PHYSICS GRADE 12
CHAPTER ONE
QUESTIONS AND PROBLEMS

QUESTION ONE **(page 13-17)**

Differentiate simple harmonic and periodic motion?

ANS: simple harmonic motion is a motion in a body (or a wave) moves back and forth over a fixed path, returning to each position and velocity after a definite interval of time.

Periodic motion is a motion of an object that regularly returns (repeats) to a given position after a fixed time interval.

QUESTION TWO

Write short note on the following:

A) Period, **B)** Frequency, **C**) force constant, **D)** reference of SHM?

ANS: A) **Period**, is the time taken to make one complete cycle **(oscillation)**

B) **Frequency,** is the number of cycle or **(oscillation)** made in one second.

C) **force constant**, is the spring constant

D) **Reference of SHM**, mass attached at the end of spring displacement, velocity, acceleration, energy, and period.

QUESTION THREE

State Hooke's law and list factors that don not effect period of simple Harmonic motion?

ANS: Hooke's law states that the restoring force applied by a spring is proportional to the displacement of the spring and opposite in direction.

Displacement (x) and acceleration (A) don't affect the period of simple harmonic motion.

QUESTION FOUR

Define simple pendulum?

ANS: simple pendulum is a mass on the end of a string which oscillates in harmonic motion.

MULTIPLE CHOICE QUESTIONS

ANS: 1) **(C)** because period depends on (G) and (L) $T=2\pi\sqrt{L/g}$

ANS: 2) (A) because $E_T \propto A^2$ $\therefore E_T=\frac{1}{2}KA^2$

ANS: 3) (B) period of SHM depends in K=force constant and mass of vibrating body, not mass of spring

ANS: 4) (B) $4\pi f^2{}_2(2+m) = 4\pi f_1{}^2 m$,

$$2+m=\frac{f1^2+m1}{f^2{}_2}=\frac{400x2}{100} \longrightarrow =2+m=8 \quad \therefore \ M=6$$

ANS: 5) (D) $k=\frac{mg}{X}=\frac{20}{0.1}=200$ $F=\frac{1}{2\pi}\sqrt{200/2}=\frac{5}{\pi}$ s^{-1}

ANS: 6) (A) $V=2\pi f A=2\pi(20)(0.03)=1.2\pi$

ANS: 7) (A) $a_{.max}=\frac{4\pi^2 A}{T^2}$ $\frac{4(\pi^2)(0.05)}{(0.1\pi)^2}=20 m/s^2$

ANS: 8) (C) $F_{.max}=a_{.max}=20x1=20N$

ANS: 9) (C) Not Clear

ANS: 10) (A) $T=2\pi\sqrt{K/m}=2\pi\sqrt{a/x}=2\pi\sqrt{0.04/0.04}=2\pi$ sec

ANS: 11) (B) $\frac{T_1{}^2}{T_2{}^2}=\frac{L_1{}^2}{L_2{}^2}=\frac{L_2}{4}\frac{16x1}{}=4m$

ANS: 12) (A) KE $\frac{1}{2}mv^2=\frac{1}{2}m(A\sqrt{k/m})^2=\frac{1}{2}x\,2\,(A^2 x\,k/m)=0.16 x 100/2=8J$

ANS: 13) (C) (a) $V=\sqrt{\frac{k}{m}}(x^2)=\sqrt{\frac{100}{1}}(0.1)^2=1$ (b) $v=\sqrt{2gh}=12 x \sqrt{(2x10x0.05)}=1$

(c) $V=\sqrt{2gh}=\sqrt{(2x10x0.1)}=1.414$

ANS: 14) (C) g_E = gravity of earth g_o ,, ,, ,, object $g_o = \frac{1}{g} g_E$ $g_E = g\ g_o$

$\frac{T_o}{T} = \sqrt{\frac{g_E}{g_o}} = \sqrt{\frac{g\ g_o}{g_o}} = 3$

ANS: 15) (D) $\frac{1}{2} k(A^2 - X^2) = \frac{5}{4}(\frac{1}{2} k A^2)$

$(A^2 - y^2) = \frac{5}{4} A^2 \quad \therefore = y^2 \frac{5}{4} (5cm)^2$

$\therefore = X \sqrt{(5cm)^2} = 2.24cm$

ANS: 16) (C) *Acceleration = -KX, Mass is constant*

ANS: 17) (A) *Velocity* = $\sqrt{\boldsymbol{K}\ (\boldsymbol{a^2 - X^2}\ )}$ *Mass is constant*

ANS: 18) (C) $T_1 = 2\pi\sqrt{m/k}$ $T_2 = 2\pi\sqrt{2m/k} = 2\pi\sqrt{m/k} \cdot \sqrt{2}$ $T = \sqrt{2} = \sqrt{2}\ T$

ANS: 19) (C) *system may possess inertia is not true for SHH.*

ANS: 20 (C) *kinetic energy is at the extreme position***.**

ANS: 21) (A) *a motion of simple pendulum is always simple harmonic.*

ANS: 22) (B) *a* $\propto x$ *and directed toward mean position***.**

ANS: 23) (B) *at means position, velocity is maximum.*

ANS: 24) (D) *it's a motion may be velocity.*

ANS: 25) (C) $KE = \frac{1}{2} k(a^2 - b^2)$

ANS: 26) (D) $\frac{T^2}{T_n^2} = \frac{L}{2L} = T_n^2 = \frac{2L\ T^2}{L} = 2\ T^2$

$\therefore T_n = \sqrt{2\ T^2} = \sqrt{2T} = \underline{\underline{\mathbf{1.414T}}}$

ANS: 27) (A) *If increase length of simple pendulum, its period will be increase*.

ANS: 28) () **No clear**

ANS: 29) (C) *The trajectory of the bob is parabolic.*

ANS: 30) (C) *Restoring force is always simple harmonic*.

ANS: 31) (A) *At moon the frequency of oscillation will be decrease.* $F_m = \frac{1}{56} F_{mE}$

ANS: 32) (A) *Simple pendulum acceleration due to gravity* ***g*** *is constant*

ANS: 33) (C) **SHM** *posses elasticity as well as inertia*.

ANS: 34) (A) $F=(\frac{k}{2}+\frac{k}{2})x = KX$

ANS: 35) (B) NM^{-1} or N/M

ANS: 36) ( ) **not Clear**

ANS: 37) (C) **PE** *is maximum at amplitude position.*

ANS: 38) (A) $T=2\pi\sqrt{K/m}$

ANS: 39) ( ) **not Clear**

ANS: 40) (A) $a = \frac{4\pi^2 A}{T^2}$ $A = \frac{aT^2}{4\pi^2}$ $\frac{aT^2}{4\pi^2} = \frac{VT}{2\pi}$ $V = \frac{2\pi A}{T}$

$A = \frac{VT}{2\pi}$ $T = \frac{4\pi^2 v}{2\pi}$ $\frac{2\pi V}{a} = \frac{2\pi v}{x}$

ANS: 41) (C) **SHM** total energy is conserved.

ANS: 42) (C) **SHM** *phase is constant*

End of Multiply choice Questions

True and false questions (page 18-21)

1.T, 2.T, 3.F, 4.T, 5.F, 6.T, 7.F, 8.T, 9.f, 10.f, 11.F, 12.T 13.F, 14.T, 15.T, 16.F.

End

1) Problems

Given

M=1kg

X=10cm = 0.1m

a) K=?

b) T=?

c) T=?

M = 2kg

Take g = 10m/s^2

SOLUTION (1)

A) = mg= kx

k=$\frac{mg}{X}$ = $\frac{1kg\ X\ 10m/s^2}{0.1m}$ **k = 100N/M**

B) T=2 π $\sqrt{K/m}$ T =2 π$\sqrt{1kg/100n/m}$ = 2 π$\sqrt{1/10}\ s^2$

=$\frac{2\ \pi}{10}$ = $\frac{\pi}{5}$ **sec** ∴ **T =0.628 sec**

C) T =2 π$\sqrt{2kg/100n/m}$ = 2 π$\sqrt{0.02}\ s^2$ = 2x3.14x0.14

∴ **T =0.879 sec**

2) Problems

Given

M=2kg

A= 0.4m

T=0.5 π sec

a) F_{max}= ?

b) a=?

X=0.2m

SOLUTION (2)

A) k = $\frac{4\pi^2 m}{T^2}$ = $\frac{4\pi^2(2kg)}{(0.5\pi)^2}$ = $\frac{4\pi^2(2kg)}{0.25\pi^2\ sec^2}$

K= 32N/M **note:** kg/s^2=N/M

F_{max} = kA 32N/M x 0.4m F_{max} **= 12.8N**

B) *from nektons' 2nd law: f=ma*

a= $\frac{f}{m}$ = $\frac{KX}{m}$ = $\frac{32N/M\ x\ 0.2m}{2kg}$ = ***3.2m/ s²***

3) Problems

Given

M_1=40g

=0.04kg

X_1= X

M_2=40g+20g

=60, =0.06kg

X_2= X+5cm

a) K=?

b) F=?

M=40g

SOLUTION (3)

$f_1 = M_1 g$ **(A)**

$kX_1 = M_1 g$= 0.04kg *x* 10m/s^2

kX=0.4N (1)

$f_2 = M_2 g$

$kx_2 = M_2 g$ =0.06kg x 10m/s^2

k(X+5cm) = 0.6N

k(X+0.05m)=0.6 ⟶(2)

Equate eg(1) and (2) substitute

kX=0.4N and KX+0.05mk = 0.6N

0.4N+0.05mk=0.6N

0.05mk=0.06n-0.4

0.05mk=0.2N ∴**0.2N/0.05m = 4N/M**

Continue Question SOLUTION (3)

B) m=40g = 0.04kg

K=4N/M

F=?

$f=\frac{1}{2\pi}\sqrt{K/m} = \frac{1}{2\pi}\frac{\sqrt{4N/M}}{0.04kg}$

$f=\frac{1}{2\pi}\sqrt{100}\,S^{-2} \quad \frac{10}{2\pi}\,S^{-1} \quad \frac{5}{\pi}$ Hz

4) Problems

Given

M=10g = 0.01kg

F = $\frac{40}{\pi}$ Hz

a) F_{max}?

b) V_{max}?

a_{max}?

c) a=? V=?

X=0.1m

SOLUTION (4)

K=4 $\pi^2 f^2$ m = 4 π^2 $(\frac{40}{\pi})^2$ (0.01) = 64N/m

a) **F_{max}** = KA= 64N/M *x* 0.2M = **12.8N**

b) **V_{max}** = $A\sqrt{K/m}$ = *0.2m x* $\sqrt{64/0.01}\,S^{-2}$

=0.2m *x* $\sqrt{6400}\,S^{-2}$ = 0.2m *x* 80 S^{-1} = ***16m/s***

a_{max} = F_{max} / m $\frac{12.8N}{0.01kg}$ = 1280m/ S^2 = 1.28 *x* 10^3m/ S^2

c) **a)** $\frac{kx}{m}$ = $\frac{64N/M \text{ x } 0.1m}{0.01kg}$ = **640m/S^2**

v) ***velocity at any time*** $\sqrt{k/m(A^2-X^2)} = \sqrt{64/0.02(0.1^2-0.1^2)}$

$=\sqrt{6400(0.04-0.01)} = \sqrt{6400(0.03)} = \sqrt{64\ x\ 3}$

$= 8\sqrt{3}$ m/s

5) Problems

Given

A=0.5m

X=0.2m

a= 5m/ S^2

a) T=?

b) V_{max}?

c) V=?

X=0.3m

SOLUTION (5)

A) F=ma

kx=ma

$\frac{X}{A} = \frac{m}{k}$

T= T=2 $\pi\sqrt{m/k}$ =2 $\pi\sqrt{X/a}$= 2 $\pi\sqrt{0.2/5}$

=2 $\pi\sqrt{0.04}\,S^2$ = 2 π(0.2) sec = **0.4 π sec**

B) V_{max} = $A\sqrt{k/m}$ = $A\sqrt{a/x}$ = 0.5m$\sqrt{5/0.2}$ = 0.5m$\sqrt{25}\,s^{-1}$

= 0.5m *x* 5 s^{-1} = *2.5m/s*

C) *V=* $\sqrt{k/m(A^2-X^2)} = \sqrt{5/0.2(0.5^2-0.3^2)}$

$= \sqrt{25(0.25-0.09)} = \sqrt{25(0.16)} = \sqrt{4}$ m/s = **2m/s**

6) Problems

Given

M=5kg

A=50cm = 0.5m

F=100N(maximum)

a) K=?

b) KE=? pE=?

a=?

X=40cm = 0.4m

SOLUTION (6)

A) $K = F_{max} / A = \frac{100N}{0.5m} =$ **200N/m**

B)) KE $\frac{1}{2}KA^2 - \frac{1}{2}KX^2 = \frac{1}{2}K(A^2 - X^2)$

$= \frac{1}{2} x 100N/m\ [(0.5m^2) - (0.4m^2)] = \frac{1}{2} x 100N/m\ (0.25\ m^2) - 0.16\ m^2)$

$= 100N/M \times 0.9m^2 = 9j$

pE$= \frac{1}{2}KX^2 = \frac{1}{2} \times 200N/M\ (0.4m)^2 = \frac{1}{2} \times 200N/M \times 0.16m^2 = 16j$

$$a = \frac{KX}{m} = \frac{200N/M \times 0.4m}{5kg} = \mathbf{16m/s^2}$$

7) Problems

Given

K = 50N/M

M=2kg

F=?

T=?

SOLUTION (7)

$$F = \frac{1}{2\pi}\sqrt{K/m} = \frac{1}{2\pi}\sqrt{50/2} = \frac{1}{2\pi} x \sqrt{25} S^{-1} = \frac{5}{2\pi} Hz$$

$$\boldsymbol{F = \frac{5}{2\pi}\ Hz}$$

$$T = 2\pi\sqrt{K/m} = 2\pi\sqrt{2/50} = 2\pi\ x\sqrt{1/25}\ sec = 2\pi\ x\frac{1}{5}\ sec$$

$$\boldsymbol{T = \frac{2\pi}{5}\ sec}$$

8) Problems

Given

K = 200N/M

T= 0.5 π sec

M=?

SOLUTION (8)

$$M = \frac{KT^2}{4\pi^2} = \frac{200N/M(0.5\pi\ sec)^2}{4\pi^2} = \frac{200N/M \times 0.25\pi^2\ sec^2}{4\pi^2}$$

$$= \mathbf{12.50kg}$$

9) Problems

Given

F=f_1

$f_1 = \frac{1}{2\pi}\sqrt{K/m}$

$f_2 = \frac{1}{2\pi}$

Mass is halved

$f_2 = \frac{1}{2\pi}\sqrt{2K/m}$ =

$= \frac{1}{2\pi}\sqrt{2}\,.\sqrt{K/m}$

$= \sqrt{2}\,(\frac{1}{2\pi}\sqrt{K/m}\,)$

SOLUTION (9)

a) $\Delta f = f_2 - f = 1.414f_1 - f_1 = 0.414f_1$

when the mass of the body is halved a factor of 0.414 increased b frequency **or** the frequency will be Increased by **0.414**

b) $T_1 / T_2 = 2\pi\sqrt{m/k}$ **/** $2\pi\sqrt{4^2 m/k}$ =

$\sqrt{\frac{m}{k} / \frac{1}{2}\ (\frac{m}{k})}$ = $\sqrt{2m/k}\frac{m}{k}$ = $\sqrt{2}$

10) Problems

Given

M=10kg

A= 0.2m

a) K=?

b) T=?

g = 10m/S^2

SOLUTION (10)

A) KA = mg K = $\frac{mg}{g} = \frac{10\text{kg x } 10\text{m/sec}^2}{0.2\text{m}}$ = ***500N/m***

B) $T=2\pi\sqrt{K/m}$ = 2 x 3.14 $\sqrt{10/500}$ sec

=6.28$\sqrt{0.02}$ sec = 6.28 *x* 0.1414sec = ***0.89sec***

11) Problems

Given

K=100N/m

X=0.4m

M=?

g = 10m/S^2

SOLUTION (11)

$M = \frac{kx}{g} = \frac{100\text{N/m x } 0.4\text{m}}{10\text{m/sec}^2}$ = 4kg

12) Problems

Given

M_1=10kg

K=200N/M

M_2= 20kg

Δx=?

$g = 10m/S^2$

SOLUTION (12)

$X_1 = \frac{m_1 g}{k} = \frac{10kg \times 10m/sec^2}{200N/m} =$ ***0.5m***

$X_2 = \frac{m_2 g}{k} = \frac{10kg \times 10m/sec^2}{200N/m} = 1m$

Displacement changes = Δx = X_1- X_2 = 1m-0.5m = ***0.5m***

13) Problems

Given

M_1=1kg

X_1= X

M_2= 1kg+9kg

=1.00g kg

=X+10cm

X_2=X+0.1m

a) K=?

b) f_1 / f_2=?

SOLUTION (13)

a) $f_1 = k X_1 = M_1 g = kx$ = 1kg x 10m/S^2 = kx = 10N= kx

$f_2 = k X_2 = M_2 g = k(X+0.1m)$

=1.00gkg x 10m/S^2 =kx + 0.1mk

=10.09N = kx+0.1mk

∴ 10.09N = 10N+0.1mk

10.09N-10N=0.1mk

0.09N=0.1mk ∴ $k = \frac{0.09N}{0.1m}$ = 0.9N/m

b) $f_1 / f_2 = \sqrt{m2} / \sqrt{m1} = \sqrt{m2/m1} = \sqrt{1.009kg/1kg}$ = ***1.004***

14) Problems

Given

A=0.5m

F=100Hz

a) V_{max}?

b) a_{max}?

take $\pi^2 \approx 10$

SOLUTION (14)

a) V_{max}? = 2 π f A = 2x3.14x100Hz x0.5m = **314m/S**

b) $a_{ma} = 4 \pi^2 f^2 A = 4(10)\ (100Hz)^2 \times 0.5 = 200{,}000 m/S^2$

$= 2x10^2$ ***m/s***

15) Problems

Given

M=10kg

A=50cm =0.5m

T=2sec

SOLUTION (15)

a) at equilibrium Position, X=0 $V= 2\pi f A = \frac{2\pi A}{T}$ =since $f= \frac{1}{T}$

$= \frac{2x3.14x0.5m}{2sec} =$ ***1.57m/S²*** $a= \frac{KX}{M} = \frac{K(0)}{M} =$ ***0***

kE=$\frac{1}{2}$ $mV^2 = \frac{1}{2}$ x10kg (1.57m/S² = ***12.3j***

PE= $\frac{1}{2}$ $kX^2 = \frac{1}{2}$ k $(0)^2 = 0$ X=0

b) at amplitude position X=A $V= \sqrt{k/m(A^2 - X^2)} = \sqrt{k/m(A^2 - A^2)}$

$= \sqrt{k/m(0)} = \sqrt{0} = 0$

Acceleration is maximum

$a_{ma}= 4\pi^2f^2A/T^2$ take,$\pi^2=10 = \frac{4(10)(0.5m)}{(2sec)^2} = \frac{4(10)(0.5m)}{4sec^2} =$**5m/S²**

kE=$\frac{1}{2}$ $mV^2 = \frac{1}{2}$ *x* 10kg *x* $(0)^2 =$ ***0***

At amplitude position its kinetic energy is lost and an equal amount of potential energy is gained.

PE = KE= 12.3j

c) at point 20cm (0.2m) from equilibrium position A=0.5m and X=0.2m

But k/m = $\frac{4X^2}{T^2} = \frac{4(10)}{4} = 10$

$V= \sqrt{k/m(A^2 - X^2)} = \sqrt{10[(0.5)^2 - (0.2)^2]} = \sqrt{10(0.25) - (0.04)}$

$=\sqrt{10(0.21)}$*m/s* = $\sqrt{2.1}$*m/s* = ***1.449m/s***

A= $\frac{KX}{M} = \frac{100N/m\ x0.2m}{10kg} =$ *2m/s²*

kE=$\frac{1}{2}$k(A^2-X^2) = $\frac{1}{2}$ x 100n/m(0.25m^2-0.04 m^2)

=$\frac{1}{2}$ x 100n/m *x* 0.21 m^2 = **10.5j**

PE = PE_{max}-kE = 12.3j-10.5j = **1.8j**

16) Problems

Given

M=2kg

A=90cm=0.9m

X=10cm=0.1m

a=1m/s^2

T=?

V=?

KE=?

PE=?

SOLUTION (16)

T=2 π $\sqrt{K/m}$ =2 π $\sqrt{x/a}$ = 2 x 3.14$\sqrt{0.1m}$/1m/S^2 = 2 x 3.14$\sqrt{0.}$1S^2

=6.28 x 0.32 sec = **2sec**

V= $\sqrt{k/m(A^2 - X^2)}$ =$\sqrt{a/x(A^2 - X^2)}$ = $\sqrt{1/0.1(0.9^2 - 0.1^2)}$ =

=$\sqrt{10(0.81 - 0.01)}$ = $\sqrt{10(0.8)}$ = $\sqrt{8}$*m/s* = ***2.83m/S***

kE=$\frac{1}{2}$k(A^2-X^2) = $\frac{1}{2}$ x 20N/m (0.81-0.01)m^2 =10n(0.8m) = ***8j***

PE= $\frac{1}{2}$kX^2 = $\frac{1}{2}$ x 20n/m x 0.01m^2 = 10n(0.01m) = **0.1j**

K= $\frac{\text{m a}}{\text{x}}$ = kx=ma $\frac{\text{x}}{\text{a}} = \frac{\text{m}}{\text{k}} = \frac{2\text{kg x } 1\text{m/sec}^2}{0.1\text{m}}$ =*20N/M*

17) Problems

Given

A=50cm =0.5m

V=10m/s

X=10cm =0.1m

a) a=?

b) T=?

SOLUTION (17)

Ma= kx $\frac{\text{a}}{\text{x}} = \frac{\text{k}}{\text{m}}$ V=A$\sqrt{k/m}$ $\frac{\text{V}}{\text{A}} = \sqrt{k/m} = (\frac{\text{V}}{\text{A}})^2 = \frac{\text{k}}{\text{A}} =$ ∴ = $(\frac{\text{V}}{\text{A}})^2$=x 0.1m

a), = $(\frac{\text{V}}{\text{A}})^2$ x = $(\frac{10\text{m/s}}{0.5\text{m}})^2$ x 0.01m = $\frac{100\text{m}^2/\text{S}^2}{0.5\text{m}^2}$ x 0.1m = 40m/s^2

b). T=2 π $\sqrt{K/m}$ = 2 π $\sqrt{X/a}$ = 2 π $\sqrt{0.1/40}$ = 2 π$\sqrt{1/400}$ = $\frac{\mathbf{2\,\pi}}{\mathbf{20}}$

π

18) Problems

Given

L_1= 1m

T_1= π sec

T_2= π/2 sec

L_2= ?

SOLUTION (18)

$T_1^2 / T_2^2 = L_1 / L_2$ ∴ $L_2 = L_1 T_2^2 / T_1^2 = L_2 = \frac{1\text{m}\left(\frac{\pi}{2}\right)^2}{(\pi)^2} = \frac{1\text{m}(\pi^2/4)}{(\pi)^2} =$

= $\frac{1}{4}$ m = **L_2 = 0.25m**

19) Problems

Given

T=3sec

L=30cm = 0.3m

g=?

$\pi^2 = 10$

SOLUTION (19)

$$g = \frac{4\pi^2 l}{T^2} = \frac{4(10)(0.3)\text{m sec}^2}{(3\text{ sec})^2} = 1.33\text{m/s}^2$$

Problem(20) **SOLUTION (20)**

Given: $g_m = g_e$ ∴ $g_e = 6\, g_m$

g_m = acceleration due to gravity on surface of moon

g_e = acceleration due to gravity on surface of earth

T_m = period of simple pendulum on moon

T_E = period of simple pendulum on earth

$T_m = 2\pi\sqrt{L/\text{gm}}$ the length of pendulum is constant $T_m / T_E = 2\pi\sqrt{L/\text{gm}} \,/\, 2\pi\sqrt{L/\text{gm}}$

$= 2\pi\sqrt{L/\text{gm}} \,/\, L/\text{gm} = \sqrt{ge/\text{ge}} = 2\pi\sqrt{6\text{gm}}\,/gm =$ $T_m / T_m = \sqrt{6}$

Problem(21) **SOLUTION (21)**

Given: L=1m T=2sec π=3.14 g=?

$$g = \frac{4\pi^2 L}{T^2} = \frac{4(3.14)(0.3)^2 \text{ x } 1\text{m}}{(2\text{ sec})^2} = \frac{4\text{x}9.86 \text{ x } 1\text{m}}{(4\text{ sec})^2} = 9.86\text{ m/s}^2$$

22). Problems

Given

L_1= 1m

N_1= 400

T_1= 8 sec

L_2= ?

N_2=100

T_2= 1 sec

SOLUTION (22)

$T_1 = t_1 / N_1 = \frac{8\text{ sec}}{400} = 0.02\text{sec}$ $T_2 = t_2 / N_2 = \frac{1\text{ sec}}{100} = 0.01\text{sec}$

$T^2_1 / T^2_2 = L_1 / L_2$ ∴ $L_2 = L_1 T^2_1 / T^2_2$

$L_2 = \frac{1\text{m}(0.01\text{sec})^2}{(0.02\text{ sec})^2} = 1\text{m}(\frac{0.01}{0.02})^2 = 1\text{m}(\frac{1}{2})^2$

$= \frac{1}{4}\text{ m}$ ***= 0.25m***

23).

Problems

Given

M=0.5kg

K=50N/m

a) T=?

SOLUTION (23)

a) $T = 2\pi\sqrt{m/k} = 2\pi\sqrt{\frac{0.5kg}{50n/m}} = 2\pi\sqrt{\frac{1}{100}}S^2 = 2\pi \times \frac{1}{10}\text{ sec} = \frac{\pi}{5}\text{ sec}$

b) $F = \frac{1}{2\pi}\sqrt{k/m} = \frac{1}{2\pi}\sqrt{\frac{50n/m}{0.5kg}} = \frac{1}{2\pi}\sqrt{100}\ S^{-2} = \frac{1}{2\pi} \times 10\ sec^{-1} = \frac{5}{\pi}\ Hz$

24).

Problems

Given

T=1sec

g= 10m/s^2

SOLUTION (24)

$L = \frac{g\,T^2}{4\pi^2} = \frac{10m/S^2(1\,S^2)}{4(10)} = \frac{1}{4}\,m =$ **0.25m**

25). Problems

Given

T= 1sec

$g_m = \frac{1}{6}\,g_m$

=0.167x9m/s^2

=1. 64m/s^2

L=?

SOLUTION (25)

$L = \frac{g\,T^2}{4\pi^2} = \frac{1.64m/S^2(1\,S^2)}{4(10)} = 0.04m$

L= 0.04m

26). Problems

Given

N=4

t= 8sec

T_e =? T_m =?

$g_m = \frac{1}{6}\,g_m$

SOLUTION (26)

$T_e = \frac{t}{n} = \frac{8\ sec}{4} = 2sec$ $\qquad$ $T_m / T_e = \sqrt{6}$

$\therefore = T_m\sqrt{6}\ T_e = \sqrt{6}\ x\ 2sec = 2.45$ x 2sec = 4.9sec

27). Problems

Given

M=4kg

X=0.98m

T=?

SOLUTION (27)

$T = 2\pi\sqrt{m/k} = 2\pi\sqrt{4kg/40n/m} = 2\pi\sqrt{0.1}S^2 = 2\pi(0.32)$ sec

=**2sec**

Mg= kx $\longrightarrow$ $k = \frac{mg}{x} = \frac{4kg \times 9.8m/S^2)}{9.8m} =$ **40n/m**

28). Problems

Given

T=1sec

$g_j = 2.63g_e$

$=2.63x9.8m/s^2$

$=25.8m/s^2$

SOLUTION (28)

g_j =acceleration due to gravity of gubiter

$L= g_j T^2 / 4\pi^2 = \frac{25.8\ m/S^2)\ (1\ S^2)}{4(3.14)^2} = 0.65m$ L=0.65m

29). Problems

Given

M=0.5kg

X=0.6cm

K=150n/m

a=?

SOLUTION (29)

$Ma = kx \quad a= \frac{kx}{m} = \frac{150\ n/m\ x\ 0.006m}{0.5kg} = 1.8m/S^2$

31). Problems

Given

T=0.40sec

X=4 m = 0.04m

a=?

SOLUTION (31)

$Ma= kx \quad m/k = x/a \quad T= 2\pi\sqrt{m/k} = 2\pi\sqrt{x/a}$

$= \frac{T}{2\pi} = \sqrt{x/a} \quad T^2/ 4\pi^2 = \frac{x}{a}$

a) $\frac{4\pi^2 X}{T^2} = \frac{4(10)\ (0.04m)}{(0.40)^2 S^2} = 1.6mS^2 = 0.16 = 10m/s^2$

31). Problems

Given

M=25g =

$=0.025kg$

X=10cm

$=0.1m$

T=1.57sec

V=0.4m/s

a) K=?

b) E_t=?

c) A=?

SOLUTION (31)

a). $T =2\pi\sqrt{m/k} = \frac{T^2}{4\pi^2} = \frac{m}{k} \quad K= \frac{4\pi^2 m}{T^2} =$

$= \frac{4(3.14)^2\ (0.025)}{(1.57)^2}$ **=0.4n/m**

b).$E_t= \frac{1}{2}mv^2 + \frac{1}{2}KX^2 = \frac{1}{2}$ x 0.025kg $(0.4m/s)^2+\frac{1}{2}$x0.4n/m$(0.m)^2$

$=2 \times 10^{-3}j +22 \times 10^{-3}j = 4 \times 10^{-3}j =$ **4mj**

c). $E_t= \frac{1}{2} kA^2 = A^2=2E_t /k =A \sqrt{2Et/k} =$

$= \sqrt{\frac{2\ x\ 4\ x10}{0.4n/m}} =$ **0.14m**

END

PHYSICS GRADE 12

Chapter two

QUESTIONS

QUESTION ONE **(page 29-30)**

Explain the meaning of the word: diffraction, interference and superposition?

Diffraction: is the change of wave path when passing through a slit or an aperture

Interference: is the phenomenon produced from the superposition of two waves is a medium.

Superposition: (when more them one wave is present) the total oscillation of any point is the sum of oscillations from each individual wave.

QUESTION TWO

Explain meaning of the word: period, frequency, amplitude, resonance, in phase and out of phase?

Period: is the time taken to make one complete cycle or oscillation of wave motion.

Frequency: is the number of cycles or oscillations per second.

Amplitude:is the maximum displacement on either side from equilibrium position

Resonance: is the traveled of waves in both direction and reflected at each end with a certain frequency from boundaries of the system containing the wave.

In phase: is a constructive interference which crest or through of wave falls on the crest or trough of other wave.

Out of phase: is a destructive interference in which the crest of one wave falls on the trough of other wave.

QUESTION THREE

Explain the difference between transverse and longitudinal wave?

Transverse: is a wave in which particles of the medium more in a direction perpendicular to the direction which the wave moves.

Longitudinal wave: is a wave in which particles of the medium in a direction parallel to the direction which the wave moves.

QUESTION FOUR

State the relations between **ʎ, V,** and ***f*** explain the standing waves?

V = velocity of waves.

ʎ = distance (s) traveled by a pulse.

T= period is time interval (t)

$\mathbf{V} = \frac{s}{t}$ *since* **S**= ʎ **t**=T

$\mathbf{V} = \frac{ʎ}{t}$ *but* $\mathbf{T} = \frac{1}{f}$

$\mathbf{V} = \frac{ʎ}{1/f}$ **V**= ʎf

V= ʎf

The waves that are confined between boundaries are called standing waves standing waves arise from the superposition of two identical waves having the same amplitude and frequency traveling with the same speed in opposite direction.

QUESTION FIVE

In a standing wave pattern, what is the relationship the length of vibrating string and the wave length?

The distance between two nearest (adjacent) nodes is half of a wave length $\left(\frac{1}{2}ʎ\right)$

The distance between one mode & one antinode is quarter of a wavelength $\left(\frac{1}{4}ʎ\right)$

Therefore: strings fixed at both end $\mathbf{L} = \frac{1}{2}ʎ$

Strings fixed at one end $\mathbf{L} = \frac{1}{4}ʎ$

Problems

1) **ʎ**=35cm =0.35m **f**=180Hz **V**=?

ʎf=0.35m x 180Hz= **63m/s**

Ans: V= 63m/N

2) **(a)** **ʎ**=0.5m **f**= 2Hz **V**=?

V= ʎf =0.5m x 2Hz **= 1m/s**

(b) **ʎ**=0.5m **f**= 4Hz **V**=?

V= ʎf =0.5m x 4Hz **= 2m/s**

Ans: (a) =**1m/s** (b) **= 2m/s**

3) **ʎ**=35m **V**= 12m/s **f=?**

$\mathbf{f} = \frac{\mathbf{V}}{\lambda} = \frac{\mathbf{12m/s}}{\mathbf{3m}} = 4\text{Hz}$

Ans: F=4Hz

4) **F=** 620Hz **ʎ**=5m **V**=?

V= **ʎf** **=** 10.5m **x** 620Hz = 6510m/s

Ans: V=6510m/s

5) F= 50Hz **V**= 345m/s **ʎ**=?

$\lambda = \frac{\mathbf{V}}{\mathbf{f}} = \frac{\mathbf{345m/s}}{\mathbf{50Hz}} = \mathbf{6.9m \approx 7m}$

Ans: ʎ = 6.9m ≈ 7m

6) **F**= 1600KHz = 1.6×10^6 Hz **V**=3×10^{10} cm/s = 3×10^8m/s **ʎ**=?

$\lambda = \frac{\mathbf{V}}{\mathbf{f}} = \frac{3 \times 10^8 \text{ m/s}}{1.6 \times 10^2 \text{ Hz}} = 187.5\text{m} \approx \mathbf{188m}$

Ans: ʎ = 187.5m ≈ **188m**

7) Distance between crest and adjacent trough is

$\frac{1}{2}$**L**= ʎ = 3m **L**=3m **ʎ**=6m **(a) f=?** **(b) V=?**

(a) f = $\frac{\mathbf{V}}{\mathbf{2L}}$ **=** $\frac{\mathbf{5m/s}}{\mathbf{2\ x\ 3\ m}}$ **=** $\frac{5}{6}$ **=** 0.83Hz

(b) V= fʎ = $\frac{5}{6}$Hz *x* 6m =5m/s

Ans: (a) f = 0.83Hz **(b)** V=5m/s

8) T= 0.5sec **V** = 4m/s **(a)** f=? **(b)** ʎ=?

(a) f= $\frac{\mathbf{1}}{\mathbf{T}}$ **=**$\frac{\mathbf{1}}{\mathbf{0.5sec}}$ **=** 2Hz

(b) ʎ= $\frac{\mathbf{V}}{\mathbf{F}}$ **=** $\frac{\mathbf{4m/s}}{\mathbf{2Hz}}$ **=** 2m

Ans: (a) f = 2Hz **(b)** ʎ = 2m

9). V=3 x 10^{10}cm/s = 3 x 10^{8}m/s **ʎ**= 200cm =2m **(a) f=? (b)= T?**

(a) f= $\frac{\mathbf{V}}{\mathit{ʎ}}$ **=** $\frac{3\ x\ 10^{8}\ m/s}{2m}$ = 1.5 x 10^{8}Hz

(b)= T= $\frac{\mathbf{1}}{\mathbf{F}}$ **=** $\frac{1}{1.5\ x\ 10^{8}\ Hz}$ = 6.7 x 10^{-9}sec

Ans: (a) F =1.5 x 10^{8}Hz **(b)T=**6.7 x 10^{-9}sec

10). ʎ= 0.6m F=550Hz V=?

V= ʎf = 0.6m x 550Hz = **330m/s**

Ans: V= 330m/s

11). L=1.5m **n**=4 **V**=300m/s **ʎ**=?

F= $\frac{\mathbf{nV}}{\mathbf{2L}}$ **=** $\frac{4\ x\ 300m/s}{2\ x\ 1.5m}$**=** = 400Hz

ʎ= $\frac{\mathbf{V}}{\mathbf{F}}$ **=** $\frac{300m/s}{400Hz}$ = 0.75m

Ans: ʎ=0.75m

12). N=6 f_n =525Hz **(a)** f_1**=?** **(b)** f_n**=?**

a) f_1**=** $n f_1 =$ $f_1 = \frac{f}{n} = \frac{525Hz}{6} = 87.5Hz$

Ans: (a) f_1= 87.5Hz **(b)** f_n =350Hz

(b) $f_n = f_n = nf_1$ f_4=4(87.5Hz) =**350Hz**

13). 3rd harmonic: **n**=3 **4th** harmonic: **n**=4 $f_3 = 3f_1$ $f_4 = 4f_1$

Δf =30Hz $\Delta f = 4f_1 - 3f_1 = 30Hz$ **L=** 70cm L= $(n_4 - n_3)\lambda$

(a) f_1 = 30Hz

(b) $\lambda_L = \frac{2L}{(n4 - n3)} = \frac{2 \times 0.7m}{(4-3)} = 1.43$

(c) 3rd overtone, **n**=1,2,3,4, **n**=4 $\lambda_4 = \frac{2L}{n} = \frac{2 \times 0.7m}{4} = 0.35m$

(d) 1st overtime, n=2

2nd overtime, n=3 $f = \frac{\Delta n V}{2L} = \Delta n$ **=(3-2)**

$V = \frac{2lF}{\Delta n} = \frac{2 \times 0.7\ m \times 30Hz}{(3-2)} = 42m/s$

Ans: (a) f_1 = 30Hz **(b)** λ_L**= 1.43 (c)** λ_4**=0.35m (d) V=42m/s**

14). L= 2m λ**=12m** **nodes=?** **Antinodes=?**

(n-1)L = λ **n-1** $= \frac{\lambda}{L}$ **(a) n=** $\frac{\lambda}{L} + 1 = \frac{12\ m}{2} + 1 =$ **6+1 = 7**

(b) n= $\frac{12}{2} + 1 = 6 + 1 = 7$

Ans: (a) nodes=7 **(b)** Antinodes=7

15). 3rd overtime: **n**=1, 3, 5, 7, one fixed string **n**=7

F_n=72Hz λ=5cm **(a) L** =n λ 7 x 5cm = **35cm**

(b) 1st Overtime: n=3 λ=4L =4 x 5cm **=20cm**

L= $\frac{7\lambda}{4}$ = λ = $\frac{4L}{7}$ = $\frac{4 \text{ x } 35cm}{7} = 20cm$

L $\frac{3\lambda}{4}$ = = λ = $\frac{4L}{3}$ = $\frac{4 \text{ x } 35cm}{3} = 47cm$

(c) f = $\frac{NV}{4L}$ n=**7, L**=35cm =0.35, **f** =72Hz

V = $\frac{4Lf}{N}$ = $\frac{4 \text{ x } 0.35m \text{ x } 72Hz}{7} = 14.4m/s$

(d) F = nf$_1$ $\therefore$ **f**$_1$ $\frac{F}{N}$ = $\frac{72Hz}{7} = 10.3Hz$

(e) L= $\frac{1}{4}$ = λ =**4L 4 x 0.35m = 1.4m**

Ans: (a) 35cm **(b)** 20cm, 47cm **(c)** $14.4m/s$ **(d)** 10.3Hz**(e)** 1.4m

16). L_1= 100cm 1st overtime N= 1, 3, 5, 7, N=3

2nd overtime N=5

$f_1 L_1 = f_2 L_2$ but **$f_1 = f_2 = f$** **$fl_1 = fl_2$** **$L_1/2 = L_1/2n$** = $\frac{100cm}{2 \, x \, 3}$ = $\frac{100cm}{6} = 16.7cm$

$L_2 = L_1/2n$ = $\frac{100cm}{10} = 10cm$

Ans: (a) L = 16.7cm **(b) L =** 10cm

END

Chapter three

SPEED OF SOUND WAVE

1). Given; = 5km → 5000m, v = 339m/s → {15 x 0.6 +330} wanted; t=?

Formula t= $\frac{\mathbf{s}}{v} = \frac{5000\mathrm{m}}{339m/s} =$ ☐

2). Given; v=336m/s f= 408Hz wanted; d=?

Formula d= $\frac{\mathbf{v}}{f} = \frac{339m/s}{408Hz} =$ ☐

3). Given; v= 344m/s f= 20KHz →20 x 1000=20,000Hz wanted; Λ =?

Formula Λ = $\frac{\mathbf{v}}{f} = \frac{344m/s}{20{,}000Hz} = 0.017\mathrm{m} \times 100 =$ ☐

4). Given; v= 330m/s (a) T= -80°f{ $\frac{5}{9}$*(°f -32)} = 62.2 °C*

(b) T= 134°f{ $\frac{5}{9}$ *– 32} 56.7 °C wanted; s =?*

Formula; a) *s= v + 0.6 x T = 330m/s +0.6(-62.2) =* ☐

b) *s= v + 0.6 x T = 330m/s +0.6 x 56.7 =* ☐

5). Given; f= 244Hz v=340m/s wanted; (a) Λ =? (b) d=?

*Formula; (*a) *Λ =* $\frac{\mathbf{V}}{F} = \frac{340\mathrm{m/s}}{244Hz} =$ ☐

*(*b) *the distance between compression nearest rarefaction =(0.7m)*

*(*d) $= \frac{\mathbf{V}}{F} = \frac{244\mathrm{Hz}}{340m/s} =$ ☐

6). Given; v = 345m/s Λ = 1.7m wanted; f=?

Formula; f = $\frac{\mathbf{V}}{F} = \frac{345\mathrm{m/s}}{1.7m} = 202.9 =$ ☐

7). Given; d = 800m, T = 5s wanted; v=? Formula; v= $\frac{2\mathrm{d}_2(800)\mathrm{m}}{t \quad 5s} =$ ☐

8). Given; T =3s V=360m/s wanted; d=?

Formula; d=v x t 360m/s x 3s = $\frac{1{,}080\text{m}}{1000}$ *=* [ ]

9). Given; v = 1500m/s t=3s wanted; d=? Formula; d= $\frac{VT}{2}$ *= (1500 m/s)(3s)*

= $\frac{2{,}250}{1000}$ *=* [ ]

10). Given; d = 300m/s v=342m/s wanted; T=?

Formula; = $\frac{2d_\ 2\ x\ 300m\ _600}{v\ 342m/s \quad 342}$ *=* [ ]

11). Given; d=6000m (a) v=342m/s (b) v= 4000m/s wanted; t=?

Formula; (a) T= $\frac{d}{v}$ *=* $\frac{6000\ m}{342m/s}$ *=* [ ]

Formula; (b) $\frac{d}{v}$ *=* $\frac{6000\ m}{4000m/s}$ *=* [ ]

12). Given; d=300m v=6,500m/s wanted; T=? Formula; T= $\frac{d_\ 300m}{v\ 6500m/s}$ *=* [ ]

13). First of all, we must consider the time the stone travels and time that the stone travels and tome that the sound travels.

Step 1. Time stone travels (t_1) h= vt+ $\frac{1}{2}$ *gt^2 = 250= 0(t) +* $\frac{1}{2}$*(9.8) t^2 = t_1* **=7.14sec**

Step 2. Time the sound travels(t_2). S=vt=> 250=336t then t_2 0.74sec

Step 3.total Time Tt= t_1+ t_2 = 7.14s + 0.74s = [ ]

14).there are two types of time T_1 = time taken by stone to travel, T_2 =time taken by sound and total time is 8 seconds. [*t_1+ t_2 =8*]

Step 1: finding the distance that the stone travels.

X=vt + $\frac{1}{2}$ *gt^2 = X =0(t) +*$\frac{1}{2}$*(9.8m S^2) t^2*

Step 2: finding the distance that the stone travels. X=vt = 345(8-t)

Comparing: (1) and (2)

2760-345t= 4.9 t^2

$4.9t^2 + 345t - 2760=0$

$t_1 = 7.25\text{sec}\ t_2 = -77.66$

Then $t^2 = 8 - t_1 = 8-7.25=$ ☐

$X= 4.9\ t^2 \Rightarrow 4.9(7.25)^2=$ ☐

15). Given; $T_1=2se$, $v=342m/s$ $T_1= 2sec$ wanted: $d_T=?$ Formula; $d_t = \frac{VT1}{2}$

$=\frac{(342\text{m/s})\ (2\text{s})}{2} = 342\text{m}$ $D_2= \frac{VT1}{2} = \frac{(342\text{m/s})\ (4\text{s})}{2} = 684\text{m}$

$D_t = d_1 + d_2 = 684m+342m =$ ☐

16). Given; $T+2.3s$, $v=345m/s$, wanted; $d=?$ Formula $d=vt=(345m/s)(2.3s)=$ ☐

17). Let t_1= be time the object takes to reach the water (90 →) and t_2 be the time the splash taken to head and T is the total required

$T= t_1+ t_2$

Step 1: finding the time (t_1) the object travels

$H = \frac{1}{2} gt_1^2 = 20\frac{1}{2} (9.8)\ t_1^2 = \{ t_1=2.02\text{sec}\}$

Step 2: finding the time (t_2) the object travels

$V=v\ t_2[v=330+0.6(20)]20=345t_2 = \{t_2=0.06\text{sec}\}$

Step 2: finding the total time

$T= t_1+ t_2 \Rightarrow 2.02 +0.06=$ ☐

18). Given; $t=1.75s$, $v=1500m/s$ wanted; $d=?$ formula $d = \frac{VT}{2} = \frac{(1500\text{m/s}\ (1.75\text{s})}{2} =$

☐

INTENSITY OF SOUND

19). Given: A=5.5 x 10^{-3} m^2 L=50 x 10^{-3} w/m^2 wanted; p=?

P=lA=(5 x10^{-5})(5.5 x 10^{-3}) = ☐

20). Given; l = 4.5 x 10-4w/m, A=4m wanted: p=? l=?

Formula: p=l x A = l x πr^2

a) (4.5 x 10^{-4} w/m) (π)(r) $(4)^2$) = ☐

b) $I = \frac{P}{\pi r^2} = \frac{2.26 \times 10^2 w}{\pi (3m)^2} =$ ☐

21). Given: P=2w, A=5m wanted; (a) l=? (b) β=?

Formula; (a) l= $\frac{P}{\pi r^2} = \frac{2w}{\pi (5m)^2} = \frac{2w}{\pi (5m)} =$ ☐

(b) β= 10blog x $\frac{1}{10}$ ***= 10dblog x*** $\frac{2.55 \times 10^{-2} w/m^{-2}}{10^{-12} w/m^{-2}} =$ ☐

22). Given: β =30db, wanted; l=? formula; β=10db log $\frac{1}{10}$ ***= 30db= 10dblog***

$= \frac{1}{10^{-12} w/cm^{-2}} =$ *antilog (3)* $(10^{-12} w/m^{-2}) =$ ☐

23). Given: l=10^{-11} w/cm^2 wanted; β=?

Formula: β=10db log = $\frac{10^{-11} w/cm}{10^{-16} w/cm/2} =$ ***β= 50db =*** ☐

24). Given: l=10^{-10} w/cm^2 wanted; β=?

Formula: β=10db log = $\frac{1}{10^{-12} w/cm^2} =$ ***β=*** ☐

25) Given A=1.52m2, β=80db, wanted: P=?

Formula: β= 80db = 10db log $\frac{1}{10^{-12}} =$ ***10^{-9}*** w/m^2

P=lxA=(10^{-9} w/m^2***) (1.52m^2) =*** ☐

26) Given: A=60cm² = 6 x 10⁻³m² β= 75db E= 1.9 x 10⁻⁹ wanted: a) p=? b) t=?

Formula 75db = 10dblog $\frac{1}{10^{-12}}$ *=then I= antilog (7.5)(10⁻¹²) = 3.2 x 10⁻⁵ w/ m²*

a) P=IxA = (3.2 x *10⁻⁵ w/ m²) (6 x 10⁻³ m²)* ☐

b) E=pt=> t= $\frac{E}{p} = \frac{1.9 \times 10^{-9}}{1.9 \times 10^{-7}} =$ ☐

27) Given: I=7x10-11w/c m² wanted; β=?

Formula β=10dblog $\frac{7 \times 10^{-11}\ w/c\ m^2}{10^{-16}\ w/\ cm^2}$ ***=*** ☐

28) Given; I=4.5 x 10-10 w/c m² **wanted: = *β=?***

Formula β=log $\frac{4.5 \times 10^{-10}\ w/c\ m^2}{10^{-16}\ w/\ cm^2}$ ***=*** ☐

29) Given; β= 10db I=? β= 10dblog $\frac{I}{I^{\circ}}$

I= antilog $\frac{\beta}{10}$ ***x*** 10^{-12} ***antilog*** $\frac{10}{10}$ ***x*** $10^{-12} = 10^{-11}\ w/\ cm^2$

30) Given; I = 2.5 x $10^{-10}\ w/\ cm^2$ ***wanted I=?***

Formula=110db = 10dblog = $\frac{1}{10^{-12}}$ ***=*** ☐

31) Given: β= 110db wanted I=?

Formula: 110db = 10dblog $\frac{1}{10^{-12}}$ ***=*** ☐

32) Given: β= 60db β₂=70db wanted; β=?

Formula: β₁= 10dblog = $\frac{1}{10}$ ***60db =10dblog =*** $\frac{1}{10^{-12}\ w/\ m^2}$

I₁= Antilog **(6)(** 10^{-12}**) = {I₁=** $10^{-6}\ w/\ m^2$**}**

β₂= 10dblog $\frac{1}{10}$ ***= 70db= 10dblog =*** $\frac{1}{10^{-12}\ w/\ m^2}$

I₂= Antilog **(7)(** 10^{-12}**) = {I₂=** $10^{-5}\ w/\ m^2$**}**

$I_1 = I_1 + I_2 = 10^{-6}\ w/m^2 + 10^{-5}\ w/m^2 = \{I_T = 1.1 \times 10^{-5}\ w/m^2\}$

$\beta = 10db\log\frac{1}{10} = 10db\log\frac{1.1 \times 10^{-5}\ w/m^2}{10^{-12}\ w^2/m} = 10db\log(11{,}000{,}000)$

$= 10db\log(7.04) =$ [ ]

33) $I_1 = 600$ $\beta_1 - \beta_0 = 10db\log I_1 - I_0 / I_0 = 10db\log 600\ I_1 - I_0 / I_0$

$= 10db\log 599\ I_0 / I_0$ $\Delta\beta = 10db\log 599 =$ [ ]

34) Given: $\beta = 58db$ wanted; $\beta = ?$

Formula; $\beta = 10db\log\frac{1}{10} = 58db = 10db\log\frac{1}{10^{-12}}$

$= Antilog(5.8)(10^{-12}\ w^2/m) = I$

$I = 6.3 \times 10^{-7}\ w/m^2 + 10 = \{I = 6.3 \times 10^{-8}\ w/m\}$

$\beta = 10db\log I / I_0 = 10db\log\frac{13 \times 6.3 \times 10^{-8}\ w/m^2}{10^{-12}\ w/m^2} =$

$\beta = 10db\log(5.9) =$ [ ]

35) Given $I_0 = 12 \times 10^{-6}\ w^2/m$ $\beta = 4db$ wanted: $I = ?$

Formula: $4db = 10db\log\frac{1}{12 \times 10^{-6}\ w/m^2}$

$= Antilog(0.4)(10^{-12}\ w^2/cm) =$ [ ]

36) Given: $\beta_1 = 90d$ $\beta_2 = 70db$ wanted: $\Delta I = ?$

Formula: $\beta_1 = 10db\log I / I_0 = 90db\log\frac{1}{10^{-12}} = I_1 = 10^{-3}\ w/m^2$

$\beta_2 = 10db\log I / I_0 = 70 = 10db\log\frac{1}{10^{-12}} = I_2 = 10^{-5}\ w/m^2$

$\Delta I = I_1 + I_2 = \frac{10^{-3}\ w/m^2}{10^{-5}\ w/m^2} =$ [ ]

37) Given: F_1= 514Hz F_2 =552Hz wanted F_b =?

Formula: $F_b = F_2 + F_1$ =552-514 = ☐ *beats*

38) Given: F_1= 280 F_2 =312 wanted F_b =?

Formula: $F_b = F_2 + F_1$ =312-280 = ☐ *beats*

39) Given: F_b= 11 F_2 =440Hz wanted F_1 =?

Formula: $F_b = F_2 + F_1$ => $F_1 = F_2 - F_b$ = 440-11 = ☐

40) let F_t be the frequency of turning frok and F_2 = second hormnic

Situation1; $F_t > F_s$ $F_s - F_s$ =6

Situation2; $F > F_t$ $F_s - F_s$ =6

$F_s \sqrt{T_2} - F_s$, $\sqrt{T_1} \rightarrow F_s \frac{Fs,\sqrt{T1}}{\sqrt{T2}} = \sqrt{200/242}$ F_s 0.91 F_s

Then substituting eq(1) and (2) we get

$F_t - F_s$ =6 $F_s - F_t$ => F_t -0.9 F_s = 6 x 0.9

$F_t - F_s$ =6 F_t -0.9 F_s =5.4

$F_t - F_s$ =6 0.09F_s =11.4 ☐

41) Beat = f_1-f_2 situation 1

Beat = f_2-f_1 situation 2

Beat = $\frac{1}{1} = \frac{1}{0.8}$ = 1.25Hz

situation 1 : 1.25HZ = 475Hz-F_2= F_2 = 475Hz-1.25= ☐

situation 2: 1.25= F_2-475Hz= ☐

42) number of beats = 12

Beat/sec = $\frac{12}{8}$ =1.5

Organ: beat = f_1-f_2 =1.5 = f_1 -200= ☐

Violin: beat = f_1-f_2 =1.5=200 f_1= ☐

43) Given 1Hz, T=0.3$_s$, t=0.45$_s$ wanted F=?

Formula: T= $\frac{1}{t}$ =$\frac{1}{0.3}$ = 3.3 f=3.3x1 = ☐

Doppler's effect

44) Given: V_s =26.4m/s, F=285Hz V=339m/s

Wanted: f'=? formula f' = F ($\frac{V}{V-Vs}$)= 285z ($\frac{345\ m/s}{339-16.6}$) = ☐

45) Given V_s = 16.6m/s , f=320Hz , V=345m/s

Wanted: f'=? formula f' = F ($\frac{V}{V+Vs}$)= 320Hz ($\frac{345\ m/s}{339+16.6}$) = ☐

46) Given V_s =25m/s f=750Hz V=342m/s

Wanted: F'=? formula = F ($\frac{V}{V+Vs}$)= ($\frac{342m/s}{342-25m/s}$)= ☐

47) Given f=500Hz, V_0 = 25m/s, V=342m/s

Wanted: f_0=? Formula a) f_0 = $\frac{V+V0}{V}$ = 500Hz $\frac{342-25}{342m/s}$ = ☐

b). 500Hz $\frac{342+25}{342m/s}$ = ☐

48) Given: 650Hz, V_s=65m/s =>0.65, V= 340m/s

Wanted: f_0=? Formula: f_0 = f ($\frac{v}{V-Vs}$) = 650Hz ($\frac{342}{342-0.65}$) = ☐

49) Given: V_0 = 25m/s, f=450Hz, v=340m/s

Wanted: f_0=? Formula: f_0 = f ($\frac{V-V0}{V}$) = 450Hz$\frac{340+25}{340}$ = ☐

f_0 = f ($\frac{V-V0}{V}$)= 450Hz$\frac{340-25}{340}$ = ☐

50) Given: V_s=150m/s, F=1000Hz, V=340m/s

Wanted: F'=? formula = F_1 =F ($\frac{V}{V-Vs}$)= 1000HZ ($\frac{340}{340-150}$) = ☐

F_2 =F ($\frac{V}{V-Vs}$)= 1000HZ ($\frac{340}{340+150}$) = ☐

$\lambda_1 = \frac{V}{f} = \frac{340}{1789}$ = ☐

$\lambda_1 = \frac{V}{f} = \frac{340}{694}$ = ☐

51) Given: f=2000Hz, F_0=2500Hz, V=340m/s

Wanted: V_s= V_o=? let V_s and V_0 be x

Formula: F_0= ($\frac{V+x}{v-x}$) = 2500=200 ($\frac{340+X}{340-X}$)=

=>25 = $\frac{6800+20X}{340-X}$, 8500-25X=6800+25X

=8500-6800=20X+25X= $\frac{1700}{45}$ = $\frac{45X}{45}$ = ☐

52) Given: f=240Hz, f'=266Hz, v=356m/s

Wanted: V_s=? formula: f'= F ($\frac{V}{V-Vs}$)=266=240 ($\frac{356}{356-Vs}$)=

=94696-266V_s = 85440 = $\frac{9256}{266}$ = $\frac{266\,vs}{266}$ = ☐

VIBRATING IN STINGS

53) Given: L= 3m, T=25N, M=0.012kg

Wanted: V=? K= $\frac{F}{X}$ = $\frac{25N}{3M}$ = 8.3N/m

Formula: v = $\sqrt{\frac{K}{m}}A$ = $\sqrt{\frac{8.3}{0.012}}$ x 3 = 26.3x3 = ☐

There is another formula that can be determined by velocity

Formula: v = $\sqrt{\frac{T}{e_L}}$ **T** *= tenseem* e_L=m/L *linear density*

54) Given: f=360Hz, ʌ= 30cm => 0.3m

Wanted: V=? formula: v=2LF = (360Hz) (2) (0.3m) = ☐

55) Given: L=10m, T=40N, M=2kg, v=1000m^3

Wanted: v=? formula: $\rho = \frac{m}{V} = \frac{2}{1000} = 0.002$

v = $\sqrt{\frac{t}{\rho/l}} = \sqrt{\frac{40}{0.002/10}} =$ ☐

56) Given: v=280m/s, F=800Hz

Wanted:L=?

Formula: $f_n = \frac{NV}{4L}$**,** $800\ \frac{280}{4L} = \frac{280}{3200} = \frac{3200L}{3200} =$ ☐

57) Given: F_1= 500Hz, F_n=1800Hz

Wanted: Harmonic=?, overtone=?

Formula: N= $\frac{f_n}{f_1} = \frac{1800}{500} =$ ☐

Ov=N-1 = 36-1 = ☐

58) Given: l=80cm=> 0.8m, f=220Hz, ʌ=2(0.8) = 1.6m

Wanted: a) v=? b) $F_{overtone}$?

Formula a) v= ʌ x F =(1.6) (220) = [v=352m/s]

b). F_2= (220)(2)= ☐

F_3= (220)(3)= ☐ **F_4= (220)(4)=** ☐

59) $v=2Lf \quad v = \sqrt{\frac{t}{\rho_1}} = 2LF\sqrt{\frac{1080}{0.003}} = 600 \quad F_1L_1 = F_2L_2$

$V=2LF \Rightarrow \Lambda=2L = \Lambda(600) = \frac{600}{600} = 1$

$L = \frac{\Lambda}{2} \Rightarrow \Lambda=2L=2(1) =$ [ ]

60) Given $T_1 = 45N, F_1=f, F_2 4f$

Wanted: $T_2 = ?$ **Formula:** $F_1\sqrt{T_2} = F_2\sqrt{T_1} = F_2\sqrt{T_2} / F_1 = 4F\sqrt{T_1} / F$

$=(\sqrt{T_2})^2 = (4\sqrt{45})^2 = T_2 = 16x45 =$ [ ]

61) Given $L_1 = 26cm, F_1 = 440Hz, F_2 = 50Hz, N=3$

Wanted: $\Delta L = ?$ *Formula* $L_2 = \frac{F1\ L1}{L2} = \frac{(440)(26)}{550} = L_2 = 20.8cm$

$\Delta L = L_1 - L_2 = 26-20.8 =$ [ ]

62) Given $T_1 = 27N, L_1 = 200cm, F_1 = 150Hz, F_2 = 50Hz, N=3$

Wanted: a) $T_2 = ?$ *b)* $M=?$

Formula: a) $F_1\sqrt{T_2} = F_2\sqrt{T_1} \Rightarrow 150\sqrt{T_2} = 50\sqrt{27}$

$T_2 = \left(\frac{50\ x\ \sqrt{27}}{150}\right)^2 = \frac{27}{9} =$ [ ]

b). $f=KX \Rightarrow w^2 = \frac{k}{m} = w^2m=k \Rightarrow f= w^2mx=m= f/ w^2$

$\Rightarrow m = \frac{f}{(2\pi f)^2 \text{ x}} = \frac{27}{4\pi^2 (150)^2 \text{ x } 2} =$ [ ]

63) Given M=0.8kg, L=0.09m, t=0.03s

Wanted: T=? formula T= $\frac{ML}{T^2}$ **=** $\frac{0.8(0.09)}{(0.03)^2}$ **=** ☐

64) Given: ----------

----

65) Given: F_2 = 550Hz, L_1 = L, L_2 = 1/2L

Wanted: F_1 =? Formula: $F_1 L_1$=> f_1 L / L= f_2 ½ L/L = 150(1/2)= ☐

VIBRATING IN PIPES

66) Given: f = 385Hz, L=20cm=>0.2m

Wanted=? Formula: Λ = $\frac{v}{f}$ **= 4L =** $\frac{v}{f}$ **=>**

V=4FL = 4(385)(0.2) = ☐

67) Given $F_1 = \frac{v}{4L_1}$ $F_2 = \frac{v}{4L_2}$

$= \frac{v}{4L_1} - \frac{v}{4L_2} \longrightarrow \frac{344}{4(0.75)} - \frac{344}{4L} = 9$

1376L-1032=81L = 1295L=1052

68) Given F_n= 300Hz, wanted: F_3= and F_5=?

Formula: $F_3=3F_n$=3 x 300Hz = ☐

$F_5=5F_n$=5 x 300Hz = ☐

69) Given f=540Hz, V=344m/s

L= $\frac{v}{4L}$ = $\frac{344m/s}{4(540)}$ = 0.159m

70) Given 42cm=>0.042m v=330m/s

Wanted: f=? formula: f $\frac{nv}{4L}$ = $\frac{3\ x\ 330}{4\ x\ 0.42}$ = 600Hz

71) Given P_1= $\frac{m}{l}$ => $\frac{0.04kg}{0.8m}$ = 0.05kg/m

While F_n= $\frac{nv\ s}{2L\ s}$ => n=6 F_n= $\frac{6\ vs}{1.6}$ Plz this point is not clear

72) Given F_1=256Hz V_1= 354m/s F_2=? V_2=339m/s

V_1 / F_1= V_2 / F_2 => $\frac{354}{256}$ = $\frac{339}{f\ 2}$ = F_2 = 245 Hz

73) Given f= 256Hz v=342m/s

Wanted: L=? formual: ʎ = $\frac{v}{f}$ = $\frac{342}{256}$ = 1.34m

L= $\frac{ʎ}{2}$ = $\frac{1.34}{2}$ = 0.67m x 100 = 67cm

74) Given

75) Given f=160Hz, v=340m/s

Wanted: L=? formula: L= $\frac{f}{3}$ = $\frac{160}{3}$ = ☐

= $\frac{160}{100}$ = ☐

76) Given: L=33.2cm, v=340m/s

Wanted=? Formula: L= $\frac{n\lambda}{2}$ = Λ=2L => 2(33.2)=664cm

F= $\frac{v}{\lambda}$ = $\frac{340}{66.4}$ = 5.12x100= ☐

77) Given F_n = 220Hz

Wanted: F_3 =? Formula: F_3 =3 F_n =3(220) = ☐

78) Given Λ=2.5m, n=2

Wanted: open pipe=? Formula: L= $\frac{n\lambda}{3}$ = $\frac{2(2.5)}{3}$ = ☐

79) Given L=50cm=>0.5m, v=345m/s

Wanted: F_3 =? , F_5 =? , F_7 =?

Formula: a) **F_3 =3(F_n)=3(172.5) = F_3 =517.5Hz**

b). F_5 =5(F_n) = 5(172.5)= F_5 = 862.5Hz

c). F_7 =7(F_n) =7(172.5)= F_7 =1207.5Hz

80) Given f=4Hz, v=345m/s

Wanted: L=? formula: Λ= $\frac{v}{f}$= $\frac{345}{4}$ = 86.25m

L= $\frac{\lambda}{4}$ = $\frac{86.25}{4}$ = ☐

Further Problems

81) Given: v=320m/s, a) 20℃, b) 40℃, c) 60℃,

Wanted: v=? Formula a) v=320-0.6(20)= ☐

b). v=320+0.6(40)= ☐

c) v=320+0.6(60) = ☐

82) Given: v=320m, $\Delta T = T_2 - T_1 = 34-10$, $\Delta T = 24℃$

Wanted: v=? Formula: v=v+0.6(24),v=326+14.4= ☐

83) Given: v=345m/s

Wanted: T=? Formula: T= $\frac{v-330}{0.6}$ **=** $\frac{345-330}{0.6}$ **=** ☐

84) Given: a) increase by $\frac{1}{10}$ **0℃, b) decreased by** $\frac{1}{8}$ **0℃**

Wanted: T_1? When increased, T=? When decreased

Formula: a) v=32x $\frac{1}{10}$ **= 32+330= {362}**

362=330+0.6(T)=362-330=0.6T=32=0.6T=>

= $\frac{32}{0.6}$ **=** $\frac{0.6T}{0.6}$ **=** ☐

b). v=320 x $\frac{1}{10}$ **= -40+330={290}**

290=330+0.6T=290-330=0.6T= -40 = 0.6T = $\frac{-40}{0.6}$ **=** $\frac{0.6T}{0.6}$ **=** ☐

85) Given: v_1=336m/s, v_2=340.8m/s

Wanted: ΔT=? Formula: T_1= $\frac{v-330m/s}{0.6}$ **=** $\frac{336-330}{0.6}$ **= 10℃**

$T_2 = \frac{v-330}{0.6} = \beta = = 18℃$

$\Delta T = T_2 - T_1 = 18-10 =$ [ ]

86) Given: $I_1 = 2.5x10^{-6}$ w/m²

Wanted: β=? **Formula:** $\beta = 10db\log\frac{1}{10} = \frac{2.5\,x\,10^{-6}}{10^{-12}} =$ [ ]

87) Given: $\beta_1 = 30db$, $\beta_2 = 75db$

Wanted: I=? **Formula: a)** $30 = db\log\frac{1}{10} = 30db\log\frac{1}{10^{-12}}$ [ ]

b). $75db = 10db\log\frac{1}{10^{-12}} =$ [ ]

88) Given: $I_1 = 10^{-10}$ w/m², $I_2 = 7x10^{-10}$ w/m²

Wanted: β=? **Formula: a)** $\beta = 10db\log\frac{1}{10} = 10db\log\frac{10^{-10}}{10^{-12}} = [20db]$

b). $\beta = 10db\log\frac{1}{10} = 10db\log\frac{7\,x\,10^{-2}}{10^{-12}} = [59db]$

89) Given: $\beta = 59db$ **Wanted:** β=?

Formula: $50 = 10db\log\frac{1}{10^{-12}}$ = I = 10^{-7} w/m²/4={I=$2.5x10^{-8}$ w/m²}

$\beta = 10db\log\frac{1}{10} = 10db\log\frac{8x2.5x10^{-8}}{10^{-12}} =$ [ ]

90) Given: t=5s, v=33m/s wanted: d=?

Formula: d= $\frac{vt}{2}$ = $\frac{333x5}{2}$ = ☐

91) Given: d = 167m, v=334m, wanted: T=?

Formula: T= $\frac{2d}{v}$ = 2 ($\frac{167}{334}$) = ☐

92) Given: T_1 = 0.4sec, T_2 = 1.6sec, V=332m

Wanted: d=? formula d= $\frac{VT\,t}{2}$ = $\frac{332(0.4+1.6)}{2}$ = ☐

END

Chapter Four

PROPERTIES OF LIGHT

1) What do you understand by shadow? And state three conditions for the formation of shadow?

   Ans(a) shadow is a dark patch formed behind an opaque body is a placed in the path of light

   (b) 1: source of light 2: opaque body 3: screen

2) what do you understand by the terms umbra and penumbra?

ANS 2 (a) the area of complete shadow behind the earth is called the umbra.

(b) penumbra is the lighted area around the shadow of planet or moon during an eclipse

3) draw a neat diagram for the format of shadow when source of light is a point? And state its characteristics?

ANS 3 (a) diagram for the formation of shadow when source of light is a point

(b) Characteristics of shadow

(a) Umbra and Penumbra are formed

(b) the size of umbra is smaller than the size of the penumbra

(c) If the distance of screen is increased umbra decreased and penumbra increase

4) Draw the diagram for the formation of shadow for an extended source of light when it is smaller and larger than opaque body and state its characteristics?

4: a diagram for formation of shadow for an extended source when it is smaller

b). diagram for formation of shadow for an extended source of light when it is larger

c) characteristics of the shadow when it is smaller than opaque

b) the size of umbra is larger than the size of penumbra increase and vice versa

c) the size the umbra and penumbra increase if the distance of screen and vise verse

d) the size of umbra and penumbra the distance extend source increase vise verse

5) what do you understand by term eclipse? And draw neat diagram for the formation of total solar eclipse

ANS 5: the shadow formed by heavily bodies such as moon, eath

Diagram for the formation of total solar eclipse

6) what are conditions which are necessary for the formation of total solar eclipse?

ANS 6: conditions which are necessary for formation of total solar eclipse are

(a) The sun, the earth and the moon should be the same plane

(b) Earth must be in the middle

(c) The lunar eclipse is classified as total lunar eclipse and partial lunar eclipse

7). Why does solar eclipse lasts for a small time at a given place?

ANS: 7) the shadow formed by earth is very large. Thus moon takes a lot of time to cross this shadow region and hence eclipse lasts longer. However shadow formed by moon is very small which can cross a place an earth in a few minute.

Hence solar eclipse does not last longer

8) Find the height of tree 240m a way that produces an image 2cm high in a pin hole camera of with 20m

Given	**Solution**
h_0 =240m	$d_0 = h_0$ xd / h_1
h_1 = 20cm	d_0 =240m x 2cm / 20cm
d_1 = 2cm	d_0 =24m

9). The magnification of an image formed by a pin hole camera is 0.0005(a) if the distance of 500m find the image distance (b) if the image size is 2.4cm find the height of the object

Given	**solution**
M=0.0005	$d_1 = md_0$
d_0 = 500m	d_1 =(0.0005) (500m)
d_1 =?	d_1 = 0.25m
B: given	solution
M=0.0005	$h_0 = h_1 /m$
h_1 =2.4cm = 0.024m	$h_0 = \frac{0.24m}{0.0005}$ **= 48m**
h_0 =?	

END

Chapter Four

REFLECTION

14) Given: A.θ=72°, =36°

Solution:A.N= $\frac{360^o}{\theta} = \frac{360^o}{72^o}$ = **5**

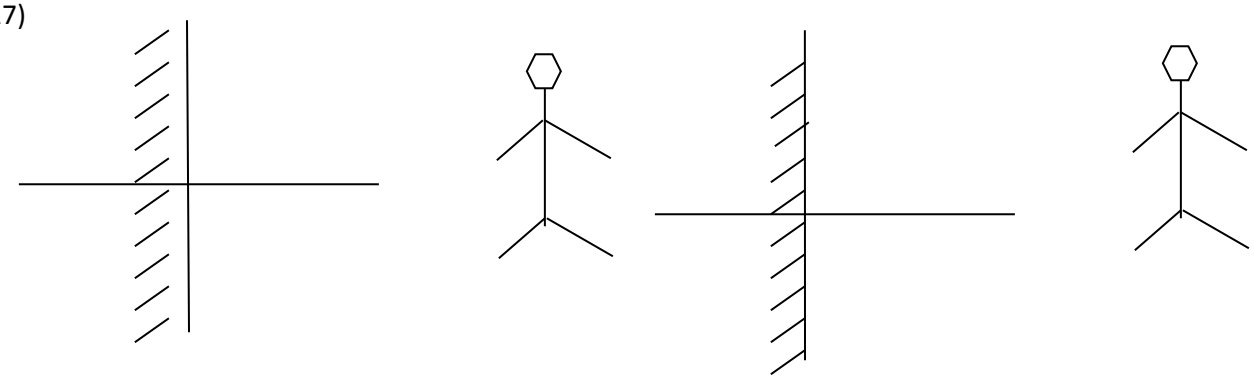
B.N= $\frac{360^o}{\theta} = \frac{360^o}{36^o}$ =10-1= **9**

16) Given: H = $\frac{182\text{ cm}}{2}$ = **91cm**

4m 4m

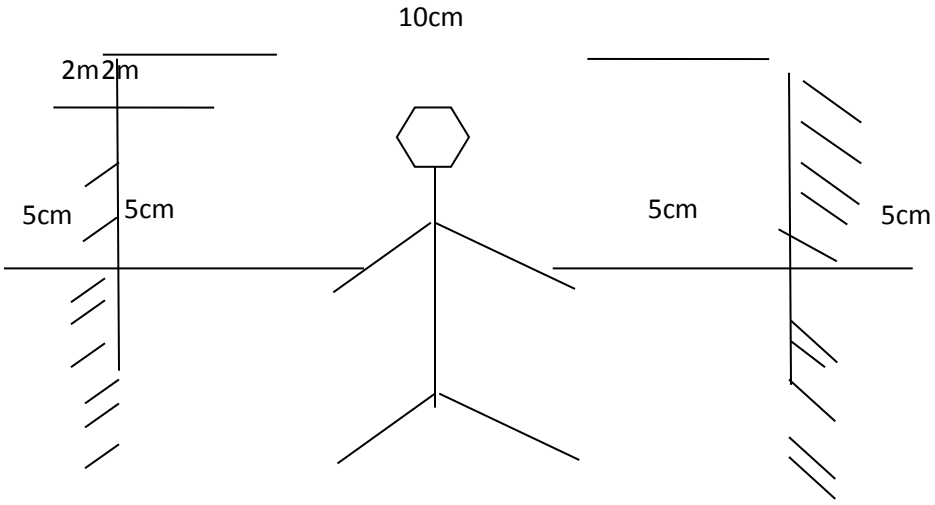
3.5 3.5

17)

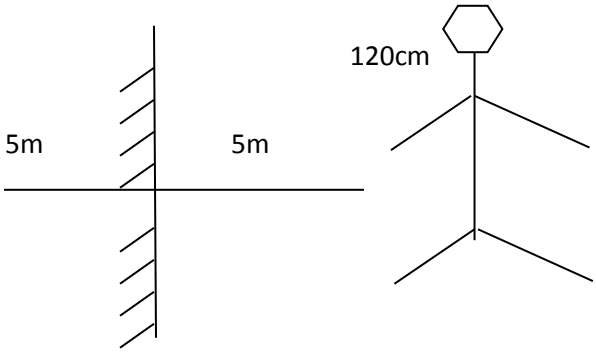


Then The Distance Between He & His Image Is 3.5+3.5=7m

18) Given:D= 10cm, Candle= 2mfro, One Mirror



19) Given:= 120cm,D=5m



A.H=120cm B.D=5+5=10m C.H= $\frac{120}{2}$ = 60cm

20) Given:H_o= 5cm D_o=10cm R=30cm D_i=? H_i=?

F=r/2=30cm/2=-15cm

a.di= $\frac{d_o f}{d_o - f}$ $=\frac{(10)(-15)}{10-(-15)}$ $= \frac{-150}{25}=$ **-6cm**

b.hi= $\frac{h_o di}{d_o} = \frac{(5)(6)}{10}=$ **3cm**

21) given:h_o=1cm h_i=1.5cm d_o=15cm d_i=? F=?

a.di= $\frac{hid_o}{h_o} = \frac{(1.5)(15)}{1}=$ **22.5cm**

-6cm

b.f= $\frac{did_o}{di+d_o} = \frac{(22.5(15)}{22.5+15}=$ **9cm**

22) given: m=1/5 d_o=30cm d_i=? F=?

a.d_i= md_o=$(-{}^{1}/_{5})(30)$ = **-6cm**

b.f=$\frac{d_o di}{d_o+di}$ =$\frac{(30)(-60}{30+(-6)}$ = **-7.5cm**

23)Given: h_o= 3cm, h_i=4.5cm, d_o= 20cm, d_i=? f=?

a.d_i=$\frac{hid_o}{h_o}$ =$\frac{(4.5)(20)}{3}$ = **30cm** b.f=$\frac{d_o di}{d_o+di}$ =$\frac{(20)(30)}{20+30}$ = **12cm**

24)Given: h_o=1.5cm, h_i=30cm, d_o= 6cm, d_i=? f=?

a.d_i=$\frac{hid_o}{h_o}$ =$\frac{(3)(6)}{1.5}$ = **12cm** b.f=$\frac{d_o di}{d_o+di}$=$\frac{(6)(-12)}{6+(-12)}$= **12cm**

25)Given: m=3, d_o=8cm, d_i=? f=?

a.d_i=md_o=(-3)(8)= **24cm** b. f=$\frac{d_o di}{d_o+di}$=$\frac{(8)(-24)}{8+(-24)}$= **12cm**

26)Given:h_o=5cm, h_i=1.25cm, d_o=24cm, d_i=? f=?

a. d_i=$\frac{hid_o}{h_o}$=$\frac{(1.25)(24)}{5}$= **-6cm** b. .f=$\frac{d_o di}{d_o+di}$=$\frac{(24)(6)}{24+(-6)}$= **-8cm**

27)Given: m=$^{1}/_{8}$, d_o=40cm, d_i=? f=?

a.d_i=md_o=$(-\,{}^{1}/_{8})(40)$= **5cm** . f=$\frac{d_o di}{d_o+di}$=$\frac{(40)(-5)}{40+(-5)}$= **-5.71cm**

28)Given:d_o=30cm, f=20cm, d_i= ? m=?

a.$d_i=\frac{d_\circ f}{d_\circ - f}=\frac{(30)(20)}{30-20}=$ **60cm** b.$m=\frac{di}{d_\circ}=\frac{60}{30}=$ **2**

29)Given: h_o=0.8cm, d_o=2m, f=1.5m, h_i=? •$d_i=\frac{d_\circ f}{d_\circ - f}=\frac{(2)(1.5)}{2-1.5}$=**6cm**

a.$h_i=\frac{h_\circ di}{h_\circ}=\frac{(0.8)(6)}{2}=$ **2.4cm**

30)Given: f=30cm, m=3, d_o=? d_i=? •$m=\frac{di}{d_\circ}=3=\frac{di}{d_\circ}$, $d_i=3d_o$, $d_o=\frac{di}{3}$. There fore

a. $d_i=\frac{d_\circ f}{d_\circ - f}=\frac{\frac{di}{3}(30)}{\frac{di}{3}-30}=\frac{\frac{30di}{3}}{\frac{di}{3}-90}=\frac{30di}{di-90}=$ d_i^2-90d_i=30d_i, d_i^2-90d_i-30d_i=0

$d_i(d_i$-120)=0, d_i=o, d_i=**120cm,** $d_o=\frac{di}{3}=\frac{120}{3}=$ **40cm**

31)Given: d_o=20cm, R=60cm, d_i=? $f=\frac{R}{2}=\frac{60}{2}$=30cm

a.$d_i=\frac{d_\circ f}{d_\circ - f}=\frac{(20)(30)}{20-30}=$ **-60cm**

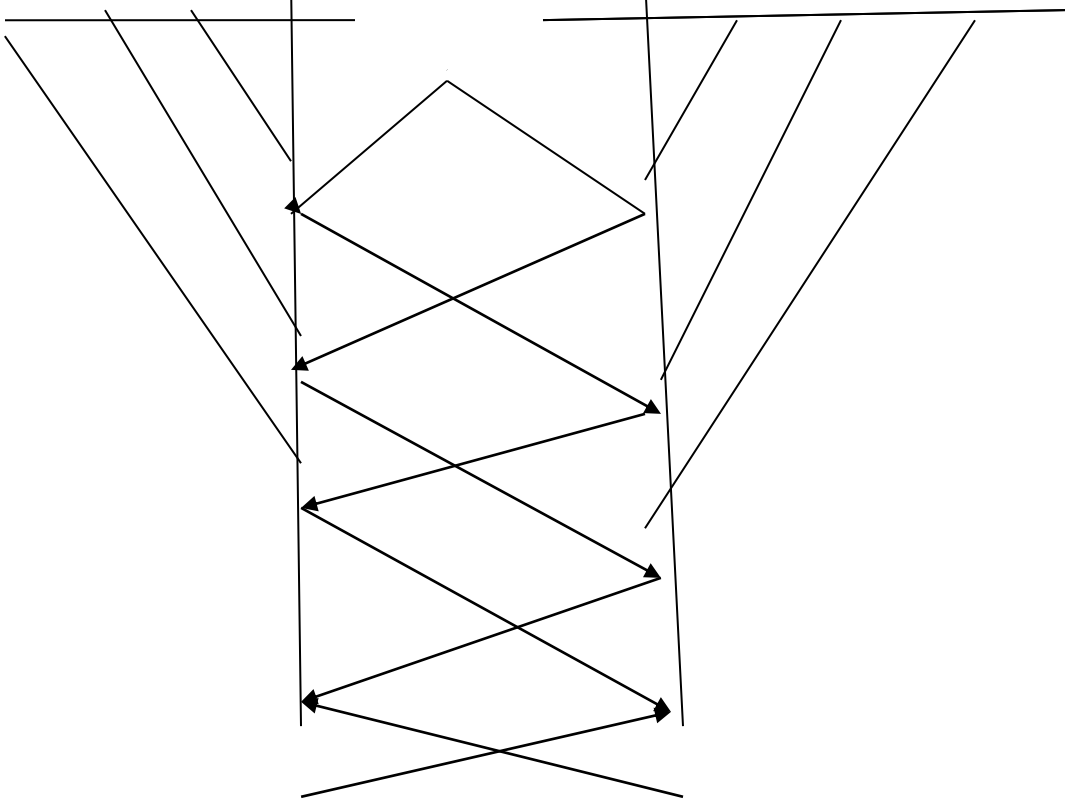
32)Given: d_o=1m, d_i=2m, f=? •$f=\frac{did_\circ}{di-d_\circ}=\frac{(2)(1)}{2-1}=$ **2m**

33)Given:d_o=30cm, f=10cm, d_i=? m=? nature.

a. $d_i=\frac{d_\circ f}{d_\circ + f}=\frac{(30)(10)}{30+10}=$ **7.5cm** b.$m=\frac{di}{d_\circ}=\frac{7.5}{30}$=**0.25,** 7.5cm behind the mirror one fourth object size.

34)Given: θ=90°, n=? $n=\frac{360^\circ}{\theta}=\frac{360^\circ}{90^\circ}$=4-1= **3**

35) 45cm 35cm 5cm 5cm 20cm 15cm 15 25cm 55cm



36)Given:d_o=20cm, R=60cm, d_i=? m=? nature •f=$\frac{R}{2}$=$\frac{60}{2}$=30cm

a.d_i=$\frac{d_o f}{d_o - f}$=$\frac{(20)(30)}{20-30}$= **-60cm** .m=$\frac{di}{d_o}$=$\frac{-60}{20}$= **-3** ure:60cm behind the mirror

magnified 3times

37)Given:R=36cm, m=$\frac{1}{9}$, d_o=? f=$\frac{R}{2}=\frac{36}{2}$=18cm, •m=$\frac{di}{d_\circ}=\frac{1}{9}=\frac{di}{d_\circ}$, $d_i=\frac{1}{9}d_o$,

a.$d_o=\frac{dif}{di-f}=\frac{\frac{1d_\circ}{9}(18)}{\frac{1d_\circ}{9}-18}=\frac{\frac{18d_\circ}{9}}{\frac{1d_\circ}{9}-162}=$ $d_o=\frac{18d_\circ}{d_\circ-162}=$

$d_o^2-162d_o=18d_o$, $d_o^2-162d_o-18d_o=0$, $d_o(d_o-180)=0$, $d_o=0$, $d_o=$ **180cm**

38)Given:h_o=7cm, d_o=15cm, R=45cm, d_i=? h_i=? f=$\frac{R}{2}=\frac{45}{2}$=-22.5cm

a.$d_i=\frac{d_\circ f}{d_\circ-f}=\frac{(15)(-22.5)}{15-(-22.5)}=$ **-9cm** b.$h_i=\frac{h_\circ di}{d_\circ}=\frac{(7)(-9)}{16}=$ **4.2cm**

natur:virtual,ererct, 9cm behind the mirror,4.2cm high.

39)Given:m=$-\frac{1}{6}$, d_o=12cm, d_i=? f=? •$d_i=md_o=(-\frac{1}{6})(12)$=**-2cm**

a.$f=\frac{d_\circ di}{d_\circ+di}=\frac{(12)(-2)}{12+(-2)}=$ **-2.4cm**

40)Given:d_o=12cm, m=5, d_i=? kind of mirror=?

41)Given:f=10cm, R=? •R=2f=2(10)= **20cm**

42)Given: R=140cm, f=? •f=$\frac{R}{2}$=$\frac{140}{2}$= **70cm**

43)Given:d_o=20cm, f=5cm, d_i=? •d_i=$\frac{d_o f}{d_o - f}$=$\frac{(20)(5)}{20-5}$= **6.67cm**

44)Given: h_o=20cm, d_o=36cm, R=40cm, d_i=? h_i=? nature=? F=$\frac{R}{2}$=$\frac{40}{2}$=20cm

a. d_i=$\frac{d_o f}{d_o - f}$=$\frac{(36)(20)}{36-20}$= **45cm** b.h_i=$\frac{h_o di}{d_o}$=$\frac{(20)(45)}{36}$= **25cm**

45)Given:d_i=15cm, f=30cm, d_o=? m=?

a.d_o=$\frac{fdi}{f-di}$=$\frac{(30)(15)}{30-15}$= **30cm** b.m=$\frac{di}{d_o}$=$\frac{15}{30}$= **0.5**

46)Given:m=$\frac{2}{3}$, L=18cm, d_o=? d_i=? f=? •d_i=$\frac{2}{3}d_o$, d_o=$\frac{di}{\frac{2}{3}}$,

a.d_o=d_i+L=$\frac{2}{3}d_o$+18, d_o=$\frac{2}{3}d_o$+54, 2d_o+54=3d_o, 54=3d_o-2d_o, d_o= **54cm**

b.d_i=d_o-L=54-18= **36cm** c.f=$\frac{d_o di}{d_o + di}$=$\frac{(54)(36)}{54+36}$= **21.6cm**

47)Given: -4, L=10cm, d_o=? d_i=? f=? •d_i=-4d_o, d_o=$\frac{di}{-4}$,

a.d_o=d_i+L, -4d_o+10, 5d_o=10, d_o= **2cm** d_i=d_o-L=2-10= **-8cm**

c. .f=$\frac{d_o di}{d_o+di}$=$\frac{(2)(-8)}{2+(-8)}$= **2.67cm**

48)Given:m=4, f=20cm, d_o=? d_i=? •d_i=4d_o,

a.d_o=$\frac{dif}{di-f}$=$\frac{4d_o(20)}{4d_o-20}$= $\frac{80d_o}{4d_o-20}$= $4d_o^2$-20d_o=80d_o, $4d_o^2$-20d_o-80d_o=0, 4d_o-100d_o=0,

d_o(4d_o-100)=0, d_o=0, 4d_o-100=0, 4d_o=100, d_o= **25cm**

b. d_o=$\frac{dif}{di+f}$=$\frac{4d_o(20)}{4d_o+20}$= $\frac{80d_o}{4d_o+20}$=4d_o^2+20d_o=80d_o, $4d_o^2$+20d_o-80d_o=0, 4d_o-60d_o=0,

d_o(4d_o-60)=0, d_o=0, 4d_o-60=0, , 4d_o=60, d_o= **15cm**

49)Given:m=4,f=18cm, d_o=? d_o=? •d_i=4d_o,

a. d_o=$\frac{dif}{di+f}$=$\frac{4d_o(18)}{4d_o-18}$= $\frac{72d_o}{4d_o-18}$=4d_o^2-18d_o=72d_o, $4d_o^2$-18d_o-72d_o=0, 4d_o-90d_o=0,

d_o(4d_o-90)=0, d_o=0, 4d_o-90=0, 4d_o=90, d_o= **22.5cm**

b. d_o=$\frac{dif}{di+f}$=$\frac{4d_o(18)}{4d_o+18}$= $\frac{80d_o}{4d_o+20}$=4d_o^2+18d_o=72d_o, $4d_o^2$+18d_o-72d_o=0, 4d_o-54d_o=0,

d_o(4d_o-54)=0, d_o=0, 4d_o-54=0, , 4d_o=54, d_o= **13.5cm**

50)Given: m=5, d_o=40mm=4cm, R=? •d_i=md_o=(5)(4)=20cm

•f=$\frac{did_o}{di-d_o}$=$\frac{(20)(4)}{20-4}$=**5cm,**

a.R=2f=2(5)= **10cm**

51)Given:d_o=50cm, f=12.5cm, m=? d_i=?

a.d_i=$\frac{d_o f}{d_o+f}$=$\frac{(50)(-12.5}{50-(-12.5)}$= **-10ccm** .m=$\frac{di}{d_o}$=$\frac{-10}{50}$=-**0.2**

52)Given:f=30cm,d_i=15cm, d_o=? •$d_o=\frac{fdi}{f-di}=\frac{(30)(15)}{30-15}$= **30cm**

53)Given: m=$\frac{1}{5}$, d_o=20cm, R=/? Kind of mirror=? •$d_i=md_o=(\frac{1}{5})(20)$=**4cm**

•f=$\frac{d_o di}{d_o-di}=\frac{(20)(4)}{20-4}$=**5cm**, a. R=2f=2(5)= **10cm** nvex

54)Given:f=10cm, d_o=60cm, d_i=? d_i=?

55)Given: f_1=15cm, f_2=20cm, d_o= 70cm, d_o=20cm, d_i=? d_i=?

END

Chapter six

16)Given: $n_1=1.31, n_2=1.54$, $n=\frac{n_2}{n_1}=\frac{1.54}{1.31}=$ **1.18**

17)Given: $n=1.50, c=3x10^8 m/s$, $v=?$ $n=\frac{c}{v}$ there fore $\frac{2x10^8 m/s}{n}$ $\frac{3x10^8}{1.50}$ =

18)Given: $n=1.5$, $\sin\theta_i=37°$, $\sin\theta_r=?$ $\sin\theta_r=\frac{\sin\theta_i}{n}=\frac{\sin 37°}{1.5}=$ 24°

19)Given: $\sin\theta_i=30°$, $\sin\theta_r=22.1°$, $n=?$ $n=\frac{\sin\theta_i}{\sin\theta_r}=\frac{\sin 30°}{\sin 22.1°}=$ 1.32

20) Given: $v=2x10^8 m/s$, $c=3x10^8 m/s$, $n=?$ $n=\frac{c}{v}=$ 1.5

21)Given: $n=2.5$, $c=3x10^8 m/s$, $v=?$ $v=\frac{c}{n}=\frac{3x10^8}{2.5}=$ $1.2x10^8 m/s$

22)Given: $\lambda_1=600nm$, $n=4/3$, $f=?$ $v=?$ $\lambda_2=?$

A)$n=\frac{\lambda 1}{\lambda 2}$, there fore $\lambda_2=\frac{\lambda 1}{n}=\frac{600nm}{4/3}=$ 450nm

B)$n=\frac{c}{v}$, $v=\frac{c}{n}=\frac{3x10^8 m/s}{4/3}=$ $2.25x10^8 m/s$

23)Given:$n=2.42$, $c=3x10^8 m/s$, $v=?$ $\lambda_2=?$

A)$v=\frac{c}{n}=\frac{3x10^8 m/s}{2.42}=$ $1.24x10^8 m/s$

B) $\lambda_2=\frac{\lambda 1}{n}=\frac{800nm}{2.24}=$ 330.5nm

24)Given: $m=0.5$, $d_i=24cm$, $f=?$ •$d_o=\frac{di}{do}=\frac{24cm}{0.5}=48cm$,

A) $f=\frac{dodi}{do+di}=\frac{(48cm)(24cm)}{48+24}=$ 16cm

25)Given: $m=4$, $d_i=6cm$, $f=?$ •$d_o=\frac{di}{m}=\frac{6cm}{4}=1.5cm$

$F=\frac{dodi}{do+di}=\frac{(6cm)(1.5cm)}{6+1.5}=$ 1.2cm

26)Given: p=+4D, a) f=? b)kind of lense=?

A) $f=\frac{1}{p}=\frac{1}{+4D}=0.25m=$ 25cm b) convex

27)Given: p=+0. 75D, a) f=? b)kind of lense=?

A)$f=\frac{1}{p}=\frac{1}{+0.75D}=$ 133.33cm b)convex

28)Given: f=-10cm, p=? $p=\frac{1}{f}=\frac{1}{-10cm}=$ -10D

29)Given: f=-40cm, p=? $p=\frac{1}{f}=\frac{1}{-0.4m}=$ -2.5D

30)Given: p=-2.75D, f=? $f=\frac{1}{p}=\frac{1}{-2.75D}=$ 36.36cm

31)Given: p=-12.5D, f=? $f=\frac{1}{p}=\frac{1}{-12.5D}=$ 8cm

32)Given: p_1=+4.5D, p_2=-5D, p=? f=?

A)$p=p_1+p_2$= +4.5D+(-5D)= -0.5D b)$f=\frac{1}{p}=\frac{1}{-0.5D}=$ 2m

33)Given: p_1=3.5D, p=+1, p_2=? F=?

A)$p_2=p-p_1$=+1D-3.5D= -2.5D b)$f=\frac{1}{p}=\frac{1}{-2.5D}=$ 0.4m

34)Given: f_1=25cm 0.25m, f_2=-10cm -0.1m, p=? f=?

A) $p=\frac{1}{f}=\frac{1}{0.25m}$=+4D, $p=\frac{1}{f}=\frac{1}{-0.1m}$=-10D

B) $p=p_1+p_2$=+4D+(-10D)= -6D c)$f=\frac{1}{p}=\frac{1}{-6D}=$ 16.67cm

35)Given: f_1=40cm, f_2=-25cm, p=? f=?

A) $p_1=\frac{1}{f_1}=\frac{100cm}{40cm}$=+2.5D, $p_2=\frac{1}{f_2}=\frac{100cm}{-25cm}$=-4D

B) $p=p_1+p_2$=+2.5D+(-4D)= -1.5D c)$f=\frac{1}{p}=\frac{1}{-1.5D}=$ 66.66cm

36)Given: f=-20cm, h_o=5cm, d_i=15cm, h_i=?

•**$d_o=\frac{dif}{d+f}=\frac{(15cm)(-20cm)}{15+(-20)}$= 60cm**

A)$h_i=\frac{h_o d_i}{d_o}=\frac{(5cm)(15cm)}{60cm}=$ 1.25cm

37) Given: f=25cm, d_i=75cm, d_o=? nature=?

A)$d_o=\frac{dif}{d-f}=\frac{(75)(25)}{75-25}=$ 37.5cm b) Real, inverted, enlarged, forms behind $2f_2$

38) Given: f=30cm, d_i=60cm, d_o=? m=?

A)$d_o=\frac{dif}{d-f}=\frac{(60)(30)}{60-30}=$ 60cm **b)$m=\frac{d_i}{d_o}=\frac{60cm}{60cm}=1$**

Nature:real,inverted, same size, forms at $2f_2$

39)Given: h_o=50cm, h_i=20cm, d_i=10cm, f=? •$d_o=\frac{h_o d_i}{hi}=\frac{(50)(10)}{20}$=25cm

A)$f=\frac{d_o d_i}{d_o+d_i}=\frac{(25)(10)}{25+10}=$ 7.14cm

40)Given: h_o=3cm, d_o=20cm, f=12cm, d_i=? h_i=**?**

A)d_i=$\frac{df}{di-f}$=$\frac{(20cm)(12cm)}{20-12}$= 30cm **b)$h_i$=$\frac{h_o di}{d_o}$=$\frac{(3cm)(30)}{20}$=4.5cm**

Nature:real, inverted, enlarged, forms behind $2f_2$

41Given: m=2, f=20cm, d_o=? m=$\frac{di}{d_o}$= 2=$\frac{di}{d_o}$= $d_i=2d_o$

A)d_o=$\frac{dif}{di-f}$=$\frac{2d_o(20)}{2d_o-20}$=$\frac{40d_o}{2d_o-20}$= $2d_o^2$-20d_o=40d_o

$2d_o^2$-60d_o=0 d_o(2d_o-60)=0 d_o=o, 2d_o=60 there fore $d_o=30cm$

42)Given: h_o=3cm, d_i=10cm, f=-15cm, d_o=? h_i=?

A)d_o=$\frac{dif}{di+f}$=$\frac{(10cm)(-15cm)}{10-15}$= 30cm **b)$h_i$=$\frac{h_o di}{d_o}$=$\frac{(3cm)(10cm)}{30cm}$=1cm**

Nature:real,inverted, diminished

43)Given: h_o=20cm, h_i=30cm, d_i=10cm, f=? •d_o=$\frac{h_o di}{d_o}$=$\frac{(20cm)(10cm)}{30cm}$=6.67cm

A)f=$\frac{d_o di}{d_o+di}$=$\frac{(6.67\square\square)(10\square\square)}{6.67+10}$= 4cm

44)Given: h_o=30cm, h_i=10cm, d_i=15cm, f=? •d_o=$\frac{h_o\square\square}{h\square}$=$\frac{(30\square\square)(15\square\square)}{10\square\square}$=45cm

A)f=$\frac{\square_o\square\square}{\square_o+\square\square}$=$\frac{(45\square\square)(15\square\square)}{45+15}$= 11.25cm

45)Given: h_o=5cm, d_o=25cm, f=20cm, d_i=? h_i=?

A)d_i=$\frac{\square_o\square}{\square_o-\square}$=$\frac{(25\square\square)(20\square\square)}{25-20}$= 100cm b)$h_i$=$\frac{h_o\square\square}{\square_o}$=$\frac{(5\square\square)(100\square\square)}{25\square\square}$=20cm

46)Given: yes, if the object will be placed between O and F_1 it will produces virtual and erect Image.

47)Given: $\square\square\square\ \square_\square$=30°, n=1.52, $\square\square\square\ \square_\square$=? •$\square\square\square\ \square_\square$=$\frac{\square\square\square\square_\square}{\square}$=$\square\square$ 19° $\frac{\square\square30°}{1.52}$)=

48)Given: $\square\square\square\ \square_\square$=30°, n=2.419, $\square\square\square\ \square_\square$=? •$\square\square\square\ \square_\square$=$\frac{\square\square\square}{\square}$ 12° $\square\square^{-1}(\frac{\square\square\square30°)}{2.419}$=

49)Given: $\square\square\square\ \square_\square$=65°, $\square\square\square\ \square_\square$=40°, n=? •n=$\frac{\square\square\square\square_\square}{\square\square\square\square_\square}$ 1.4 $\frac{\square}{\square\square\square40°}$=

50)Given: $\square\square\square\ \square_\square$=30°, $\square\square\square\ \square_\square$=25°, n=? •n=$\frac{\square\square\square\square_\square}{\square\square\square\square_\square}$ 1.2 $\frac{\square}{\square}$=

51)Given: n=1.333, c=3x10^8 $\square/\square$, v=?

•$V=\frac{□}{□}=\frac{3□10^8□/□}{1.333}=$ $2.26x10^8 m/s$

52)Given: $v=2x10^8□/□$, $c=3x10^8□/□$, $n=?$

•$n=\frac{□}{□}=\frac{3□10^8□/□}{2□10^8□/□}=$ 1.5

53)Given: $□□□\ □_□=37°$, $□□□\ □_□=30°$, $n=?$ •$n=\frac{□□□□_□}{□□□□_□}=\frac{□□□37°}{□□□30°}=1.2$

A)$v=\frac{□}{□}=\frac{3□10^8□/□}{1.2}=$ $2.5x10^8 m/s$

54) Given: $□□□\ □_□=45°$, $n_1=1.333$, $n_2=0.75$, $□□□\ □_□=?$

A)$\sin□_□=□□□^{-1}(\frac{□□□45°}{1.333})$ 32° b) $\sin□_□=□□□^{-1}(\frac{□□}{(}$ 70°

55)Given: $d_1=2.5km$, $d_2=3.5km$, $n=?$ •$n=\frac{□_2}{□_1}=\frac{3.5□□}{2.5□□}=$ 1.4

56)Given: $f=5x10^{14}□□$, $c=3x10^8□/□$, $□=?$

C=□f there fore $=\frac{□}{□}=\frac{3□10^8□/□}{5□10^{14}□□}=6x10^{-7}m$, $□_2=\frac{□_2}{□}=\frac{6□10^{-7}□}{1.5}=$ $\mathbf{4x10^{-7}}m$

57)Given:f=20cm, a)$d_o=60cm$, b)$d_o=40cm$, C)$d_o=30cm$, d)$d_o=20cm$, e)$d_o=10cm$, $d_i=?$ $m=?$

A)$d_i=\frac{□_◦□}{□_◦-□}=\frac{(60□□)(20□□)}{60-2□}=$ **30cm** •$m=\frac{□□}{□□}=\frac{30□□}{60□□}=0.5$

B) $d_i=\frac{□_◦□}{□_◦-□}=\frac{(40□□)(20□□)}{40-20}=$ **40cm** •$m=\frac{□□}{□□}=\frac{40□□}{40□□}=1$

C) $d_i=\frac{□_◦□}{□_◦-□}=\frac{(30)(20)}{30-20}=$ **60cm** •$m=\frac{□□}{□□}=\frac{60}{30}=2$

D) $d_i=\frac{□_◦□}{□_◦-□}=\frac{(20)(20)}{20-20}=$ ∞ •$m=\frac{□□}{□□}=\frac{∞}{20}=0$

E) $d_i=\frac{□_◦□}{□_◦-□}=\frac{(10)(20)}{10-20}=$ -20cm •$m=\frac{□□}{□□}=\frac{-20}{10}=-2$

58)Given: $m=2$, $d_i=12cm$, $d_o=?$ $f=?$

A)$d_o=\frac{□□}{□}=\frac{12□□}{2}=$ 6cm b)$f=\frac{□_◦□□}{□_◦+□□}=\frac{(6)(12)}{6+12}=$ 4cm

59)$d_o=15cm$, $f=-10cm$, $d_i=?$ $m=?$

A)$d_i=\frac{□□□}{□□-□}=\frac{(15)(-10)}{15-(-10)}=$ -6cm b)$m=\frac{□□}{□□}=\frac{-6}{15}=-0.4$

60)Given: $\sin□_□=75°$, $\sin□_□=45°$, $n=?$

$n=\frac{□□□□_□}{□□n□_□}=\frac{□□□□_□75°}{□□□□_□45°}$ 1.37

61)Given: $n=2.42$, $\sin□_□=?$ •$□_□=□□□^{-1}(1 \div 2.42$ 24°

62) _____

_____

63)Given: h_o=10cm, d_o=150cm, f=5cm, d_i=? h_i=?

A)$d_i=\frac{\square\square\square}{\square\square-\square}=\frac{(150)(5)}{150-5}=$ 5.17cm

b)$h_i=\frac{\square.\square\square}{\square_\circ}=\frac{(10)(5.17)}{150}=0.34cm$

64)Given: d_o=2cm, f=-3cm, d_i=? nature=?

A) $d_i=\frac{\square\square\square}{\square\square-\square}=\frac{(2)(-3)}{2-(-3)}=$ -1.2cm , nature:virtual,erect,

65)Given: f=-30cm, h_o=2cm, d_o=80cm, d_i=? h_i=?

A) $d_i=\frac{dof}{do-f}=\frac{(80)(-30)}{80-(-30)}=$ -21.8cm b)$h_i=\frac{h_\circ d_i}{d_\circ}=\frac{(2)(-21.8)}{80}=-0.55cm$

66)Given: $m=1/3$, f=12cm, d_o=? •$d_i=1/3 d_o$, A)$d_o=\frac{dif}{di-f}=\frac{\frac{1}{3}do(12)}{\frac{1}{3}do-12}=\frac{-\frac{12do}{3}}{\frac{1}{3}do-36}=\frac{-12do}{do-36}=$ $d_\circ^2-36d_\circ=-12d_\circ$

$d_\circ^2-36d_\circ+12d_\circ=0$, $d_\circ^2-24d_\circ=0$, $d_o(d_o-24)=0$, $d_o=0$, $d_o-24=0$ d_o=24cm

67)p_1=-3.5D, p=+1D, F_1=? F_2=?

A)$f_1=\frac{1}{p}=\frac{1}{-3.5D}=$ 28.7cm

B)$p_2=p-p_1=+1D-3.5D=-2.5D$, •$f=\frac{1}{p}=\frac{1}{-2.5D}=$ -40cm

68) p_1=-4.5D, p=+0.75D, F_1=? F_2=?

A) $f_1=\frac{1}{p}=\frac{1}{-4.5D}=$ -22.22cm

B) $p_2=p-p_1=+o.75D-4.5D=-3.75D$, •$f=\frac{1}{p}=\frac{1}{-3.75D}=$ -26.67cm

END