FE Mechanical Practice Exam 2026

40 exam-style questions — print it, take it on paper, then check the key.

Every question is original, written to the official exam blueprint — practice questions, not leaked ones. Answer letters are in the key on the last page; every full explanation is free on the practice page in the footer.

1. In a counterflow heat exchanger, hot water enters at 90°C and leaves at 50°C, while cold water enters at 20°C and leaves at 60°C. Both streams have equal mass flow rate and specific heat. What can be concluded about the heat exchanger's energy balance?

A. The energy balance is satisfied, because both streams experience the same 40°C temperature change, consistent with their equal mass flow rates and specific heats
B. The heat exchanger must be operating in parallel flow rather than counterflow, based on these temperatures
C. The energy balance is violated because the cold stream's exit temperature exceeds the hot stream's exit temperature
D. The energy balance cannot be evaluated without knowing the overall heat transfer coefficient

2. A cast iron component fractures suddenly with little visible plastic deformation prior to failure, while a low-carbon steel component of similar geometry necks visibly before fracturing under similar loading. What does this comparison best illustrate?

A. Cast iron has a higher ductility than low-carbon steel
B. Both materials exhibit identical fracture toughness because they are both iron-based alloys
C. Cast iron behaves in a brittle manner while the low-carbon steel behaves in a ductile manner
D. The steel component failed due to brittle fracture while the cast iron exhibited ductile yielding

3. A force of 200 N is applied at the end of a 0.5 m wrench handle, directed perpendicular to the handle. What moment does this force create about the bolt at the other end of the handle?

A. 10 N·m, from a decimal-placement error in the multiplication
B. 100 N·m, from multiplying the force by the perpendicular lever arm
C. 25 N·m, from squaring the lever arm and dividing by an unrelated factor
D. 400 N·m, from dividing the force by the lever arm instead of multiplying

4. A machine shaft is subjected to a cyclic stress amplitude below the material's endurance limit. Based on typical fatigue behavior described by an S-N curve, what is the expected outcome for the shaft's fatigue life?

A. The shaft can theoretically withstand an essentially infinite number of cycles without fatigue failure
B. The shaft's fatigue life is independent of stress amplitude once the stress is below the ultimate tensile strength
C. The shaft will fail immediately, because any cyclic stress causes fatigue cracking
D. The shaft will fail after exactly 10^3 cycles regardless of the stress level

5. Five tensile test specimens yield ultimate strengths of 60, 62, 58, 64, and 61 ksi. What is the sample standard deviation of these results, using n-1 in the denominator?

A. 2.00 ksi, from dividing the sum of squared deviations by n instead of n-1 before the square root
B. 4.47 ksi, from taking the square root of the sum of squared deviations without dividing by n-1
C. 2.24 ksi, from dividing the sum of squared deviations by n-1 = 4 and taking the square root
D. 1.58 ksi, from dividing the sum of squared deviations by 2n before the square root

Source: National Council of Examiners for Engineering and Surveying (NCEES)

6. A pump delivers water at a flow rate of 0.02 m^3/s against a total head of 30 m. Using a water density of 1000 kg/m^3 and g = 9.81 m/s^2, what is the hydraulic power required, using P = gQH?

A. 58.9 kW, from a decimal-placement error of a factor of 10

B. 11.8 kW, from using a total head of 60 m instead of the given 30 m

C. 0.6 kW, from omitting the gravitational acceleration term entirely

D. 5.89 kW, from evaluating P = gQH with the given values

7. A pressure transducer has a stated accuracy of ±0.5% of its full-scale range of 200 kPa. What is the maximum expected measurement error, in kPa, for a reading taken anywhere within this transducer's range?

A. 0.5 kPa, from an arithmetic slip while applying the percentage to the full-scale range

B. 1.0 kPa, from applying the stated percentage to the full-scale range

C. 10 kPa, from treating the stated 0.5% accuracy as if it were 5%

D. 2.0 kPa, from doubling the correctly computed error value

8. Water flows through a pipe that narrows from a diameter of 100 mm to 50 mm. If the velocity in the larger section is 2 m/s, what is the velocity in the smaller section, using the continuity equation A1V1 = A2V2?

A. 8 m/s, from scaling velocity by the square of the diameter ratio, matching the ratio of cross-sectional areas

B. 2 m/s, from assuming velocity stays constant because volumetric flow rate is constant

C. 16 m/s, from scaling velocity by the cube of the diameter ratio instead of the square

D. 4 m/s, from scaling velocity by the ratio of diameters instead of the ratio of areas

9. A power plant operating on a Rankine cycle rejects 600 kJ/kg of heat in the condenser while the boiler adds 1000 kJ/kg of heat to the working fluid. What is the thermal efficiency of the cycle?

A. 400%, from using the net work value directly as a percentage without dividing by the heat added

B. 40%, from computing net work as heat added minus heat rejected and dividing by heat added

C. 167%, from inverting the ratio of heat added to net work

D. 60%, from reporting the fraction of heat rejected as if it were the thermal efficiency

10. A simple proportional feedback control system is used to regulate the speed of a motor. Increasing the proportional gain of the controller generally has what effect on the system's steady-state error and stability margin?

A. Gain has no effect on either steady-state error or stability in a feedback system

B. Steady-state error tends to decrease, but excessively high gain can reduce the stability margin and cause oscillation or instability

C. Steady-state error always increases while stability always improves, regardless of the gain value

D. Increasing gain always improves both steady-state error and stability with no trade-off

11. A resistive heating element draws 4 A of current when connected to a 120 V supply. What is the power dissipated by the element?

A. 14,400 W, from squaring the voltage without dividing by resistance

B. 124 W, from adding the voltage and current instead of multiplying them

C. 30 W, from dividing the voltage by the current instead of multiplying

D. 480 W, from multiplying the voltage by the current using P = VI

12. A piece of equipment is purchased for $80,000 and has an estimated salvage value of $10,000 after a 7-year useful life. Using straight-line depreciation, what is the annual depreciation charge?

A. $8,750/year, from dividing the depreciable amount by an incorrect 8-year life

B. $10,000/year, from dividing the depreciable amount of $70,000 by the 7-year life

C. $70,000/year, from failing to divide the depreciable amount by the useful life at all

D. $11,429/year, from dividing the full purchase price by the useful life without subtracting salvage value

13. At a point in a loaded machine component, the stress state consists of a normal stress of 80 MPa (tension) and a shear stress of 30 MPa on the same plane, with no stress on the perpendicular plane. What is the maximum principal stress at this point, using 1 = x/2 + sqrt((x/2)² + xy²)?

A. 90 MPa, from evaluating 40 + sqrt(40² + 30²)

B. 50 MPa, from omitting the x/2 term and using only the square-root term

C. 110 MPa, from simply summing the given normal and shear stresses

D. 10 MPa, from computing the minimum rather than the maximum principal stress

14. Determine the value of the definite integral of (3x² - 4x + 1) evaluated from x = 0 to x = 2.

A. 10, from an arithmetic slip while combining the evaluated terms

B. 2, from correctly forming the antiderivative x³ - 2x² + x and evaluating it at the limits

C. 18, from a sign error that turns -4x into +4x in the antiderivative

D. 0, from omitting the constant term when forming the antiderivative

15. A rigid tank contains an ideal gas at 300 K and 200 kPa. If the tank is heated at constant volume until the pressure reaches 250 kPa, what is the final temperature of the gas?

A. 375 K, from scaling the initial temperature by the ratio of final to initial pressure

B. 300 K, from assuming temperature stays constant simply because volume is held constant

C. 240 K, from inverting the pressure ratio used to scale the initial temperature

D. 350 K, from adding a fixed increment rather than applying a proportional scaling

16. A simply supported beam 6 m long carries a single concentrated load of 12 kN located 2 m from the left support. What is the reaction force at the right support?

A. 8 kN, which is actually the reaction at the left support rather than the right

B. 6 kN, from splitting the load evenly between the two supports

C. 4 kN, from summing moments about the left support and solving for the right reaction

D. 12 kN, from assuming the right support alone carries the full applied load

17. A steel rod with a cross-sectional area of 500 mm² is subjected to an axial tensile load of 100 kN. What is the normal stress in the rod?

A. 50 MPa, from using an incorrect area of 2000 mm² in the calculation

B. 20 MPa, from a decimal-placement error in the division

C. 200 MPa, from dividing the axial load by the given cross-sectional area

D. 500 MPa, from using an incorrect area of 200 mm² in the calculation

18. A medium-carbon steel part is heated above its critical transformation temperature and then rapidly quenched in water, rather than being furnace-cooled slowly. What is the primary effect of this rapid quenching on the steel's microstructure and resulting mechanical properties?

A. It has no effect on microstructure, since cooling rate does not influence phase transformation

B. It promotes formation of coarse pearlite, increasing ductility and reducing hardness

C. It promotes formation of martensite, increasing hardness and strength but reducing ductility

D. It causes the steel to fully anneal, softening the material uniformly

19. A component on a rotating machine travels in a circular path of radius 0.3 m at a constant angular velocity of 100 rad/s. What is the magnitude of the centripetal acceleration of the component?

A. 3000 m/s², from evaluating a = ²r with the given values

B. 30 m/s², from using a = r instead of a = ²r

C. 33,333 m/s², from mistakenly dividing ² by r instead of multiplying

D. 300 m/s², from a decimal-placement error in the final multiplication

20. A steel bar is rigidly fixed at both ends so it cannot expand or contract. If the bar's temperature increases by 40°C, and steel has a coefficient of thermal expansion of about 12×10-6/°C and a modulus of elasticity of 200 GPa, what is the magnitude of the thermal stress induced in the bar?

A. 192 MPa, from using a temperature change of 80°C instead of the given 40°C

B. 96 MPa, from evaluating = ET with the given values

C. 48 MPa, from using a temperature change of 20°C instead of the given 40°C

D. 9.6 MPa, from a decimal-placement error of a factor of 10

21. Two force vectors are given as A = 3i + 4j (N) and B = 4i - 3j (N). What is the angle between vectors A and B?

A. 45°, from averaging the directions of the two vectors without computing the dot product

B. 90°, from finding that the dot product A·B equals zero

C. 0°, from assuming the vectors are parallel because they share the same component magnitudes

D. 180°, from assuming the vectors point in exactly opposite directions

22. A solid block with a volume of 0.05 m³ and a density of 600 kg/m³ is fully submerged in water (density 1000 kg/m³). Using g = 9.81 m/s², what is the net vertical force on the block due to buoyancy and gravity combined?

A. 294.3 N downward, from accounting only for the block's weight and ignoring buoyancy

B. 98.1 N upward, from using an incorrect density difference of 200 kg/m³ instead of the actual 400 kg/m³

C. 490.5 N upward, from accounting only for the buoyant force and ignoring the block's weight

D. 196.2 N upward, from subtracting the block's weight from the buoyant force computed with the water's density

23. A machine component of mass 4 kg is mounted on a spring with stiffness 1600 N/m. What is the undamped natural frequency of vibration of this system, in rad/s, using n = sqrt(k/m)?

A. 0.05 rad/s, from inverting the ratio of stiffness to mass before taking the square root

B. 20 rad/s, from evaluating sqrt(1600/4)

C. 400 rad/s, from omitting the square root in the calculation

D. 14.1 rad/s, from using twice the given mass in the calculation

24. Three forces act concurrently at a point: F1 = 100 N at 0°, F2 = 100 N at 90°, and F3 acts at 225° (measured from the positive x-axis). For the point to be in static equilibrium, what must be the magnitude of F3?

A. 141.4 N, from matching the magnitude of the resultant of F1 and F2

B. 70.7 N, from taking half of the resultant of F1 and F2

C. 200 N, from simply summing the magnitudes of F1 and F2

D. 100 N, from assuming F3 needs to balance only one of the two other forces

25. A hot plate with a surface area of 2 m² and a surface temperature of 80°C is cooled by air at 20°C, with a convective heat transfer coefficient of 15 W/(m²·K). What is the rate of convective heat loss from the plate, using Q = hAT?

A. 1800 W, from evaluating Q = hAT with the correct temperature difference of 60°C

B. 900 W, from using half of the actual temperature difference

C. 120 W, from omitting the convection coefficient from the calculation

D. 2400 W, from using the plate's absolute surface temperature instead of the temperature difference

26. During a project, an engineer identifies that specifying a cheaper alloy would save the client money but would reduce the safety margin of a rotating component below accepted design practice. The client insists on the cheaper alloy. What should the engineer do?

A. Resign from the project without informing the client of the underlying safety reason

B. Specify the cheaper alloy but omit the reduced safety margin from the calculations

C. Comply with the client's wishes, since the client is paying for the work

D. Refuse to proceed with the unsafe specification and explain the safety risk to the client, escalating if necessary

27. A licensed engineer discovers that a colleague's design report contains a calculation error that could compromise the structural safety of a pedestrian bridge already under construction. According to standard engineering codes of ethics, what is the engineer's primary obligation in this situation?

A. Say nothing, since the report was not authored by this engineer

B. Correct the report quietly without informing anyone, to avoid conflict with the colleague

C. Wait until the bridge is complete to see whether the error causes a visible problem

D. Report the safety concern to the appropriate parties, holding paramount the safety, health, and welfare of the public

28. A capacitor with a capacitance of 10 F is charged to 100 V. How much energy is stored in the capacitor, using $E = (1/2)CV^2$?

A. 50 J, from mistaking the 10 F capacitance for 10 mF

B. 0.05 J, from evaluating $(1/2)(10\times10\text{-}6)(100)^2$

C. 0.10 J, from omitting the factor of one-half in the energy formula

D. 0.0005 J, from using V instead of V^2 in the calculation

29. A manufacturer is choosing between two machines. Machine A has a fixed cost of $20,000/year and a variable cost of $8/unit. Machine B has a fixed cost of $35,000/year and a variable cost of $5/unit. At what annual production volume do the two machines have equal total cost?

A. 3,000 units, from using a variable-cost difference of $5 instead of the actual $3 difference

B. 15,000 units, from dividing only the fixed-cost difference by the variable cost of Machine A

C. 5,000 units, from setting 20,000 + 8Q equal to 35,000 + 5Q and solving for Q

D. 1,875 units, from dividing the sum of the fixed costs by the sum of the variable costs

30. A straight conductor carrying a current of 5 A is placed perpendicular to a uniform magnetic field of 0.2 T. If the conductor length within the field is 0.4 m, what is the magnitude of the magnetic force on the conductor, using F = BIL?

A. 1.0 N, from using a conductor length of 1 m instead of the given 0.4 m

B. 4.0 N, from a decimal-placement error in multiplying the three given values

C. 0.4 N, from evaluating F = (0.2)(5)(0.4)

D. 0.04 N, from a decimal-placement error in the opposite direction

31. An engineer invests $10,000 today in a fund that grows at an annual compound interest rate of 8%. Approximately how much will the investment be worth after 10 years, using F = P(1+i)^n?

A. $21,589, from evaluating 10,000 × (1.08)^10

B. $18,000, from computing simple rather than compound interest

C. $25,937, from using a 10% growth rate instead of the given 8% rate

D. $10,800, from applying only a single year of growth instead of 10 years

32. A projectile is launched horizontally from a height of 20 m above the ground with an initial speed of 15 m/s. Using g = 9.81 m/s² and neglecting air resistance, what is the horizontal distance traveled when the projectile lands?

A. 40.0 m, from using an incorrect fall-time formula that overstates the time of flight

B. 60.0 m, from assuming a fall time that is double the correct value

C. 15.0 m, from assuming the fall time is exactly 1 second

D. 30.3 m, from finding the correct fall time of about 2.02 s and multiplying by the horizontal speed

33. A linear regression relating applied load (x) to measured deflection (y) for a beam yields a correlation coefficient r = 0.98. What does this value indicate about the relationship between load and deflection in the tested range?

A. The relationship is strong but must be quadratic rather than linear

B. Only 2% of the variation in deflection is explained by the load

C. Deflection is the cause of the applied load increasing, rather than the reverse

D. There is a strong, nearly linear positive relationship between load and deflection

34. A composite flat bracket consists of a rectangular plate 6 cm wide by 2 cm tall (area 12 cm^2, centroid 1 cm from the base) bonded directly beneath a second rectangular plate 6 cm wide by 4 cm tall (area 24 cm^2, centroid 4 cm from the base). What is the y-coordinate of the centroid of the composite section, measured from the base?

A. 3.0 cm, from computing the area-weighted average of the two centroid locations

B. 2.0 cm, from swapping the two areas when applying the weighting

C. 3.33 cm, from using an incorrect total area of 32 cm^2 in the denominator

D. 2.5 cm, from simply averaging the two individual centroid locations without weighting by area

35. A solid disk flywheel with a mass moment of inertia of 5 $kg \cdot m^2$ is subjected to a net torque of 15 N·m. What is the resulting angular acceleration of the flywheel?

A. 3 rad/s^2, from dividing the net torque by the mass moment of inertia

B. 10 rad/s^2, from an arithmetic slip in the division

C. 75 rad/s^2, from multiplying torque and inertia instead of dividing

D. 0.33 rad/s^2, from inverting the ratio of inertia to torque

36. A flat wall 0.2 m thick has a thermal conductivity of 0.8 W/(m·K) and a cross-sectional area of 10 m^2. If the temperature difference across the wall is 25°C, what is the rate of heat conduction through the wall, using Fourier's law Q = kAT/L?

A. 500 W, from using a wall thickness of 0.4 m instead of the given 0.2 m

B. 100 W, from omitting the area term from the calculation

C. 40 W, from multiplying by the wall thickness instead of dividing by it

D. 1000 W, from evaluating Q = kAT/L with the given values

37. Two identical-geometry connecting rods are produced, one by sand casting and one by hot forging. Assuming no other defects, which statement best reflects the expected difference in mechanical properties between the two parts?

A. The forged rod generally has superior strength and fatigue resistance due to grain refinement and reduced internal porosity

B. The cast rod is stronger, because casting always produces a finer grain size than forging

C. The cast rod generally has superior fatigue resistance because casting produces a more uniform grain structure than forging

D. Both parts have identical mechanical properties because both are made from the same base alloy

38. A mechanical engineer serves as an expert witness in a product liability case. The engineer's honest analysis would not favor the party paying for the testimony. What does professional ethics require of the engineer?

A. Decline to testify unless the analysis can be adjusted to favor the paying party

B. Delay the testimony indefinitely to avoid the conflict

C. Present the findings objectively and truthfully, regardless of which party they favor

D. Present only the portions of the analysis that support the client's position

39. During a tensile test, a specimen experiences a stress of 210 MPa and a corresponding strain of 0.00105 within the linear elastic region. What is the modulus of elasticity of this material, and which common engineering material does that value most closely correspond to?

A. 2 GPa, consistent with a polymer, from a decimal-placement error in the division

B. 400 GPa, exceeding typical structural metals, from a factor-of-two error in the division

C. 70 GPa, consistent with aluminum, from using an incorrect strain value in the division

D. 200 GPa, consistent with steel, from dividing the given stress by the given strain

40. Water (density 1000 kg/m³, dynamic viscosity 0.001 Pa·s) flows through a 50 mm diameter pipe at an average velocity of 2 m/s. What is the Reynolds number of this flow, and is the flow laminar or turbulent?

A. Re ~ 100,000; turbulent, from evaluating Re = VD/ and comparing it to the typical transition threshold

B. Re ~ 10,000; turbulent, from a decimal-placement error of a factor of 10 in the calculation

C. Re ~ 100,000; laminar, from computing the correct Reynolds number but drawing the wrong flow-regime conclusion

D. Re ~ 100; laminar, from omitting the density term when computing Reynolds number

Answer key

1. A 2. C 3. B 4. A 5. C

6. D 7. B 8. A 9. B 10. B

11. D 12. B 13. A 14. B 15. A

16. C 17. C 18. C 19. A 20. B

21. B 22. D 23. B 24. A 25. A

26. D 27. D 28. B 29. C 30. C

31. A 32. D 33. D 34. A 35. A

36. D 37. A 38. C 39. D 40. A

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