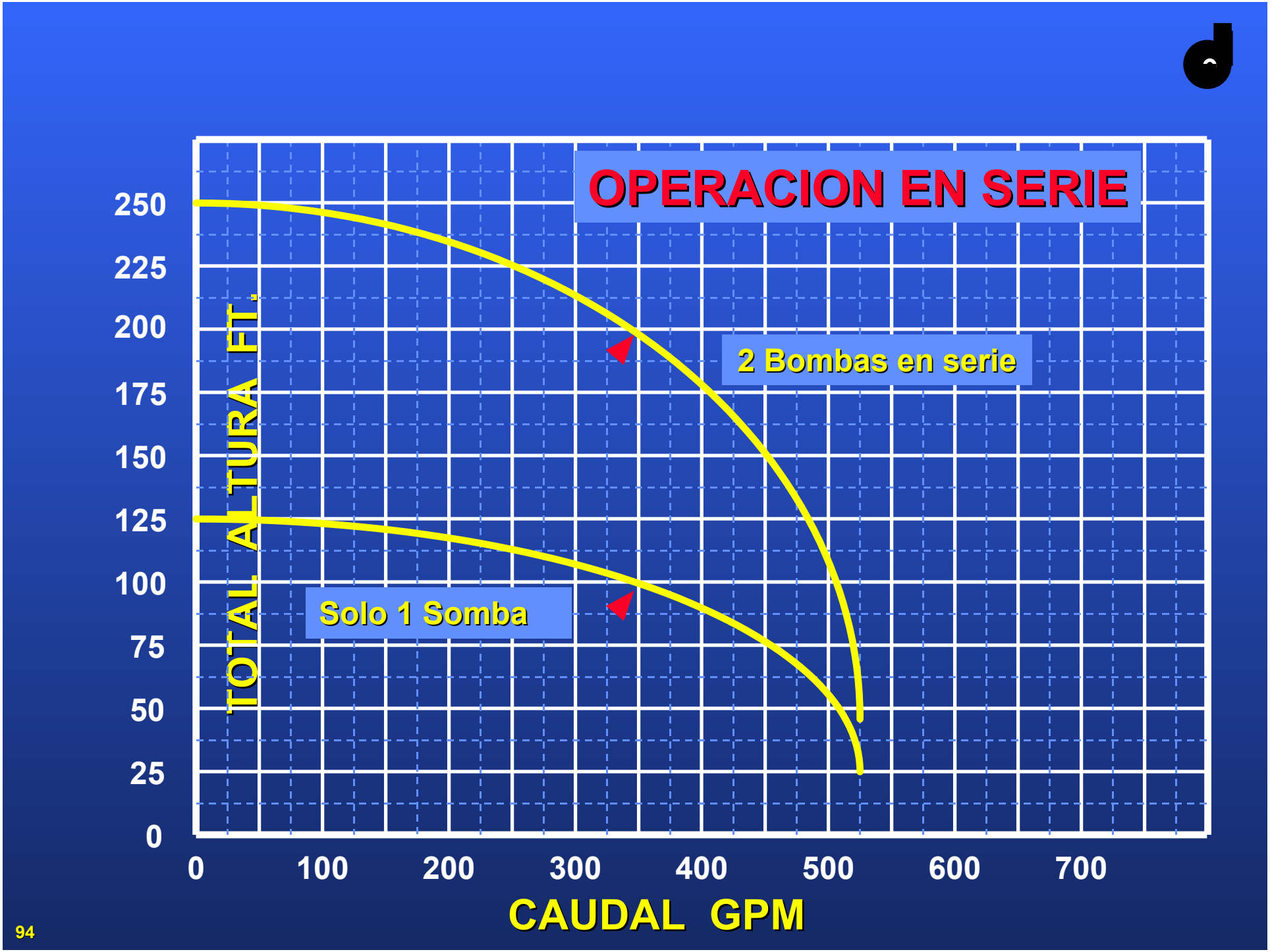
$$\frac{(1.69 - 1.69)}{.99} \quad 2.31 + 6 - 1 = 5 \text{ ft}$$

Presión de Vapor 120 °F agua = 1.69 PSIA

Gravedad Especifica 120 °F agua = 0.99

OPERACION EN PARALELO




OPERACION EN SERIE
2 Bombas en serie
Solo 1 Somba
TOTAL ALTURA FT.
250
225
200
175
150
125
100
75
50
25
0
0
100
200
300
400
500
600
700
CAUDAL GPM

CAMBIOS DE VELOCIDAD

$$\frac{RPM_1}{RPM_2} = \frac{GPM_1}{GPM_2} = \sqrt{\frac{ALTURA_1}{ALTURA_2}} = \sqrt[3]{\frac{BHP_1}{BHP_2}}$$

$$\left[\frac{RPM_1}{RPM_2}\right]^3 = \frac{BHP_1}{BHP_2}$$

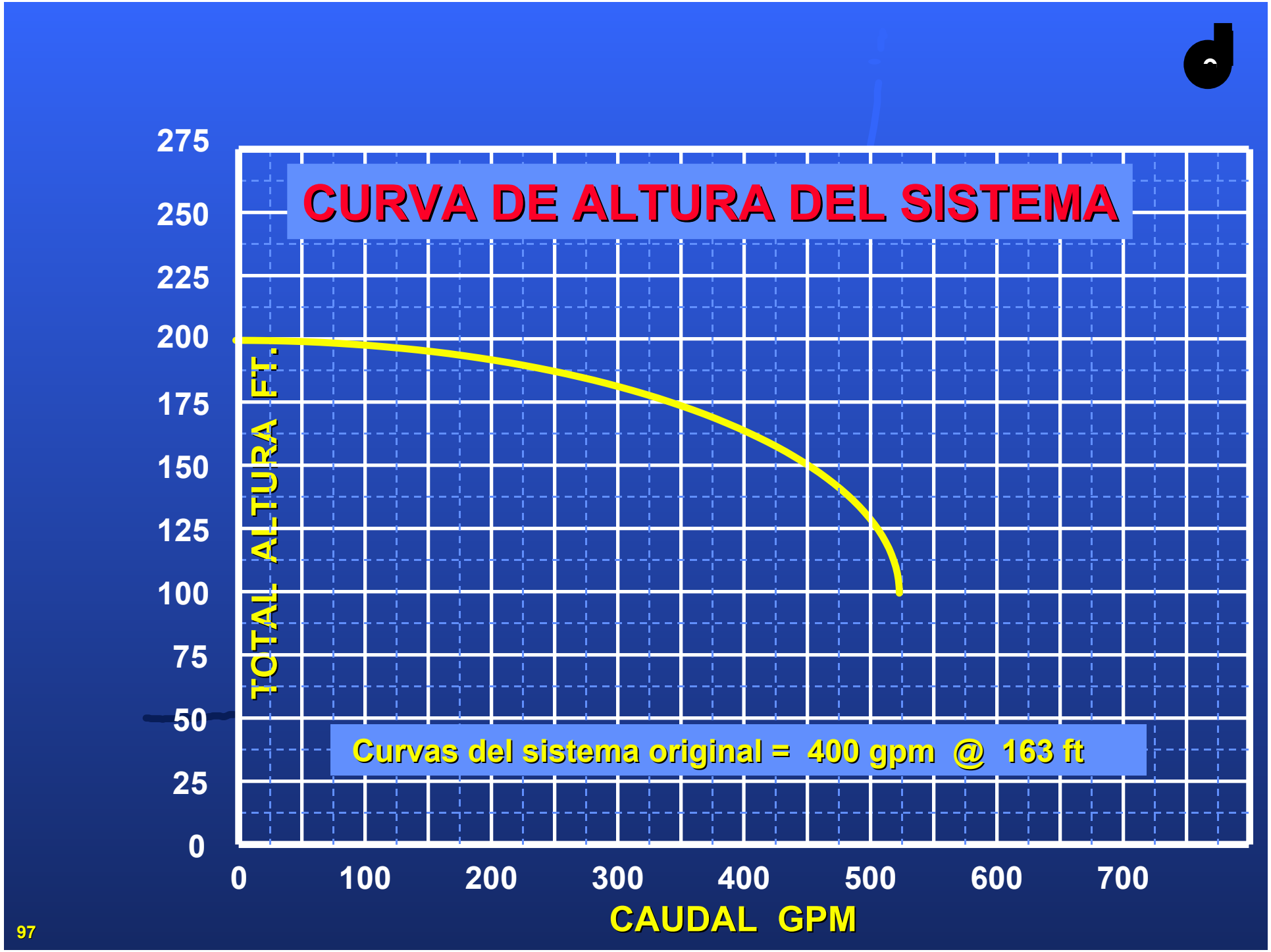
$$\left[\frac{RPM_1}{RPM_2}\right]^2 = \frac{ALTURA_1}{ALTURA_2}$$

CAMBIO DE DIAMETROS DEL IMPULSOR

$$\frac{IMP_1}{IMP_2} = \frac{GPM_1}{GPM_2} = \sqrt{\frac{ALTURA_1}{ALTURA_2}} = \sqrt[3]{\frac{BHP_1}{BHP_2}}$$

$$\left[\frac{IMP_1}{IMP_2}\right]^3 = \frac{BHP_1}{BHP_2}$$

$$\left[\frac{IMP_1}{IMP_2}\right]^2 = \frac{ALTURA_1}{ALTURA_2}$$


CURVA DE ALTURA DEL SISTEMA
TOTAL ALTURA FT.
275
250
225
200
175
150
125
100
75
50
25
0
0
100
200
300
400
500
600
700
CAUDAL GPM
Curvas del sistema original = 400 gpm @ 163 ft

CURVA DE ALTURA DEL SISTEMA APROXIMADO

Curvas del Sistema = 400 gpm @ 163 ft **Solicitar Altura Estatica = 50 ft**

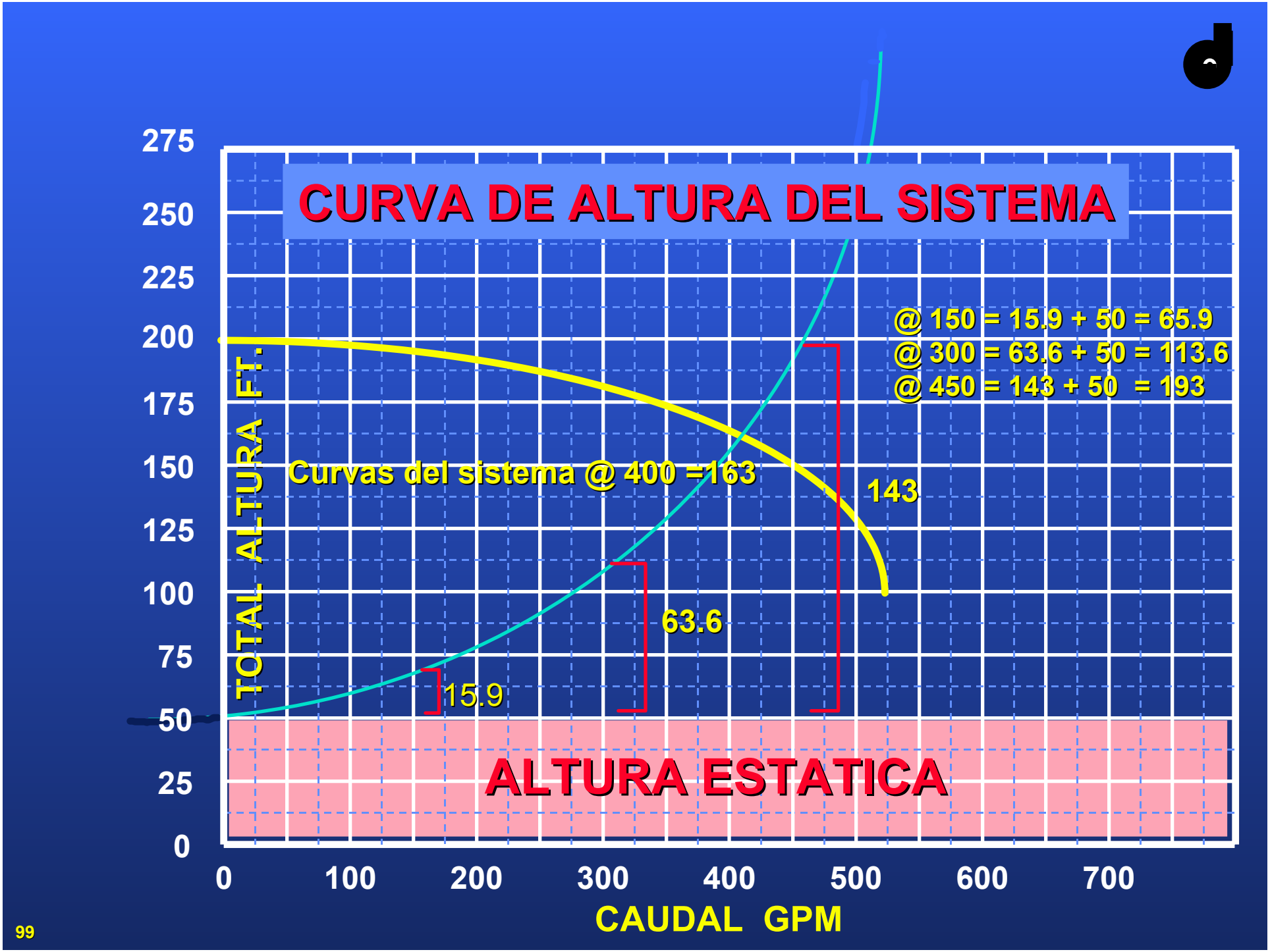
Componentes de fricción en 400 gpm is (163 ft - 50 ft) = 113

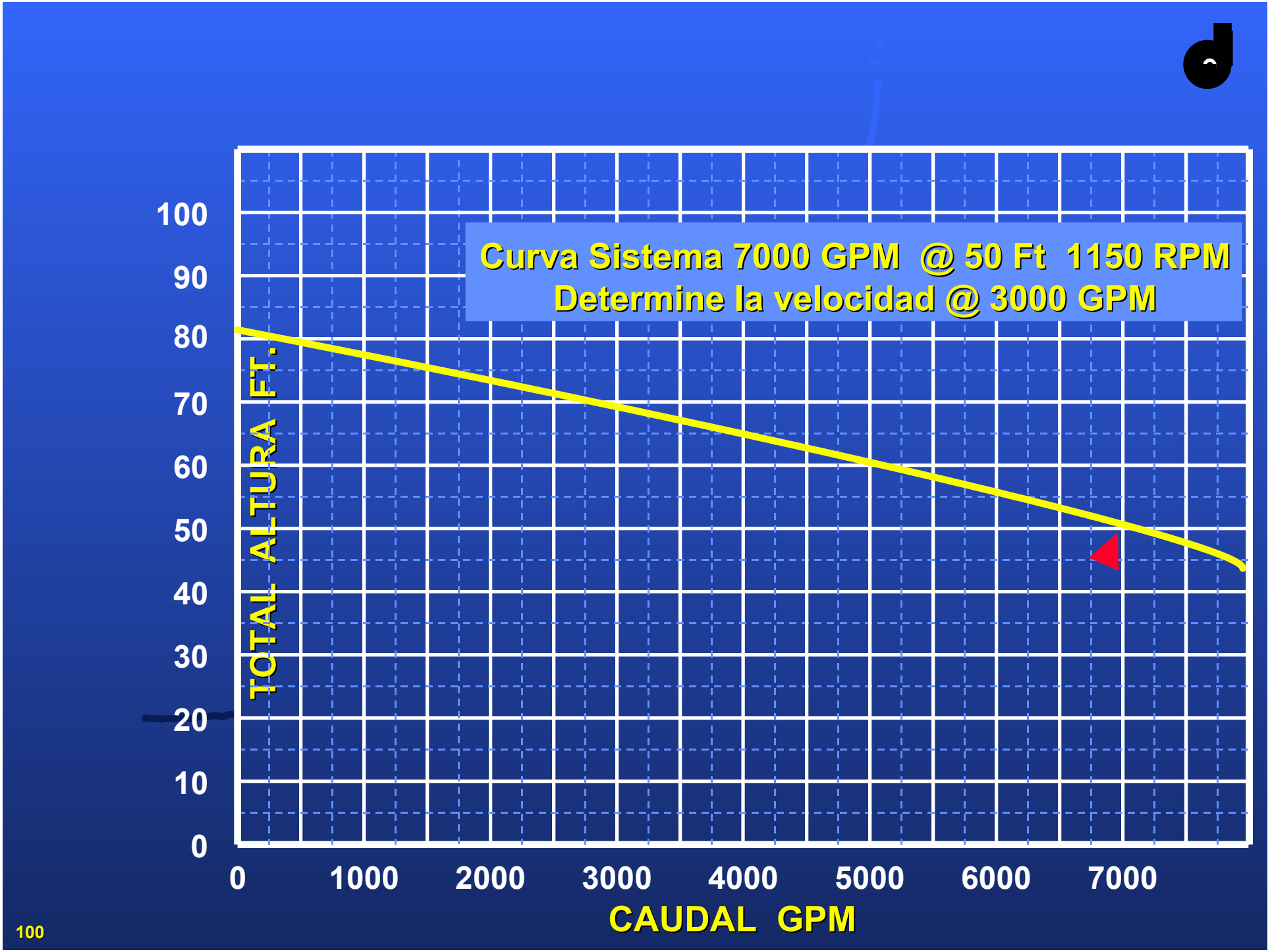
Pot leyes de afinidad se calculan componentes de fricción en otros caudales. Ejemplo:

A 150 gpm $\left(\frac{150}{400}\right)^2$ **x 113 = 15.9 ft + 50 ft Estatica = 65.9**

A 300 gpm $\left(\frac{300}{400}\right)^2$ **x 113 = 63.6 ft + 50 ft Estatica = 113.6**

A 450 gpm $\left(\frac{450}{400}\right)^2$ **x 113 = 143 ft + 50 ft Estatica = 193**


CURVA DE ALTURA DEL SISTEMA
TOTAL ALTURA FT.
275
250
225
200
175
150
125
100
75
50
25
0
0
100
200
300
400
500
600
700
CAUDAL GPM
@ 150 = 15.9 + 50 = 65.9
@ 300 = 63.6 + 50 = 113.6
@ 450 = 143 + 50 = 193
Curvas del sistema @ 400 =163
143
63.6
15.9
ALTURA ESTATICA


Curva Sistema 7000 GPM @ 50 Ft 1150 RPM
Determine la velocidad @ 3000 GPM
TOTAL ALTURA FT.
100
90
80
70
60
50
40
30
20
10
0
0
1000
2000
3000
4000
5000
6000
7000
CAUDAL GPM

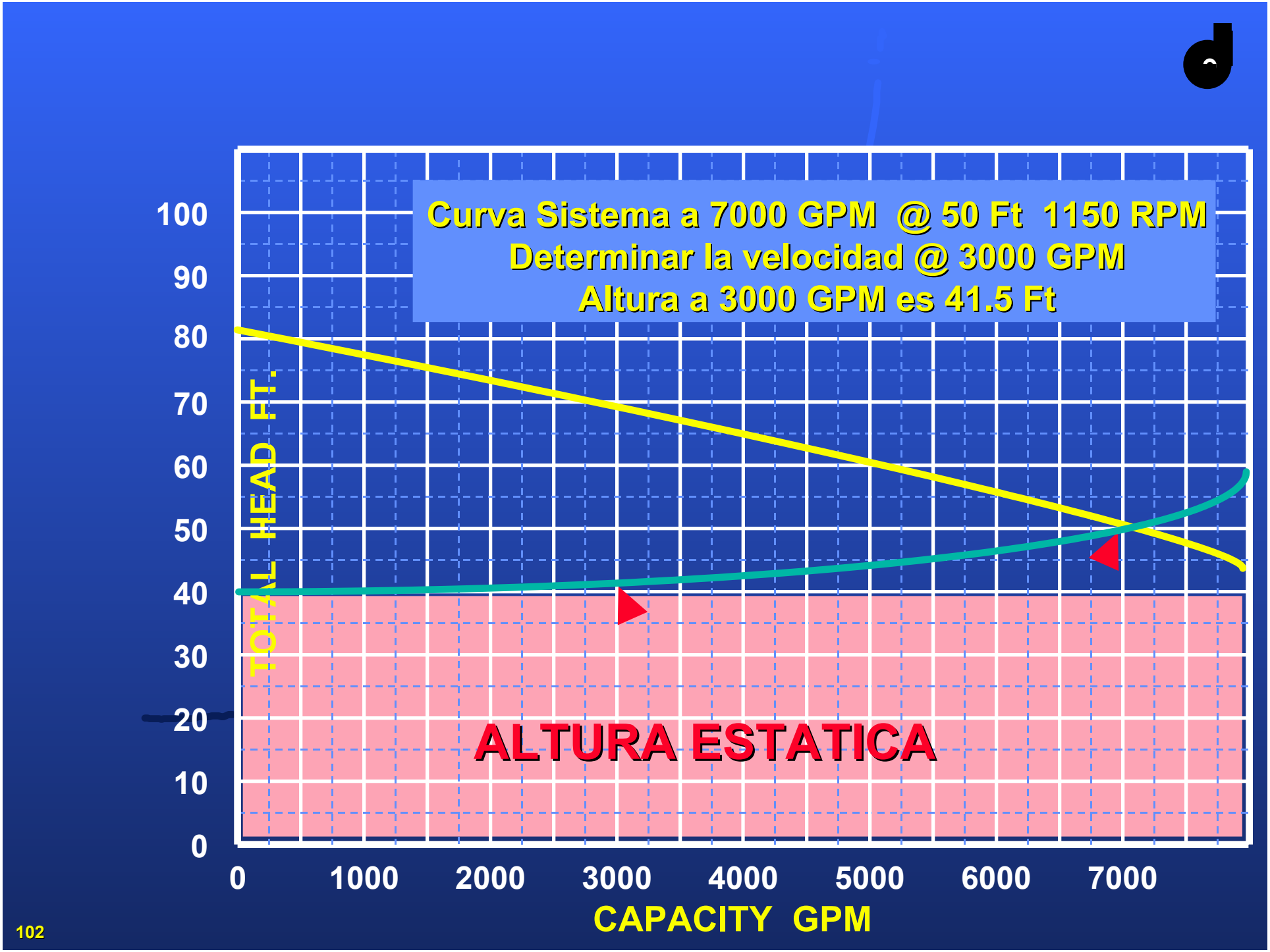
Curva del Sistema = 7000 GPM @ 50 Ft Altura 1150 RPM
Segun cliente altura estatica = 40 Ft

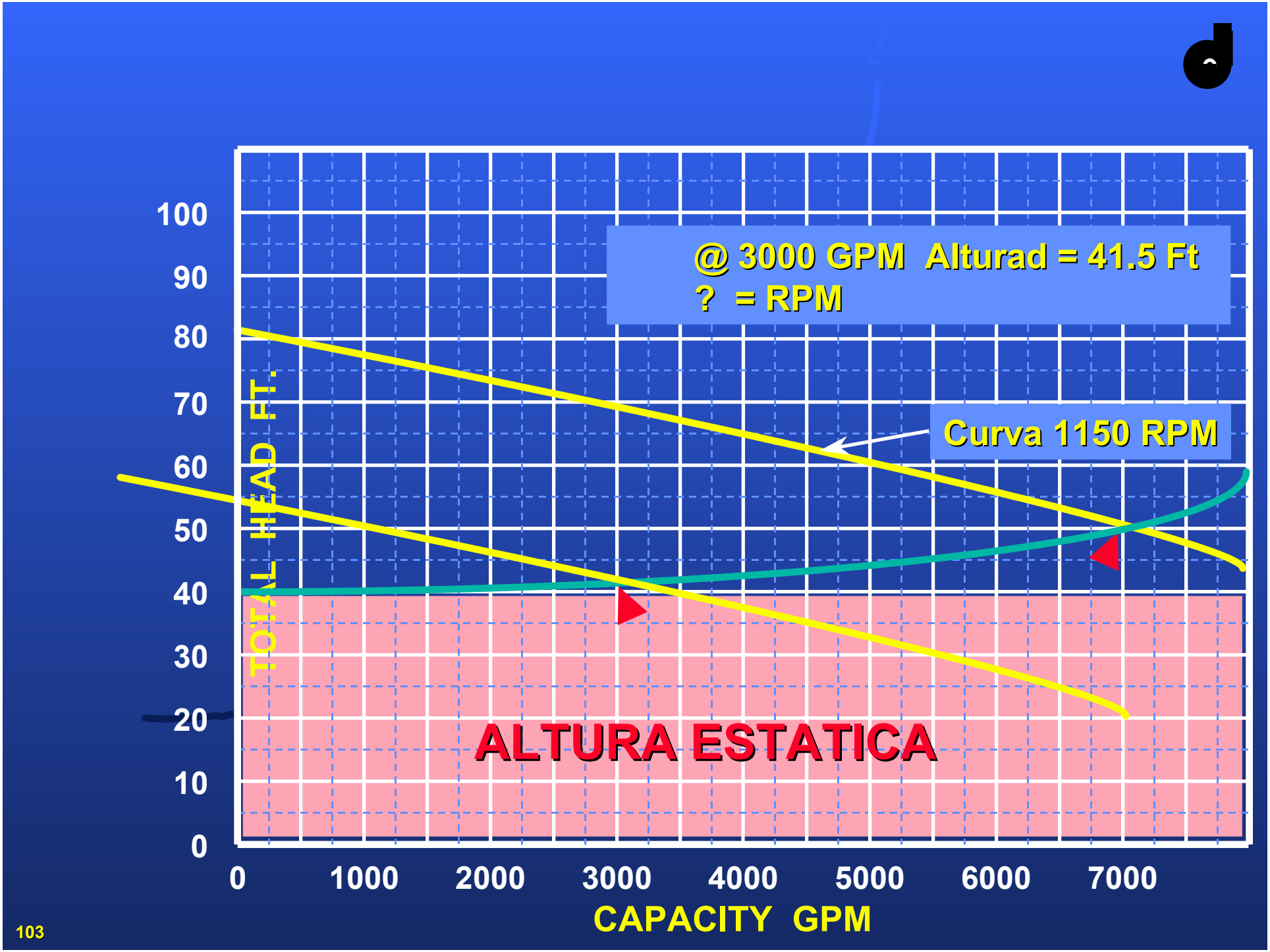
Componentes de fricción a 7000 GPM es (50 - 40) o 10 Ft

A 2000 gpm $\left(\frac{2000}{7000}\right)^2 x\ 10 = 0.8$ ft + 40 ft Estatica = 40.8

A 5000 gpm $\left(\frac{5000}{7000}\right)^2 x\ 10 = 5$ ft + 40 ft Estatica = 45

A 8500 gpm $\left(\frac{8500}{7000}\right)^2 x\ 10 = 14.7$ ft + 40 ft Estatica = 54.7


Curva Sistema a 7000 GPM @ 50 Ft 1150 RPM
Determinar la velocidad @ 3000 GPM
Altura a 3000 GPM es 41.5 Ft
TOTAL HEAD FT.
100
90
80
70
60
50
40
30
20
10
0
ALTURA ESTATICA
0
1000
2000
3000
4000
5000
6000
7000
CAPACITY GPM


@ 3000 GPM Alturad = 41.5 Ft
? = RPM
Curva 1150 RPM
ALTURA ESTATICA
TOTAL HEAD FT.
100
90
80
70
60
50
40
30
20
10
0
0
1000
2000
3000
4000
5000
6000
7000
CAPACITY GPM

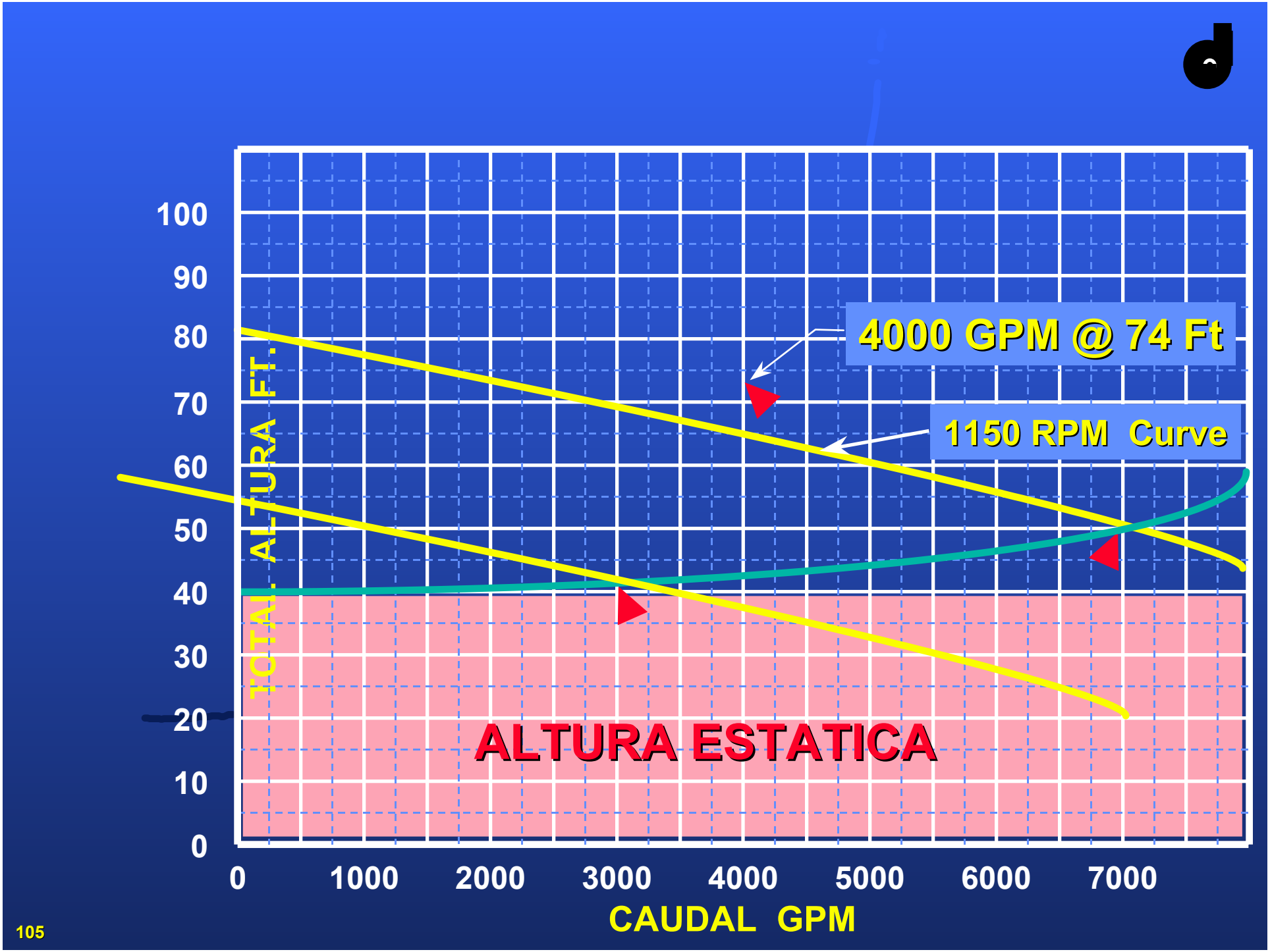
Como determinamos esta velocidad?

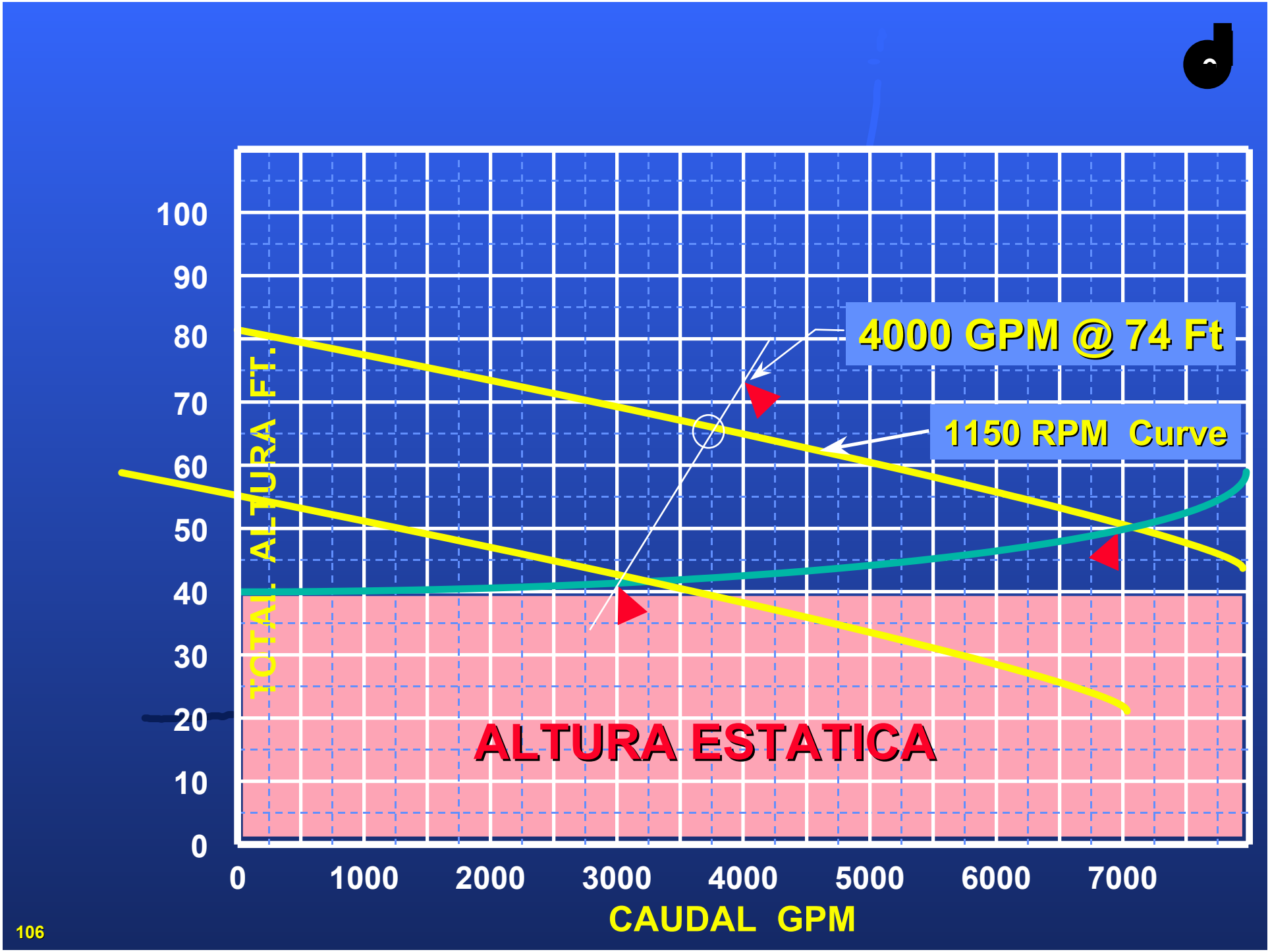
Primero asumimos que el punto en 3000 GPM y 41.5 Ft se trasladara a un punto de mayor capacidad y altura.

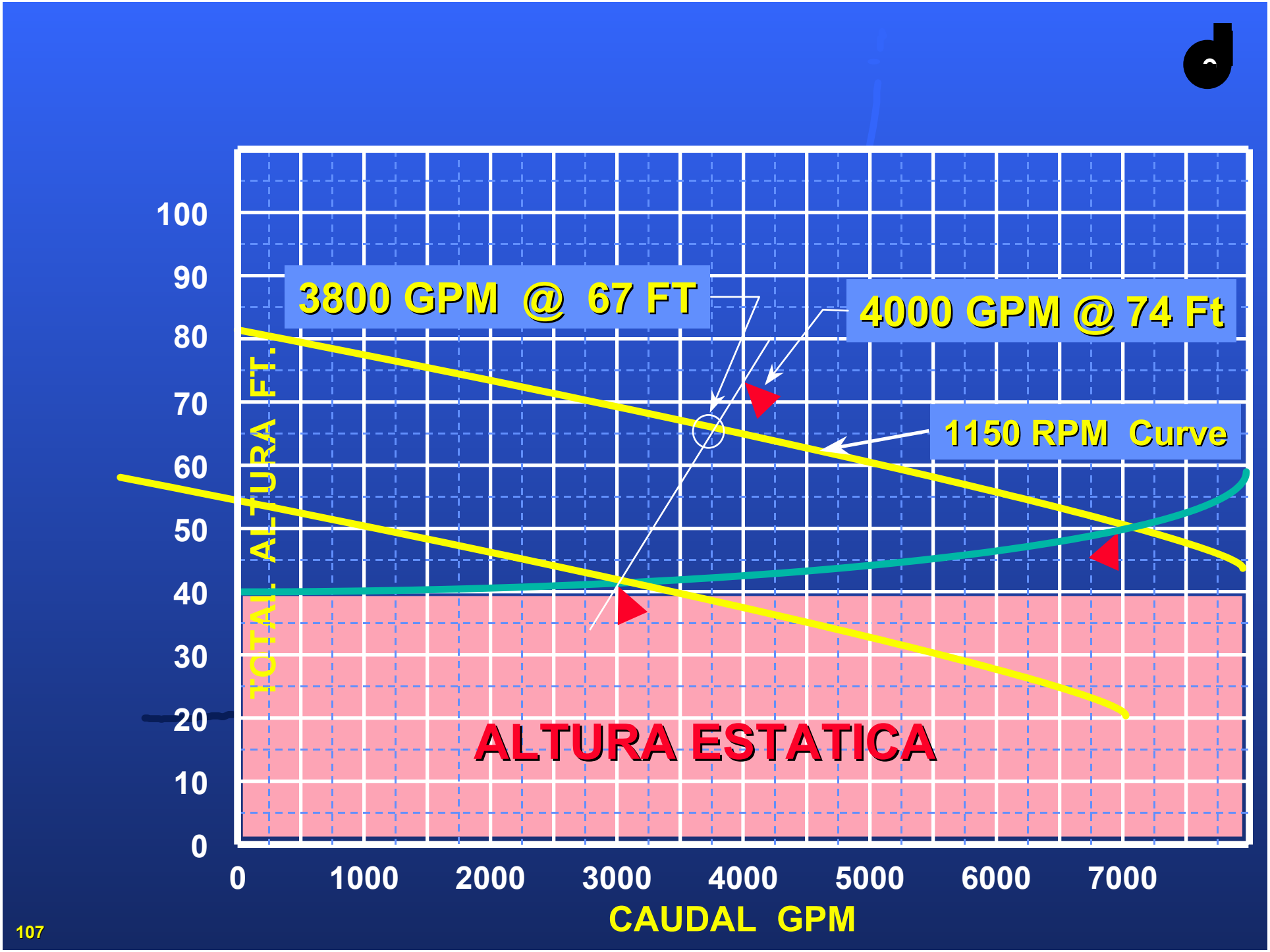
Podemos usar un caudal mayor que 3000 GPM, 3750, 4000, o 4250. Usaremos 4000 GPM.

Ahora aplicamos las leyes de afinidad para determinar la nueva altura a 4000 GPM.

$$\left(\frac{4000}{3000}\right)^2 \times 41.5 = 74 \text{ Ft}$$


100
90
80
70
60
50
40
30
20
10
0
TOTAL ALTURA FT.
4000 GPM @ 74 Ft
1150 RPM Curve
ALTURA ESTATICA
0
1000
2000
3000
4000
5000
6000
7000
CAUDAL GPM


100
90
80
70
60
50
40
30
20
10
0
TOTAL ALTURA FT.
4000 GPM @ 74 Ft
1150 RPM Curve
ALTURA ESTATICA
0
1000
2000
3000
4000
5000
6000
7000
CAUDAL GPM


3800 GPM @ 67 FT
4000 GPM @ 74 Ft
1150 RPM Curve
TOTAL ALTURA FT.
ALTURA ESTATICA
100
90
80
70
60
50
40
30
20
10
0
0
1000
2000
3000
4000
5000
6000
7000
CAUDAL GPM

Este es el punto, 3800 GPM @ 67 Ft, el cual trasladado se convierte en 3000 GPM @ 41.5 Ft low
En la medida que la velocidad es reducida

Ahora aplicamos las leyes de afinidad para determinar la velocidad inferior

$$\frac{3000}{3800} \times 1150 = 908 \text{ RPM}$$

Como chequeo:

$$\frac{\sqrt{41.5}}{\sqrt{67}} \times 1150 = 905 \text{ RPM}$$

Este procedimiento jamas resultara en la velocidad exacta porque es una aproximación. Sin embargo la velocidad calculada usando caudal y altura sera similar (3 RPM en este caso) o se abra incurrido en un error.

HIDRAULICA BASICA