新东方烹饪学校大专物理试题

Question No.	1	2	3	4	5	6	7	8		
Score	30	4	12	10	10	12	10	12		

This exam paper contains __8__ questions and the score is __100__ in total. (Please hand in your exam paper, answer sheet, and your scrap paper to the proctor when the exam ends.)

1. Multiple Choice Questions, there is only one correct answer for each question. (3×10 = 30 marks)

1) During a short interval of time the speed v in m/s of an automobile is given by $v = at^2 + bt^3$, where the time t is in seconds. The units of a and b are respectively:

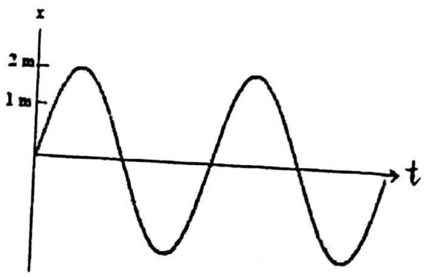
A) $m \cdot s^2$; $m \cdot s^4$ B) s^3/m; s^4/m C) m/s^2; m/s^3 D) m/s^3; m/s^4 E) m/s^4; m/s^5

2) A 3.00 g bullet traveling horizontally at 400 m/s hits a 3.00 kg wooden block, which is initially at rest on a frictionless horizontal table. The bullet buries itself in the block without passing through. The speed of the block after the collision is:

A) 1.33 m/s B) 0.40 m/s C) 12.0 m/s D) 12.6 m/s E) 40.0 m/s

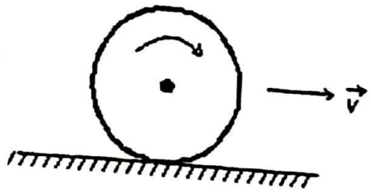
3) This plot shows a mass oscillating as $x = x_m \cos(\omega t + \varphi)$. What are x_m and φ?

A) 1 m, 0°
B) 2 m, 90°
C) 2 m, -90°
D) 4 m, 0°
E) 4 m, 90°

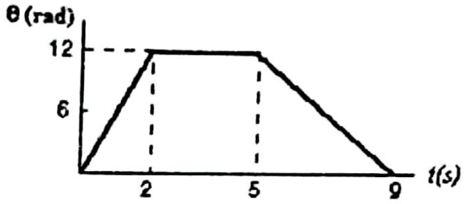


4) A wheel of radius 0.5 m rolls without sliding on a horizontal surface as shown. Starting from rest at $t = 0$, the wheel moves with constant angular acceleration 6 rad/s^2. The distance traveled by the center of the wheel from $t = 0$ to $t = 3$ s is:

A) 0 m
B) 27 m
C) 13.5 m
D) 18 m
E) none of these

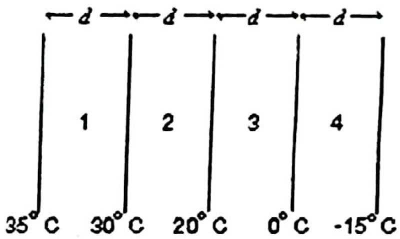


5) This graph shows the angular position of an object as a function of time. What is its instantaneous (瞬时) angular velocity at $t = 1.5$ s?



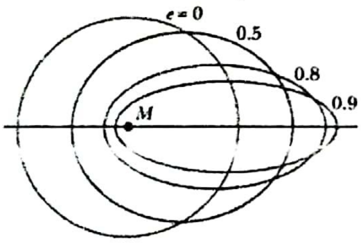
A) −6 rad/s
B) 6 rad/s
C) 9 rad/s
D) 12 rad/s
E) Need additional information.

6) The diagram shows four slabs of different materials with equal thickness and cross-section area, placed side by side. Heat flows from left to right and the steady-state temperatures of the interfaces are given. Rank the materials according to their thermal conductivities, smallest to largest.



A) 1, 2, 3, 4
B) 2, 1, 3, 4
C) 1, 2, 4, 3
D) 3, 4, 2, 1
E) 4, 3, 2, 1

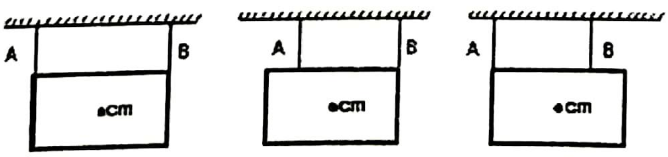
7) Consider the orbits shown in the drawing. Each of the orbits has the same semimajor axis (半长轴), but differs in the eccentricities, which are given. In which of these orbits would an object have the greatest total mechanical energy, if any?



A) All of the orbits have the same total energy.
B) $e = 0$
C) $e = 0.5$
D) $e = 0.8$
E) $e = 0.9$

8) A meter stick of length one meter is pivoted at a point a distance a from its center and swings as a physical pendulum. Of the following values for a, which results in the shortest period of oscillation?
A) $a = 0.1$ m
B) $a = 0.2$ m
C) $a = 0.3$ m
D) $a = 0.4$ m
E) $a = 0.5$ m

9) A picture is to be hung from the ceiling by means of two wires. Order the following arrangements of the wires according to the tension in wire B, from least to greatest.



I II III

A) I, II, III B) III, I, II C) I and II tie, then III D) II, I, III E) all tie

10) An ideal gas, consisting of n moles, undergoes a reversible isothermal process during which the volume changes from V_i to V_f. The change in entropy of the thermal reservoir in contact with the gas is given by:

A) $nR(V_f - V_i)$
B) $nR\ln(V_f - V_i)$
C) $nR\ln(V_i/V_f)$
D) $nR\ln(V_f/V_i)$
E) none of the above (entropy can't be calculated for the thermal reservoir)

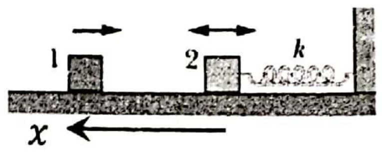
2. Fill in the Blank Questions. (Just write down the result, and the detailed process is not needed.)

1) (2 marks)

A French submarine and a U.S. submarine move toward each other during maneuvers in motionless water in the North Atlantic. The French sub moves at the speed $v_F = 48.00\,Km/h$, it sends out a sonar signal (sound wave in water) at $1.560 \times 10^3 Hz$, then detects a frequency of $1.630 \times 10^3 Hz$ in the signal reflected back to it by the U.S. sub. Sonar waves travel in water at $5470\,Km/h$. What is the speed of the U.S. submarine?

2) (2 marks)

Block 2 of mass 2.00Kg oscillates on the end of a spring in SHM with a period of 14.1ms, the coordinate system was shown in the figure, the block's position is given by $x = (1.00\text{cm})\cos(\omega t + \pi/2)$. Block 1 of mass 4.00Kg slides toward block 2 with a velocity of magnitude $6.00\,m/s$, directed along the spring's length. The two blocks undergo a completely inelastic collision at time t = 5.00ms. The duration of the collision is much less than the period of motion. The horizontal surface is frictionless. What is the velocity of two blocks at time t = 7.50ms ?



Text Questions: (Please write down the detailed process.)

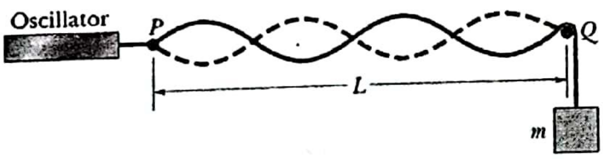
3. (12 marks) A child whose weight is 267 N slides down a 6.50 m ramp(斜面) that makes an angle of 20° with the horizontal. The coefficient of kinetic friction between ramp and child is 0.100. (a) When the child sides from the top to the bottom, how much energy is transferred to thermal energy? (b) If she starts at the top with a speed of 0.457 m/s, what is her speed at the bottom?

4. (10 marks) A uniform disk of mass $10m$ and radius $3r$ can rotate freely on a horizontal surface about its fixed center like a merry-go-round. A smaller uniform disk of mass m and radius r lies on top of the larger disk, concentric with it. Initially the two disks rotate together with an angular velocity of 20 rad/s. Then a slight disturbance (扰动) without external torques about its center causes the smaller disk to slide outward across the larger disk, until the outer edge of the smaller disk catches on the outer edge of the larger disk. Afterward, the two disks again rotate together (without further sliding). (a)What then is their angular velocity about the center of the larger disk? (b) What is the ratio K/K_0 of the new kinetic energy of the two-disk system to the system's initial kinetic energy?

5. (10 marks) A typical neutron star may have a uniform mass equal to that of the Sun but a radius of only 10 km. (a) What is the gravitational acceleration at the surface of such a star? (b) An object fells from rest at a height of 1.0 m above the surface of the star, what is the speed of the object when arriving on the star's surface? (Assume the star is a uniform sphere and does not rotate.)

6. (12 marks) In an experiment, 200 g of aluminum at 100°C is mixed with 50.0 g of water at 20.0°C, with the mixture thermally isolated. (a) What is the equilibrium temperature? (b) What is the entropy change of the water?
(The specific heat of aluminum is 900 J/kg·K and the specific heat of water is 4190 J/kg·K.)

7. (10 marks) A string, tied to a sinusoidal oscillator at P and running over a support at Q, is stretched by a block of mass m. Separation L = 1.20 m, linear density μ=1.60 g/m, and the oscillator frequency f=120 Hz. The amplitude of the motion at P is small enough for that point to be considered a node. A node also exists at Q. What mass m allows the oscillator to set up the fourth harmonic on the string?



8. (12 marks) In an industrial process the volume of 30.0 mol of a monatomic ideal gas is reduced at a constant rate from 0.600 m^3 to 0.200 m^3 in 2.00 h while its temperature is increased at a constant rate from 27.0°C to 427°C. Throughout the process, the gas passes through thermodynamic equilibrium states. What are (a) the work done on the gas, and (b) the energy absorbed by the gas as heat during the whole process?

Chapter2

#Instantaneous Velocity

$$v = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t} = \frac{dx}{dt}$$

#Average acceleration $a_{avg} = \frac{\Delta v}{\Delta t}$

#Instantaneous acceleration

$$a = \frac{dv}{dt} = \frac{d^2x}{dt^2}$$

#Constant acceleration

$$v = v_0 + at$$

$$x - x_0 = v_0 t + \frac{1}{2}at^2$$

$$v^2 = v_0^2 + 2a(x - x_0)$$

$$x - x_0 = \frac{1}{2}(v_0 + v)t$$

$$x - x_0 = vt - \frac{1}{2}at^2$$

Chapter3

#Components of a Vector

$a_x = a\cos\theta$, $a_y = a\sin\theta$

$a = \sqrt{a_x^2 + a_y^2}$, $\tan\theta = \frac{a_y}{a_x}$

#The scalar product $\vec{a}\cdot\vec{b} = ab\cos\phi$

#The vector product $\vec{c} = \vec{a}\times\vec{b}$, $c = ab\sin\phi$

Chapter4

#Instantaneous velocity $\vec{v} = \frac{d\vec{r}}{dt}$

#Average acceleration $\vec{a}_{avg} = \frac{\Delta\vec{v}}{\Delta t}$

#Instantaneous acceleration $\vec{a} = \frac{d\vec{v}}{dt}$

#Trajectory of projectile motion

$$y = (\tan\theta_0)x - \frac{gx^2}{2(v_0\cos\theta_0)^2}$$

#Horizontal range $R = \frac{v_0^2}{g}\sin 2\theta_0$

#Uniform circular motion

$$a = \frac{v^2}{r} \qquad T = \frac{2\pi r}{v}$$

#Relative motion $\vec{v}_{PA} = \vec{v}_{PB} + \vec{v}_{BA}$

Chapter5

Newton's second law $\vec{F}_{net} = m\vec{a}$

#A gravitational force $F_g = mg$

Chapter6

#The maximum static friction force

$$f_{s,max} = \mu_s F_N$$

#The kinetic friction force

$$f_k = \mu_k F_N$$

#Drag force $D = \frac{1}{2}C\rho A v^2$

#Terminal speed $v_t = \sqrt{\frac{2F_g}{C\rho A}}$

#Uninform circular motion

$$a = \frac{v^2}{R} \qquad F = m\frac{v^2}{R}$$

Chapter7

#Kinetic energy $K = \frac{1}{2}mv^2$

#Work done by a constant force

$$W = Fd\cos\phi = \vec{F}\cdot\vec{d}$$

#Work-kinetic energy theorem

$$\Delta K = K_f - K_i = W$$

#Work done by the gravitational force

$$W_g = mgd\cos\theta$$

#Work done in lifting and lowering an object $\Delta K = K_f - K_i = W_a + W_g$

#Spring force

$$\vec{F}_s = -k\vec{d} \qquad F_x = -kx$$

#Work done by a spring force

$$W_s = \frac{1}{2}kx_i^2 - \frac{1}{2}kx_f^2$$

#Work done by a variable force

$$W = \int_{x_i}^{x_f} F_x dx + \int_{y_i}^{y_f} F_y dy + \int_{z_i}^{z_f} F_z dz$$

#Power $P_{avg} = \frac{W}{\Delta t}$ $\quad P = \frac{dW}{dt}$

$$P = Fv\cos\phi = \vec{F}\cdot\vec{v}$$

Chpater8

Potential energy

$\Delta U = -W$ $\quad \Delta U = -\int_{x_i}^{x_f} F(x)dx$

#Gravitational potential energy

$$\Delta U = mg(y_f - y_i) = mg\Delta y$$

$$U(y) = mgy$$

#Elastic potential energy

$$U(x) = \frac{1}{2}kx^2$$

#Mechanical energy $E_{mec} = K + U$

#Principle of conservation of mechanical energy

$$K_2 + U_2 = K_1 + U_1$$

$$\Delta E_{mec} = \Delta K + \Delta U = 0$$

#Potential energy curves

$$F(x) = -\frac{dU(x)}{dx}$$

$$K(x) = E_{mec} - U(x)$$

#Work done on a system by an external force

$$W = \Delta E_{mec} = \Delta K + \Delta U$$

$$W = \Delta E_{mec} + \Delta E_{th}$$

$$\Delta E_{th} = f_k d$$

#Conservation of energy

$$W = \Delta E = \Delta E_{mec} + \Delta E_{th} + \Delta E_{int}$$

#Power $P_{avg} = \frac{\Delta E}{\Delta t}$ $\quad P = \frac{dE}{dt}$

Chapter9

#Center of mass $\vec{r}_{com} = \frac{1}{M}\sum_{i=1}^{n} m_i\vec{r}_i$

#Newton's second law for a system

$\vec{F}_{net} = M\vec{a}_{com}$

#Linear momentum and newton's second law

$\vec{p} = m\vec{v}$, $\vec{F}_{net} = \dfrac{d\vec{p}}{dt}$

$\vec{P} = M\vec{v}_{com}$, $\vec{F}_{net} = \dfrac{d\vec{P}}{dt}$

#Collision and impulse

$\vec{p}_f - \vec{p}_i = \Delta\vec{p} = \vec{J}$

$\vec{J} = \int_{t_i}^{t_f} \vec{F}(t)dt$, $J = F_{avg}\Delta t$

$F_{avg} = -\dfrac{n}{\Delta t}\Delta p = -\dfrac{n}{\Delta t}m\Delta v$

$F_{avg} = -\dfrac{\Delta m}{\Delta t}\Delta v$

#Conservation of linear momentum

$\vec{P} = \text{constant}$, $\vec{P}_i = \vec{P}_f$

#Inelastic collision in one dimension

$\vec{p}_{1i} + \vec{p}_{2i} = \vec{p}_{1f} + \vec{p}_{2f}$

$m_1v_{1i} + m_2v_{2i} = m_1v_{1f} + m_2v_{2f}$

#Elastic collisions in one dimension

$v_{1f} = \dfrac{m_1 - m_2}{m_1 + m_2}v_{1i}$,

$v_{2f} = \dfrac{2m_1}{m_1 + m_2}v_{1i}$

#Collisions in two dimensions

$\vec{P}_{1i} + \vec{P}_{2i} = \vec{P}_{1f} + \vec{P}_{2f}$

$K_{1i} + K_{2i} = K_{1f} + K_{2f}$

#Variable-mass system

$Rv_{rel} = Ma$, $v_f - v_i = v_{rel}\ln\dfrac{M_i}{M_f}$

Chapter10

Angular velocity and speed

$\omega_{avg} = \dfrac{\Delta\theta}{\Delta t}$, $\omega = \dfrac{d\theta}{dt}$

#Angular acceleration

$\alpha_{avg} = \dfrac{\Delta\omega}{\Delta t}$, $\alpha = \dfrac{d\omega}{dt}$

#The kinetic equations for constant angular acceleration

$\omega = \omega_0 + \alpha t$

$\theta - \theta_0 = \omega_0 t + \dfrac{1}{2}\alpha t^2$

$\omega^2 = \omega_0^2 + 2\alpha(\theta - \theta_0)$

$\theta - \theta_0 = \dfrac{1}{2}(\omega_0 + \omega)t$

$\theta - \theta_0 = \omega_0 t - \dfrac{1}{2}\alpha t^2$

#Linear and angular variables related

$s = \theta r$, $v = \omega r$, $a_t = \alpha r$,

$a_r = \dfrac{v^2}{r} = \omega^2 r$, $T = \dfrac{2\pi r}{v} = \dfrac{2\pi}{\omega}$

#Rotational kinetic energy and rotational inertia

$K = \dfrac{1}{2}I\omega^2$

$I = \sum m_i r_i^2$, $I = \int r^2 dm$

#The parallel-axis theorem

$I = I_{com} + Mh^2$

#Torque $\tau = rF_t = r_\perp F = rF\sin\phi$

#Newton's second law in angular form

$\tau_{net} = I\alpha$

#Work and rotational kinetic energy

$W = \int_{\theta_i}^{\theta_f} \tau d\theta$, $P = \dfrac{dW}{dt} = \tau\omega$

$W = \tau(\theta_f - \theta_i)$

$\Delta K = K_f - K_i = \dfrac{1}{2}I\omega_f^2 - \dfrac{1}{2}I\omega_i^2 = W$

Chapter11

#Rolling bodies

$v_{com} = \omega R$, $a_{com} = \alpha R$,

$K = \dfrac{1}{2}I_{com}\omega^2 + \dfrac{1}{2}Mv_{com}^2$

$a_{com,x} = -\dfrac{g\sin\theta}{1 + I_{com}/MR^2}$

Torque as a vector

$\vec{\tau} = \vec{r} \times \vec{F}$

#Angular momentum of a particle

$\vec{l} = \vec{r} \times \vec{p} = \vec{r} \times (m\vec{v})$

$l = rmv\sin\phi$

#Newton's second law in angular form

$\vec{\tau}_{net} = \dfrac{d\vec{l}}{dt}$

#Angular momentum of a system

$\vec{L} = \vec{l}_1 + \vec{l}_2 + \cdots + \vec{l}_n = \sum_{i=1}^{n}\vec{l}_i$

$\vec{\tau}_{net} = \dfrac{d\vec{L}}{dt}$

#Angular momentum of rigid body

$L = I\omega$

#Conservation of angular momentum

$\vec{L} = \text{constant}$, $\vec{L}_i = \vec{L}_f$

#Precession of a gyroscope

$\Omega = \dfrac{Mgr}{I\omega}$

Chapter12

#Static equilibrium

$\vec{F}_{net} = 0$, $F_{net,x} = 0$ $F_{net,y} = 0$

$\vec{\tau}_{net} = 0$, $\tau_{net,z} = 0$

#Elastic moduli

$\dfrac{F}{A} = E\dfrac{\Delta L}{L}$, $\dfrac{F}{A} = G\dfrac{\Delta x}{L}$,

$p = B\dfrac{\Delta V}{V}$

Chapter13

#The law of gravitation

$F = G\dfrac{m_1m_2}{r^2}$

#Gravitational acceleration

$F = ma_g$, $a_g = \dfrac{GM}{r^2}$

#Gravitation with a spherical shell

$F = \dfrac{GmM}{R^3}r$

#Gravitational potential energy

$$U=-\frac{GMm}{r}$$

#Potential energy of a system

$$U=-(\frac{Gm_1m_2}{r_{12}}+\frac{Gm_1m_3}{r_{13}}+\frac{Gm_2m_3}{r_{23}})$$

#Escape speed

$$v=\sqrt{\frac{2GM}{R}}$$

#Law of periods

$$T^2=(\frac{4\pi^2}{GM})r^3$$

#Energy in planetary motion

$$U=-\frac{GMm}{r},\ K=\frac{GMm}{2r}$$

$$E=K+U$$

$$E=-\frac{GMm}{2r},\ E=-\frac{GMm}{2a}$$

Chapter15

Period $T=\frac{1}{f},\ \omega=\frac{2\pi}{T}=2\pi f$

#Simple harmonic motion

$$x=x_m\cos(\omega t+\phi)$$

$$v=-\omega x_m\sin(\omega t+\phi)$$

$$a=-\omega^2x_m\cos(\omega t+\phi)$$

#The linear oscillator

$$\omega=\sqrt{\frac{k}{m}},\quad T=2\pi\sqrt{\frac{m}{k}}$$

#Pendulums

$$T=2\pi\sqrt{I/\kappa},\ T=2\pi\sqrt{L/g}$$

$$T=2\pi\sqrt{I/mgh}$$

#Damped harmonic motion

$$x(t)=x_me^{-bt/2m}\cos(\omega' t+\phi)$$

$$\omega'=\sqrt{\frac{k}{m}-\frac{b^2}{4m^2}}$$

$$E(t)\approx\frac{1}{2}kx_m^2e^{-bt/m}$$

#Forced oscillations and resonance

$$\omega_d=\omega$$

Chapter16

#Sinusoidal waves

$$y(x,t)=y_m\sin(kx-\omega t)$$

$$k=\frac{2\pi}{\lambda},\quad \frac{\omega}{2\pi}=f=\frac{1}{T}$$

$$v=\frac{\omega}{k}=\frac{\lambda}{T}=\lambda f$$

#Equation of a traveling wave

$$y(x,t)=h(kx\pm\omega t)$$

#Wave speed on stretched string

$$v=\sqrt{\frac{\tau}{\mu}}$$

#Power $P_{avg}=\frac{1}{2}\mu v\omega^2y_m^2$

#Interference of waves

$$y'(x,t)=[2y_m\cos\tfrac{1}{2}\phi]\sin(kx-\omega t+\tfrac{1}{2}\phi)$$

#Standing waves

$$y'(x,t)=[2y_m\sin kx]\cos\omega t$$

#Resonance

$$f=\frac{v}{\lambda}=n\frac{v}{2L},\quad \text{for n=1,2,3,...}$$

Chapter17

#Sound waves

$$s=s_m\cos(kx-\omega t)$$

$$\Delta p=\Delta p_m\sin(kx-\omega t)$$

$$\Delta p_m=(v\rho\omega)s_m,\quad v=\sqrt{\frac{B}{\rho}}$$

Interference $\phi=\frac{\Delta L}{\lambda}2\pi$

#Fully constructive interference

$$\phi=m(2\pi),\quad \frac{\Delta L}{\lambda}=0,1,2,\cdots$$

#Fully destructive interference

$$\phi=(2m+1)\pi,$$

$$\frac{\Delta L}{\lambda}=0.5,1.5,2.5,\cdots$$

#Sound intensity

$$I=\frac{P}{A},\ I=\tfrac{1}{2}\rho v\omega^2s_m^2,\ I=\frac{P_s}{4\pi r^2}$$

#Sound level in decibels

$$\beta=(10dB)\log\frac{I}{I_0},$$

$$I_0=10^{-12}\ W/m^2$$

#Standing wave patterns in pipe

$$f=\frac{v}{\lambda}=\frac{nv}{2L},\quad \text{n=1,2,3,...}$$

$$f=\frac{v}{\lambda}=\frac{nv}{4L},\quad \text{n=1,3,5,...}$$

#Beats $f_{beat}=f_1-f_2$

#The Doppler effect

$$f'=f\frac{v\pm v_D}{v\mp v_s}$$

Chapter18

#The Kelvin temperature scale

$$T=(273.16K)(\lim_{gas\to 0}\frac{p}{p_3})$$

#Celsius and Fahrenheit scales

$$T_C=T-273.15^0,\ T_F=\tfrac{9}{5}T_C+32^0$$

#Thermal expension $\beta=3\alpha$

$$\Delta L=L\alpha\Delta T,\quad \Delta V=V\beta\Delta T,$$

#Heat capacity and specific heat

$$Q=C(T_f-T_i),\quad Q=cm(T_f-T_i)$$

#Heat of transformation $Q=Lm$

#Work associated with volume change

$$W=\int dW=\int_{V_i}^{V_f}pdV$$

#First law of thermodynamics

$$\Delta E_{int}=E_{int,f}-E_{int,i}=Q-W$$

$$dE_{int}=dQ-dW$$

Course Name: General Physics B (...

5) This graph shows th...
(解析) angular v...
A) −6 rad/s
B) 6 ...

Formulas and constants

#Conduction $P_{con} = \frac{Q}{t} = kA\frac{T_H - T_C}{L}$

#Radiation

$P_{rad} = \sigma\varepsilon A T^4$, $P_{abs} = \sigma\varepsilon A T_{env}^4$

Chapter19

#Avogadro's number $M = mN_A$

$n = \frac{N}{N_A} = \frac{M_{sam}}{M} = \frac{M_{sam}}{mN_A}$

#Ideal gas

$PV = nRT$, $PV = NkT$

#Work in an isothermal volume change

$W = nRT \ln\frac{V_f}{V_i}$

#Pressure, temperature, and molecular speed $p = \frac{nMv_{rms}^2}{3V}$, $v_{rms} = \sqrt{\frac{3RT}{M}}$

#Temperature and kinetic energy

$K_{avg} = \frac{3}{2}kT$

#Mean free path $\lambda = \frac{1}{\sqrt{2}\pi d^2 N/V}$

#Maxwell speed distribution

$P(v) = 4\pi(\frac{M}{2\pi RT})^{3/2} v^2 e^{-Mv^2/2RT}$

$v_{avg} = \sqrt{\frac{8RT}{\pi M}}$, $v_P = \sqrt{\frac{2RT}{M}}$

#Molar specific heats

$Q = nC_V\Delta T$, $Q = nC_p\Delta T$

$\Delta E_{int} = nC_V\Delta T$, $E_{int} = nC_V T$

$C_p = C_V + R$

#Degrees of freedom and Cv

$C_V = \frac{f}{2}R$

#Adiabatic process

$PV^\gamma =$ a constant, $\gamma = C_p/C_V$

Chapter20

#Calculating entropy change

$\Delta S = S_f - S_i = \int_i^f \frac{dQ}{T}$

$\Delta S = S_f - S_i = \frac{Q}{T}$

$\Delta S = S_f - S_i = nR\ln\frac{V_f}{V_i} + nC_V\ln\frac{T_f}{T_i}$

#The second law of thermodynamic

$\Delta S \geq 0$

#Engines

$\varepsilon = \frac{\text{energy we get}}{\text{energy we pay for}} = \frac{|W|}{|Q_H|}$

#A Carnot engine

$\varepsilon = 1 - \frac{|Q_L|}{|Q_H|} = 1 - \frac{T_L}{T_H}$

#Refrigerators

$K = \frac{\text{what we want}}{\text{what we pay for}} = \frac{|Q_L|}{|W|}$

#A Carnot refrigerator

$K_C = \frac{|Q_L|}{|Q_H| - |Q_L|} = \frac{T_L}{T_H - T_L}$

#Entropy from a statistics view

$W = \frac{N!}{n_1! n_2!}$, $S = k\ln W$

Constants

#Speed of light $c = 3.00\times10^8\ m/s$

#Free-fall acceleration $g = 9.81\ m/s^2$

#Gravitational constant

$G = 6.67\times10^{-11}\ m^3/s^2\cdot kg$

#Universal gas constant

$R = 8.31\ J/mol\cdot K$

#Boltzmann constant

$k = 1.38\times10^{-23}\ J/K$

#Mass of the sun $1.99\times10^{30}\ kg$

#Mass of the earth $5.98\times10^{24}\ kg$

#Mass of the moon $7.36\times10^{22}\ kg$

#Some rotational inertias for uniform bodies.

(a) Hoop about central axis $I = MR^2$

(b) Annular cylinder (or ring) about central axis $I = \frac{1}{2}M(R_1^2 + R_2^2)$

(c)Solid cylinder (or disk) about central axis $I = \frac{1}{2}MR^2$

(d) Solid cylinder (or disk) about central diameter $I = \frac{1}{4}MR^2 + \frac{1}{12}ML^2$

(e)Thin rod about axis through center perpendicular to length $I = \frac{1}{12}ML^2$

(f) Solid sphere about any diameter

$I = \frac{2}{5}MR^2$

Prefix for SI Units

Factor	Prefix	Symbol
10^{15}	peta-	P
10^{12}	tera-	T
10^9	giga-	G
10^6	mega-	M
10^3	kilo-	K
10^2	hecto-	h
10^1	deka-	da
10^{-1}	deci-	d
10^{-2}	centi-	c
10^{-3}	milli-	m
10^{-6}	micro-	μ
10^{-9}	nano-	n
10^{-12}	pico-	p
10^{-15}	femto-	f

$\int\frac{a+bx}{A+Bx}dx = \frac{bx}{B} + \frac{aB-bA}{B^2}\ln(A+Bx)$