

Practice Examination #2: Afternoon Session

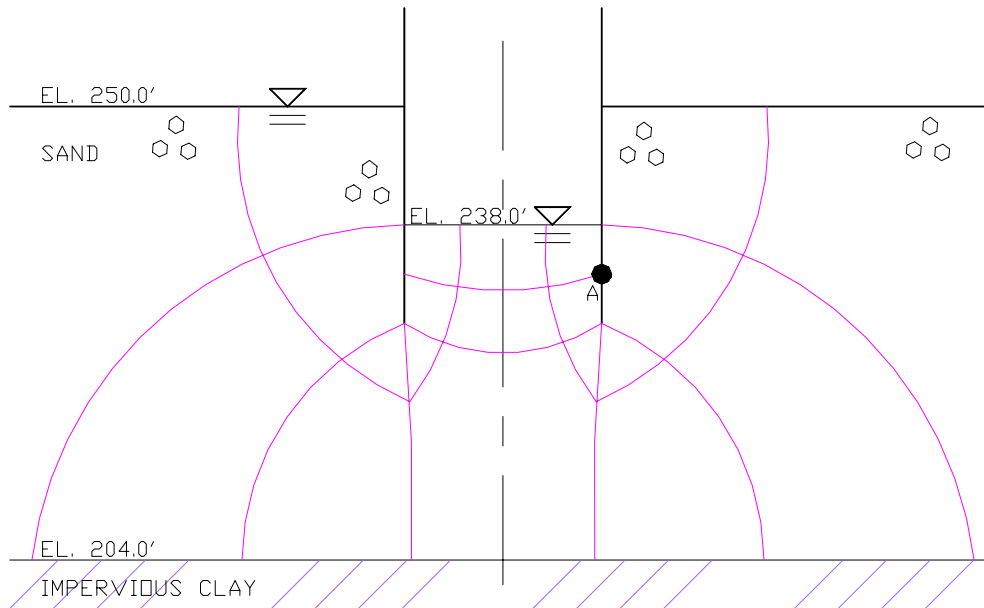
Soil and Water

501. A commercial grower in southeastern Virginia has hired your company to design and construct a drip irrigation system for one of their 250 acre fruit tree orchards. The orchard has a slope of 1% and the trees are spaced every 25 feet, on-center. What is an acceptable design emission (emitter) uniformity percentage for the designed system?

- a) 78%
- b) 81%
- c) 86%
- d) 91%

502. A cross-section of an excavation is as shown below. Two sheetpiles are used to support a 20' wide x 12' deep utility excavation in a sandy soil, characterized by a permeability of 0.1 ft./min., a void ratio of 0.5 and a specific gravity of 2.75. The bottoms of the sheetpiles are driven to a depth of 34' below the ground surface and the interior of the excavation is dewatered to an elevation of 238.0 ft.

The engineer in charge of the project has provided the following flow net for the excavation section to be evaluated:



Determine the pore water pressure at point A, which lies on the inside face of the sheetpile at an elevation of 230 ft.:

- a) 499.2 lbs/ft²
- b) 624.0 lbs/ft²
- c) 873.6 lbs/ft²
- d) 1622.4 lbs/ft²

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503. If a soil material used for the liner is highly calcareous and is classified as a CL (Unified Soil Classification System) soil. Which soil amendment would cost effectively decrease the permeability of the soil.:
- a) Soda Ash (NaCO_3)
 - b) Bentonite
 - c) Poly Acrylamide
 - d) All of the above
504. A cross-stream water storage impoundment is to be located at the base of a watershed which has a 25-year return period peak runoff rate of $2.0 \text{ m}^3/\text{s}$ and a water surface area of 0.81 hectares at the design (normal) water level. The top of the embankment is at an elevation of 263.2 meters and the original stream at the centerline of the embankment is at an elevation of 258.6 meters. What size in inches is required for the principle spillway. The project specifications mandate that the principal spillway can only be constructed of Schedule 40 PVC pipe.
- a) 8
 - b) 10
 - c) 12
 - d) 14
505. Which of the following causes the most non-point source pollution to rivers in the U.S.?
- a) Microbial pathogens
 - b) Industrial waste discharges
 - c) Nutrients
 - d) Siltation

506. Evapotranspiration

507. Principals of nutrient management/loading rates in soils

508. Water Quality, Evapotranspiration, irrigation, or nutrient management

Power and Machinery

509. The tongue of a certain implement is expected to withstand a static load of 25000 lb with a factor of safety of 3.0. The tongue is made from 3" (outside dimension) square tubing 1/4" thick. Which of the following materials is sufficient?
- a) 1008HR
 - b) 1010HR
 - c) 1015HR
 - d) 1030HR

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510. A round solid rod is used to power an oscillator on a machine and experiences loads varying from 8000 lb in compression to 2000 lb in tension. If SAE 1030HR steel is used what diameter in inches is required to maintain a factor of safety of 3.0?

- a) 0.75
- b) 1.00
- c) 1.25
- d) 1.50

511. How many liters of diesel fuel could a 4.0 liter engine theoretically burn per hour if it is naturally aspirated and has a volumetric efficiency of 85% at 2500 rpm? Assume a stoichiometric air to fuel ratio based on cetane. Assume a typical day with air density of 1.15 kg/m^3 .

- a) 10
- b) 15
- c) 20
- d) 25

512. A 12V mobile vehicle system has a changeover circuit to use the two 12V batteries in series during starting to get 24V. If the starter motor requires 6kW, which of the following size in millimeters, conductors (wire) should be used, assuming an intermittent load and an allowed temperature rise of 150°C ? 2 mm, 4 mm, 5 mm, 8 mm

- a) 5
- b) 6
- c) 7
- d) 8

513. In a simple pump-motor hydraulic circuit, motor torque demand is 2000 in-lb and motor displacement is $5 \text{ in}^3/\text{rev}$. The pump is driven at 1600 rpm and has a displacement of $6 \text{ in}^3/\text{rev}$. Assuming a system efficiency of 60%, the power in horsepower that the pump prime mover needs to provide is most nearly.

- a) 75
- b) 100
- c) 125
- d) 150

514. A bucket elevator is to be used to convey grain 35 meters vertically at a rate of 2000 kg/min. If the conveyor has a power efficiency of 90%, how much power (kW) does the transmission system need to provide to the sprocket powering the bucket chain?

- a) 9.6

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- b) 10.9
- c) 11.4
- d) 12.7

515. A certain model ball bearing has an average life of 1500 hours at 1000 rpm when the radial load is 800 lb and at 1400 rpm if the radial load is 1100 lb. The expected average life in hours is most nearly.

- a) 400
- b) 600
- c) 800
- d) 1000

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Processing / Handling Biological Products

516. Air at 27°C is flowing through a packed bed that is 3 meters in height. The packing consists of cubes of 5 mm on a side, and the porosity of the bed is 0.45. The air enters with a pressure of 5 bars, and has an average density (average of inlet and discharge conditions) of 5.239 kg / m³. The Reynolds Number of the particle (N_{ep}) is 225.1. The mass velocity of the air is 3000 kg/hr×m². What is the exit pressure of the air (bars) is most nearly:

- a) 4.99
- b) 0.0102
- c) 4.39
- d) 4.01

517. Air at 40°C is flowing through a packed bed that is 5 meters in height. The air enters at an absolute pressure of 10 bars and leaves with a temperature of 200°C. The viscosity of the air at the stated flow conditions is 1.85 x 10⁻⁵ Pa×s. The approximate density of the air (kg/m³) in the system is most nearly:

- a) 5.57
- b) 4.62
- c) 3.68
- d) 3.15

518. Fundamental physical chemistry

519. Air with a density of 8.711 kg / m³ is flowing through a packed bed. The superficial velocity of the air is 0.45 m / sec. The packing consists of cubes of 5 mm on a side having a porosity of 0.45. The viscosity of the air is 2.31 x 10⁻⁵ Pa×s. At the stated conditions the flow is:

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- a) laminar
- b) transient
- c) supersonic
- d) turbulent

520. Compatibility of biological materials

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Structures and Environment

521. Which of the following gases is the greatest danger in a manure storage?

- a) carbon dioxide
- b) nitrogen
- c) ammonia
- d) hydrogen sulfide

522. In using diaphragm design of a post frame building each post is:

- a) ignored
- b) considered infinitely stiff
- c) considered a part of the elemental frame
- d) loaded only in the vertical direction

523. Electrical wiring and fixtures in livestock housing should be:

- a) dust-tight
- b) explosion proof
- c) hidden inside the walls
- d) all metal

524. In the design of a long, thin steel beam, which would be the most important?

- a) bracing of the bottom flange
- b) bracing of the top flange
- c) neither need bracing
- d) both are of equal importance

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525. Estimate the wind (perpendicular to building) induced ventilation in a building where the eave and ridge areas are each equal to 40 m^2 . The $12 \text{ m} \times 40 \text{ m}$ building is located in sheltered area with large trees and the wind velocity at 10 m is 8.0 m/s . The eave height is 4 m .
- a) 220
 - b) 152
 - c) 193
 - d) 277
526. Air flow through a 25 m^2 inlet has a velocity of 5 m/s . If the coefficient of discharge is 0.6 and the air density is 1.2 kg/m^3 , what is the pressure difference (Pa) between inside and outside?
- a) 5.0
 - b) 25
 - c) 0.3
 - d) 7.5
527. What should be the design wind load in pounds on a 72 ft long horizontal conveyer that is suspended 85 foot in the air between a vertical elevator and a bin? The conveyer is 42 in. deep and 24 in wide, and it is located in central Iowa.
- a) 52.6
 - b) 5441
 - c) 2628
 - d) 4734

Biological Systems

528. What is the volume in cubic feet of a lagoon that is 12 ft deep, 180 ft long, 60 ft wide and has side slopes of $3:1$?
- a) 46,700
 - b) 25,900
 - c) 129,600
 - d) 97,300
529. All of the following represent source characterization of a chemical likely to contaminate groundwater reservoirs, EXCEPT:
- a) total mass (or volume) of chemical released
 - b) flow time of chemical to the nearest well or critical recharge area
 - c) total surface area affected by infiltration of the chemical
 - d) time sequence of chemical release

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530. A 2" water line from a well supplies a one story commercial building with potable (domestic) water. The building is in operation 16 hours per day. On average, water use over this period is approximately twelve (12) gallons per minute, with peak demand at approximately forty (40) gallons per minute for a two-hour period in the middle of the operational day. Recent water testing has revealed nitrate-nitrogen concentration levels in the water at approximately 14 mg/L. Specify the most appropriate water treatment system to reduce the nitrate-nitrogen concentration levels in this water to below those specified in the drinking water standards.
- a) Ion Exchange System
 - b) Charcoal Filter System
 - c) Ultraviolet (UV) Filter System
 - d) Reverse Osmosis System

531. Biological Systems, Environmental and Ecological Systems

Agricultural Engineering Principles

532. A roof truss for a post frame building to be located in the northern US should be design for which of the following load combinations?
(L = live load; D = dead load; S = snow load; W = wind load; T = total load)
- a) $T/3$
 - b) $2D + L + S + W$
 - c) $D + L + W + S/2$
 - d) $D + 2L + S$
533. How much moisture (g/s) is removed by a ventilation air flow rate of $4 \text{ m}^3/\text{s}$, if the incoming air is 5C, 80% relative humidity (RH) and the outgoing air is 22C, 60% RH?
- a) 47.0
 - b) 1.19
 - c) 26.4
 - d) 22.4

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534. Calculate the heat loss (BTU/h) from a room which is 20 ft by 30 ft by 12 ft high and has one 3 ft by 8 ft door. Ignore heat loss through the floor. The inside and outside temperatures are 50°F and -10°F, respectively. Use the following R-values:

Walls	24 hr-ft ² -F/Btu
Ceiling	30 hr-ft ² -F/Btu
Door	4 hr-ft ² -F/Btu

- a) 4500
b) 4560
c) 34134
d) 3000
535. What would be the total R-value (m²C/W) for a wall composed of four layers having the following R-values? R₁ = 0.4 m²C/W; R₂ = 42 mC/W (50 mm thick); R₃ = 14 mC/W (12 mm thick); and R₄ = 0.02 m²C/W.

- a) 56
b) 2268
c) 2007
d) 3

536. Core Knowledge
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539. Equipment Applications
540. Professional Practice