

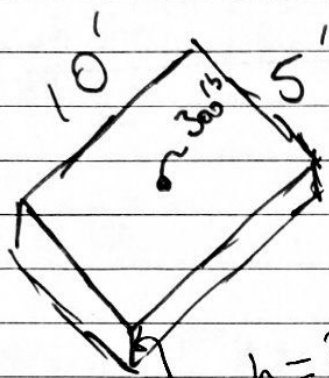


Date 8/17/2026 M T W T F S S

Problem of the Day 211!

How Deep is the raft set in the water? AKA The raft's Draft.

The raft is 300lbs + is 5' by 10'



$h = ? = \text{Draft of the raft}$

$$\gamma_w = 62.4 \text{ lb/ft}^3$$

$$A = 50 \text{ ft}^2$$

Force = 300 lbs

$$300 \text{ lb} / 50 \text{ ft}^2 = 6 \text{ lb/ft}^2$$

$$6 \text{ lb/ft}^2 / 62.4 \text{ lb/ft}^3 = 0.09 \text{ ft} = \boxed{1.15''}$$

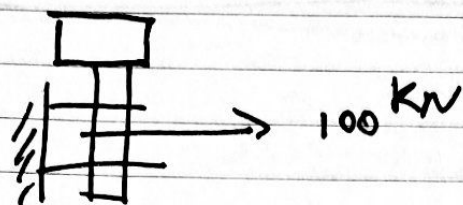
$$\frac{\text{lb}}{\text{ft}^2} \frac{\text{ft}^3}{\text{lb}} = \text{ft}$$



Date 8/18/2026 M T W T F S S

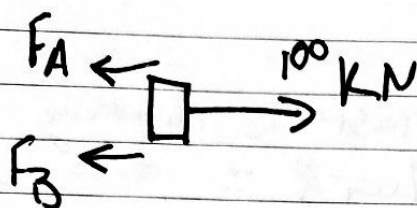
Problem of the Day 212!

Find the minimum Dia of the pin when $\tau_f = 50 \text{ mpa}$



FBD

$$F_A = F_B$$



$$100 = 2F_A \quad F_A = 50 \text{ kN}$$

$$\tau = \frac{P}{A}$$

$$\tau_f = 50,000,000 \text{ pa}$$

$$F_A = 50,000$$

$$A = \pi r^2 = ?$$

$$50,000,000 = \frac{50,000}{A} \rightarrow A = \frac{50,000}{50,000,000} = 0.001 \text{ m}^2$$

$$0.001 = \pi r^2$$

$$\sqrt{\frac{0.001}{\pi}} = r = 0.0178 \text{ m}$$

$$D = 2r = 0.0356 \text{ m} = \boxed{35.6 \text{ mm}}$$



Date 8/19/2026

M T W T F S S

Problem of the Day 213!

If a raft is 6 inches in the water + weighs 700 lbs what is its area?

$$\gamma_w = 62.4 \text{ lb/ft}^3$$

$$A = ?$$

$$\text{Depth} = 0.5 \text{ ft}$$

$$P = 700 \text{ lbs}$$

$$\gamma_{\text{raft}} = \gamma_{\text{water}} \quad (\text{since the raft is displacing the water!})$$

$$62.4 \frac{\text{lb}}{\text{ft}^3} = \frac{700 \text{ lbs}}{(0.5 \text{ ft} \cdot A)}$$

$$A = \text{Area}$$

$$62.4 = \frac{700}{0.5 \cdot A}$$

$$0.5A = \frac{700}{62.4}$$

$$0.5A = 11.2$$

$$A = 22.43 \text{ ft}^2$$



Date 8/20/2026 M T W T F S S

Problem of the Day 214!

Vector $\vec{a} \cdot \vec{b}$?Where $\vec{a} = 2i - 3j$ + $\vec{b} = 4i + 2j$

$$\vec{a} = 2i - 3j$$

$$\vec{b} = 4i + 2j$$

$$a \cdot b = 2 \cdot 4 + (-3 \cdot 2)$$

$$a \cdot b = 8 - 6$$

$$a \cdot b = 2$$



Date 8/21/2026

M T W T F S S

Problem of the Day 215!

Find the angle of the 2 vectors
using the Dot product!

$$\vec{a} = 1\vec{i} + 2\vec{j}$$

$$\vec{b} = 3\vec{i} - 1\vec{j}$$

$$\cos(\theta) = \frac{a \cdot b}{|a| \cdot |b|}$$

$$a \cdot b = 1 \cdot 3 + 2 \cdot -1$$

$$a \cdot b = 3 - 2 = 1$$

$$|a| = \sqrt{1^2 + 2^2} = 2.23$$

$$|b| = \sqrt{3^2 + (-1)^2} = 3.16$$

$$\cos(\theta) = \frac{1}{2.23 \cdot 3.16}$$

$$\cos(\theta) = \frac{1}{7.0418} = 0.1418$$

$$\theta = \cos^{-1}(0.1418)$$

$$\theta = 81.85^\circ$$



Date 8/22/2026 M T W T F S S

problem of the Day 2/6!

$$\frac{1}{2x+3} + \frac{1+x}{4x-1} \quad \text{solve!}$$

$$\frac{1}{2x+3} \cdot \frac{(4x-1)}{(4x-1)} + \frac{1+x}{4x-1} \cdot \frac{(2x+3)}{(2x+3)}$$

$$(2x+3)(4x-1) \rightarrow 8x^2 - 2x + 12x - 3$$
$$8x^2 + 10x - 3$$

$$(4x-1)$$

$$(1+x)(2x+3) \rightarrow 2x + 3 + 2x^2 + 3x$$
$$2x^2 + 5x + 3$$

$$\frac{(4x-1) + (2x^2 + 5x + 3)}{8x^2 + 10x - 3} \rightarrow \frac{2x^2 + 9x + 2}{8x^2 + 10x - 3}$$

$$\boxed{\begin{array}{r} 2x^2 + 9x + 2 \\ \hline 8x^2 + 10x - 3 \end{array}}$$



Date 8/23/2026

M T W T F S S

Problem of the Day 217!

$$f(x) = \sin(4x - 2x^2)$$

Take the Derivative!

$$f'(x) = \cos(4x - 2x^2)(4 - 4x)$$

$$f'(x) = (4 - 4x) \cos(4x - 2x^2)$$



Date 8/24/2026 M T W T F S S

problem of the Day 218!

$$f(x) = \sin(\ln(4x))$$

take the Derivative!

$$f'(x) = \cos(\ln 4x) \cdot \frac{1}{4x} \cdot 4$$

$$f'(x) = \cos(\ln 4x) \cdot \frac{1}{x}$$

$$f'(x) = \frac{\cos(\ln 4x)}{x}$$



Date 8/25/2026 M T W T F S S

Problem of the Day 219!

$$\frac{\sin^2 x + \cos^2 x}{\tan x} = ?$$

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

$$\frac{1}{\tan x} = \boxed{\cot(x)}$$



Date 8/26/2026 M T W T F S S

Problem of the Day 220!

$$\frac{\sin(x) \cos(x)}{\cot(x)} = ?$$

$$\frac{\sin(x) \cos(x)}{\cot(x)} = \frac{\sin(x) \cos(x)}{\frac{1}{\tan(x)}} = \sin(x) \cos(x) \tan(x)$$

$$\sin(x) \cancel{\cos(x)} \cdot \frac{\sin(x)}{\cancel{\cos(x)}} \rightarrow \boxed{\sin^2(x)}$$



Date 8/27/2026 M T W T F S S

Problem of the Day 221!

$$2x + \sin^2(x) + \tan^2(x) = ?$$

$$2x + \sin^2(x) + \frac{\sin^2(x)}{\cos^2(x)}$$

Find a common Denominator!

$$\frac{2x \cos^2(x)}{\cos^2(x)} + \frac{\sin^2(x) \cos^2(x)}{\cos^2(x)} + \frac{\sin^2(x)}{\cos^2(x)}$$

$$\frac{2x \cos^2(x) + \sin^2(x) \cos^2(x) + \sin^2(x)}{\cos^2(x)}$$



Date 8/28/2026 M T W T F S S

Problem of the Day 222!

$$\frac{\cos x - \cot x}{\sec x + \sin x} = ?$$

$$\frac{\cos(x) - \frac{\cos(x)}{\sin(x)}}{\frac{1}{\cos(x)} + \sin(x)} \quad \text{Find a common Denominator!}$$

$$\frac{\frac{\sin(x)\cos(x) - \cos(x)}{\sin(x)}}{\frac{1 + \cos(x)\sin(x)}{\cos(x)}}$$

$$\frac{\sin(x)\cos(x) - \cos(x)}{\sin(x)} \cdot \frac{\cos(x)}{1 + \cos(x)\sin(x)}$$

$$\frac{\sin(x)\cos^2(x) - \cos^2(x)}{\sin(x) + \cos(x)\sin^2(x)} \rightarrow \frac{\sin(x)\cos^2(x) - \cos^2(x)}{\sin(x) + \sin^2(x)\cos(x)}$$



Date 8/27/2026

M T W T F S S

Problem of the Day

223!

$$\frac{\cot(x)}{\tan(x)} = ?$$

$$\frac{\frac{\cos(x)}{\sin(x)}}{\frac{\sin(x)}{\cos(x)}} \rightarrow \frac{\cos(x)}{\sin(x)} \cdot \frac{\cos(x)}{\sin(x)} \rightarrow \frac{\cos^2(x)}{\sin^2(x)}$$

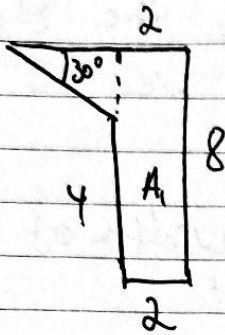
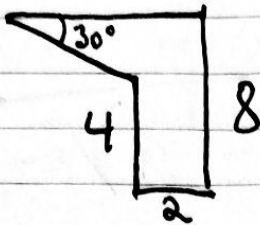
~~7.6~~ $\boxed{= \cot^2(x)}$



Date 8/30/2026 M T W T F S S

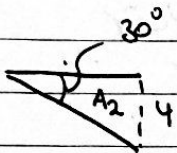
Problem of the Day 224!

Find the area of the shape!



$$A_1 = 2 \cdot 8 = 16 \text{ units}^2$$

Soh cah toe



$$\cos(30^\circ) = \frac{a}{h} \quad \text{nope}$$

$$\tan(30^\circ) = \frac{4}{a}$$

$$\frac{4}{\tan(30^\circ)} = a = 6.93$$

$$A_2 = (6.93 \cdot 4) \cdot 0.5 = 13.86 \text{ units}^2$$

$$A_1 + A_2 = 29.86 \text{ units}^2$$



Date 8/31/2026 M T W T F S S

Problem of the Day 225!

Weir formula!

A general equation!

$$Q = C \cdot L \cdot H^m$$

Q = Discharge rate (flow rate) ft^3/s or m^3/s
flow volume

C = Discharge coefficient (varies by the shape of the weir & material the weir is made of)

L = The length of the crest (width of the weir) this is in ft or m !

m = Exponent based on the weir
usually 1.5 if rectangular



Date 7/01/2026 M T W T F S S

Problem of the Day 226!
Take the Derivative!

$$f(x) = \sin(x) + \ln(7x + \sin(x))$$

$$f'(x) = \cos(x) + \frac{1}{7x + \sin(x)} (7 + \cos(x))$$

$$f'(x) = \cos(x) + \frac{7 + \cos(x)}{7x + \sin(x)}$$



Date 9/02/2026 M T W T F S S

Problem of the Day 227!

$$\frac{\cos^2(x) + \sin^2(x)}{\sin(x)}$$

$$\sin(x)$$

$$\frac{1}{\sin(x)} = \boxed{\csc(x)}$$



Date 9/03/2026 M T W T F S S

Problem of the Day 228!

What is Hooke's Law?

Statement 1: Hooke's Law was Discovered by Robert Hooke in 1660.

Statement 2: What he discovered is that if an object is not stretched or compressed passed its elastic limit, the resulting stretch + compression will scale perfectly with the force applied. Then if this force is released then the object will snap back in place.

* This would be the linear elastic region of the stress strain diagram.

* Why is this important?

- This linear elastic region helps Engineers predict how materials behave + we can value this behavior with The Modulus of Elasticity.
or young's modulus

Modulus of Elasticity: IS a ratio of stress + strain in the linear elastic region (It is constant)

* Simple note (it is the slope of the stress strain Diagram)

* Additional Note: It basically allows you to value the materials stiffness + it is easy to deform the material.

$$\sigma = E \epsilon$$

σ = stress
 E = modulus of elasticity
 ϵ = strain



Date 9/04/2026 M T W T F S S

Problem of the Day 229!

Hooke's Law part 2!

$$E = \frac{\sigma}{\epsilon}$$

 E = modulus of Elasticity σ = stress (force over area) ϵ = change in shape
or Displacement.

$$\sigma = \frac{F}{A}$$

 F = force
 A = Area

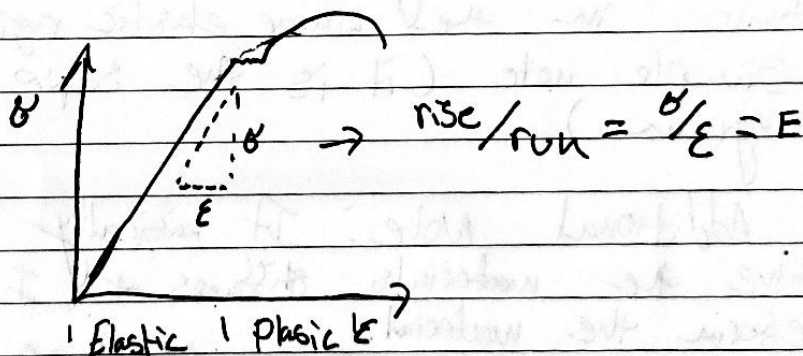
$$\epsilon = \frac{\Delta L}{L_0}$$

 ΔL = total length
 L_0 = original length

$$E = \frac{\frac{F}{A}}{\frac{\Delta L}{L_0}} \rightarrow \frac{F}{A} \frac{L_0}{\Delta L} = \boxed{\frac{F \cdot L_0}{A \cdot \Delta L}}$$

Fully Broken Down
Formula!

$$E = \frac{F \cdot L_0}{A \cdot \Delta L}$$





Date 9/05/2026 M T W T F S S

Problem of the Day 230!

Average ~~shear strain~~ Normal strain
caused by Temperature change.

$$\epsilon_T = \alpha \Delta T$$

ϵ_T = Average Normal strain caused by Temperature change

α = Coefficient of Thermal Expansion

$$\Delta T = T_{\text{Final}} - T_{\text{Initial}} \quad (\text{Temp})$$

* How to Find Deformation

$$\delta_T = \alpha \Delta T L$$

δ_T = Deformation Due to temp change

L = Length of Object

EX) $\alpha_{\text{steel}} = 6.5 \times 10^{-6} / ^\circ\text{F}$ $\Delta T = ?$

T_1 was 75°F in the morning & then it got to T_2 of 107°F in the afternoon.
The girder is 120 Feet long what is the Deformation?

$$\delta_T = \alpha_{\text{steel}} \Delta T L = 6.5 \times 10^{-6} / ^\circ\text{F} \cdot (107 - 75) \cdot 120'$$

$$\delta_T = 0.024' = \underline{0.29 \text{ inches}} \rightarrow \underline{0.3''}$$



Date 9/06/2026

M T W T F S S

Problem of the Day 231!

Take the Derivative!

$$f(x) = 7x^4 + e^x$$

$$f'(x) = 28x^3 + e^x$$



$$7 \cdot 4 x^{4-1}$$



Date 9/07/2026 M T W T F S S

Problem of the Day 232!

Take the Derivative!

$$f(x) = \ln(4x^4 + \sin(e^x))$$

$$f'(x) = \frac{1}{(4x^4 + \sin(e^x))} \cdot (16x^3 + \cos(e^x)) e^x$$

$$f'(x) = \frac{e^x(16x^3 + \cos(e^x))}{(4x^4 + \sin(e^x))}$$



Date 9/08/2026 M T W T F S S

Problem of the Day 233!

Take the Derivative!

$$f(x) = 8^{(x^4)}$$

$$f'(x) = \frac{d}{dx} (8^{x^4}) \quad \left| \frac{d}{dx} [a^u] = a^u \ln(a) \frac{du}{dx} \right|$$

 $\downarrow$

$$f'(x) = \frac{d}{dx} (8^x) \cdot \frac{d}{dx} (x^4)$$

$$f'(x) = \ln(8) \cdot 8^x \cdot 4x^3$$

$$f'(x) = \ln(8) \cdot 8^{x^4} \cdot 4x^3$$

$$f'(x) = \ln(8) \cdot 2^{3x^4+2} \cdot x^3$$



Date 9/09/2026 M T W T F S S

Problem of the Day 234!

$$\frac{x+4}{3} - \frac{3x+4}{2x}$$

Solve!

$$\frac{x+4}{3} - \frac{3x+4}{2x}$$

$$\frac{x+4}{3} \cdot \frac{(2x)}{(2x)} - \frac{3x+4}{2x} \cdot \frac{(3)}{(3)} \rightarrow \frac{2x^2+8x}{6x} - \frac{9x+12}{6x}$$

$$\frac{2x^2+8x - (9x+12)}{6x}$$

 $\rightarrow$

$$\boxed{\frac{2x^2 - x - 12}{6x}}$$

 $\downarrow$

$$2x^2 - x - 12$$

$$\frac{\quad}{6x}$$



Date 9/10/2024 M T W T F S S

Problem of the Day 235!

Take the Derivative of the function!
class

$$f(x) = 3x^4 - 2x$$

* calc 1

Apply The Power rule!

$$\frac{d}{dx} [x^n] = nx^{n-1}$$

Part (1)

$$\begin{array}{c} 3x^4 \\ \downarrow \\ 3 \cdot 4x^{4-1} \\ \downarrow \\ 12x^3 \end{array}$$

Part (2)

$$\begin{array}{c} -2x \\ \downarrow \\ -2 \cdot 1x^{1-1} \\ \downarrow \\ -2 \end{array}$$

$$f'(x) = 12x^3 - 2$$



Date 9/11/2026

M T W T F S S

Problem of the Day 236!

Take the Derivative of the function!

$$f(x) = \tan(x^2) \cos(x)$$

class

★ Calc 1

Apply the Product Rule!

$$\frac{d}{dx} [f(x)g(x)] = f'(x)g'(x) + f'(x)g(x)$$

$$f(x) = \tan(x^2) \cos(x)$$

✓ chain rule!!!

1)

$$f(x) = \tan(x^2)$$

$$f'(x) = \sec^2(x^2) \cdot 2x$$

$$g(x) = \cos(x)$$

$$g'(x) = -\sin(x)$$

2) Plug terms into the formula

$$f'(x) = \tan(x^2) \cdot -\sin(x) + 2x \sec^2(x^2) \cos(x)$$

$$f'(x) = -\tan(x^2) \sin(x) + 2x \sec^2(x^2) \cos(x)$$

$$= -\frac{\sin(x^2)}{\cos(x^2)} \cdot \sin(x) + 2x \left(\frac{1}{\cos(x^2)} \right)^2 \cdot \cos(x)$$

Find common denominator

$$= \frac{-\sin(x^2) \sin(x)}{\cos(x^2)} + \frac{2x \cos(x)}{(\cos(x^2))^2}$$

Find CD

$$\frac{-\cos(x^2) \sin(x^2) \sin(x) + 2x \cos(x)}{(\cos(x^2))^2}$$



Date 9/12/2026 M T W T F S S

Problem of the Day 237!

Take the Derivative of the function!

$$f(x) = e^{(\cos(x^7) + 8x)}$$

Class
★ Calc 1

Apply the Chain Rule!

$$\frac{d}{dx} ((f(x))^n) = n(f(x))^{n-1} \cdot f'(x)$$

$$f'_1(x) = e^{(\cos(x^7) + 8x)}$$

$$f'_2(x) = -\sin(x^7) + 8$$

$$f'_3(x) = 7x^6$$

Plug into Chain Rule

$$f'(x) = e^{(\cos(x^7) + 8x)} \cdot (-\sin(x^7) + 8) \cdot 7x^6$$

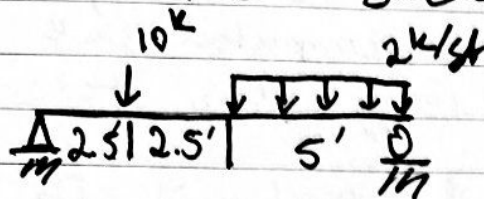


Date 9/13/2026

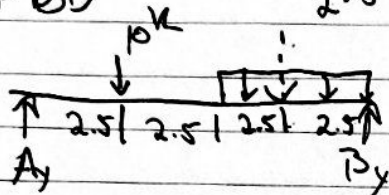
M T W T F S S

Problem of the Day 238!

Find the shear diagram of the beam!

*class
skates

1) solve for reactions

FBD $2.5 = 10k$ 

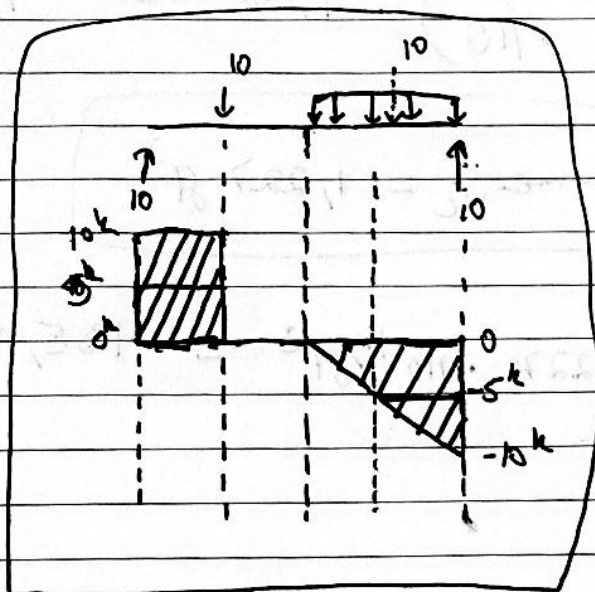
$$\sum M_A = -10(2.5) - 10(7.5) + B_y(10)$$

$$= -25 - 75 + B_y(10)$$

$$B_y = 10k$$

$$\sum F_y = 0 = A_y - 10 - 10 + 10$$

$$A_y = 10k$$





Date 9/14/2026 M T W T F S S

Problem of the Day 239!

A soil has a compacted unit weight of 135 lb/ft^3 + a uncompact unit weight of 110 lb/ft^3 how many tons +

how much volume uncompact material Do you need to fill a $1,000 \text{ ft}^3$ hole fully compacted?

★ Class Heavy highway construction

$$\text{Volume}_c = 1,000 \text{ ft}^3$$

$$\gamma_c = 135 \text{ lb/ft}^3$$

$$\gamma_{uc} = 110 \text{ lb/ft}^3$$

$$\left(\frac{135}{110} \right) \cdot 1,000 = 1,227 \text{ ft}^3$$

$$\text{Volume}_{uc} = 1,227 \text{ ft}^3$$

$$1,227 \cdot 110 \text{ lb/ft}^3 = 135,000 \text{ lb} = \frac{135,000}{2000} = 67.5 \text{ tons}$$



Date 9/15/2026 M T W T F S S

Problem of the Day 240!

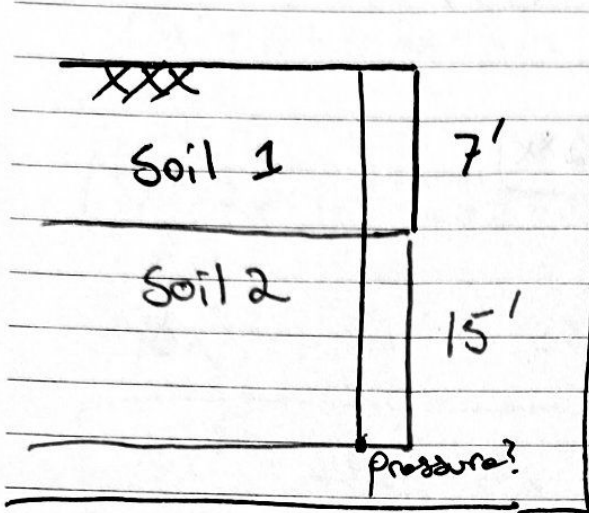
* class
geotech

Soil 1 = 120 lb/ft^3 + Soil 2 = 140 lb/ft^3

Soil 1 h = 7'

soil 2 h = 15'

What is the pressure @ 22' below ground



$$\text{Pressure soil}_1 = 7' \cdot 120 \text{ lb/ft}^3$$

$$\text{Pressure soil}_2 = 15' \cdot 140 \text{ lb/ft}^3$$

$$P_{\text{soil}_1} = 840 \text{ psf}$$

$$P_{\text{soil}_2} = 2,100 \text{ psf}$$

$$P_T = 840 + 2,100 = \boxed{2,940 \text{ psf}}$$



Date 9/16/2026 M T W T F S S

Problem of the Day 241!

* Algebra

$$(x+4)7x$$

Solve! / Simplify

$$(x+4)7x \rightarrow (7x \cdot x) + 7x \cdot 4$$

$$\downarrow$$
$$\boxed{7x^2 + 28x}$$



Date 9/17/2026 M T W T F S S

Problem of the Day 242! Algebra

$$(8x^2 + 4x)(2x - 4)$$

Solve! / Simplify

$$(8x^2 + 4x)(2x - 4)$$

$$(8x^2 \cdot 2x) + (4x \cdot 2x) + (8x^2 \cdot -4) + (4x \cdot -4)$$

$$16x^3 + 8x^2 - 32x^2 - 16x$$

$$16x^3 - 24x^2 - 16x$$

↓

$$x(16x^2 - 24x - 16)$$

↓

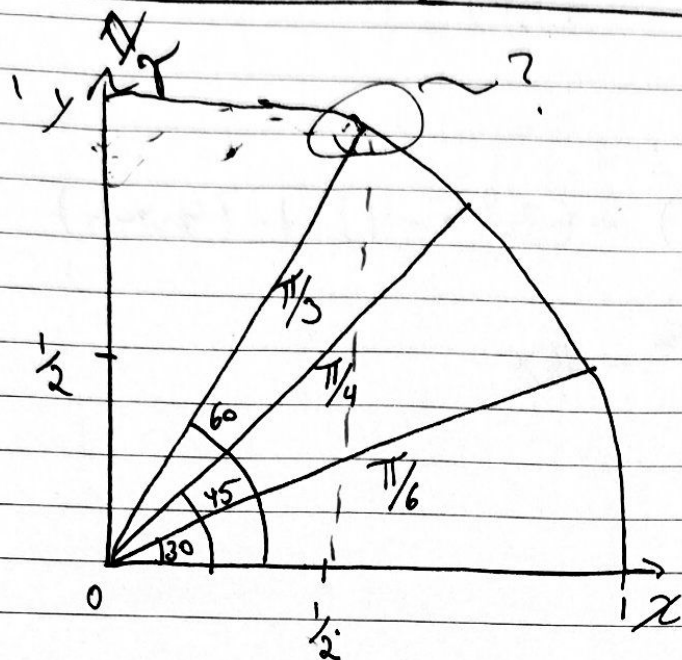
$$8x(2x^2 - 3x - 2)$$



Date 9/18/2026 M T W T F S S

Problem of the Day 243!

I identify (x, y) coordinates when
 $\theta = \pi/3$ on the unit circle!



$$x = \frac{1}{2}$$

$$y = ? \rightarrow y > \frac{1}{2} + \frac{\sqrt{2}}{2} \text{ so, } \frac{\sqrt{3}}{2}$$

$$y = \frac{\sqrt{3}}{2}$$



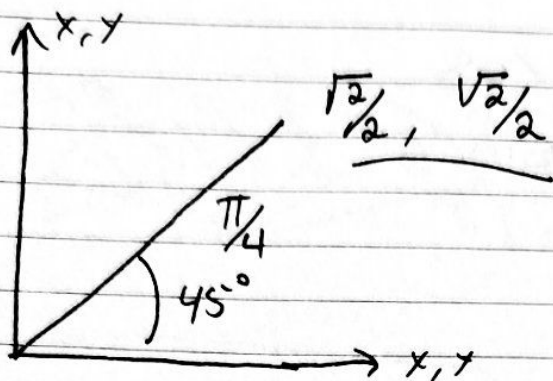
Date 9/19/2026

M T W T F S S

Problem of the Day 2441

What is $\sin$ of $\pi/4$?

Use the unit circle!



$$\sin(\pi/4) = \boxed{\frac{\sqrt{2}}{2}}$$

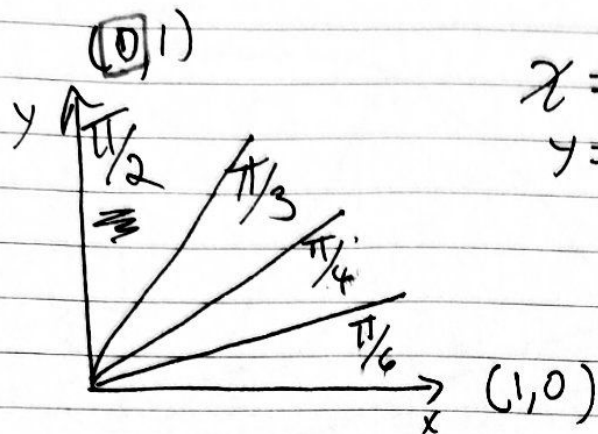


Date 9/20/2026 M T W T F S S

Problem of the Day 245!

what is $\cos(\pi/2)$?

Use the unit circle!!!



$$x = \cos$$

$$y = \sin$$

$$\cos(\pi/2) = 0$$