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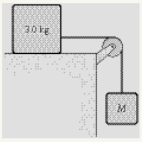
1
Marks: 4

The system shown is released from rest, accelerates uniformly, and moves 50 cm in 0.50 s. What is the value of M ? All surfaces are frictionless. The block on the table has a mass of 3 kg. (g=9.8 m/s^2)



Choose one answer.

a. 0.59 Kg
b. 0.50 Kg
c. 0.34 Kg
d. 2.1 Kg
e. 0.42 Kg

2
Marks: 4

Two slits separated by a distance of d=0.05 mm (mm=millimeter). The are illuminated with light of wavelength λ=540 nm (1nm=10^{-9} m). The distance to the screen is L= 0.10 m. How many bands of bright lines are present between the central maximum and the position at 0.12 m?

Choose one answer.

a. 1111
b. 111
c. 11111
d. 1
e. 11

3
Marks: 4

A Michelson interferometer is adjusted such that the monochromatic light beam produces maximum intensity at the detector. If the adjustable mirror is moved by a distance ΔL=0.015 mm and during this motion the intensity of light decreases to reach a minimum, what is the wavelength of this light?
(answer in micrometer=10^{-6} m)

Choose one answer.

a. 30
b. 60
c. 7.5
d. 3.75
e. 70.5

4
Marks: 4

An object weighs 40.0 N in the air , but it weighs 20.0 N when submerged in water. If the same object is then submerged in a liquid of unknown density, it weighs 25 N.The density of water is1000 kg/m^3. What is the density of the unknown liquid (**in Kg/m^3**):

Choose one answer.

a. 1100
b. 200
c. 350

d. 750

e. 500

5
Marks: 4

A closed-open organ pipe of length 2.6 m contains air for which the speed of sound is 340 m/s. The frequency of the standing wave of the third harmonics is:

Choose one answer.

a. 98 Hz

b. 33 Hz

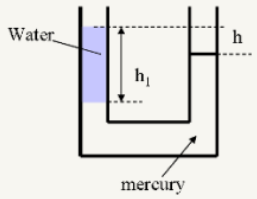
c. 196 Hz

d. 163 Hz

e. 63 Hz

6
Marks: 4

A u-shaped tube open to the air at both ends contains mercury initially. Some water is poured into the left arm of the tube until the vertical column of the water reaches a height h_1=10 cm. The density of water is 1000 Kg/m^3 and the density of mercury is 13.7 x10^3 Kg/m^3. What is the height h shown in the Figure (difference between the top levels of Water and mercury ?



Choose one answer.

a. 13.9 cm

b. 3.97 cm

c. 2.78 cm

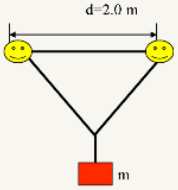
d. 2.65 cm

e. 9.26 cm

7
Marks: 4

A block of mass m=12 Kg hangs in equilibrium from a string with a total length L=5.0 m having a linear mass density μ=0.001 Kg/m. The string is wrapped (taken around) two frictionless pulleys separated by a distance d=2.0 m (see Figure).

At what frequency must the string vibrate in order to form a standing wave in the fundamental mode? .(g=9.8 m/s^2)



Choose one answer.

a. 211 Hz

b. 140 Hz

c. 121 Hz

d. 242 Hz

e. 70 Hz

8
Marks: 4

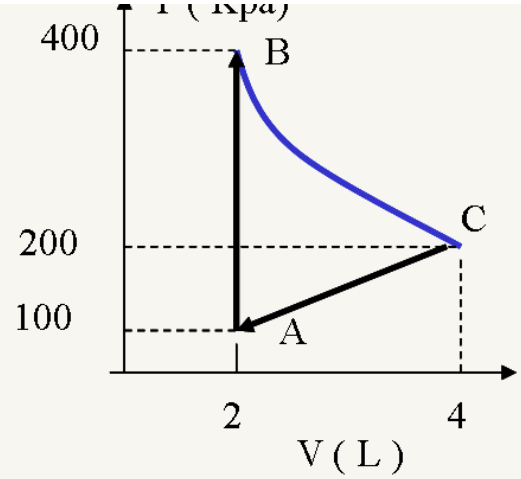
An ideal monatomic gas having n=0.096 moles undergoes the cyclic process ABCA shown in the Figure, where the process B to C is isothermal and C to A is straight line. The heat absorbed between A and B is given to be 1012.1J. (1 L=10^{-3} m^3 , Kpa=10^3 pa).

What is the heat ejected between C and A (Q_{CA})?

(No unit needed and answer in Joules. Be careful with the sign)

(this question needs time)

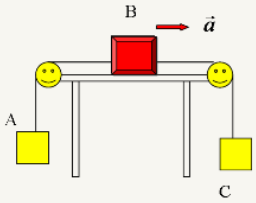
P (Kpa)



Answer:

9
Marks: 4

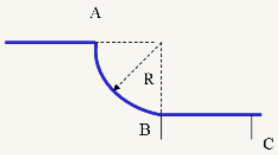
Block A has a mass 3.3 kg and block B has a mass 19.8 kg. The coefficient of kinetic friction between block B and the table is μ=0.20. Suppose the block B is moving to the right with an acceleration a=2.0 m/s^2, what is the mass of block M_c (in Kg). (g=9.80 m/s^2)



Answer:

10
Marks: 4

A block of m=4 kg is released from rest at point A (see Figure) slides down a rough surface that is one quarter of circle R=1.6 m. If the block achieves a speed v_B=4.0 m/s at position B, how much work is done on the block by friction as it slides down from position A to B? . (g=9.8 m/s^2)



Choose one answer.

- a. -30.72 J
- b. +30.72 J
- c. -7.7 J
- d. +15.4 J
- e. -15.4 J

11
Marks: 4

An object of mass m=2 kg has a speed v=5.0 m/s when it passes the origin (x=0) in its way along the positive x-axis. If this object is subject to a retarding force F_x= -(5.0 N/m) x, at what position (x_f) does the object stop?

Choose one answer.

- a. 6.32 m
- b. 2.5 m
- c. 3.16 m
- d. 4.0 m
- e. 2.0 m

12 ✍
Marks: 4

A two-dimensional force is given by the function:

$\mathbf{F} = 2x^2\,\mathbf{i} + 5y\,\mathbf{j}$ **(boldface means vector)**

This force moves an object along two paths:

Path 1: from (x,y)=(0,0) to (1,1) along y = x (straight line)

Path 2: from (x,y)=(0,0) to (1,1) along $y= x^2$ (Parabola)

The work done along path 1, W_1, compared to W_2 is:

Choose your answer:

(1) $W_2/W_1=1.0$ (2) $W_2/W_1=0.50$

(3) $W_2/W_1=0.25$ (4) $W_2/W_1=2.0$

(5) $W_2/W_1=0.333$

Choose one answer.

- a. (4)
- b. (2)
- c. (1)
- d. (3)
- e. (5)

13 ✍
Marks: 4

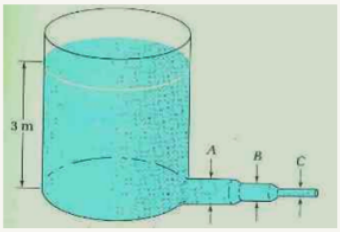
A stone of mass m=3.0 kg falls from rest in a viscous medium. There is a net force of 22.4 N acting downward on the stone. A retarding (or restoring force) velocity-dependent force is also acting which is given by **F**=(4.0 N.m/s) **v** (force proportiona to velocity) **.** What is the terminal velocity of the stone (**in m/s**) **.** (no unit needed with your answer. **Give 2 digits after the point.**

Answer:

14 ✍
Marks: 4

Water flows from a tank of a height of 3.0 m as shown in the Figure below and from the height of 3.0 m. The cross section of the tube A is 0.055 m^2, the cross section of the tube B is 0.04 m^2 and the cross section at C is 0.025 m^2. the density of water is 1000 kg/m^3 .

What is the pressure difference between point and point c, ($(P_A - P_C)$ (in N/m^2) ? (^ mean power of ten)



Choose one answer.

- a. zero
- b. 4.7x10^4
- c. 1.8x10^4
- d. 5.2x10^3
- e. 2.35x10^4

15 ✍
Marks: 4

The electric fields arriving at a point P on the screen from coherent sources are described by:

$E_1=E_0 \sin(\omega t)$

$E_1 =E_0 \sin(\omega t+\pi/4)$

$E_3 = E_0 \sin(\omega t+\pi/2)$

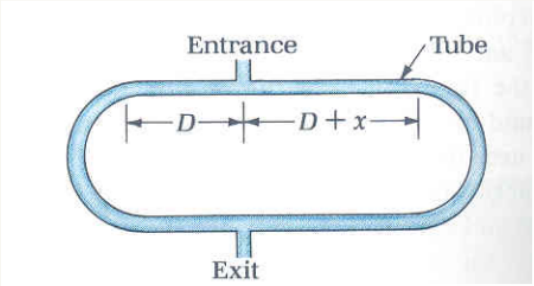
What is the amplitude of the resultant field at point P(in terms of E_0?)

Choose one answer.

- a. 1.5
- b. 3.7
- c. 1.7
- d. 1.0
- e. 2.4

16
Marks: 4

Sound of a frequency 1605.9 Hz enters the tube shown in the Figure below. For what value of x (in cm) will the first maximum be heard at the exit? Assume the speed of sound to be 340 m/s.



Answer:

17
Marks: 4

Find the change in entropy (**in J/K**) when 3.0 moles of an ideal monatomic gas are allowed to expand isobarically (constant pressure) from an initial volume of 20 cm^3 to a final volume of 100 cm^3.
(R=8.31 J/(mole . K)

Choose one answer.

- a. 152 J/K
- b. 100 J/K
- c. 52 J/K
- d. 167 J/K
- e. 67 J/K

18
Marks: 4

A heat pump absorbs heat from the outside air at -15 °C and transfers it into home at a temperature of 30 ° C. What is the maximum COP (Coefficient Of Performance) of the heat pump?

Choose one answer.

- a. 0.5
- b. 0.2
- c. 6.7
- d. 7.6
- e. 4.4

19
Marks: 4

Two harmonic waves traveling in opposite direction interfere to produce a standing wave given by:

$$y = (2\ m) \sin[(\pi/2)\, x] \cos(3\pi\, t)$$

The distance between the first two antinodes is (in m):

Choose one answer.

- a. 0.5 m
- b. 4 m
- c. 8 m
- d. 2 m
- e. 1 m

20
Marks: 4

what is the specific heat (in J/(Mole . K) of a gas kept at constant volume when it takes 1.0×10^4 J of heat to raise the temperature of 5.0 moles of the gas 400 K above its initial temperature?

Choose one answer.

- a. 2.4
- b. 7.5
- c. 5.0
- d. 12.5
- e. 10

21 Marks: 4

A 0.40-kg particle moves under the influence of a single conservative force. At point A where the particle has a speed of 10 m/s, the potential energy associated with the conservative force is +40 J. As the particle moves from A to B, the force does +20 J of work on the particle. What is the value of the potential energy at point B?

Choose one answer.

- a. -40 J
- b. +15 J
- c. +40 J
- d. +65 J
- e. -20 J
- f. +20 J

22 Marks: 4

A thin film has a coating with a refraction index n=1.50 and is on glass having n_g =1.60. What is the smallest thickness t (**in nm**)of this film for which destructive interference can take place by reflection?. The light used has a wavelength 671.4 nm falls nearly vertical on the film.
(answer: 2 digits after the point)

Answer:

23 Marks: 4

Two harmonic waves described by

$y_1 = (3\text{cm}) \sin(8\pi\, x/\text{m} + 2\pi\, t/\text{s})$

$y_2 = (3\text{cm}) \sin(8\pi x/\text{m} - 2\pi\, t/\text{s})$

What is the smallest positive value of x (in cm) corresponding to a node of the resulting wave?

Choose one answer.

- a. 0.25 cm
- b. 0.0 cm
- c. 6.0 cm
- d. 1.5 cm
- e. 3 cm

24 Marks: 4

Monochromatic light is used in a double-slit experiment where the slits are d=0.25 mm (mm=millimeter) apart and the distance to the screen is L=1.0 m. It is known that the spacing between two adjacent (neighboring) dark fringes is 2.2 mm. Assume the angle of deviation is small. What is the wavelength (in nanometer=nm) of the used light?

Choose one answer.

- a. 632 nm
- b. 550 nm
- c. 520 nm
- d. 500 nm
- e. 650 nm

25 Marks: 4

A standing wave with one antinodes exists on a 1.60-m long string which is held fixed at each end. The string vibrates at a frequency of 7.2 Hz.
The wave function of this standing wave is:

(1) y=A sin (45t) cos (3.9x) (2) y=A cos(45t) sin (1.96x)
(3) y=A sin(45t) cos (1.96x) (4) y=A cos (45t) sin (3.9x)

Choose one answer.

- a. (1)
- b. (2)
- c. (3)
- d. (4)

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