Problem 1.

Calculate the sample mean for the following sample of values:

$x_1 = a + 3$
$x_2 = a$
$x_3 = a - 4$
$x_4 = a + 5$
$x_5 = a + 2$

where a is a positive real number (parameter).

Group of answer choices

- $a + 1.2$
- $a + 1.4$
- $a + 1.5$
- $a + 1.75$
- $a + 2.4$
- $a + 3$
- None of the other answers

Problem 2.

Assume we obtain the following set of measurements of some quantity of interest x:

65, 64, 63, 67, 59, 60, 62, 61, 62, 64

Then the best estimate for x (the sample mean) is 62.7, and the sample standard deviation is 2.41.

Calculate the uncertainty of the best estimate. Round your answer to two (2) decimal places for entry into Canvas. Do not enter units. Example: 1.23

Problem 3.

Each side of a rectangular block is measured with different calipers. The sides are measured as 25.0 ± 0.08 mm, 12.5 ± 0.03 mm, and 6.0 ± 0.02 mm, respectively. The nominal value of the volume of the block is 1875.0 mm^3.

What is the uncertainty in the volume of the block expressed in mm^3?

Round your answer to two (2) decimal places for entry into Canvas. Do not enter units. Example: 12.34

Problem 4.

A quantity of interest Q is a function of three independent variables x, y, and theta:

Q = (x + 2) / (x + y*cos(4*theta))

Given x = 10 ± 2, y = 7 ± 1, and theta = 40 degrees ± 3 degrees, calculate the uncertainty in Q.

Assume that all errors are independent and random.

Round your answer to two (2) decimal places for entry into Canvas. Do not enter units. Example: 1.23

Problem 5.

A quantity of interest Q is a function of x:

$Q = (1 - x^2) * \cos((x+2) / x^3)$

Given x = 1.70 ± 0.02, calculate the uncertainty in Q.

Round your answer to three (3) decimal places for entry into Canvas. Do not enter units. Example: 0.123

Problem 6.

Experimental time and position data are shown in the table below. The position measurements have too much noise and need to be smoothed with a three point moving average, $\bar{x}_i = \frac{1}{3}(x_{i-1} + x_i + x_{i+1})$. Using the smoothed position values, calculate the velocity (in m/s) at time t = 0.5 s using a first order forward finite difference.

Round your answer to one (1) decimal place for entry into Canvas. Do not enter units. Example: 12.3

Time, s	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
Position, m	3	5	7	13	15	19	21	24	27	29

Problem 7.

For a population of watermelons, 75.4 % of the watermelons have radii between 15.0 cm and 22.0 cm. If the population mean is known to be 18.5 cm, determine the population standard deviation. Assume that the radius values are normally distributed.

Round your answer to two (2) decimal places for entry into Canvas. Do not enter units. Example: 1.23

Problem 8.

An air filter is rated to catch 90% of airborne particles. If the average particle diameter is 0.5 microns and the population standard deviation is 0.2 microns, what is the largest diameter particle (in microns) that will pass through the filter? Assume that the diameter of particles in the air is normally distributed.

Round your answer to three (3) decimal places for entry into Canvas. Do not enter units. Example: 0.123

Problem 9.

The average zinc concentration recovered from a sample of measurements taken in 36 different locations in a river is found to be 2.6 grams per milliliter. Find the 99% confidence interval for the mean zinc concentration in the river. Assume that the population standard deviation is 0.3 gram per milliliter.

Enter the lower bound (expressed in g/ml). Round your answer to two (2) decimal places for entry into Canvas. Do not enter units. Example: 1.23

Problem 9.

Enter the upper bound (expressed in g/ml). Round your answer to two (2) decimal places for entry into Canvas. Do not enter units. Example: 1.23

Problem 10.

The average zinc concentration $\bar{x}$ gram per milliliter is recovered from a sample of measurements taken in n different locations in a river. Assume that the population standard deviation is 0.3 gram per milliliter.

How large of a sample is required if we want to be 95% confident that our estimate of the mean zinc concentration in the river, μ, is off by less than 0.05 g/ml?

That is, you can use the following equation to solve for n (sample size)
$\bar{x} - L$=0.05 g/ml
where L is the lower bound of the 95% confidence interval for the mean zinc concentration in the river. (Recall that $L \leq \mu \leq U$.)
Alternately, you can use this equation: $U - \bar{x}$=0.05 g/ml.

Round up your answer to the nearest integer.

Problem 11.

A random sample of 100 automobile owners in the city X shows that an automobile is driven on average 23,500 kilometers per year. Assume that the population standard deviation is 3900 kilometers per year. Assume the distribution of measurements to be approximately normal.

Construct a 99% confidence interval for the average number of kilometers an automobile is driven annually in city X.

Enter the lower bound (expressed in km/year). Round your answer to the nearest integer. Do not include units.

Problem 11.

Enter the upper bound (expressed in km/year). Round your answer to the nearest integer. Do not include units.

Problem 12.

Mass crosses the boundaries of a closed system.

Group of answer choices

- True
- False

Problem 13.

Enthalpy is an extensive quantity.

Group of answer choices

- True
- False

Problem 14.

A simplified version of the Universal Accounting Equation (UAE) for an extensive quantity that is conserved is

FINAL – INITIAL = GENERATION – CONSUMPTION

Group of answer choices

- True
- False

Problem 15.

In the 6-term form of the Universal Accounting Equation (UAE), the INPUT and OUTPUT terms represent intensive quantities.

Group of answer choices

- True
- False

Problem 16.

Casein, a dairy product used in making cheese, contains 25% moisture when wet. A dairy sells this product for $40/100 kg. If requested, they will dry the casein to 12% moisture. The drying costs are $5/100 kg of water removed. Assume that that the dairy has 1000 kg of the original product (wet casein) that will be dried to 12% moisture and then sold.

How much dried casein is produced (in kg)? Round your answer to the nearest integer.

Problem 16.

How much water is removed (in kg)? Round your answer to the nearest integer.

Problem 16.

What is the cost of removing water (in $)? Round your answer to one (1) decimal place for entry into Canvas. Do not enter units. Example: 1.2

Problem 16.

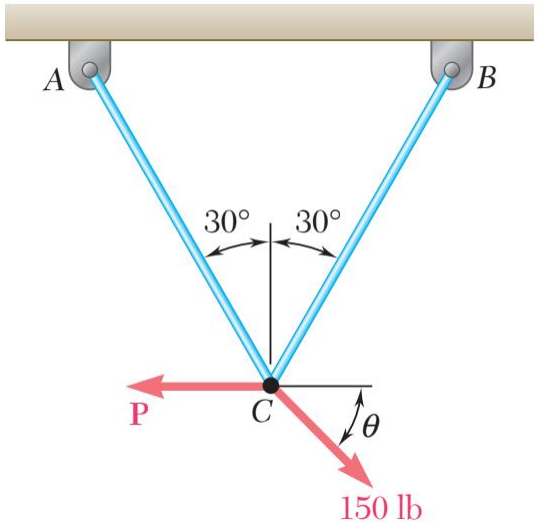
What should the dairy sell the dried product for in order to realize the same margin of profit?

How to enter your answer: for example, if your answer is $45.2/100 kg, then enter 45.2

Problem 17.

Cables AC and BC are tied together at C and are loaded as shown. If P=100 lb, what value of θ (theta) in degrees would create equal tension in the cables?

Round your answer to one (1) decimal place for entry into Canvas. Do not enter units. Example: 12.3

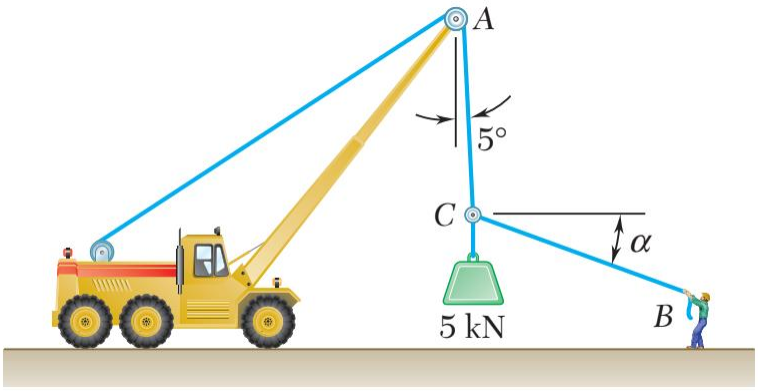


Problem 17.

When the tensions in the cables are equal, what is the value of the tension in lb? Round your answer to one (1) decimal place for entry into Canvas. Do not enter units. Example: 12.3

Problem 18.

In the figure below, if the angle α (alpha) is 15 degrees, what is the tension in cable AC in kN? Round your answer to two (2) decimal places for entry into Canvas. Do not enter units. Example: 12.34



Problem 18.

What is the tension in cable BC in kN? Round your answer to three (3) decimal places for entry into Canvas. Do not enter units. Example: 1.234

Problem 19.

Two blocks slide toward each other on a frictionless surface. Block 1 moves to the right with a velocity of $4a$, and block 2 moves to the left with a velocity of a, where a is a parameter. After the blocks collide, if block 1 travels to the right with a velocity of a, and block 2 travels to the right with a velocity of 5 a, what is the ratio of the mass of block 1 to the mass of block 2 (m_1/m_2)?

Group of answer choices

- 0.25
- 0.5
- 1
- 2
- 3
- 4
- 6
- None of the other answers

Problem 20.

An engineer designs a baseball-powered cart to transport small amounts of equipment. The 10 kg cart has a sail that catches baseballs thrown at it by a baseball gun (similar to those used for batting practice). The ball drops into the cart after it's caught by the sail. Each baseball has a mass of 145 grams and travels at a velocity of 35 m/s. If the cart is initially at rest, what is its velocity in m/s after 10 balls have been thrown at it?

Round your answer to two (2) decimal places for entry into Canvas. Do not enter units. Example: 1.23

Problem 21.

Consider the two points A(-4, -1) and B(2, 7) in the xy-plane. Distances are given in centimeters.

The line of action of a 75 N force goes through the linear segment AB.

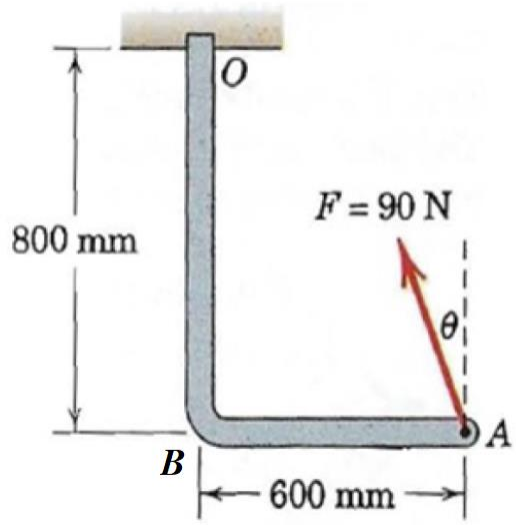
Determine the magnitude of the moment of the force (in N*cm) about the origin (0, 0).

Round your answer to one (1) decimal place for entry into Canvas. Do not enter units. Example: 123.4

Problem 22.

An L-shaped bar OBA is acted upon by a force at point A as shown below. Vertical distance OB = 800 mm, horizontal distance AB = 600 mm. Determine the angle theta, θ (in degrees; between 0 and 90 degrees) at which the 90-N force must act at A so that the moment of this force about point O equals zero.

Round your answer to one (1) decimal places for entry into Canvas. Do not enter units. Example: 12.3

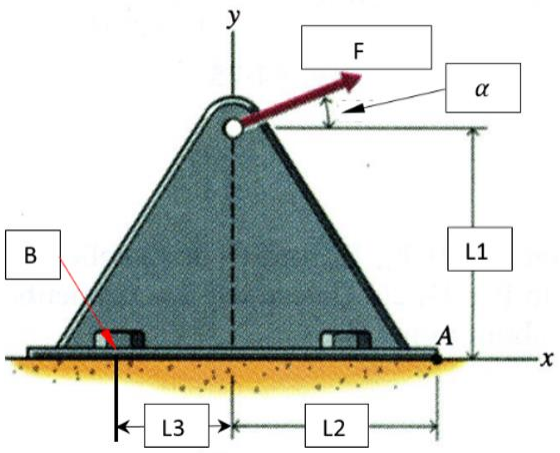


Problem 23.

Find the moment about Point B due to the force ***F*** using the following values:

L1 = 2.2 m
L2 = 1.0 m
L3 = 0.7 m
α = 33°
F = 220 N

Take counterclockwise moments as positive. If the direction of the moment is clockwise, enter a negative value; if counter-clockwise, enter a positive value. Round your answer to two (2) decimal places for entry into Canvas. Example: -45.67 or 12.34. Do not enter units.



Problem 24.

The center of mass of a system of particles is so defined that

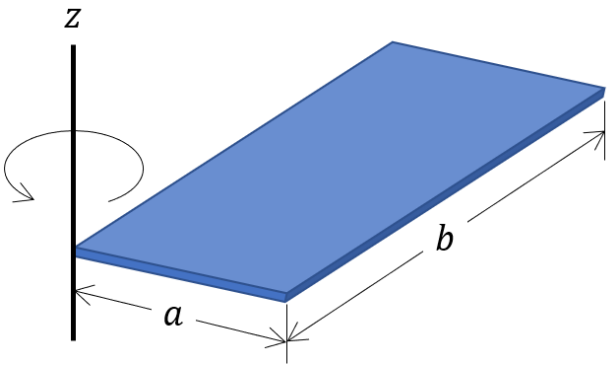
A. it is always at rest.
B. it is always at rest or moving with constant velocity.
C. it always moves in a straight line even if the particles are rotating about it.
D. the kinetic energy of the system is a maximum about any axis through the center of mass.
E. its location depends only on the masses of the particles and their locations.
F. the sum of the external torques equals the sum of the internal torques.

Group of answer choices

○ A ○ B ○ C ○ D ○ E ○ F

Problem 25.

A thin rectangular plate, uniform in both shape and mass, is shown below. It has width a and length b and rotates about axis z. The moment of inertia at its center of mass is given by $I_{cm} = \frac{1}{12}m(a^2 + b^2)$. What is the ratio of the moment of inertia about axis z to the moment of inertia about its center of mass?



Group of answer choices

- 0.083
- 0.25
- 0.333
- 0.5
- 2
- 3
- 4
- 12
- None of the other answers

Problem 26.

An electric motor is used to accelerate a solid disk (cylinder) flywheel. The flywheel has a mass of 30 kg and a radius of 0.25 m. The flywheel is initially at rest when the electric motor applies a torque of 30 Nm for 15 seconds. What is the final angular speed in revolutions per second of the flywheel?

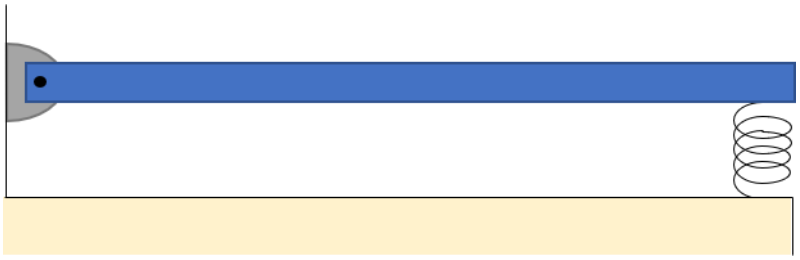
Round your answer to one (1) decimal place for entry into Canvas. Do not enter units. Example: 12.3

Problem 27.

A uniform board is pinned to the wall at its left end and is attached to a spring at its right end as shown below. The board has a mass of 12 kg and the spring constant is 1300 N/m. A diver jumps off of the right end of the board and causes it to oscillate with a small amplitude. What is the period of the oscillations in seconds?

Hint: In simple harmonic motion $a = -\omega^2 y$ and the moment of inertia of the board about the pin is $I = \frac{1}{3}mL^2$

Round your answer to two (2) decimal place for entry into Canvas. Do not enter units. Example: 1.23



Problem 28.

What is the period of a simple pendulum with a length of 1.5 m inside of an elevator accelerating upward at a rate of 2.0 m/s^2?

Round your answer to two (2) decimal place for entry into Canvas. Do not enter units. Example: 1.23

Problem 29.

Engineers shall at all times strive to serve their employer.

Group of answer choices

- True
- False

Problem 30.

Bad news, criticism, questions, and information outside expectations are regarded as nega tives by the organization. This is an example of suppression of open communication.

Group of answer choices

- True
- False

Note:

Dear Students,

For the following topics, many great problems can be found in your physics textbooks:

1. Particle statics
2. Linear momentum. Collisions. Conservation of momentum analysis
3. Rigid body statics
4. Center of mass and angular momentum. Rotational motion
5. Harmonic motion

Group of answer choices

- True
- False