BIOE 332

Dr. Johnson

Quiz Questions

Discussion

What are two purposes of the introduction section of the design report?

Give three likely characteristics of the client who hires a consulting engineer.

Give three attributes of the person who is likely to read your design repot.

What are two purposes for the Introduction Section of a Design Report?
What does errata mean?

a. It's Latin for erratic
b. It's Latin for professor
c. It's Latin for errors
d. It's Latin for engineering

Who wrote the course textbook?

How many paragraphs should your summary contain?

Outline the general steps used in problem solving.

What information should be included in the summary?

Should you do more work than asked for in a design report? Why or why not?

What are two purposes of the introduction section of the design report?

Give three attributes of the person who is likely to read your design report.

What are two purposes for the Introduction Section of a Design Report?

Briefly discuss the relevance of ethos, logos, and pathos to an engineering design report.

Correct the following sentence from an engineering design report:
"As far as I know, there is no doubt that viscosity ought to be assumed to be valued at 0.00157 N sec/m^2 and I will do so."

Contrast the styles of a design report written for technical and no technical audiences.

Correct the following sentence from an engineering design report:
"As far as I know, there is no doubt that viscosity ought to be assumed to be valued at 0.00157 N sec/m^2 and I will do so."

The following are data describing a publication:

Title: Mixed convection about fruits.
Authors: Liangyou Tang and Arthur T. Johnson
Library Call Number: QPI J86
Pages: 15 though 27
Journal: Journal of Agricultural Engineering Research
Volume: 51
Year: 1992
Address of Authors: Agricultural Engineering Department,
University of Maryland
College Park, MD 20742

Indicate how this publication should appear in the list of references at the end of the design report.

Compare ethos, logos, and pathos. What place should each of these have in the design report.

Correct the following sentence from an engineering design report:

"As far as I know, there is no doubt that viscosity ought to be assumed to be valued at 0.00157 N sec/m^2 and I will do so."

Correct the following sentence:

Fluid which flows through a pipe demonstrates inertance.

Correct the following sentence:

A balloon which increases pressure as its volume increases demonstrates inertance.

What things must be kept in mind when using graphics in your report?

Where do you place the caption on the figures?

Where do you place the captions on a table?

What are two purposes of the introduction section of a design report?

Give an example of passive voice. When is the use of passive voice to be preferred? How does this relate to writing a design report?

Given the following information:

Title: Philosophical Foundations of Biological Engineering
Journal: Journal of Engineering Education

Authors: Arthur T. Johnson and Winfred M. Phillips
Date: October 1995
Volume: vol. 84, number 4
Pages: 311-318
Publisher: American Society for Engineering Education
Library Call Number: TK J18.A4
"How would reference be made to this article in the bibliography"

Explain the type of information that is put into the design concept section of the design report.

Given the following information:

Title: Philosophical Foundations of Biological Engineering
Journal: Journal of Engineering Education
Authors: Arthur T. Johnson and Winfred M. Philips
Date: October 1995
Volume: Vol84, number 4
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Publisher: American Society of Engineering Education
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How would reference be made to this article in the bibliography?

Explain the type of information that is put into the design concept section of the design report.

List two of the four steps involved in problem solving as given in Videotape #1.

The following are data describing a publication:

Title: mixed convection about fruits
Authors: Liangyou Tan and Arthur T. Johnson
Library Call Number QP1 J86
Pages: 15 through 27
Journal: Journal of Agricultural Engineering Research
Volume: 51
Year 1992
Address of Authors: Agricultural Engineering Department
University of Maryland
College Park, MD 20742

Indicate how this publication should appear in the list of references at the end of the design report.

What are the purposes of the Introduction Section of the Design Report?

The following sentences appeared in a design report. What is wrong with them?
"Values for specific gravity for the fluids in question were found to be 102 and 1.04 respectfully. It is my opinion that their will be no further correction necessary."

You want to refer to an article in the library:

Call Number is: QX432.6
Journal is: Journal of Applied Betterment
Volume and number are: 56, no. 2
Month and year are: July 1987
Article is found on pages: 384 through 389
Title of the article is "Improving Life through Biological Engineering"
Author is: Peale V. Norman, P.E.

Compose the bibliographic entry to describe this article.

How should the following references be cited in the text of your design report (454 students) or biological examples (603 students)?

Title: Mixed convection about fruits.
Authors: Liangyou Tang and Arthur T. Johnson
Library Call Number: QPI.J86
Pages: 15 through 27
Journal: Journal of Agricultural Engineering Research
Volume: 51
Year: 1992

List 3 likely characteristics of the person to which your design report will be written.

Give three attributes of the person who is likely to read your design report.

When do you use That and Which?

When do you use comprised of and composed of?

1.1

Use the following conversion factors to determine how many barrels/hour there are in 0.056 microliters/mm H_2O. Show all work.

3.281 bushel/barrel	1.422×10^{-3} psi/mmH_2O
4.0 Peck/ bushel	760 mm Hg/atm
10^{-6} liter/microliter	13.6 mm H_2O/ mm Hg
10.409 Liter-atm/BTU	0.9869 Atm/Bar
2.838×10^{-2} bushel/liter	

1.1

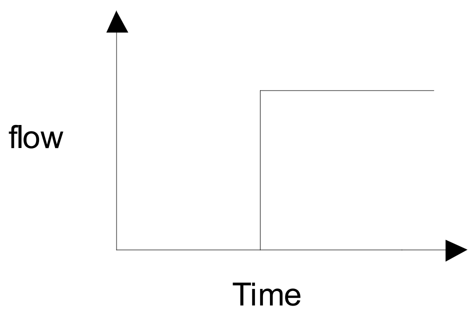
Use the following conversion factors to determine the number of scruples in a 12 oz can of miller Lite beer. Show all work.

1 oz = 28.349 g
1 dram = 6.25×10^{-2} oz
1 grain = 3.657×10^{-2} drams (avdp)
1 pound = 14.583 oz (troy)

1 scruple = 20.0 grains

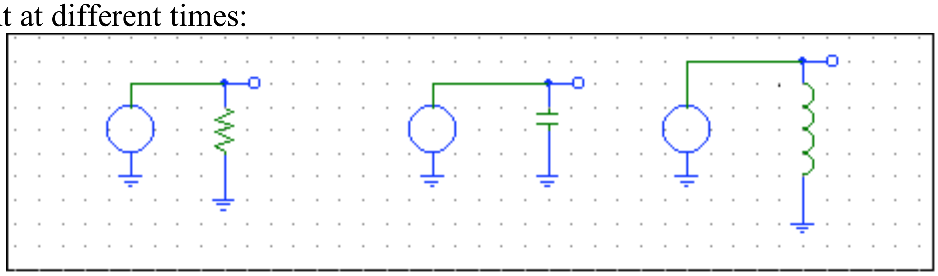
1.2
Define effort and flow variables.

1.2
If the flow variable looks like the figure below, sketch the effort variable for a resistance through which the flow flows. Also, sketch the effort variable for capacity and for an inertia.



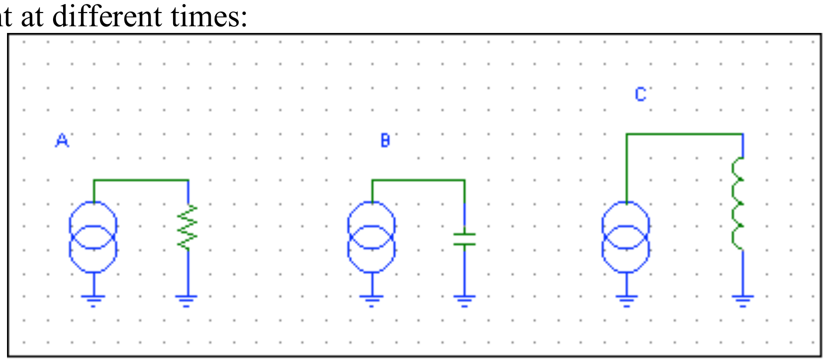
1.4
Using the equation for flow variable storage: $q = \xi V \, d\Phi/dt$ what is the system capacity?

1.4
An ideal effort source is connected to a resistance, capacity element, and an inertia element at different times:



Sketch the effort variable that appears at the output terminal for each of these cases.

1.4
An ideal flow source is connected to a resistance, a capacity element, and an inertia element at different times:



Sketch the effort variable that appears at output terminal 1 for each of these cases.

1.4.3
Describe what happens to effort in a capacity element as the flow variable accumulates?

1.4.4
Describe the effect of inertia in a system.

1.4.6
What is standard deviation of a measurement?

1.6
What would be expected if two flow sources are connected in parallel?

1.6
What would be expected if two flow sources are connected in series?

1.6 & 1.7
Which of the following statements are true?

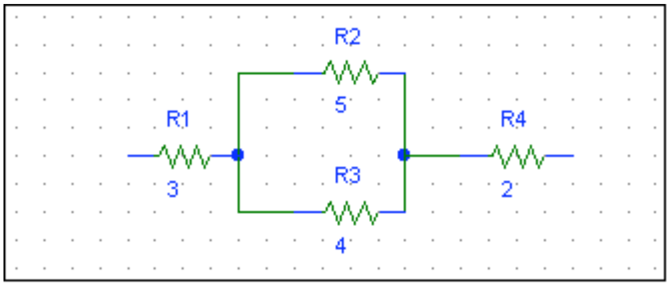
a. If two capacity elements are in series then the resulting sum is greater than either of the two.
b. The solution to a differential equation depends very strongly on the boundary condition.
c. The solution to the general field equation obtained for the hollow cylindrical shape can be applied to a solid cylinder.
d. ENBE 454 is a rotten course.

1.6.1
Draw the serial combination of two ideal flow sources. What is the consequence of this combination?

1.6.1
Draw the parallel combination of two ideal flow sources. What is the consequence of this combination?

1.6.1
What would be expected if two effort sources are connected in parallel?

1.6.2
Given the following combination of resistance:



R1=3, R2=5, R3=4, R4=2

Calculate the total resistance of this combination.

1.7

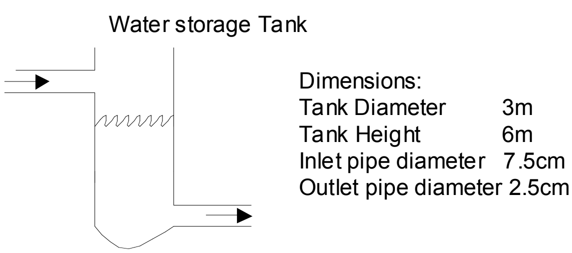
If the rate of water inflow is 0.050 m^3/sec, and the outflow is 0.025 m^3/sec, how long does it take for the tank to overflow?

1.7

If the water level in the tank is not changing, and the rate of water inflow is 0.050 m^3/sec, what is the velocity of the water in the outflow pipe?

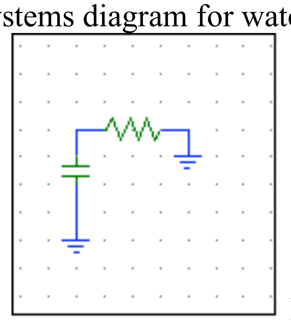
1.7

Refer to the following diagram: Write a flow balance for the tank.



1.7

The systems diagram for water flowing from a tank through a pipe is given as



Explain the meaning of each component.

1.7

If thermal capacity is 10^{-2} N m/ $^{\circ}$C and thermal resistance is 3.0 °C sec/ (N m), what value is the thermal time constant?

1.7

If the thermal capacity is 10^{-2} N m/°C and thermal resistance is 3.02 °C sec/(N m), what value is the thermal time constant? To determine the thermal time constant of the system, you decide to experimentally determine the relationship between temperature and time as you apply heat. When you plot the data on semi-log graph paper you discover that it plots as a straight line. What data should you plot on each axis of the graph in order to get a straight line, and what information can you obtain from the slope of the straight line?

1.7
Kirchhoff's generalized loop equation is:

1.7
If a transport system consists of a resistance and capacity element, what will be the time response of flow to a sudden change in effort input?

1.7
What is the generalized Kirchoff junction equation?

1.7 - 1.8
What is the essential difference between energy storage in capacity and inertia element?

1.7.2
According to the law of Lap lace, explain how the radius of curvature and wall thickness is related, assuming that the wall material doesn't vary.

1.7.2
The law of Laplace relates pressure inside a container to the wall tensile stress and the container radius. Why are the bottoms of champagne bottles concave rather than flat?

1.7.2.1
What is the law of Laplace, and how is it important in biological systems?

1.7.3
Give the general balance in words.

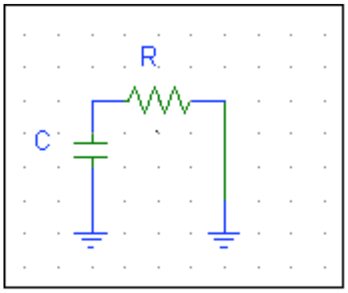
1.7.3
Give the general balance equation in words.

1.7.3.2
To determine the thermal time constant of the system in question 3, you decide to experimentally determine the relationship between temperature and time as you apply heat. When you plot the data on semi-log graph paper you discover that it plots as a straight line. What data should you plot on each axis of the graph in order to get a straight line, and what information can you obtain from the slope of the straight line?

1.7.5

An ideal effort source, a resistance, a capacity element, and an inertia element are connected in series to form a loop. Mathematically describe the effort variable across each element.

1.7.5
The systems diagram for water flowing from a tank and through a pipe is given as:



Give the systems that correspond to this diagram.

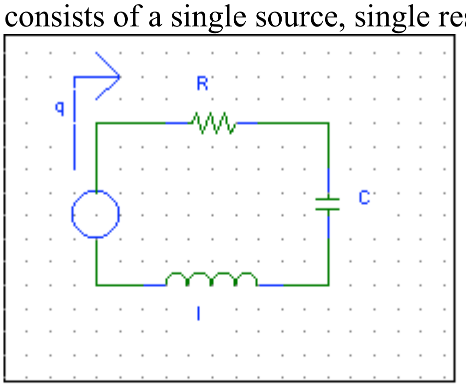
1.7.5
Kirchhoff's generalized loop equation is?

1.7.5
Kirchhoff's generalized junction equation is:

1.7.5
What is the generalized Kirchoff loop equation?

1.7.5
What is the generalized Kirchoff junction equation?

1.7.5
A loop consists of a single source, single resistance, single capacity, and single inertia:



Write Kirchoff's loop equation for this situation.

1.8
A shape is said to have a heat transfer equation of $q = k(\theta_2 - \theta_1)/(\pi^2 \cosh \eta)$. What is its thermal resistance? What are the units of this thermal resistance?

1.8.2
If the thermal resistance of a sheep fleece is 5 (°C sec)/(N m), estimate the amount of heat lost by the sheep to an environment at 10°C.

1.8.2
If the thermal resistance of a sheep fleece is 2 (°C sec)/(N m), estimate the amount of heat lost by the sheep to an environment at 10°C.

1.8.2 or 3.7.1.2
Calculate the thermal resistance of a cm^2 of human skin (2mm thick).

Thermal Conductivity	= 0.627N/(C sec)
Specific Heat	= 3470 N m/(kg C)
Density	= 1100 kg/m^3

1.8.3
If the mass transfer resistance is 20 sec/m^3, and the total mass transfer is 80 kg/sec, what is the concentration difference?

1.8.4
If thermal capacity is 10^{-2} N m/°C and thermal resistance is 3.02 C sec/(N m), what value is the thermal time constant? To determine the thermal time constant of the system, you decide to experimentally determine the relationship between temperature and time as you apply heat. When you plot the data on semi log graph paper you discover that it plots as a straight line. What data should you plot on each axis of the graph in order to get a straight line, and what information can you obtain from the slope of the straight line?

1.9
Give the systems diagram for the movement through the soil of a spill of gasoline.

1.9
Draw a thermal systems diagram of Cuong Nguyen sitting in this classroom.

1.9.1
The fire ant lays an odor trail to a food source, which disappears below threshold in two minutes. Draw a systems diagram representing the scent over time.

2.1
What are the effort variables associated with fluid flow?

2.1
Draw a systems diagram for a fluid flow mass balance.

2.1
Draw a fluid systems diagram for water in a growing plant.

2.2

The 15 cm diameter pipe in question 1 is reduced to 7.5 cm diameter. What will be the new velocity of the water in the pipe?

2.2.1
A 15 cm diameter pipe is reduced to 7.5 cm diameter. If the volume rate of flow is 0.05 m^3/sec in the larger sized pipe, what is the volume rate of flow in the smaller pipe?

2.2.1
A 5cm diameter pipe that carries flowing liquid is connected to a pipe of 2.5 cm diameter. How does the velocity in the second pipe relate to that in the first?

2.2.1
A 15 cm diameter horizontal pipe 30 m long flows full of water. It feeds into a 7.5 cm horizontal pipe 30 m also flowing full of water. If the velocity in the first section of pipe is 1.5 m/sec, what will be the velocity in the second section?

2.2.1
If the pressure in the first section of pipe in question above is 5000N/m^2, what is the pressure in the second section (neglecting friction)?

2.2.1
Fill in the following table for fluid flow:

Modes of action
Effort variables
Flow variables
Resistance
Capacity
Inertia

2.3
If the pressure in the first section of pipe in question above is 5000 N/m^2, what is the pressure in the second section (neglecting friction)?

2.3.1
Human blood pressure measured at the level of the heart is about 16.0 kN/m^2 (systolic) and 10.7 kN/m^2 (diastolic). What is the blood pressure at the level of the brain stem for an upright posture? Blood density is 1050 kg/m^3.

2.3.2
A 30m long horizontal pipe with 6.5 m^3/sec flowing full of liquid has a diameter of 5 cm. If the pipe suddenly expands to 25cm in a second 30m section, how does the average velocity change? If the pressure in the first section of pipe is 5000 N/m^2, what is the pressure in the second section (neglect friction)?

2.4
Where in the fluid in a pie will the shear stress be a maximum?

2.4.1

Given:

Temp °C	Viscosity of H_2O Kg/(m sec)	Viscosity of oil kg/(m sec)	Consistency Coefficient
10	1.3077×10^{-3}	5.670×10^{-3}	-
20	1.0050×10^{-3}	5.476×10^{-3}	-
30	0.8007×10^{-3}	5.296×10^{-3}	-

Calculate the viscosity of water at 25°C.

2.4.1

Properties for air are:

Temperature (°C)	0	10
Specific heat (N m/(kg °C))	1.0048	1.0048
Linear Viscosity (N sec/m^2)	1.72×10^{-5}	1.78×10^{-5}
Thermal Conductivity (N m/(sec m °C)	0.02423	0.02458
Density (kg/m^3)	1.293	1.246

Determine physical property values at 5°C

2.4.2

Where is the fluid in a pipe will shear stress be minimum?

2.4.2

Where in the fluid in a pipe will shear stress be max?

2.5

What is the hydraulic diameter of a pipe with an equilateral triangular cross-section?

2.5

How can we determine whether or not fluid is flowing laminar or turbulent?

2.5

A 15 cm diameter pipe 30 m long flows full of water at a velocity of 0.1 m/sec. Which will be greater: the compliance or the inertance of the water in the pipe? Why?

2.5

A rectangular slab with height a and width b flows half full. What is its hydraulic diameter?

2.5

A 14 cm diameter rigid pipe 30 m long flows full of water at a velocity of 0.1m/sec. Which will be greater: the compliance or the inertance of the water in the pipe? Why?

2.5.1

Find the Reynolds number for water flowing 1/3 full though a square pipe. Flow rate= 56 ft^3/min, viscosity = $0.658x10^{-3}$ lb m/ft sec, density = 62.3 lb m/ft^3, pipe side dimension = 2 ft.

2.5.1
Diagram the process to obtain friction factor using the Colbrok-White equation.

2.5.1
If the pressure drop along the first section of pipe is 0.625 N/m^2, what is the pressure drop along the second section?

2.5.1
A 4 m tube carrying water in laminar flow is doubled in length and halved in diameter. How do the resistances of the modified tube compare to the original?

2.5.1
What is the hydraulic diameter of the second section?
2.5.1
What is the hydraulic diameter of a pipe flowing full with a rectangular cross-section?

2.5.1
A 4m tube carrying water in laminar flow is doubled in length and doubled in diameter. How does the resistance of the modified tube compare to the original?

2.5.1
Calculate the hydraulic diameter of a pipe of square cross-section flowing 1/3 full.

2.5.1
If the diameter of a pipe is doubted, what happens to its resistance to laminar flow?

2.5.1
What is the hydraulic diameter of water flowing full in a pipe with the shape of an equilateral triangle? Show all work.

2.5.1
Two pipes carry the same volume rate of flow. One pipe is 20m long and six cm in diameter. The other is 10 meters long and three cm in diameter. Compare the friction loss in both pipes assuming laminar flow in both.

2.5.1
Find the Reynolds number for water flowing 1/3 full through a square pipe. Flow rate =$1.2X10^{-4}$ m^3/sec, viscosity = $1X10^{-3}$ kg/(m sec), density = 100 kg/m^3, pipe side dimension =15 cm.

2.5.1

Two pipes carry the same volume rate of flow. One pipe is 20 feet long and six inches in diameter. The other is 10 feet long and three inches in diameter. Compare the friction loss in both pipes assuming laminar flow in both.

2.5.1
A 4 m tube carrying water in laminar flow is halved in length and doubled in diameter. How does the resistance of the modified tube compare to the original?

2.5.2.2
Define entrance length. When is it used?

2.5.3.1
A cylindrical tank contains water with no air above it. The water fills the tank half full. What is the compliance of the water in the tank? (If you can't remember the numbers, at least indicate the symbols and what they stand for.)

2.5.3.1
Show the compliance of an ideal gas depends on the square of its volume.

2.5.3.1
Show the compliance of an ideal gas depends on the square of its volume.

2.5.3.1
A cylindrical tank contains air at atmospheric pressure. What is its compliance? (If you can't remember the numbers, at least indicate the symbols and what the symbols stand for).

2.5.3.3
If the resistance of the first section of pipe is 10 N sec/m^5, what is the resistance in the second section?

2.5.3.3
A 30m long horizontal pipe with 6.5 m^3/sec flowing full of liquid has a diameter of 5 cm. If the pipe suddenly expands to 25cm in a second 30m section, how does the average velocity change? If the resistance of the first section of pipe is 10 N sec/m^5, what is the resistance in the second section?

2.5.5.1
Pulmonary vascular resistance of an aquatic snake is 6.46×10^{-12} N sec/m^5 and its pulmonary blood pressure is 2400 N/m^2. What is its pulmonary blood flow?

2.5.7
You are James Bond, riding on the wing of a plane flying at the speed of sound. There is a plane just in front of you with an open cockpit. You shout to the other pilot, but the pilot does not respond. Why not?

2.5.7.1
The velocity of air flowing in a pipe cannot exceed what velocity?

2.5.8
Compare xylem diameters in trees 20 m tall and 100 m tall on the basis of required capillarity.

2.5.8
Without capillary how high would water rise in a plant?

2.5.9
Why should suspensions be transported in turbulent flow?

2.5.9
Why is water containing sediment usually pumped fast enough to cause turbulence?

2.6
The kinetic energy term in the Bernoulli equation is given as $V^2/(\alpha g)$. What determines the value of α?

2.6
What is the difference between no Newtonian and Newtonian fluids?

2.6.1
How are consistency coefficient values corrected for temperature effects?

2.6.1
How are flow behavior index values corrected for temperature effects?

2.6.1
A suspension of polysaccharides will probably act as a: 1)pseudoplastic, 2)Newtonian, or 3) dilatent fluid?

2.6.1
These two fluids have the following properties:

Fluid	Consistency Coefficient	Flow Behavior index
Tomato Concentrate I	2.25	0.59
Tomato Concentrate II	187.40	0.4

Which of these fluids will tend to develop turbulent flow at lower Reynolds number? Explain.

2.6.1
Consistency coefficients listed in a bale are all give for a temperature of 12°C. The fluid you are considering has a temperature of 40°C. How would you correct the tabled values to the proper temperature?

2.6.1
What types of fluids are likely to exhibit pseudoplastic behavior? Is human blood a pseudoplastic, dilatent, or Newtonian fluid?

2.6.1
You have a fluid composed of small glass beads suspended in a small amount of water. Would you expect this fluid to act as a Bingham plastic, dilatent, Newtonian, or pseudoplastic fluid?

2.6.1
How is the consistency coefficient value adjusted for temperature effects?

2.6.1
A suspension of polysaccharides will probably act as a:

Pseudoplastic
Newtonian
Dilatent

Fluid?

2.6.1
Given:

Temp [°C]	Viscosity of H_2O [kg/(m sec)]	Viscosity of oil [kg/(m sec)]	Consistency Coefficient
10	$1.3077x10^{-3}$	$5.670x10^{-3}$	-
20	$1.0050x10^{-3}$	$5.476x10^{-3}$	-
30	$0.8007x10^{-3}$	$5.296x10^{-3}$	62.5

Calculate the consistency coefficient at a temperature of 20°C.

2.6.2
For fully developed laminar flow in a rigid tube, what does the velocity profile look like? Where is the velocity greatest? Where is the static pressure the greatest? Where is the shear stress greatest?

2.6.2.2
Why is the correction factor α necessary in the formulation of liquid kinetic energy?

2.6.2.2
Two fluids flow through the same length of 60 cm pipe. One fluid is Newtonian. The other is non-Newtonian. They both have the same average velocity. Why will there be a difference between them in the amount of kinetic energy each possess?

2.6.2.2
Two fluids flow through the same length of 2 cm pipe. One fluid is Newtonian. The other is non-Newtonian. They both have the same average velocity. Why will there be a difference between them in the amount of kinetic energy each possesses?

2.6.2.3

One fluid has a consistency coefficient of 32.5 and another has a consistency coefficient of 16. Which is more likely to be turbulent?

2.6.2.3
A flowing non-Newtonian fluid has a generalized Reynolds number of 2200, a flow behavior index of 0.5, and a consistency coefficient of 1.2 N sec^n/m^2. Would you expect the flow to be laminar or turbulent?

2.6.2.3
A pseudoplastic fluid with a flow behavior index 0.2 flows inside a pipe. The generalized Reynold's number is 4000. Is the flow more likely to be laminar or turbulent?

2.6.2.3
Reynold's number is 4000. Is the flow more likely to be laminar or turbulent? A dilatent fluid with a flow behavior index 2.5 flows inside a pipe.

2.6.2.3
Between two fluids :

Type	Consistency Coefficient	Flow Behavior Index
Apple sauce	56.3	.47
Apricot puree	54.0	.29

In which fluid will laminar flow exist at higher Reynolds number?

2.6.2.3
The transition from laminar to turbulent flow for pseudoplastic fluids is at a Reynolds number greater or less than for Newtonian fluids?

2.7.1.1
Which type of heat exchanger will result in the most constant output temperature of the existing fluid?

2.7.2.2
A can of food at uniform initial temperature of 20°C is suddenly immersed in boiling water. The Heisler chart for a cylinder with the can radius gives a temperature difference ratio of 0.45, the Heisler chart for a slab with a thickness equal to the length of the can gives a temperature difference ratio of 0.30, the Heisler chart for a sphere with the radius of the can gives a temperature difference ratio of 0.35, and the Heisler chart for a slab with a thickness of one-half the height of the can gives a temperature difference ratio of 0.50. What is the overall temperature difference ratio of the can?

2.7.2.2
For the can in question 1, what is the temperature in the can?

2.7.2.2

A can of food at uniform initial temperature of 21°C is suddenly immersed in boiling water. The Heisler chart for a cylinder with the can radius gives a temperature difference ratio of 0.45, the Heisler chart for a slab with a thickness equal to the length of the can gives a temperature difference ratio of 0.30, the Heisler chart for a sphere with the radius of the can gives a temperature difference ratio of 0.34, and the Heisler chart for a slab with a thickness of one-half the height of the can gives a temperature difference ratio of 0.50. What is the overall temperature difference ratio of the can?

2.8
Draw a fluid system diagram for a piston pump.

2.8
What elements are required to specify a pump?

2.8
What is the difference between a positive displacement pump and a variable displacement pump? Give a systems diagram for each.

2.8
Why must the pump power requirement for nonNewtonian fluids be multiplied by the specific gravity of the fluid before the pump power can be specified?

2.8
Explain the difference between a variable displacement pump and a positive displacement pump. Give an example of each kind.

2.8
Why must the specific gravity of a liquid be involved in the pump power calculation from the Bernoulli equation?

2.8
List four or more pump specifications, which need to be determined before a pump can be purchased?

2.8
List the elements to be calculated to determine the power requirements of a pump.

2.8
Why must the specific gravity of a liquid be involved in the pump power calculation from the Bernoulli equation?

3.1
Compare heat transfer and fluid flow as transport processes.

3.1
Give a heat example of effort source and a flow source.

3.1
Fill in the following table for heat transfer:

Modes of action:
Effort variables:
Resistance:
Inertia:
Time:

3.1
What are the basic mechanisms by which heat may be transferred from one object or substance to another?

3.1
The mixed air is question 1 is heated with 2.4 BTU/lb. What is the final temperature of the mixture?

3.1
Give the basic heat balance equation in words.

3.2
Explain the difference between conduction and convection heat transfer.

3.2 & 3.3
Compare conduction and convection.

3.2.1
What is the heating transfer through the wall when the inside temperature is 25°C and the outside temperature is 15 °C?

3.2.1
What is the difference between thermal conductivity and thermal conductance?

3.2.1
If the thermal resistance of a sheep fleece is 5 (C sec)/(N m), estimate the amount of heat lost by the sheep to an environment at 10°C.

3.2.2.1
A trumpygos has a heat transfer equation of $q = (\pi k(\theta_2-\theta_1))/(\mathrm{erf}(r_o/r_i))$ what is its thermal resistance.

3.2.2.2
Calculate the thermal resistance of a cm^2 of human skin (2 mm thick).

Thermal Conductivity = 0.627 N/(°C sec)
Specific heat = 3470 N m/(kg °C)
Density =1100 kg/m^3

3.2 & 3.3
Explain the difference between conduction and convection heat transfer.

3.2 & 3.3 & 3.4
Compare radiation, convection, and conduction heat transfer mechanisms.

3.3
In what fundamental way does convection differ from conduction?

3.3
For the liquid of problem 4, what is the convection coefficient on the inside surface of the pipe?

3.3
In a system of two parallel horizontal plates, with the space between them filled with air, the upper plate is warmer than the lower plate by 100°C. Which mode of heat transfer will be the most significant, and why?

3.3
What is the difference between thermal conductivity and conductance?

3.3
Compare forced and natural convection.

3.3
Define logarithmic mean temperature and film temperature.

3.3
For the liquid of problem 1, what is the convection coefficient on the inside surface of the pipe?

3.3.1
What are three differences between natural and forced convection?

3.3.1
Would you expect the convection coefficient in turbulent flow to be greater or less than the convection coefficient in laminar flow?

3.3.1
How does the convection coefficient for the boiling compare to normal values of convection coefficient for a body surrounded by water?

3.3.1
Why is it important to know the film temperature?

3.3.1
Would you expect equivalent convection coefficient for boiling to be greater or less than the convection coefficient in forced convection?

3.3.1.1
How does the Nusselt number for flow along the length of a cylinder differ from the Nusselt number for flow across the circular direction of the cylinder?

3.3.1.2
The temperature of fluid entering a long pipe is 20°C. If the pope wall temperature is maintained at 150°C, what is the film temperature?

3.3.1.2
The temperature of fluid entering a long pipe is 20°C and the temperature of the same fluid leaving the pipe is 120°C. If the pipe wall is maintained at 150°C, what is the film temperature?

3.3.1.2
A liquid with a specific heat of 6.5 N m/(kg °C) flows at a rate of 5 kg/min through a long pipe with 19.5 m^2 inside surface area. The entrance temperature of the fluid is 16°C and the exit temperature is 4°C. The average temperature of the surface of the pipe is 10°C. What is the value of the convection coefficient in the pipe?

3.3.1.2
Define logarithmic mean temperature and film temperature.

3.3.1.2
List four fluid physical properties that can vary with temperature.

3.3.1.2
When is the logarithmic mean temperature used?

3.3.1.2
A liquid with a specific heat of 6.5 J/(kg °C) flows at a rate of 5 kg/min through a long pipe with 19.5 m^2 inside surface area. The entrance temperature of the fluid is 16°C and the exit temperature is 4°C. The average temperature of the surface of the pipe is 10°C. What is the value for the convection coefficient inside the pipe?

3.3.1.2
The temperature of the fluid entering a long pipe is 20°C and the temperature of the same fluid leaving the pipe is 120°C. If the pipe wall temperature in maintained at 150°C, what is the film temperature?

3.3.1.3
An equation of the form

N= m $\sqrt[4]{Gr\,\mathrm{Pr}}$ relates to forced or natural convection?

3.3.1.3
The energy required to evaporate water from houseplants in your home comes from what source?

3.3.1.3
An equation of the form Nu = A $\sqrt[4]{Gr\,\mathrm{Pr}}$ relates to forced or natural convection?

3.3.1.3
An equation of the form:

$$N = A\sqrt[4]{Gr\,\mathrm{Pr}}$$

Relates to forced or natural convection?

3.3.1.4
If the Reynolds number is 20 and Grashof number is 400, does forced or natural convection predominate? Why?

3.3.1.4
The Reynold's number is 25. The Grashof number is 100. Does forced or natural convection predominate?

3.3.1.4
You calculate Grashof number=8,000 and the Reynolds number = 1000. Does forced or natural convection predominate?

3.3.1.4
The Reynold's number is 500. The Grashof number is 10,000. Does forced or natural convection predominate?

3.3.1.4
You calculate the Grashof number = 10,000 and the Reynolds number = 800. Does forced or natural convection predominate?

3.3.1.4
If the Grashof number is 30000 and the Reynolds number is 1000, does forced or natural convection predominate? How do you know?

3.3.1.4
You calculate the Generalized Reynolds Number for a highly pseudoplastic fluid to be 4000. Is the flow likely to be laminar or turbulent?

3.3.1.4
What is mixed convection?

3.3.1.4

If the Grashof number is 30,000 and the Reynolds number is 10000, does forced or natural convection predominate?

3.3.1.4
What ratio do we check to determine if we have mixed convection?

3.3.1.4
You calculate

Grashof number = 8,000
Reynolds number = 800
Does forced or natural convection predominate?

3.3.1.4
For a convection system you calculate

Grashof number= 10,000
Reynolds number = 80
Does forced or natural convection predominate?

3.3.1.4
If the Grashof number is 10,000 and Reynolds number is 80, does forced or natural convection predominate? Justify your answer.

3.3.1.4
If the Grashof number is 400 and Reynolds number is 20, does forced or natural convection predominate? Why?

3.3.1.5
Flowing air encounters an obstacle in the flow stream. Compare the air temperature on the downstream side to that on the upstream side of the obstacle.

3.3.1.7
Calculate the thermal resistance of a cm^2 of human skin (2 mm thick).

Thermal Conductivity = 0.627 N/(°C sec)

Specific Heat	3470 N m/(kg °C)
Density	1100 Kg/m^3

3.3.2
Draw a thermal systems diagram for heat flow through the outside wall of this classroom.

3.3.2
If thermal resistances for the outside wall of this room are:

Block resistance	5 °C sec/(N m)
Brick resistance	4 °C sec/(N m)
Window resistance	0.5 °C sec/(N m)
Inside convection resistance	1 °C sec/(N m)
Outside convection resistance	0.2 °C sec/(N m)

3.4.0
If an opaque substance reflects 90% of the incident radiation, what is its transmissivity?

3.4.0
The surface emissivity of an opaque material 0.65. What is its absorptivity? Transmissivity? Reflectivity?

3.4.4
Draw the systems diagram for radiant heat exchange among three black bodies.

3.4.4
Draw the systems diagram for a radiant heat exchange between two gray bodies.

3.5.3.1
Give four phases of microbial growth.

3.5.3.2
How does biological heat generation usually depend on temperature?

3.5.3.2
What is the largest contributor to human heat production? Under what circumstance is this not the largest?

3.5.3.3
How much heat can be expected to be produced by living plants?

3.5.3.4
If apples produce heat at the rate of 120W at 30°C, estimate their heat production at 0°C. Page 377 Section 3.5.

3.5.3.4
If apples produce heat at the a rate of 120W at 30°C, estimate their heat production at 0°C.

3.5.3.4
Calculate the consistency coefficient at a temperature of 30°C.

3.5.4.1
Draw a thermal systems diagram for a piece of food being heated in a microwave oven.

3.6.3
Why does a warm metallic object feel hotter than a nonmetallic object at the same temperature?

3.6.5

Calculate the thermal capacity of a body with a surface emissivity of 0.87, a Van't hoff coefficient of 3.6, a mass of 20 kg, and a specific heat of 2900 N m/ (kg C).

3.6.5
Calculate the thermal capacity of a body with a surface emissivity of 0.87, a Van't Hoff coefficient of 3.6, a mass of 15 kg, and a specific heat of 2900 N m/ (kg °C).

3.6.5
Calculate the thermal capacity of a body with a surface emissivity of 0.87, a Van't Hoff coefficient of 2.5, a mass of 150 kg, and a specific heat of 3900 N m/(kg C).

3.7.1.1
What type of heat exchanger gives the maximum amount of heat transfer?

3.7.1.1
A liquid flows within a 100m long, 10 cm diameter pope. The wall of the pipe is maintained at 45°C. If the liquid flows at a rate of 0.05 kg/sec, the temperature of the entering fluid is 95°C, and the temperature of the fluid leaving the pipe is 50°C, how much heat is transferred from the liquid (1994)?

Liquid Physical Properties	
Thermal Conductivity	0.680 N•m/(m°C)
Specific heat	4.208 N•m/(kg °C)
Viscosity	3027 kg/ (m sec)
Density	965.34 kg/m^3

3.7.1.1
Explain the difference between counter flow and parallel flow heat exchangers.

3.7.1.1
What type of heat exchanger is represented by the radiator in your car?

3.7.1.2
If the convection coefficient is halved, what happens to the convection thermal resistance?

3.7.1.2
Two fluids flow through a heat exchanger. Fluid A is hotter than fluid B when it enters. The following are the table of physical parameters. Which fluid limits the heat transferred through he heat exchanger?

	Fluid A	Fluid B	
Density	0.596	0.221	kg/m^3
Thermal Conductivity	0.0254	0.0484	W/(m°K)
Specific heat	1700	1499	J/(kg K)
Viscosity	0.0228	0.0555	N/(m^2 s) x 10^{-3}
Flow Rate	122	136	kg/s

3.7.1.2

Two fluids flow through a heat exchanger. Fluid A is hotter than fluid B when it enters. The following is a table of physical parameters. Which fluid limits the heat transferred through the heat exchanger?

	Fluid A	Fluid B	
Density	0.245	0.221	kg/m^3
Thermal Conductivity	0.0254	0.0484	N m/(sec m °K)
Specific heat	1750	1499	N m/(kg °K)
Viscosity	0.0228	0.0555	$N/(m^2\ sec) x\ 10^{-3}$
Flow rate	124	136	kg/sec

3.7.1.2

How do you determine which fluid in a heat exchanger limits the heat transferred?

3.7.1.2

Two fluids flow through a heat exchanger. Fluid A is hotter than fluid B when it enters. The following table of physical parameters. Which fluid limits the heat transferred through the heat exchanger? Why?

	Fluid A	Fluid B	Units
Density	0.596	0.221	kg/m^3
Thermal conductivity	0.0254	0.0484	W/(m K)
Specific heat	1350	1500	J/(kg K)
Viscosity	0.0228	0.0555	$N/(m^2\ s)\ x\ 10^{-3}$
Flow Rate	148	136	kg/s

3.7.1.2

A liquid flows within a 100 m long, 10 cm dia pipe. The all of the pipe is maintained at 45°C. If the liquid flows at a rate of 0.05kg/sec, the temperature of the entering fluid is 95°C, and the temperature of the fluid leaving the pipe is 50°C, how much heat is transferred from the liquid?

Liquid physical properties	
Thermal Conductivity	0.680 N m/(m °C)
Specific heat	4.208 N m/ (kg °C)
Viscosity	3027 kg/ (m sec)
Density	965.34 kg/m^3

3.7.1.2

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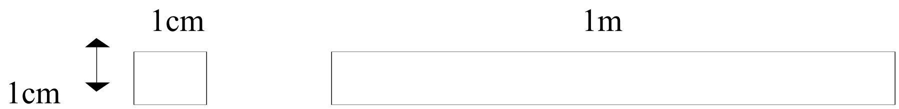
Density	0.596	0.221	kg/m^3
Thermal Conductivity	0.0254	0.0484	N m/ (sec m °K)
Specific heat	1700	1499	$N/(m^2\ sec)\ x\ 10^{-3}$
Flow rate	122	136	kg/sec

3.7.2.2



A piece of iron is heated in a foundry and molded to the above dimensions. It is then plunged in oil to complete the process. If the temperature of the steel bar is 1000°F and the temperature of the oil is 70°F, what is the temperature of the steel bar after 30 minutes?

Rate of Heat supplied to the Iron Bar:	10,000 BTU/Hr
Convection Coef:	100 BTU/ (Hr °F FTC)
Specific heat Oil:	1.0BTU/1bm
Specific heat Iron:	2.0 BTU/1bm
Effective Thermal Conductivity of Oil:	0.5 BTU/Hr °F ft
Effective Thermal Conductivity of Iron:	1.0 BTU/HR °F ft
Specific Weight Oil:	0.4 lb/ft^3
Specific Weight Iron:	100lb/ft^3

3.7.2.2
You are trying to determine the temperature in the center of a can 11cm x 7.5 cm diameter immersed in hot water. You know that you are to obtain temperature difference ratios from Heisler charts for cylinder and slab. You calculate the Biot number for the slab using the 11 cm length. What have you done wrong?

3.7.2.2
A can of food at uniform initial temperature of 20°C is suddenly immersed in boiling water. The Heisler chart for a cylinder with the can radius gives a temperature difference ratio of 0.45, the Heisler chart for a slab with a thickness equal to the length of the can gives a temperature difference ratio of 0.30, the Heisler chart for a sphere with the radius of the can gives a temperature difference ratio of 0.35, and the Heisler chart for a slab with a thickness of one-half the height of the can gives a temperature difference ratio of 0.50. What is the overall temperature difference ratio of the can?

3.7.3
What is the purpose of a pin fin?

3.7.3
How does a pin fin facilitate heat transfer? Under what circumstance do pin fins decrease heat transfer?

3.7.3
What is a pin fin and why would someone want one?

3.8

A stack of six pork slabs, each 12” x 12” X 2”, is chilled in a cold room with an air temperature of 32°F. Assume the thermal conductivity for pork is 0.30 (BTU ft)/ (hr ft^2 °F), the specific weight is 64 lb/ft^3 and the specific heat is 0.50 BTU/ (lb °F). The convective heat transfer coefficient is 6 BTU/(hr ft^2 °F). What is the time for the center of the stack to reach 56°F if the initial temperature is uniformly 80°F?

3.8.1.1
Draw a systems diagram for heat transfer from a strawberry blossom being sprayed with water to protect against freezing on a cold spring night.

3.8.1.2
Draw a thermal system diagram for heat flow for a person sitting in this classroom.

3.8.1.2
Draw a systems diagram for heat transfer from a clothed person sitting on a long next to a campfire on a cold autumn evening. Identify what all components represent. Be specific.

3.8.1.3
How does natural convection in water below 4°C differ from natural convection in water above 4°C?

3.8.1.3
What is sublimation?

3.8.3
A container of plant tissue culture medium is being sterilized in an autoclave. What is the effect on the calculated time for heating to the sterilization temperature if the medium is liquid rather than sold? Explain why.

4.2
Give a mass balance as a systems diagram.

4.2
Give the mass balance in words.

4.2.2.4
Name the two general classes of membranes.

4.3
Explain how diffusion is related to the random movement of molecules.

4.3
The diffusion coefficient for water through air is 0.256 cm^2/sec, measure at 25°C and 101.3 kN/m^2 pressure. What is the value for the diffusion coefficient at 50°C and 200 kN/m^2 pressure?

4.3
Which has the greater dependence on temperature: mass diffusivity of a gas or mass diffusivity of a liquid?

4.3
The diffusion coefficient for sucrose in water is 0.697×10^{-9} m^2/sec, measured at 20°C and 101.3 kN/m^2. What is the value for the diffusion coefficient at 50°C and 200 kN/m^2 pressure?

4.3
The diffusion coefficient for hydrogen through iron is 2.59×10^{-13} m^2/sec, measured at 293°K and 101.3 kN/m^2. What is the value for the diffusion coefficient at 350°C and 200kN/m^2 pressure?

4.3
If total pressure on a diffusing gaseous medium is doubled, how does the diffusion rate compare to the original? What if the diffusing medium were liquid?

4.3
The permeability of polyethylene to oxygen is 4.17×10^{-8} (mL O_2)/(sec cm^2 atm/cm). If the produce inside the package uses oxygen at the rate of 5×10^{-10} m^3/sec, what is the partial pressure of the oxygen inside the package? The surface area of the package is 100 cm^2 and the thickness of the film is 0.5mm.

4.3.1
Explain why mass diffusion depends on concentration.

4.3.2.1 & 4.3.2.2
Is diffusion of one substance within another faster in gases or liquids? How do you know?

4.3.2.2
How does mass diffusivity depend on temperature for liquids?

4.3.2.1
The diffusion coefficient for a gas is measured at a certain temperature and pressure. Temperature is double and pressure is doubled. How would the diffusion coefficient value be affected?

4.3.2.1
If the mass diffusivity of air through helium ($D_{air\text{-}He}$) at 0 °C is 0.138×10^{-4} m^2/sec, what is the mass diffusivity of helium through air ($D_{He\text{-}air}$)?

4.3.2.1
What is the diffusivity of air through helium at 37 °C?

4.3.2.2
If the substance in question above were a liquid and not a gas, what would the answer be.

4.3.2.2
What are the units of mass diffusivity?

4.3.2.3
If the substance in question above were a solid instead of a gas what would the answer be?

4.3.3.1
Name one or more ways to enhance skin permeability.

4.3.3.3
Draw a mass systems diagram for a semi permeable membrane separating two fluids with different osmotic pressures.

4.3.3.3
Define osmotic pressure.

4.5.1.2
What are immunoassays used for?

4.5.1.3
What is a biosensor?

4.7.2.2
You are trying to determine the temperature in the center of a can immersed in hot water. The temperature difference ratio you obtain from the Heisler chart for a slab is 0.45. The temperature difference ration you obtain from the Heisler chart for a cylinder is 0.1. What is the temperature difference ratio for the can?

4.7.3.2
What is special about Taylor dispersion?

4.7.3.7
Draw a mass systems diagram for carbon in a growing plant.

4.8
One hundred pounds per minute of air at 100°F dry bulb temperature and 50 grains/lb da absolute humidity are used to dry corn. Exhaust air dry bulb temperature is 80°F How much water is removed from the grain in 10 hours?

4.8

If the saturated water vapor pressure is 47 mm HG, atmospheric pressure is 760mm Hg, temperature is 37 °C, and relative humidity is 70%, what is the actual water vapor pressure in the air?

4.8
What gets wetter as it dries?

4.8.2.2
Draw a typical equilibrium moisture content curve. Label axes.

4.8.2.3
Name the temporal drying periods. What is the difference in the product between these two?

4.8.1.6
Air at 90°F and 100% relative humidity is mixed with an equal amount of air at 55°F and 50 grains/lb d.a. specific humidity. What is the final temperature of the mixture?