Final Exam 2025-3

This final exam is comprised of questions related to "Framing the Profession", "Beyond the Technical", and a reduced length FE Exam simulation (reduced length and scope). The FE exam simulation based on circa 2017 and earlier materials. You are allowed the NCEES supplied reference and a calculator (the embedded calculator in Canvas is turned on, but be careful to clear work between problems).

1 Multiple Choice 1 point

What does ABET define as "breadth of knowledge" in civil engineering education?

- ◯ Knowledge across multiple disciplines to address complex challenges
- ◯ Exclusive focus on technical design principles
- ◯ In-depth expertise in one technical area
- ◯ Specialization in mathematics and natural sciences

2 Multiple Choice 1 point

Which of the following is one of ABET’s seven broad student outcomes?

- ◯ Achieving full professional licensure before graduation
- ◯ Conducting feasibility studies on government contracts
- ◯ Mastering advanced programming languages for design
- ◯ Which of the following is one of ABET’s seven broad student outcomes?

3 Multiple Choice 1 point

What is an example of the technical breadth requirement in ABET's criteria?

- Advanced knowledge in one field of physics or chemistry
- Proficiency in designing a structural components
- Mastery of engineering mechanics and ability to apply it to various civil engineering problems
- Exclusive focus on geotechnical engineering

4 Multiple Choice 1 point

Why are humanities and social sciences important in civil engineering education?

- They provide context for societal needs and improve communication with stakeholders.
- They focus solely on public relations and marketing.
- They fulfill elective requirements unrelated to engineering practice.
- They replace technical coursework for non-engineering students.

5 Multiple Choice 1 point

What is a core example of ABET's focus on ethical responsibility in engineering?

- Adhering to sustainable practices while designing transportation systems
- Exclusively focusing on technical outcomes without public input
- Ensuring budget constraints are prioritized over safety
- Reducing communication with stakeholders to streamline designs

6 Multiple Choice 1 point

What is the primary purpose of the ASCE Body of Knowledge (BOK3)?

- To set international standards for civil engineering projects
- To define academic curricula for all engineering disciplines
- To outline knowledge, skills, and attitudes required for professional civil engineers
- To create professional licensure exams for civil engineers

7 Multiple Choice 1 point

How many outcomes are outlined in the ASCE BOK3?

- 12
- 21
- 15
- 25

8 Multiple Choice 1 point

What domain involves knowledge and intellectual skill development, including recall and recognition of facts and concepts?

- Ledger Domain
- Psychomotor Domain
- Affective Domain
- Cognitive Domain

9 Multiple Choice 1 point

What does the Affective Domain emphasize in the ASCE BOK3?

- Emotional aspects, including values, motivations, and attitudes
- Physical coordination and motor skills
- Memorization of technical facts
- Intellectual reasoning and critical thinking

10 Multiple Choice 1 point

What does the Psychomotor Domain emphasize in the ASCE BOK3?

- Physical coordination and motor skills
- Intellectual reasoning and critical thinking
- Memorization of technical facts
- Emotional aspects, including values, motivations, and attitudes

11 Multiple Choice 1 point

Which of the following was a key engineering failure at the TEPCO Fukushima Power Plant during the 2011 disaster?

- Over-reliance on solar power systems
- Failure to construct additional reactors
- Insufficient tsunami protection measures
- Lack of earthquake-resistant designs

12 Multiple Choice 1 point

Which of the following is a core consideration for sustainable engineering practices as related to public health?

- Reducing greenhouse gas emissions and improving air quality
- Ensuring rapid project completion
- Prioritizing cost efficiency over long-term benefits
- Maximizing the lifespan of infrastructure

13 Multiple Choice 1 point

Which of the following is an example of a fail-safe design?

- A pressure relief valve that opens automatically when system pressure exceeds a threshold value.
- A redundant control system in an airplane
- A monitoring system that records structural performance over time
- A bridge designed with multiple layers of redundant structural supports

14 Multiple Choice 1 point

What is a common method engineers use to account for uncertainty in their designs?

- Ignoring low-probability risks
- Simplified modeling
- Conservative design and worst-case scenario planning
- Prioritizing aesthetics over safety

15 Multiple Choice 1 point

Which principle underpins welfare considerations by ensuring no group can be made better off without making another group worse off?

- Utility Ethics
- Environmental Justice
- Cost-Benefit Analysis
- Pareto Optimality

16 Multiple Choice 1 point

According to Freeman's Stakeholder Approach, stakeholders are:

- Any group or individual affected by or affecting the organization
- Only government regulators and policy make
- Primarily the project engineers and technical staff
- Only the investors who provide capital

17 Multiple Choice 1 point

Why is stakeholder management critical in engineering projects?

- It eliminates the need for professional ethics
- It ensures only the most powerful stakeholders are satisfied
- It balances the priorities of multiple groups that may conflict
- It avoids dealing with legal liability altogether

18 Multiple Choice 1 point

Which document provides international guidance on project management, including stakeholder engagement?

- ISO 14001: Environmental Management Systems
- ISO 21500: Guidance on Project Management
- ISO 9001: Quality Management Systems
- ASTM E84: Surface Burning Characteristics

19 Multiple Choice 1 point

 Calculator

Why are trade policies and tariffs important in global engineering projects?

- They can significantly alter project costs and feasibility
- They guarantee compliance with labor laws
- They encourage cultural preservation
- They improve project aesthetics

20 Multiple Choice 1 point

Which global organization provides frameworks for evaluating anti-corruption policies?

- World Bank
- International Monetary Fund
- NATO
- United Nations

21 Multiple Choice 1 point

Calculator

5. Which of the following equations describes a circle with center at $(2,3)$ and passing through the point $(-3,-4)$?

- $(x+3)^2+(y+4)^2=85$
- $(x+3)^2+(y+2)^2=\sqrt{74}$
- $(x-2)^2+(y-3)^2=74$
- $(x-3)^2+(y-2)^2=74$

22 Multiple Choice 1 point

Calculator

Evaluate the following integral.

$$\int \frac{x^2}{4+x^2}dx$$

- $x-4\tan^{-1}\frac{x}{2}+C$
- $x+2\tan^{-1}\frac{x}{2}+C$
- $x-\tan^{-1}\frac{x}{4}+C$
- $x-2\tan^{-1}\frac{x}{2}+C$

23 Multiple Choice 1 point

Calculator

The roots of $F = \dfrac{x^3 + 6x^2 + 11x + 6}{x + 1}$ are most nearly:

- $-1, -2, -3$
- $2, 3$
- $2, -3$
- $-2, -3$

24 Multiple Choice 1 point

Calculator

12. Force vectors **A**, **B**, and **C** are applied at a single point.

$$\mathbf{A} = \mathbf{i} + 3\mathbf{j} + 4\mathbf{k}$$

$$\mathbf{B} = 2\mathbf{i} + 7\mathbf{j} - \mathbf{k}$$

$$\mathbf{C} = -\mathbf{i} + 4\mathbf{j} + 2\mathbf{k}$$

What is most nearly the magnitude of the resultant force vector, **R**?

- 15
- 13
- 16
- 14

25 Multiple Choice 1 point

Calculator

5. A study has a sample size of 5, a standard deviation of 10.4, and a sample standard deviation of 11.6. What is most nearly the variance?

- 130
- 52
- 46
- 110

26 Multiple Choice 1 point

12. A simulation model for a transportation system is run for 30 replications, and the mean percentage utilization of the transporter used by the system is recorded for each replication. Those 30 data points are then used to form a confidence interval on mean transporter utilization for the system. At a 95% confidence level, the confidence interval is found to be $37.2\% \pm 3.4\%$.

Given this information, which of the following facts can be definitively stated about the system?

- At 5% confidence, the population mean of transporter utilization lies inside of the range of $37.2\% \pm 3.4\%$.
- At 95% confidence, the population mean of transporter utilization lies outside of the range of $37.2\% \pm 3.4\%$.
- At 95% confidence, the population mean of transporter utilization lies in the range $37.2\% \pm 3.4\%$.
- At 95% confidence, the sample mean of transporter utilization lies in the range $37.2\% \pm 3.4\%$.

27 Multiple Choice 1 point

You would like to test the null hypothesis at a 5% level of significance that the mean shear strength of spot welds is at least 450 psi. You randomly select 15 welds, measure the shear strength, and determine the following results.

sample mean ($\bar{x}$): 445 psi

sample standard deviation (s): 10 psi

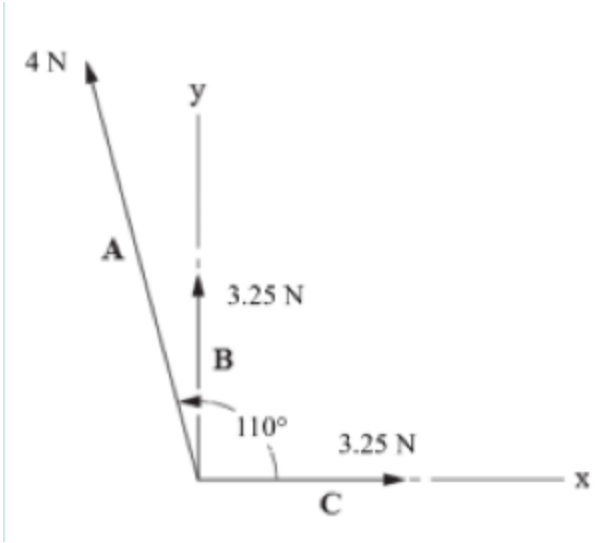
Based upon the data,

- the null hypothesis is false
- there is not enough information to say the hypothesis is true
- there is not enough information to say the hypothesis is false
- the null hypothesis is true

28 Multiple Choice 1 point

Calculator

The magnitude (N) of the resultant of the three co-planar forces, A, B, and C, is most nearly:



- 8.9
- 10.5
- 7.3
- 9.0

29 Multiple Choice 1 point

Calculator

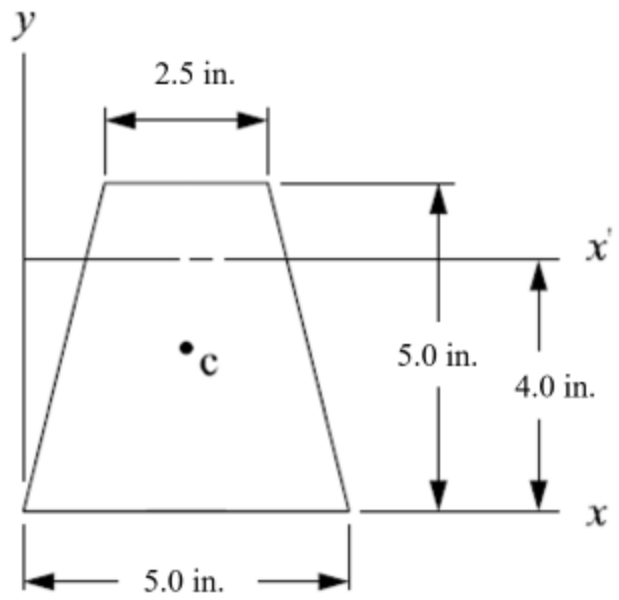
Select the location on the x-axis where an additional load must be placed in order to achieve equilibrium of the L-shaped bar

image.png

- 11
- 12
- 8
- 9

30 Multiple Choice 1 point

Calculator



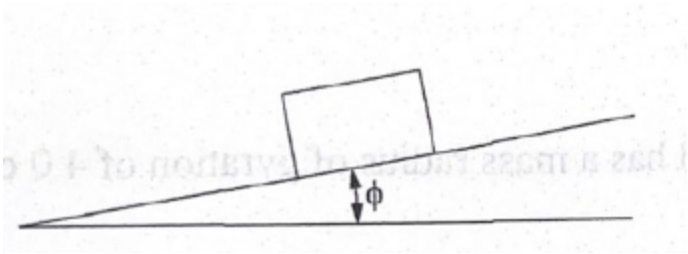
The moment of inertia (in^4) of the area about the x' axis ($I_{x'}$) is most nearly:

- 130.2
- 337.6
- 96.9
- 37.6

31 Multiple Choice 1 point

Calculator

In the figure below, the coefficient of static friction between the block and the inclined plane is 0.5. The block is in equilibrium.

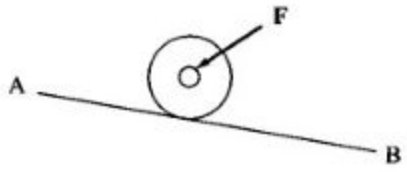


As the inclined plane is raised, the block will begin to slide when:

- sin Φ = 2.0
- cos Φ = 0.5
- sin Φ = 0.5
- tan Φ = 0.5

32 Multiple Choice 1 point

A heavy roller is held in equilibrium on a friction-less Plane AB by the force **F**, as shown.




Option A


Option B


Option C

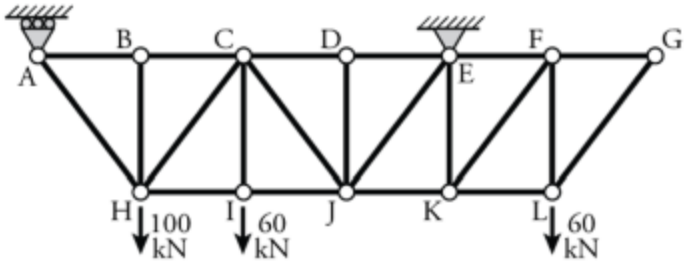

Option D

Which diagram correctly shows a vector polygon of the forces acting on the roller?

- Option A
- Option B
- Option C
- Option D

33 Multiple Choice 1 point

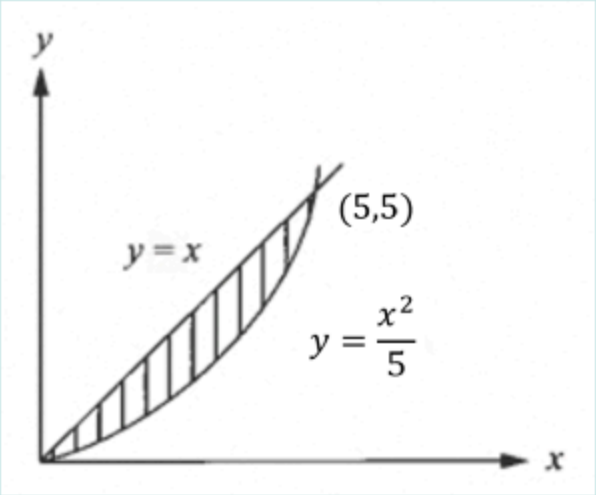
The figure below shows a simple truss. Which members in the truss have no (zero) force in them?



- BH, DJ, FG, GL
- BH, DJ
- BH, DJ, FG, FL, GL
- DJ

34 Multiple Choice 1 point

What is the shaded area between the two functions ?



A. $\frac{\int_0^5 \left(x-\frac{x^2}{5}\right)dx}{\int_0^5 \left(x^2-\frac{x^3}{5}\right)dx}$

B. $\frac{\int_0^5 \left(x^2-\frac{x^3}{5}\right)dx}{\int_0^5 \left(x-\frac{x^2}{5}\right)dx}$

C. $\frac{\int_0^5 \frac{x^3}{5}dx}{\int_0^5 \left(x+\frac{x^2}{5}\right)dx}$

D. $\frac{\int_0^5 \left(\frac{x^2}{2}+\frac{x^3}{5}\right)dx}{\int_0^5 \left(x-\frac{x^2}{5}\right)dx}$

Answer A

Answer B

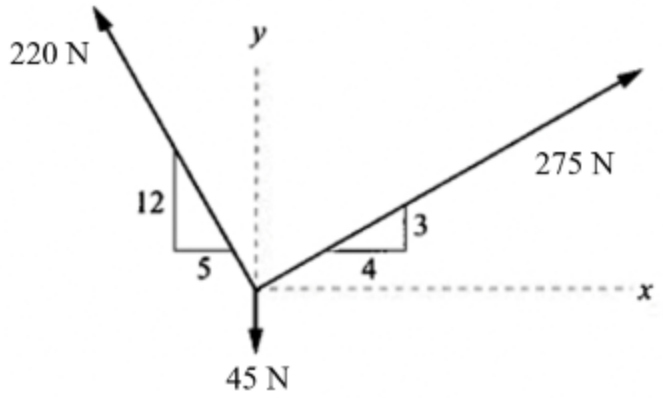
Answer C

Answer D

35 Multiple Choice 1 point

Calculator

Three forces act as shown below.



The magnitude of the resultant of the three forces (N) is most nearly:

- 323
- 135
- 350
- 355

36 Multiple Choice 1 point

Calculator

An object experiences rectilinear acceleration a(t) = 10 – 2t. How far does it travel in 6 seconds if its initial velocity is 10 m/s?

- 126 m
- 182 m
- 142 m
- 168 m

37 Multiple Choice 1 point

Calculator

A wheel is rotating at 4000 rpm. If it experiences a deceleration of 20 rad/s^2, through how many revolutions will it rotate before it stops?

- 4400
- 700
- 320
- 2100

38 Multiple Choice 1 point

Calculator

A small rotating robotic arm weighs 6.5 N and has a mass radius of gyration of 5.0 cm. The mass moment of inertia (kg*cm^2) is most nearly:

- 13.0
- 10.6
- 16.6
- 162.5

39 Multiple Choice 1 point

Calculator

A boat accelerates at a constant rate of 15 ft/sec^2. The boat travels 150 ft while its speed changes to 75 ft/sec. The initial velocity (ft/sec) was most nearly:

- 33.5
- 67.0
- 11.0
- 58.0

40 Multiple Choice 1 point

During impact of two objects, which of the following is true?

- Energy is never conserved.
- Momentum is always conserved.
- Momentum is never conserved.
- Energy is always conserved.

41 Multiple Choice 1 point

Calculator

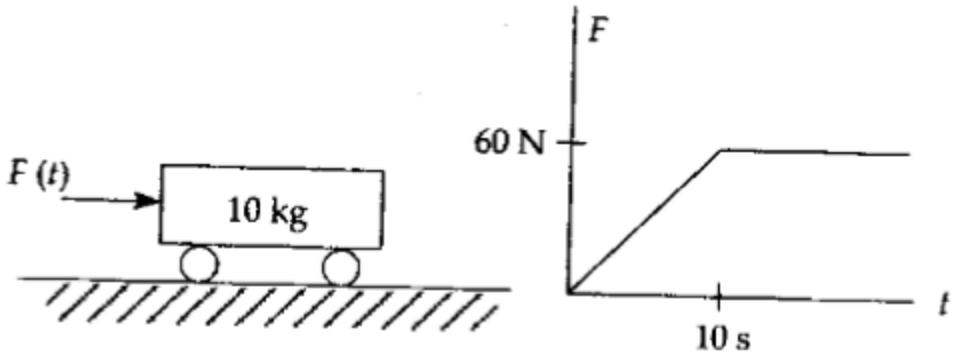
A wheel begins to rotate about an axis through its center with constant angular acceleration $\alpha = 3\ \frac{rad}{sec}$ starting from rest? The number of revolutions it completes until it achieves an angular velocity of100 rpm is most nearly:

- 10.5
- 18.3
- 2.91
- 4.27

42 Multiple Choice 1 point

Calculator

The force F(t) acts on the mass shown. What is its velocity after 20 *s* if it starts from rest?

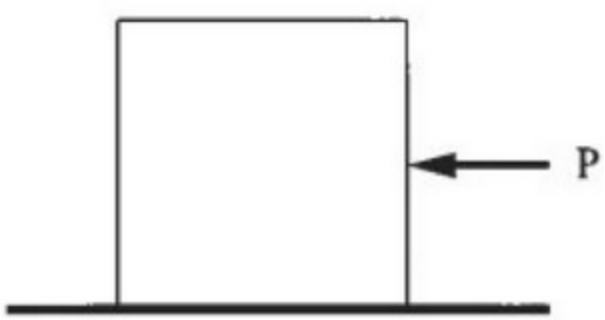


- 90 m/s
- 60 m/s
- 80 m/s
- 70 m/s

43 Multiple Choice 1 point

Calculator

A 7.5-kg block is sliding along a friction-less surface and is acted on by a constant force **P** of 25 N.



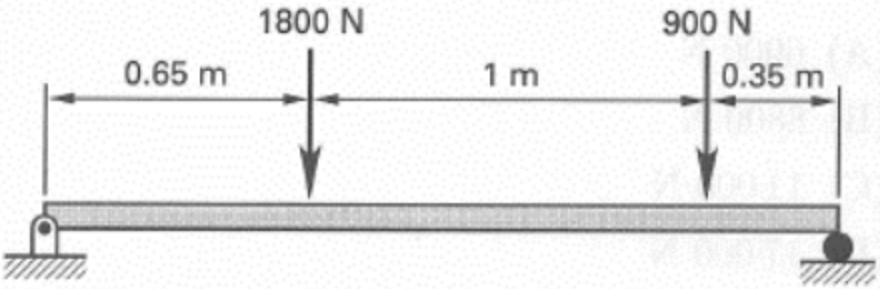
The time (seconds) when the block is moving at 16 m/s is most nearly:

- 53.33
- 3.33
- 4.50
- 4.80

44 Multiple Choice 1 point

Calculator

3. Refer to the simply supported beam shown.



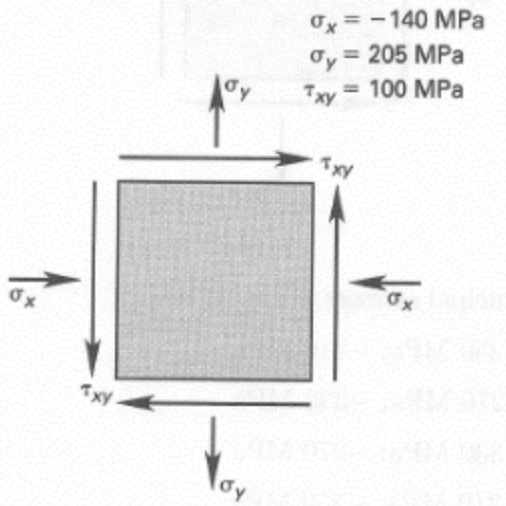
What is most nearly the maximum bending moment?

- 460 N·m
- 340 N·m
- 890 N·m
- 660 N·m

45 Multiple Choice 1 point

Calculator

1. The element is subjected to the plane stress condition shown.



What is the maximum shear stress?

- 160 MPa
- 100 MPa
- 210 MPa
- 200 MPa

46 Multiple Choice 1 point

Calculator

A 1-ft rod with a diameter of 0.5 in. is subjected to a tensile force of 1,300 lb and has an elongation of 0.009 in. The modulus of elasticity (ksi) of the material is most nearly:

- 740 ksi
- 10,000 ksi
- 8,840 ksi
- 884 ksi

47 Multiple Choice 1 point

Calculator

5. A rectangular steel bar 37.5 mm wide and 50 mm thick is pinned at each end and subjected to axial compression. The bar has a length of 1.75 m. The modulus of elasticity is 200 GPa. What is most nearly the critical buckling load?

- 93 kN
- 110 kN
- 60 kN
- 140 kN

48 Multiple Choice 1 point

Calculator

The following preliminary concrete mix has been designed assuming that the aggregates are in oven-dry condition.

Water = 305 lb/yd^3
Cement = 693 lb/yd^3
Coarse aggregate (SSD) = 1,674 lb/yd^3
Fine aggregate (SSD) = 1,100 lb/yd^3

The properties of the aggregates are:

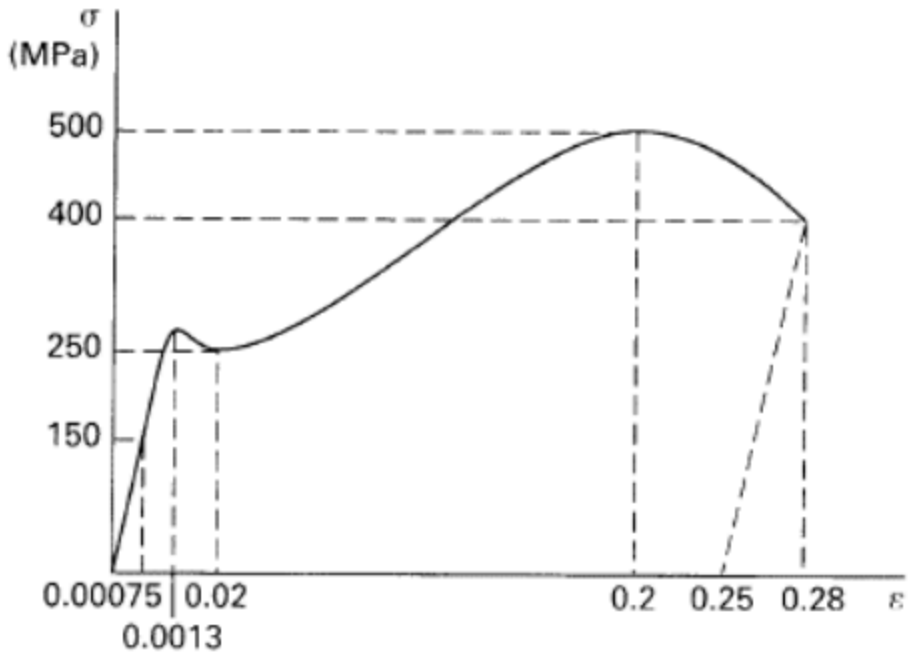
Property	Coarse Aggregate	Fine Aggregate
Absorption (moisture content at SSD)	0.5%	0.7%
Moisture content as used in mix	2.0%	6.0%

The amount of water (lb/yd^3) that would be used in the final mix is most nearly:

- 206
- 305
- 388
- 222

Calculator

10. A stress-strain diagram is shown.



What is most nearly the modulus of elasticity of the material?

- 100 GPa
- 20 GPa
- 200 GPa
- 80 GPa

50 Multiple Choice 1 point

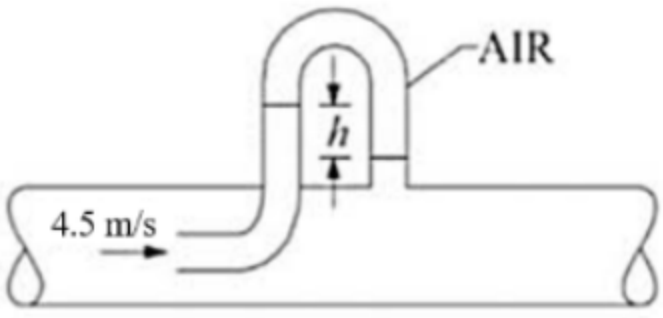
8. If δ is deformation, and L is the original length of the specimen, what is the definition of normal strain, ε?

- $\varepsilon = \frac{\delta}{L}$
- $\varepsilon = \frac{L+\delta}{\delta}$
- $\varepsilon = \frac{\delta}{L+\delta}$
- $\varepsilon = \frac{L+\delta}{L}$

51 Multiple Choice 1 point

Calculator

The pitot tube shown below is placed at a point where the velocity is 4.5 m/s. The specific gravity of the fluid is 2.5, and the upper portion of the manometer contains air.



The reading *h* (m) on the manometer is most nearly:

- 1.03
- 45.0
- 25.0
- 4.05

52 Multiple Choice 1 point

Calculator

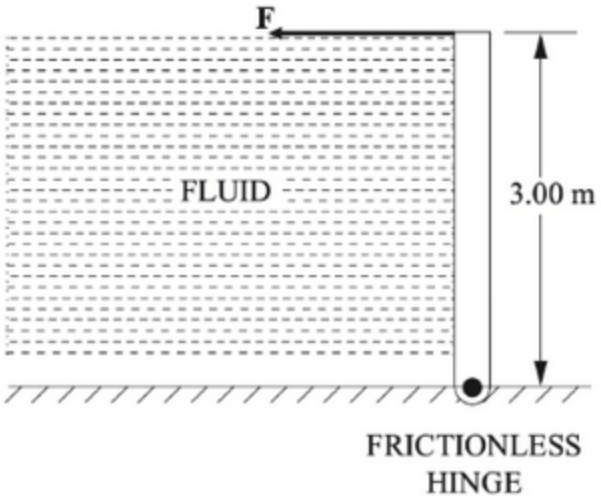
If the standard density of water is 1,000 kg/m^3, a fluid having a specific gravity of 1.524 and an absolute dynamic viscosity of 1.3 kg/(m•s) has a kinematic viscosity (m^2/s) of most nearly:

- 1.98 x 10^{-3}
- 1.17 x 10^{-3}
- 8.53 x 10^{-4}
- 1.30 x 10^{-3}

53 Multiple Choice 1 point

Calculator

The rectangular homogeneous gate shown below is 6.00 m high x 1.00 m wide and has a frictionless hinge at the bottom.



If the fluid on the left side of the gate has a density of 1,750 kg/m^3, the magnitude of the force **F** (kN) required to keep the gate closed is most nearly:

- 154
- 51
- 24
- 103

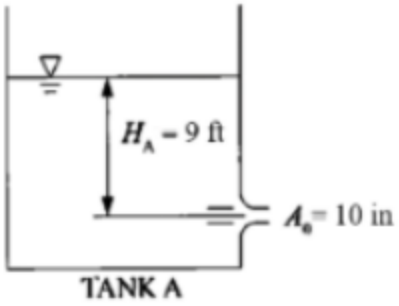
54 Multiple Choice 1 point

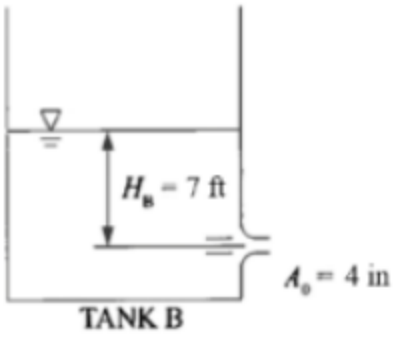
Archimedes' principle states that:

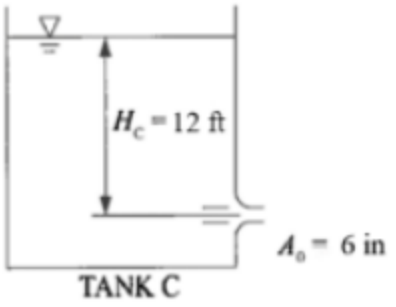
- flow passing two points in a stream is equal at each point
- a floating body displaces a weight of fluid equal to its own weight
- the sum of the pressure, velocity, and elevation heads is constant
- the buoyant force on a body is equal to the volume displaced by the body

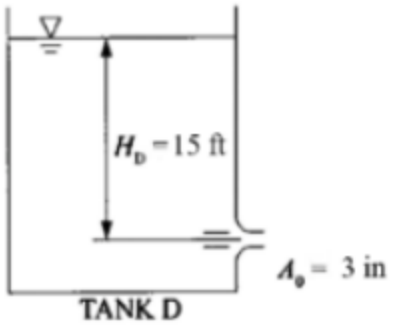
55 Multiple Choice 1 point

Four water tanks are shown with varying heights H and varying nozzle cross-sectional areas A_0. Assume no minor losses in the discharge and a common coefficient of discharge $C = 0.6$ for all the nozzles.









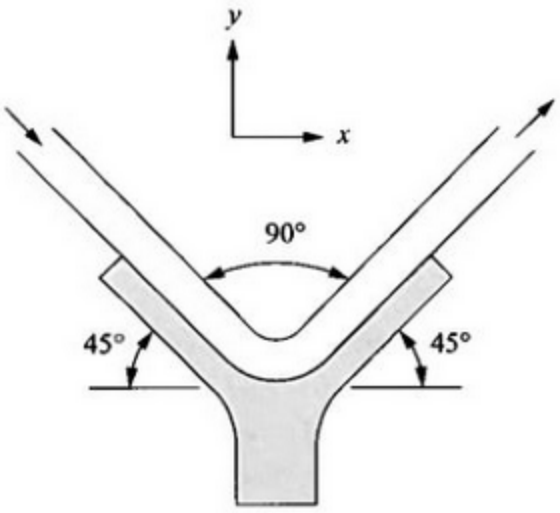
List the tanks from lowest to highest magnitude of discharge velocity

- Tank D, Tank C, Tank A, Tank B
- Tank B, Tank A, Tank C, Tank D
- Tank A, Tank C, Tank B, Tank D

Tank D, Tank B, Tank C, Tank A

56 Multiple Choice 1 point

A 1-in-diameter jet of 50°F water is deflected 90° by an angled chute as shown.The water enters with a velocity of 32.5 ft/sec and freely exits into the atmosphere with the same velocity.



The forces (lb) in the *x* and *y* directions of the chute are most nearly:

$F_x = 0$

Fy = 15.80 lb

$F_x = 15.80$ lb

Fy = 15.80 lb

$F_x = 15.80$ lb

Fy = 0

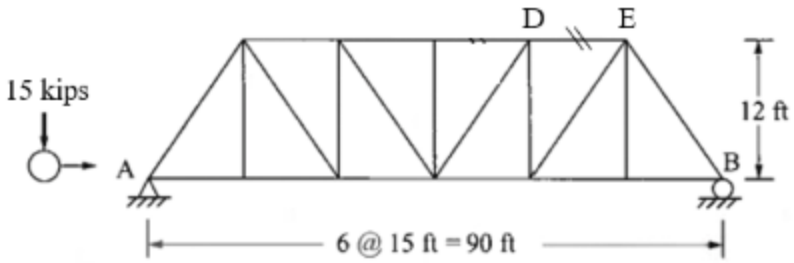
$F_x = 0$

Fy = 7.90 lb

57 Multiple Choice 1 point

Calculator

A concentrated load of 15 kips moves through the truss shown. Neglecting the weight of the truss, the maximum force (kips) in Member DE due to the moving load is most nearly:

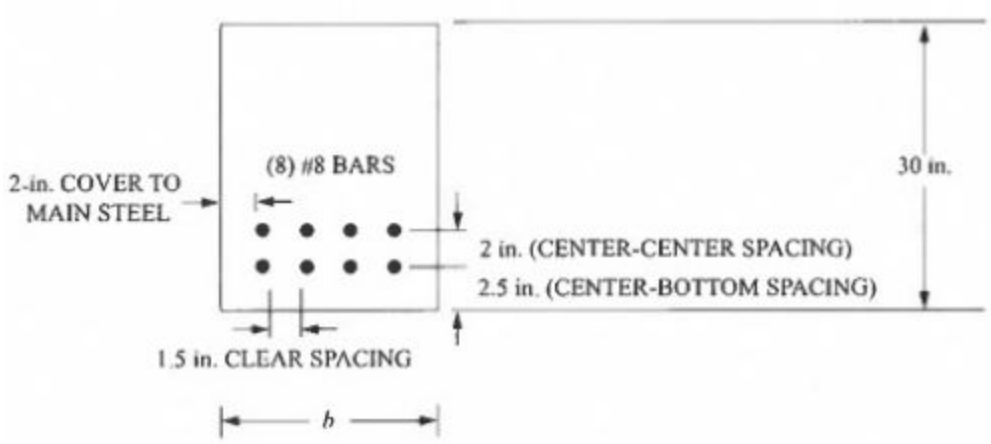


- 18.75
- 37.5
- 31.25
- 25

58 Multiple Choice 1 point

Calculator

A reinforced concrete beam is subjected to a factored moment M_u = 621 ft-kips. For concrete, f'_c = 4,000 psi. For steel, f_y = 60,000 psi. The beam is reinforced with eight #8 bars in two rows, positioned as shown in the figure. Assume that Φ = 0.90. The minimum adequate overall width *b* for this beam is most nearly:

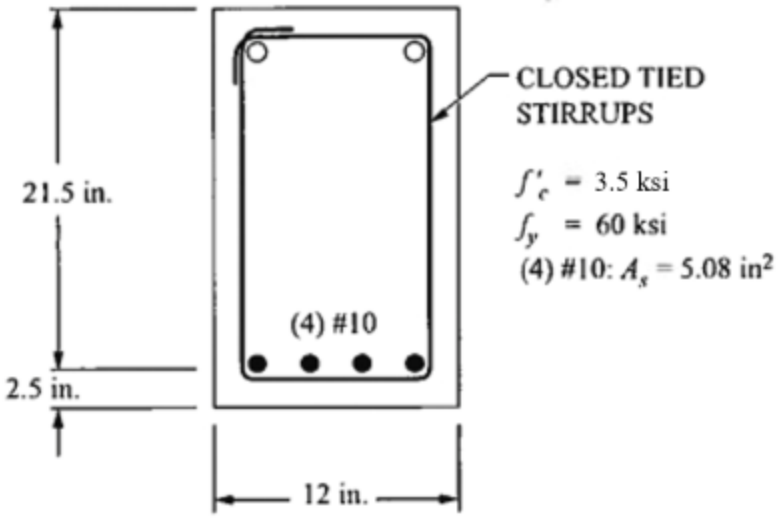


- 12
- 10
- 15
- 13

59 Multiple Choice 1 point

Calculator

According to American Concrete Institute (ACI) 318-14, the value of Φ that should be used in computing the design moment strength ΦM_n for the beam section shown below is most nearly:

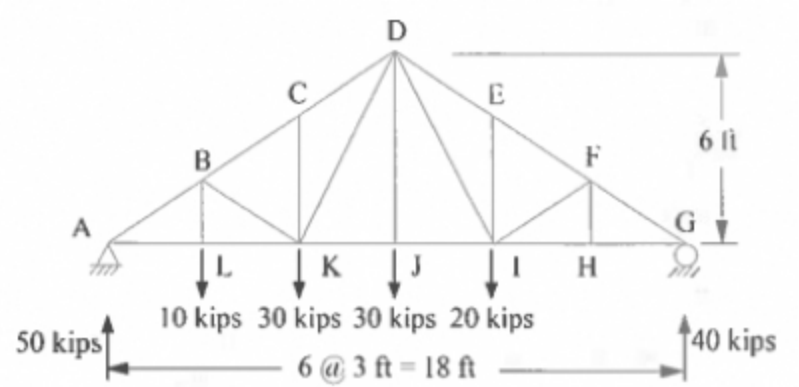


- 0.76
- 0.85
- 0.89
- 0.81

60 Multiple Choice 1 point

Calculator

In the truss shown, there is a pin connecting the members at each joint. The force (kips) in Member JI is most nearly:



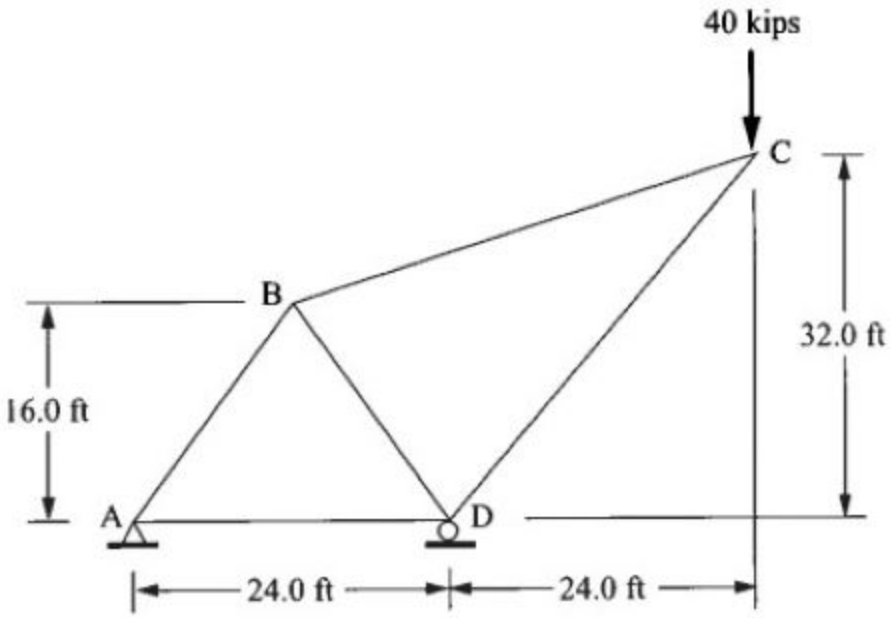
- -113 (compression)
- 50 (tension)
- -81 (compression)
- 75 (tension)

61 Multiple Choice 1 point

Calculator

The 40-kip vertical load at Joint C in the steel truss shown below produces the forces given in the accompanying table. The cross-sectional area of each member is 4.0 in^2, and the length of each member is given in the table. The elastic modulus of steel is 29,000 ksi. The downward vertical displacement (in.) of Joint C is most nearly:

Member	Force, F (kips)	Length, L (in.)	$\frac{FL}{AE}$	f	$f \cdot \frac{FL}{AE}$
AB	50.0	240	0.1034	1.25	0.1292
BC	49.2	473	0.2008	1.231	0.2472
CD	–75.0	480	–0.3103	–1.875	0.5818
AD	–30.0	288	–0.0745	–0.75	0.0559
BD	–25.0	240	–0.0517	–0.625	0.0323

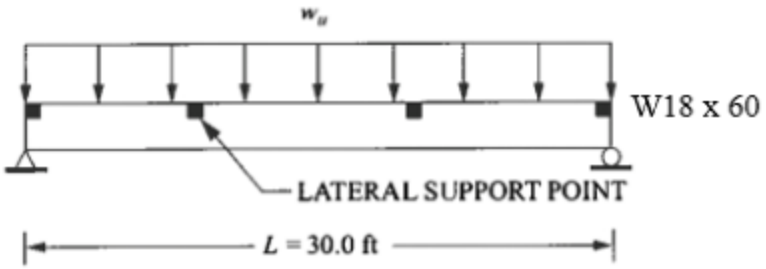


- 1.046
- 0.294
- 0.102
- 0.132

62 Multiple Choice 1 point

Calculator

The W18 x 60 steel beam shown in the figure has its compression flange laterally braced at the one-third points over its full length. Assume F_y = 50 ksi and C_b = 1.0 for the critical segment. The maximum factored load w_u (kips/ft) that the beam can carry for this length is most nearly:

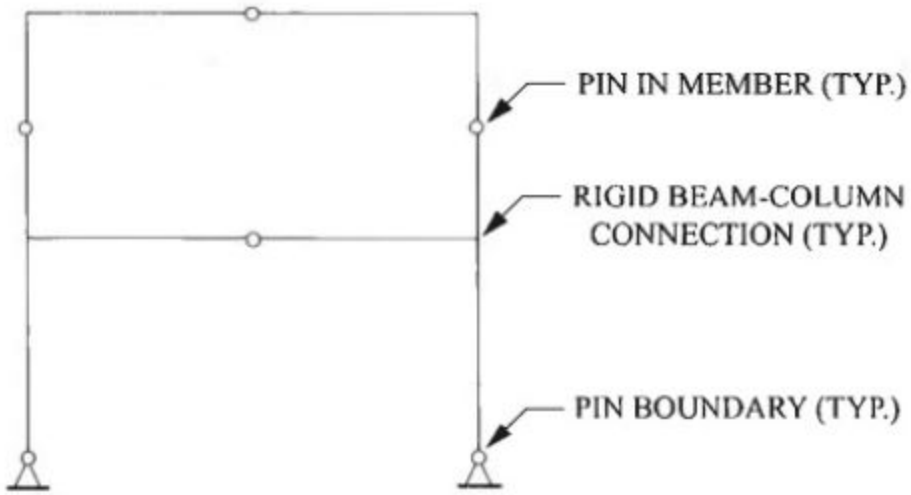


- 3.573
- 3.360
- 3.333
- 2.809

63 Multiple Choice 1 point

Calculator

The frame in the figure below is:



- unstable
- indeterminate two degrees
- stable and determinate
- indeterminate one degree

64 Multiple Choice 1 point

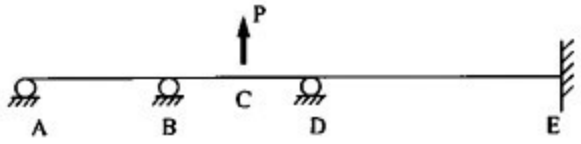
Calculator

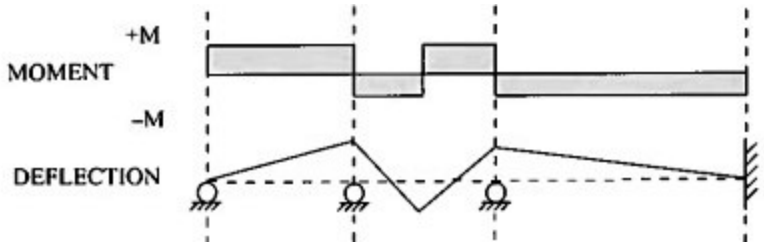
The proportional limit and modulus of elasticity for a material are 45 ksi and 32,000 ksi, respectively. A square column made from this material has a moment of inertia equal to 6.6 in^4 and an area equal to 8.8 in^2. Assume a fixed-pinned connected column. The **maximum** column length (in.) based on the Euler formula is most nearly:

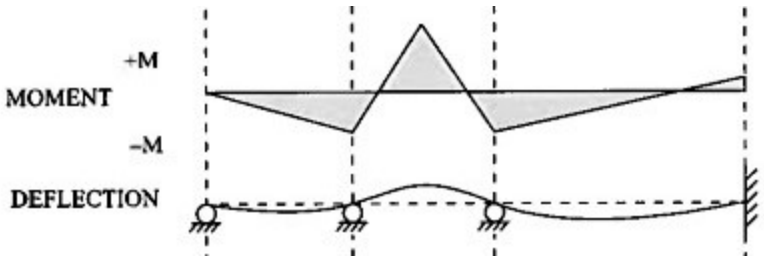
- 103.6
- 89.8
- 72.5
- 50.0

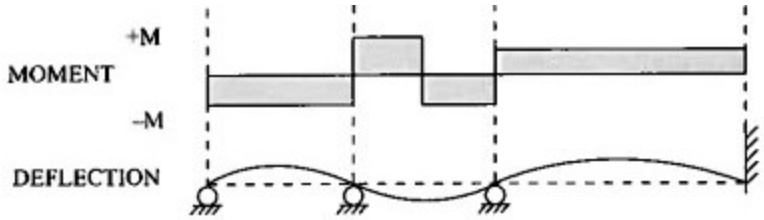
65 Multiple Choice 1 point

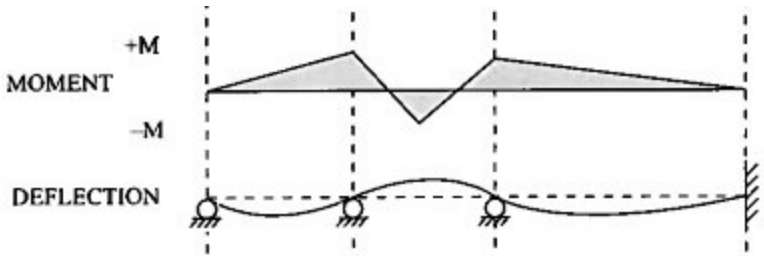
Which combination of moment diagram and deflection shape most accurately corresponds to the continuous beam with loading shown?





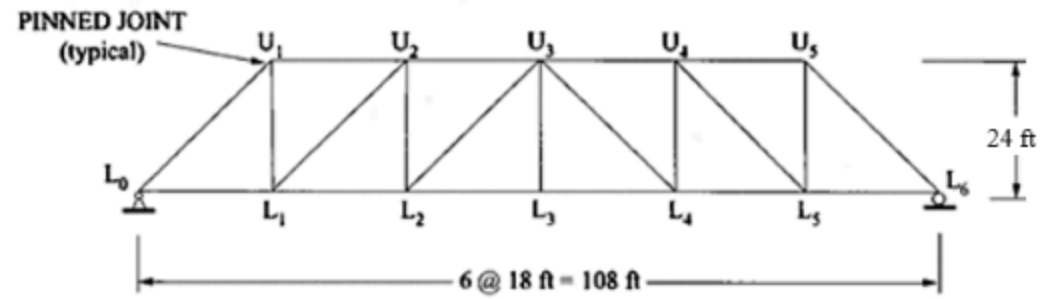


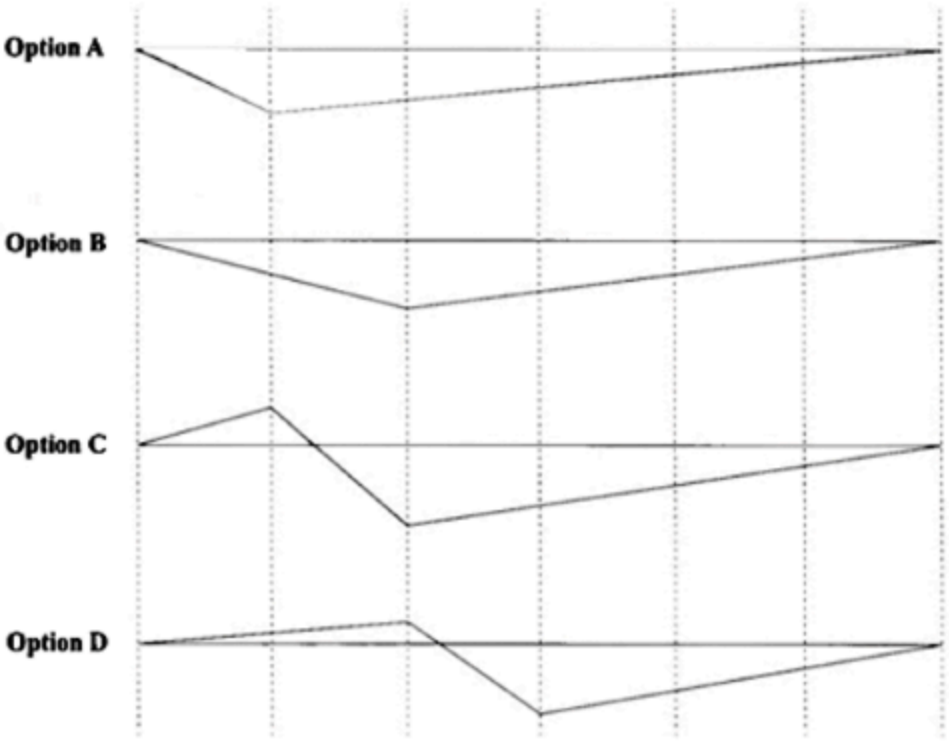




66 Multiple Choice 1 point

Which of the vertical-load influence lines shown below is correct for Member U_2U_3 of the truss shown below?





- Option C
- Option D
- Option B
- Option A

67 Multiple Choice 1 point

Calculator

A flexible pavement system is to be designed using the AASHTO structural number design method with the following criteria:

Material	Minimum Thickness (in.)	Coefficient of Structural Layer
AC surfacing	2	0.44
Aggregate base	4	0.25
Aggregate subbase	4	0.10
Structural number = 2.50		

If the minium thicknesses of the sufacing and aggregate base are used, the required thickness (in.) of the aggregate subbase is most nearly:

- 4
- 6.5
- 5
- 8.5

68 Multiple Choice 1 point

Calculator

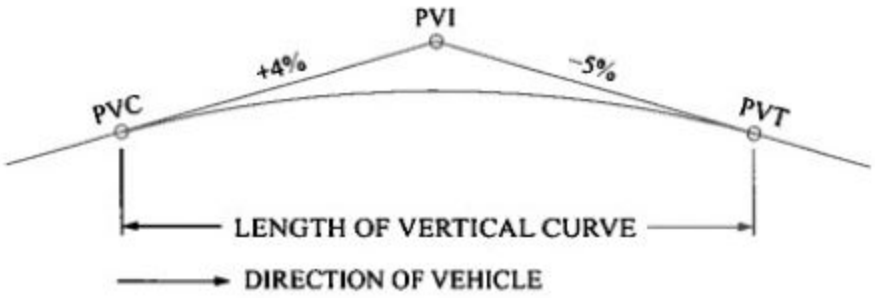
A freeway lane has a volume of 1,400 vehicles/hr and an average vehicle speed of 45 mph. The time spacing (sec) between vehicles (center to center) is most nearly:

- 5.2
- 2.6
- 31
- 15

69 Multiple Choice 1 point

Calculator

A highway profile is shown in the figure. If the design stopping sight distance is 600 ft, the driver's eye height above the roadway surface is 3.50 ft, and the height of an object in the roadway to be avoided by stopping is 1.00 ft, the minimum design length (ft) of the vertical curve is most nearly:



- 3,600
- 1,136
- 1,966
- 1,017

70 Multiple Choice 1 point

Calculator

An urban intersection is being reconstructed to address safety problems, and it is estimated that the two mutually exlcusive countermeasures have a crash reduction factor of 0.25 and 0.15, respectively. If the expected number of crashes per year is 10 and no signifcant growth in traffic is anticipated, the expected number of average crashes per year after reconstruction is most nealry:

- 4.0
- 6.0
- 3.6
- 6.4

71 Multiple Choice 1 point

Calculator

At an urban pedestrian crosswalk, the initial WALK signal is displayed for 6.0 seconds, after which a flashing DON'T WALK signal is displayed. The pedestrian walking speed is 3.5 ft/sec, and the street to be crossed is 31.5 ft wide. At the end of the green time, the flashing DON'T WALK signal is terminated. The **minimum** length of time (sec) the green must be displayed is most nearly:

- 6.0
- 15.0
- 12.5
- 9.0

72 Multiple Choice 1 point

At two-way stop-controlled intersections, the sight distance required for minor street movements is determined by:

- departure sight triangles
- approach sight triangles
- decision sight distance
- stopping sight distance

73 Multiple Choice 1 point

For a given loading, soil conditions, and design life, which of the following pavement types will most likely be the thinnest highway pavement design?

- Composite hot-mix asphalt over Portland cement concrete
- Portland cement concrete
- Hot-mix asphalt
- Warm-mix asphalt

74 Multiple Choice 1 point

Calculator

To encourage more carpooling during the peak commute times, a metropolitan area is considering adding HOV lanes to a busy interestate segment. An exisitng transit route has a utility of -0.65, which is unaffected by the proposed change. If the existing non-HOV lanes have a utility of +1.2 and the proposed change introducing a carpool mode has a utility of -0.40, the percentage of trips expected to carpool is most nearly:

- 15%
- 0%
- 17%
- 74%

75 Multiple Answer 1 point

Which of the following statements about a basic freeway segment are true according to the *Highway Capacity Manual?*

Select **all** that apply.

- [ ] Freeway segments with 75-mph free-flow speed experience a reduction in operating speeds at a lower-volume threshold than a freeway segment with a 55-mph free-flow speed.
- [ ] The capacity of a freeway segment with a 75-mph free-flow speed is higher than a similar facility with a 55-mph free-flow speed.
- [ ] The free-flow speed of a freeway segment is impacted by the the amount of lateral clearance on the right side of the roadway.
- [ ] Increases in traffic volume lower the estimated operating speed of a freeway segment for both low- and high-volume ranges.
- [ ] A freeway segment with 13-ft lanes has higher free-flow speeds than a similar facility with 12-ft lanes.

76 Multiple Choice 1 point

Calculator

A 12-ft-high retaining wall has backfill of granular soil with an angle of internal friction of 30° and a unit weight of 125 pcf. The resultant Rankine active force (lb/ft) on the wall is most nearly:

- 3,000
- 2,250
- 27,000
- 9,000

77 Multiple Choice 1 point

Calculator

A consolidated, undrained triaxial shear test was performed on an overconsolidated clay mix specimen with a diameter of 1.4 in. The test yielded a cohesion of 530 psf and an angle of internall friction of 18°. If the normal load at failure was 125 lb, the shear strength (psi) of the soil is most nearly:

- 10
- 26
- 556
- 30

78 Multiple Choice 1 point

Calculator

A normally consolidated 10-ft clay layer is surcharged, which causes a decrease in thickness. The coefficient of consolidation is 0.16 ft^2 per day and the time factor is 1.2 for U = 50%. The clay layer is confined between two layers of dense sand. The time (days) required for 50% consolidation is most nearly:

- 188
- 5
- 38
- 750

79 Multiple Choice 1 point

A slope of clay-mix material experiences failure along a 100-ft-long slip surface at an angle of 27°. The soil above the slip surface weighs 100 tons, has an angle of internal friction of 20°, and has a cohesion of 1.2 psi. The factor of safety at slope failure is most nearly:

- 0.7
- 0.9
- 381.3
- 1.7

80 Multiple Choice 1 point

Calculator

A strip of footing having a width B = 2 ft is to be constructed at ground suface (D_f = 0). Underlying the footing is sand having the following bearing capactiy factors: N_c = 0, N_γ = 25, N_q = 20. The unit weight of sand γ = 120 pcf. The ultimate bearing capacity q_{ult} (psf) of the footing is most nearly:

- 2,400
- 4,800
- 1,200
- 3,000

81 Multiple Choice 1 point

A three-story concrete building will be constructed on a vacant parcel in a city. The soil boring log shows a 20-ft-thick layer of loose soil over a 5-ft-thick limestone layer. Which of the following foundations will provide the least settlement for this building?

- Spread footings
- Mats foundation
- Wall foundation
- Deep foundation

82 Multiple Choice 1 point

An undisturbed sample of soil has a specific gravity of solids of 2.70, a moisture content of 10.5%, and void ratio of 0.63. The degree of saturation is most nearly:

- 25%
- 85%
- 45%
- 65%

83 Multiple Choice 1 point

Calculator

Direct shear test data of a sand are shown below:

Area of sample = 16 in^2
Normal load at failure = 512 lb
Shear stress at failure = 16 psi

The angle of internal friction is most nearly:

- 0°
- 63°
- 30°
- 27°

84 Multiple Choice 1 point

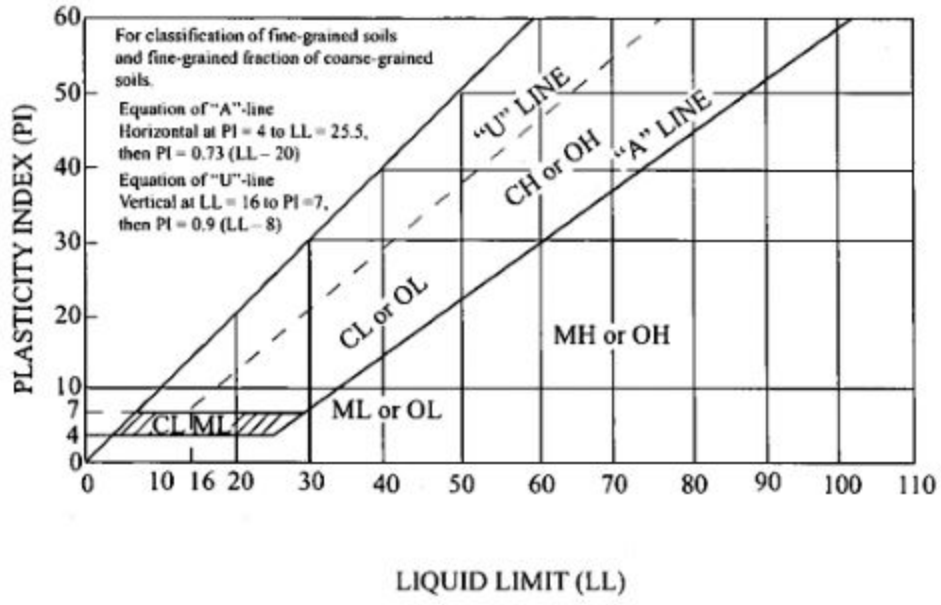
Calculator

Subsurface exploration indicates that a level site has a 10-ft upper layer of sand. The groundwater table is at the ground surface. The unit weight of the sand is 135.0 pcf. The effective overburden stress (psf) at a depth of 10 ft is most nearly:

- 1,350
- 1,975
- 625
- 725

85 Multiple Choice 1 point

Which area of the Atterberg chart provided is associated with an elastic silt?

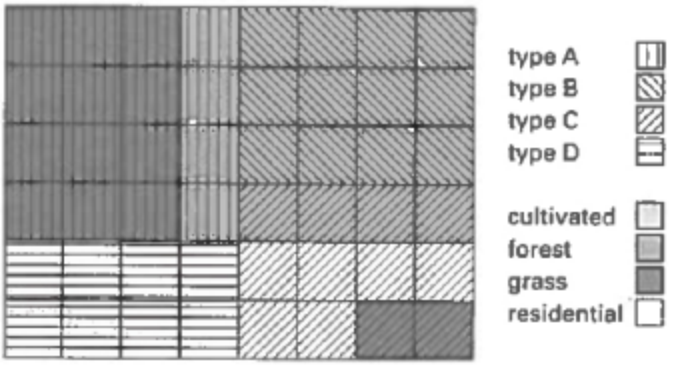


- CH or OH
- MH or OH
- ML or OL
- CL or OL

86 Multiple Choice 1 point

Calculator

Each square in the watershed shown is 1 acre in size.



curve numbers

land use	soil type			
	type A	type B	type C	type D
residential	57	72	81	66
grass	30	58	71	78
forest	25	55	70	77
cultivated	62	71	78	81

Using the tabulated curve numbers for the land uses based on soil type, what is the weighted curve number for the entire 48 acre watershed?

- 56
- 68
- 49
- 61

87 Multiple Choice 1 point

Calculator

The flow rate in a rectangular channel 4 meters wide is 20 m^3/s. The critical depth is

- 2.7 meters
- 1.4 meters
- 2.0 meters
- 1.0 meters

88 Multiple Choice 1 point

Calculator

A residential lot of 0.37 acres contains a house that occupies 0.05 acres, and a driveway that covers 0.035 acres. The runoff coefficients are 0.50 for the undeveloped portions of the lot, 0.85 for the house, and 0.90 for the driveway. The peak discharge from the lot during a storm event with rainfall intensity of 0.5 inches per hour is

- 0.110 cfs
- 0.250 cfs
- 0.085 cfs
- 0.320 cfs

89 Multiple Choice 1 point

Calculator

A 25 acre drainage basin has a curve number of 81. The basin receives 4.5 inches of rainfall in a 24 hour period. The total runoff, in watershed inches is

- 0.81 inches
- 2.60 inches
- 4.80 inches
- 0.33 inches

90 Multiple Choice 1 point

Calculator

A 6 meter wide, rectangular channel carries 24 m^3/s at critical depth. The velocity is

- 1.1 m/s
- 3.4 m/s
- 14 m/s
- 6.3 m/s

91 Multiple Choice 1 point

Calculator

A 3.5 acre drainage area receives a rainfall intensity of 0.5 in/hour; the peak runoff from the area is 500 gallons per minute. What is the runoff coefficient?

- 0.31
- .11
- 0.64
- 0.86

92 Multiple Choice 1 point

Calculator

A rectangular concrete channel has a depth of 3 meters, a width of 5 meters, and a slope of 0.004. The Manning's roughness coefficient for the channel is 0.013. When full, the velocity of water in the channel is

- 15 m/sec
- 90 m/sec
- 6.0 m/sec
- 1.0 m/sec

93 Multiple Choice 1 point

Calculator

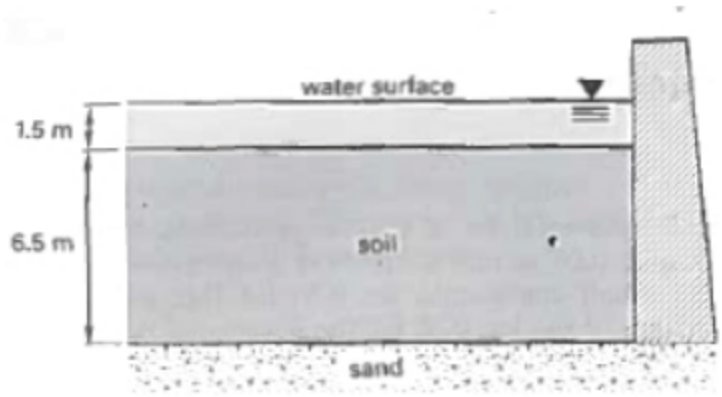
A drainage basin with a curve number of 72 receives 5 inches of rain during a two-day storm. The runoff from the basin in watershed inches is

- 0.62 inches
- 2.20 inches
- 0.52 inches
- 4.10 inches

94 Multiple Choice 1 point

Calculator

A concrete dam impounds water as shown. The standing water depth is 1.5 meters. The soil layer under the reservoir is underlain by a highly porous sand layer. The sand layer at the bottom of the soil profile has horizontal drainage and zero pore pressure.



The water level of the reservoir is constant. The total surface area of the reservoir pool is 1000 m^2, and the hydraulic conductivity of the soil layer is 4.7×10^{-6} mm/sec. The loss from seepage through the soil layer per year is

- 1.1 cubic meters
- 34 cubic meters
- 2.8 cubic meters
- 180 cubic meters

95 Multiple Choice 1 point

Calculator

An unconfined aquifer is 300 feet deep, and has a hydraulic conductivity of 0.5 feet per day. A one-foot diameter well is drilled into the aquifer an pumped at a rate of 50 gallons per minute. The well's radius of influence is 1000 feet. After pumping has continued long enough for equilibrium to be established, the depth of water in the well is

- 90 feet
- 270 feet
- 240 feet
- 220 feet

96 Multiple Choice 1 point

Calculator

4. A water analysis of lake water has the results shown, with all values reported as $CaCO_3$.

alkalinity	151.5 mg/L
sodium	120.0 mg/L
calcium	127.5 mg/L
iron (III)	0.107 mg/L
magnesium	43.5 mg/L
potassium	8.24 mg/L
chloride	39.5 mg/L
fluoride	1.05 mg/L
nitrate	1.06 mg/L
sulfate	106 mg/L

The water's hardness is most nearly

- 170 mg/L
- 150 mg/L
- 300 mg/L
- 290 mg/L

97 Multiple Choice 1 point

4. Which of the following equations represents the formation of acid rain?

(A) $S + O_3 + H_2O \rightarrow H_2SO_4$

(B) $SO + O_2 + H_2O \rightarrow H_2SO_4$

(C) $SO_2 + H_2O \rightarrow H_2SO_3$

(D) $SO_3 + H_2O \rightarrow H_2SO_4$

- ○ $SO_3 + H_2O \rightarrow H_2SO_4$
- ○ $S + O_3 + H_2O \rightarrow H_2SO_4$
- ○ $SO_2 + H_2O \rightarrow H_2SO_3$
- ○ $SO + O_2 + H_2O \rightarrow H_2SO_4$

98 Multiple Choice 1 point

10. Which of the following are generally true for water treatment relative to the adsorption of a contaminate by activated carbon?

I. The adsorption is a chemical reaction and typically irreversible.

II. The adsorption is a physical reaction (van der Waals forces) and generally reversible.

III. Water soluble, inorganic contaminants with low molecular weights are best adsorbed by activated carbon.

IV. The contaminant sticks to the surface of the activated carbon particles.

- ○ II and IV
- ○ I, II, III, and IV
- ○ I, II, and III
- ○ III and IV

99 Multiple Choice 1 point

Calculator

A municipal wastewater treatment plant is processing a waste flow with a 5-day BOD of 200 mg/L at 20°C. If the BOD rate constant k_1 (base e) at 20°C is 0.23 day^{-1}, the ultimate BOD (mg/L) of the raw wastewater at 20°C is most nearly:

- ○ 133
- ○ 233
- ○ 420
- ○ 292

100 Multiple Choice 1 point

Calculator

A backsight of 7.76 ft is taken on a turning point with an elevation of 2,325.58 ft. If the foresight taken on the top of a construction pin is 4.25 ft, the elevation (ft) of the top of the pin is most nearly:

- 2313.57
- 2329.09
- 2322.07
- 2337.59

101 Multiple Choice 1 point

Calculator

A total station is set up 5.00 ft above a benchmark that has an elevation of 820.50 ft. A slope angle and slope distance of $-3°15'$ and 645.90 ft, respectively, are measured to a reflector that is set up 4.25 ft above a hub at Point B. Neglecting curvature and refraction, the elevation (ft) of the hub at Point B is most nearly:

- 785.76
- 784.63
- 779.63
- 783.88

102 Multiple Choice 1 point

Calculator

The cross-sectional areas to be excavated (cut) at certain sections of a road project are as follows:

Station	Area (ft^2)
3+00	247
4+00	269
4+35	322
5+00	395
5+65	418
6+00	293
7+00	168

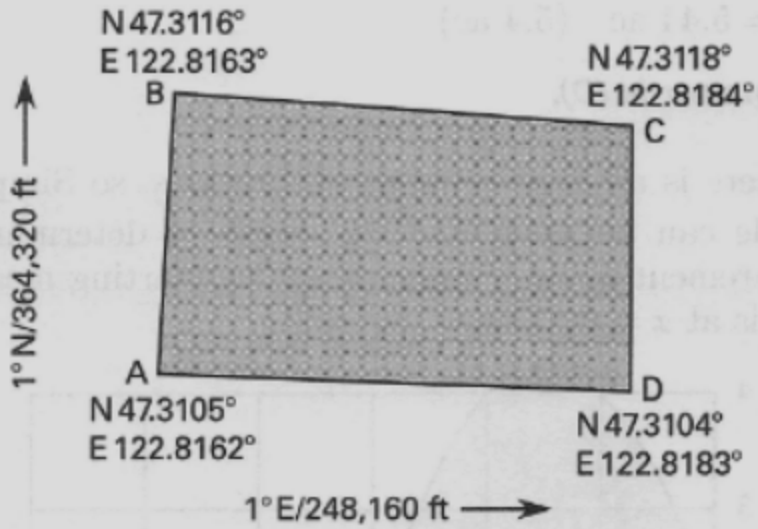
Using the prismoidal method, the volume of earth to be excavated (yd^3) between Stations 4+35 and 5+65 is most nearly:

- 1900
- 1860
- 1840
- 1460

103 Multiple Choice 1 point

Calculator

Global positioning system (GPS) latitudes and longitudes were taken of a plot of land. In the region where the plot is located, the length of a degree of latitude is 364,320 ft, and the length of a degree of longitude is 248,160 ft.

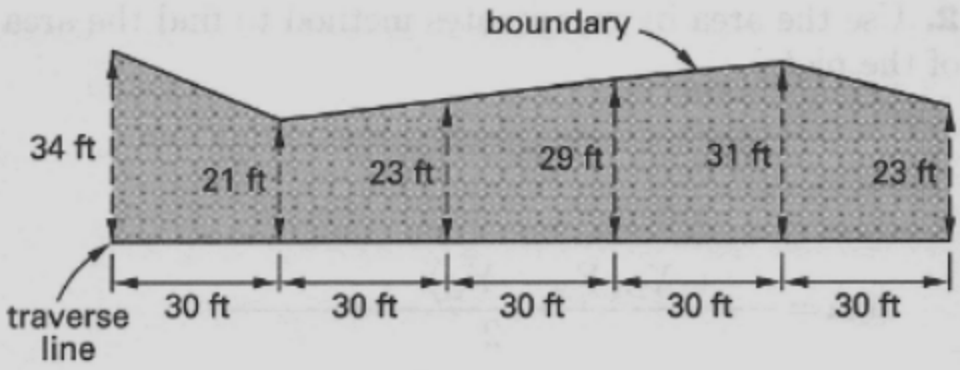


- 5.4 acres
- 5.1 acres
- 5.0 acres
- 5.3 acres

104 Multiple Choice 1 point

Calculator

Boundary and traverse lines bounding an irregular area are shown.



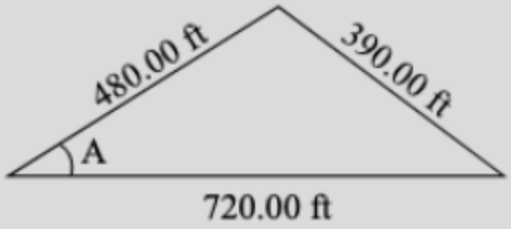
The total area between the irregular boundary and the traverse line is most nearly

- 4000 ft^2
- 3800 ft^2
- 3600 ft^2
- 4200 ft^2

105 Multiple Choice 1 point

Calculator

The value of angle A in the figure is most nearly:



NOT TO SCALE

- 39^{o} 05' 38"
- 42^{o} 35' 09"
- 30^{o} 18' 47"
- 32^{o} 47' 50"