Answers to Example Problems - Chapter 31

EX OICDX.)

ω = 1659 Hz

0.0013 g/cm^3 = 1.3 kg/m^3

28 Pa

$\Delta x=\Delta p/v\rho\omega=3.8\times10^{-5}$ m

3×10^{-5} Pa

$\Delta x=4.1\times10^{-11}$ m

EX WSZJ.)

Speed and density go up, thus Δp goes up

EX KBGVF.)

$I=P/4\pi r^2$

$I=1.0\times10^{-5}$ W/m^2

EX NMHB.)

P=I.Area

P = 39375 W

E = 1.4×10^9 J

EX MJNB.)

A.) $\beta=10\log(I/I_\circ)$

$20=\log(I/I_\circ)$

$10^{20}=I/I_\circ$

$I=10^8$ W/m^2

b.) I=P/Area

$P=(10^8)(4\pi(50^2))$

$P=3.14\times10^{12}$ W

c.) 60 dB=10^{-6} W/m^2

$10^{-6}=3.14\times10^{12}/(4\pi r^2)$

$r=5\times10^8$ m

EX OINH.)

$I = (60\text{ W})/4\pi r^2 = 0.298$ W/m^2

$\beta=10\log(I/I_\circ)$

β=115 dB

EX WMOX.)

1000 times

EX THFU.)

A.) $10^{\beta1} = I_1/I_\circ$

$10^{\beta 2} = I_2/I_o$

$10^{\beta 1-\beta 2} = I_1/I_2$

b.) Skip

EX UVXCR.)

$F_r = F_s\{(340)/(3400-25)\}$

$F_r = 2159$ Hz

EX LOPHY.)

A.) 43 Hz

b.) 37 Hz

c.) 40 Hz

d.) 40 Hz

EX OEIW.)

$V/\lambda_1 = (v/\lambda_2)(1-v_r/v)$

$750/760 = 1 - v_r/v$

$v_r = 3.95x10^6$ m/s

EX KIJU.)

Perpendicular $v = v\sin\theta = vd/(sqr(d^2+x^2))$

EX EVUH.)

8 beats per second at 354 Hz

EX HUYG.)

Either 436 or 444 Hz

Answers to Example Problems - Chapter 32

EX CVM.) $n = f_{harmonic}/f_{fundamental}$

EX ZSW.)

Skip equation parts

EX URRCV.)

9 or 10 octaves

EX JKHY.)

C:E = 262/330 = 0.79 = 4:5
E:G = 330/392 = 0.84 = 5:6
G:C= 392/524 = 0.74 = 6:8

Augmented
4/4.8 = 262/x
x = 314 (E flat)

314/x = 4.8/5.76
x = 377 (G flat)

thus C, E flat, G flat, C

EX JUHY.)

$f_n/f_o = r_o/r_n$
f_n = 240 Hz

EX HGTF.)

$f_o/f_n = L_n/L_o$
$256/f_n = 30/35$
f_n = 299 Hz

$f_n/f_o = \sqrt{T_n}/\sqrt{T_o}$
$f_n/299 = \sqrt{32}/\sqrt{27}$
f_n = 326 Hz

Answers to Example Problems - Chapter33

EX RDE.)

$I = (60\ W)/4\pi(2)^2 = 1.19\ W/m^2$

$S=(2/\mu_o c)E^2$
$1.19=(2/((1.26x10^{-6})(3x10^8))E^2$
$E = 15\ N/C$
$B=E/c=5x10^8\ T$

EX WMIGH.)

P=100 W=100 J in one second

$f=v/\lambda=4x10^{14}$ Hz
thus $4x10^{14}$ waves in one second

thus each wave brings 100 J/$4x10^{14}$ Hz = $2.5x10^{-13}$ J

EX TGB.)

$I_t = I_i\cos^2\theta$
$I_1/I_i = \cos^2 20^o = 88\%$
$I_1/I_2 = \cos^2 60^o = 25\%$

$I_{total} = (88\%)(25\%) = 22\%$

EX OIUN.)

Use an approximation $d\sin\theta=m\lambda$
$(0.07)(\sin\theta)=\lambda$
$(0.07)(0.05/7)=\lambda$
$\lambda=5x10^{-4}$ m

Answers to Example Problems - Chapter 34

EX JKIU.)

$E=hf=hc/\lambda=3.06\times10^{-19}$ J = 1.9 eV

skip momentum part

EX RVJU.)

1 photon = $hc/\lambda = 3.98\times10^{-19}$ J

in one second 60 J given off

= 60 J/3.98×10^{-19} J = 1.5×10^{20} photons

EX IJUHY.)

A.) $f_c = \omega/h = 1.1\times10^{15}$ Hz

b.) $E = hc/\lambda$ = 10.5 eV

T=10.5 eV - 4.7 eV = 5.65 eV

c.) 5.65 Volts

Answers to Example Problems - Chapter 35

EX BHG.)

$n=c/v$

$n=f_1\lambda_1/f_2\lambda_2$

$n=\lambda_1/\lambda_2$

EX RTY.)

$n=c/v \quad v=2x10^8$ m/s

$n=\lambda_1/\lambda_2 \quad \lambda_2 = 500$ nm

EX KIU.)

$n\sin\theta = n_2\sin\theta_2$

$\sin(35) = 1.33\sin\theta_2$

$\theta_2 = 25^o$

EX XMJ.)

$\sin(50) = 1.5\sin\theta$

$\theta=31^o$

using triangle on top of prism, gives $\theta_2 = 1^o$

$1.5\sin(1) = \sin\theta_3$

$\theta_3 = 1.5^o$ to normal

EX NTP.) Skip

EX TBH.)

$\theta_t = 19.5^o$

$\tan(19.5) = x/2.0$ cm

$x_1 = 0.71$ cm

$\tan(30^o) = x_2/2.0$ cm

$x_2 = 1.15$ cm

$\Delta x = 0.44$ cm

EX. COI.) Skip

EX PUH.)

$\theta_c = n_2/n_1$

glass $\theta_c = 42^o$

diamond $\theta_c = 24^o$

EX. LOC.) Skip

EX FWE.)

Constructive: $2L=\lambda/2n$

$L = \lambda/4n$ (or $3\lambda/4n$ or $5\lambda/4n$)

Destructive: $2L=\lambda/n$

$L=\lambda/2n$ or $2\lambda/2n$ or $4\lambda/2n$

EX VEF.)

Note use $n=1.5$

$L=\lambda/4n = 1.25\times10^{-7}$ m

$L_2=3\lambda/4n=3.75\times10^{-7}$ m

$L_3=5\lambda/4n=6.25\times10^{-7}$ m

EX XXC.)

Use $n=1.5$

constructive: $L=\lambda/4n, 3\lambda/4n, 5\lambda/4n$

$(1.65\times10^{-6})=\lambda, 3\lambda, 5\lambda$

$\lambda_1 = 1.65\times10^{-6}$ m

$\lambda_2 = 5.5\times10^{-7}$ m

$\lambda_3 = 3.3\times10^{-7}$ m

destructive

$L= \lambda/2n, \lambda/n, 2\lambda/n$

$(8.25\times10^{-7}) = \lambda, 2\lambda, 4\lambda$

$\lambda_1 = 8.25\times10^{-7}$ m

$\lambda_2 = 4.125\times10^{-7}$ m

$\lambda_3 = 2\times10^{-7}$ m

Answers to Example Problems - Chapter 36

EX BRO.)

A.) $1/i + 1/o = 1/f$
$1/i + 1/5 = 1/15$

$i = -7.5$ cm
$m = -i/o = 1.5$
virtual, upright

b.) No image

c.) $i = 37.5$ cm
$m = -1.25$
real, inverted

EX YGG.)

A.) $1/i + 1/o = 1/f$
$i = -6$ cm
$m = 0.6$
virtual, erect

b.) $i = -10$ cm
$m = 0.33$
virtual, erect

EX QGN.)

In air:
$1/f = (n-1)(1/r_1 - 1/r_2) = (0.56)(1/35 - 1/-43)$
$f = 34.5$ cm

$i = 80.9$ cm
$m = -1.35$
real, inverted

for water:
$f = 111.6$ cm
$i = -129$ cm
$m = 2.16$
virtual, erect

EX QGO.)

$1/f = (0.56)(1/-35 - 1/43)$

f = -34.5 cm
i = -21.9 cm
m = 0.365
virtual, erect

EX PKJ.)
1/i + 1/45 = 1/25
i = 56.25 cm
m = -1.25
real and inverted

EX ECV.)
1/i + 1/45 = 1/-25
i = - 16 cm
m = 0.357
virtual and erect

EX RUY.)
1/i + 1/10 = 1/25
i = -16.7 cm
m = 1.67
virtual, inverted

EX KIJDE.) Skip problem

Answers to Example Problems - Chapter 37

EX JUH.)

$\Delta L = L\alpha\Delta T$

$\Delta L = (12 \text{ inches})(1.1\text{x}10^{-5})(37 \text{ C})$

$\Delta L = 0.004884$ inches

length = 11.995 inches

EX YCD.)

$A_n = (L_1+\Delta L_1)(L_2+\Delta L_2)$

$L_1L_2 + L_1\Delta L_2 + L_2\Delta L_1 + \Delta L_1\Delta L_2$

$\Delta A = A_{new} - A_{old}$

$L_1\Delta L_2 + L_2\Delta L_1 + \Delta L_1\Delta L_2$

$L_1(L_2\alpha\Delta T) + L_2(L_1\alpha\Delta T) + \Delta L_1\Delta L_2$

$2\alpha L_1L_2\Delta T + \Delta L_1\Delta L_2$

$2\alpha A_{old}\Delta T + \Delta L_1\Delta L_2$

if $\gamma=2\alpha$ then we have

$\Delta A = \gamma A\Delta T + \Delta L_1\Delta L_2$

note the last term is not in the approximation

EX GTF.)

1 gal = 231 in^3 = 3786 cm^3

$\Delta V = V\beta\Delta T = 18 \text{ cm}^3$

new V = 3768 cm^3

old water level: 16.83 cm

new dimensions of container: 14.996 cm x 14.996 cm

new water level: 16.76 cm

note: the change in the volume has nothing to do with the change in the container

EX FGTN.)

$H = kA(T_h - T_c)/L$

$= (0.00927)(40)(13) = 4.8$ J/sec

in 6 hours: 104120 J

convert: 104120 J (1 kwhr/$3.6\text{x}10^6$ J) = 0.029 kw.hrs

cost = 0.29 cents

EX OIJU.)

$\Delta T = \Delta T e^{-At}$

$13 = 68e^{-(0.0012)t}$

$0.19117 = e^{-(0.0012)t}$

$\ln(0.19117) = e^{-At}$

$-1.6545 = -At$

$t = 1378.8$ sec

Answers to Example Problems - Chapter 38

EX HYN.)

$W=mgh=2.94$ J

$\Delta E=-W=-2.94$ J

EX TRCV.)

$Q=nC_v\Delta T$

$1000 = (6)(12.6)(\Delta T)$

$\Delta T=13.2$ K

$P_1/T_1 = P_2/T_2$

$500/303 = P/316.2$

$P_2 = 521.8$ Pa

EX PFN.)

$W = P\Delta V = (500)(0.6) = 300$ J

$PV=nRT$

$T_1 = 24.6$ K

$T_2 = 43$ K

$\Delta T=18.4$ K

$Q=nC\Delta T=795$ J

EX UNH.)

$P_1V_1 = P_2V_2$

$V_2 = 0.114\ m^3$

$PV/nR = T = 24$ K

$Q=W=nrT\ln(V_2/V_1)=223$ J

EX UHN.)

$W=Area=(150)(0.03)=4.5$ J

EX JNH.)

$\Delta S_{house} = -10000/300\ K = -33.3$ J/K

$\Delta S_{outside} = 10000/288\ K = 34.7$ J/K

$\Delta S_{total} = 1.4$ J/K

EX UBNB.)

$Q=mc\Delta T=5404$ J

$\Delta S = 5404 \text{ J}/283 \text{ K} = 19 \text{ J/K}$

EX JUH.)

$\text{Eff} = 1 - T_c/T_H$

$\text{eff} = 1 - 278/301 = 7.6\%$

$H = mc\Delta T = (2000 \text{ g})(4.19)(23 \text{ C})$

$0.076 = 193000/\text{in}$

$\text{in} = 2536000 \text{ J}$

Answers to Example Problems -Chapter 39

EX HIOH.)

$C = 4\pi(0.032/2\pi(8.31)(300\ K))^{3/2} = 3.67x10^{-8}$

a.) $p\Delta v = C(5^2)e^{-1.6x10(-4)}\Delta V = 9.17x10^{-6}$ (percentage)

$p\Delta V(8\ moles) = 7.3x10^{-5}=4.4x10^{-19}$ atoms

b.) $P\Delta V=C(407.5)^2e^{-1.066}=0.0315$ (percentage)

$1.5\ x10^{23}$ atoms

EX NRD.)

A.) $KE = (3/2)kT = 6.21x10^{-21}$ J

b.) $KE = (1/2)mv^2 = (1/2)(0.028/6.02x10^{23})v^2$

$v = 517$ m/s

c.) $C = 4\pi(0.028/2\pi R(300))^{3/2} = 3x10^{-8}$

$P(v) = c(517)^2e^{-1.5} = 0.0018$

$P\Delta v = 7.1\%$

EX CRD.)

For each degree: $(2\ moles)(N_A)(1/2)(k)(300) = 2492$ J

a.) 7476 J

b.) 12460 J

c.) 14952 J

EX MNJUH.)

1.) 2 moles O_2 (diatomic)

A.) $C_v = 20.8$

$C_p = 29.2$

b.) $\gamma = 1.4$

c.) $(N_A)(2)(5/2)kT=12461$ J

2.) 1 mole C (monatomic)

A.) $C_v = 12.5$

$C_p = 20.8$

b.) $\gamma = 1.66$

c.) $(N_A)(1)(3/2)kT=3738$ J

3.) 1 mole polyatomci

A.) $C_v = 24.9$

$C_p = 33.3$

b.) $\gamma = 1.33$

c.) $(N_A)(1)(6/2)kT=7476$ J

EX BHUN.)

$1.01x10^5$ Pa = 1 atm

$\gamma=1.404$

PV=nRT
V_1=0.0247 m^3

$P_1V_1^{\gamma} = P_2V_2^{\gamma}$
$(1.01x10^5)(0.0247)^{1.404} = (2.02x10^5)V_2^{1.404}$
$0.00277=V_2^{1.404}$
$\ln(0.00277)=1.404\ln(V_2)$
$-4.194 = \ln(V_2)$
$e^{-4.194} = V_2$
$0.015 = V_2$

EX JNH.)

$\lambda = v/(\sqrt{2}\pi d^2 N)$

V= nRT/P = 0.247 m^3
$\lambda = 1.0x10^{-7}$ m

EX KIJ.)

S = k.ln(W)

State	W	S
a	1	0
b	6	2.47x10^-23
c	15	3.74x10^-23
d	20	4.13x10^-23
e	15	3.74x10^-23
f	6	2.47x10^-23
g	1	0

EX JU.)

Most probable: 25/25
$W = 50!/(25!25!) = 2.52x10^{12}$
$S = k.\ln(W) = 3.94x10^{-22}$

next two: 26/24 and 24/26
$W = 50!/(26!24!) = 2.43x10^{12}$
$S = 3.93x10^{-22}$