Slide ①

- How do we define and calculate "INTENSITY" of a wave and the factors which govern the intensity.

- symbol I
- units Wm^{-2}
- define :- Intensity is defined as Power of a wave falling on a unit area

- formula $I = \frac{P}{A}$ since $P = \frac{E}{t}$

$$I = \frac{E}{t \cdot A}$$

Factors which affect the Intensity of a wave

(1) Amplitude (A)
(2) distance from the Source (d)

- Intensity is known to be directly proportional to the square of the Amplitude of the wave, hence

$$I \propto A^2$$

$$I = KA^2$$

(double)^2
(Thrice)^2

A = double
I = increases 4 times

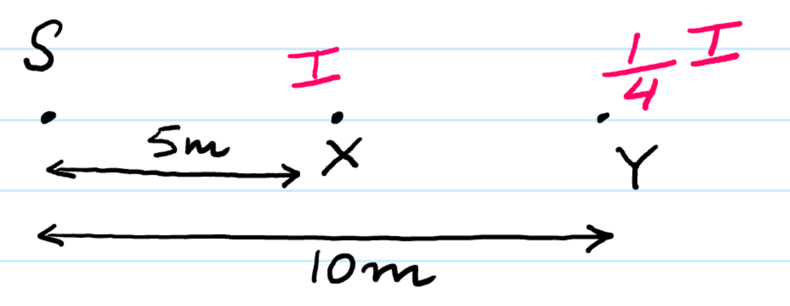
A = Trice
I = increases 9 times

- Intensity is known to be inversely proportional to the square of the distance from the source, hence

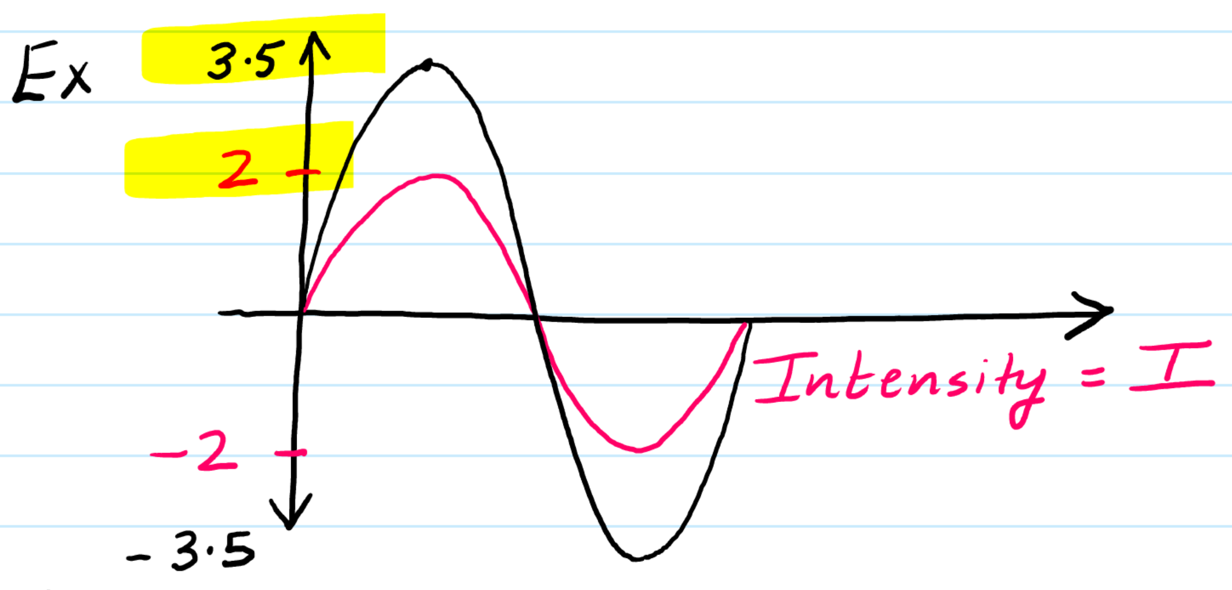
$$I \propto \frac{1}{d^2}$$

$$I = \frac{K}{d^2}$$

one-fourth (double)^2



Ex



Construct a Second wave on the same diagram which has THRICE the Intensity and is IN PHASE with the first wave.

$I = KA^2$

① ← $I = K(2)^2$ $k = \frac{I}{4}$

② ← $3I = K(A)^2$

$3I = \frac{I}{4}(A)^2$ ∴ $A = 3.5$

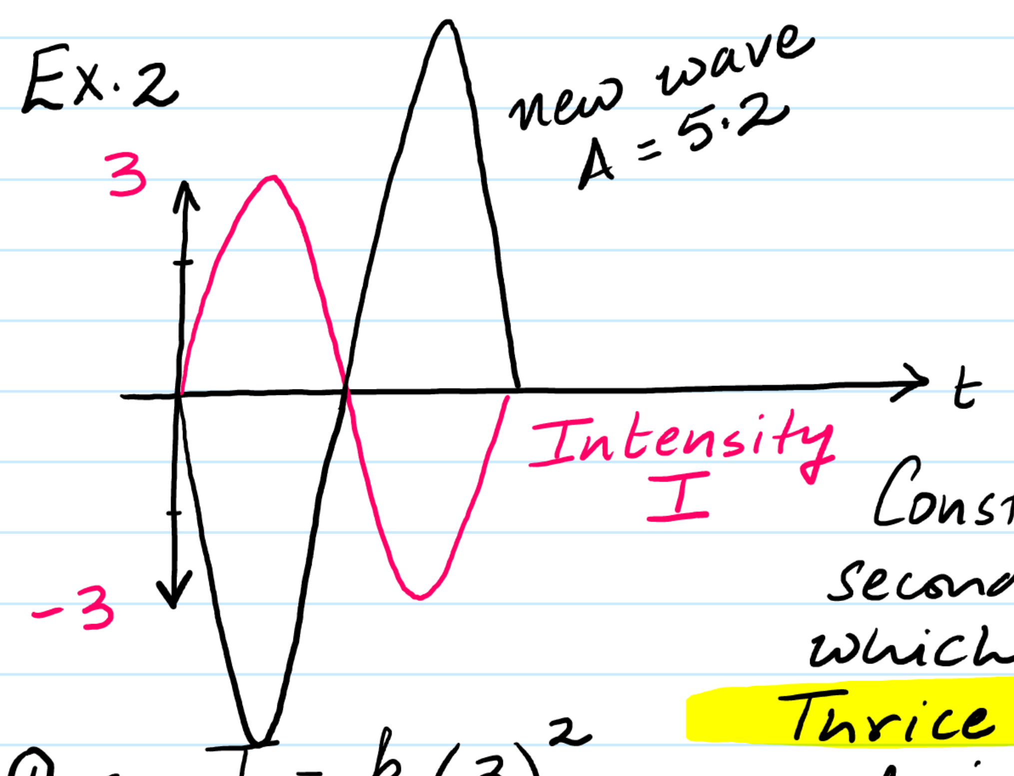
Hence calculate the Resultant Intensity (y) if these waves were to interfere constructively? (give your answer in terms of I).

Resultant Amplitude = 2 + 3.5 = 5.5
Resultant Intensity = y (find)

$I = kA^2$
$y = k(5.5)^2$
$y = \frac{I}{4}(5.5)^2$

$y = 7.6\,I$

Ex.2



Construct a second wave which has Thrice the Intensity and is out of phase with the first wave.

① ← $I = k(3)^2$

$k = \frac{I}{9}$

② ← $3I = k(A)^2$
$3I = \frac{I}{9}(A)^2$

$A = 5.2$

Hence cal. the Resultant Intensity (z) if the two waves interfere destructively give your answer in terms of I.

Resultant Amplitude = 5.2 − 3 = 2.2
Resultant Intensity = z (find)

$I = kA^2$
$z = \frac{I}{9}(2.2)^2$

$z = 0.5\,I$

Grid 1 waves5

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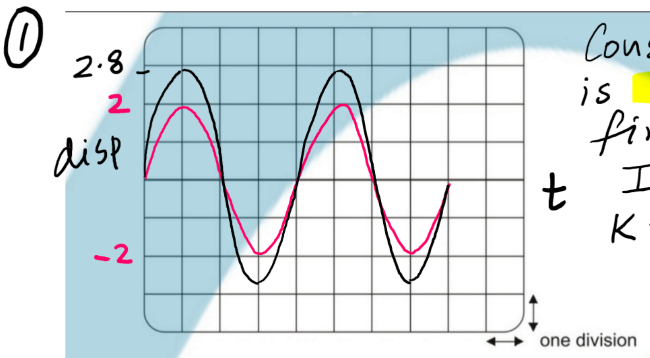


Construct a second wave whose Intensity is Twice and it is In phase with the first one

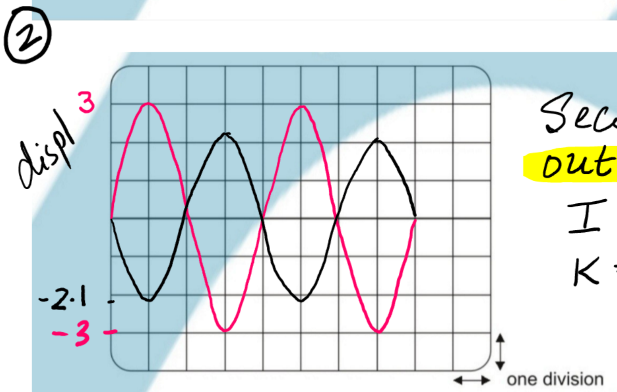
$I = K(2)^2$

$K = \frac{I}{4}$

$2I = K(A)^2$

$2I = \frac{I}{4}(A)$

$\therefore A = 2.8$



Second wave half the Intensity & out of phase with the first one?

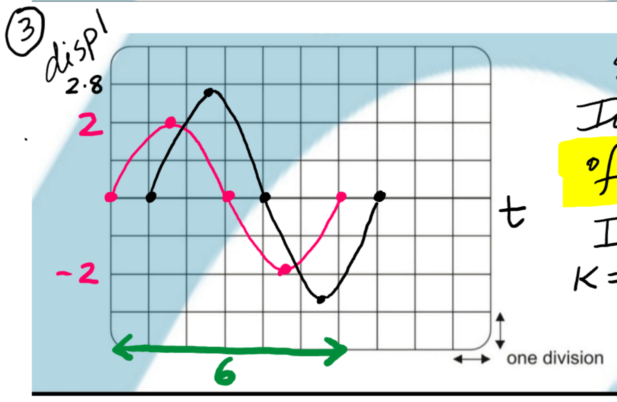
$I = K(3)^2$

$K = \frac{I}{9}$

$\frac{1}{2}I = K(A)^2$

$\frac{1}{2}I = \frac{I}{9}(A)^2$

$A = 2.1$



Second wave which has Twice the Intensity and has a phase diff of 60° with the first wave.

$I = K(2)^2$

$K = \frac{I}{4}$

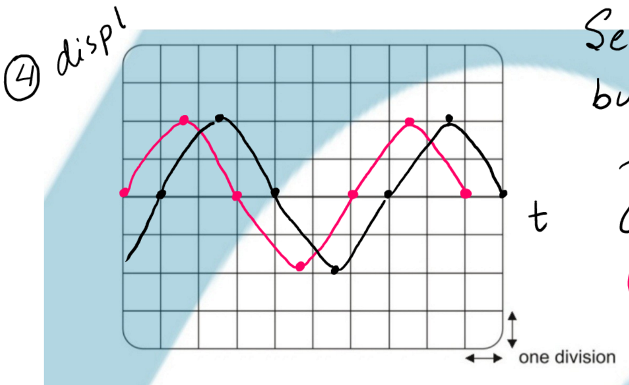
$2I = K(A)^2$

$\therefore$ A = 2.8

6 boxes ⟶ 360°

1 box ⟵ 60°

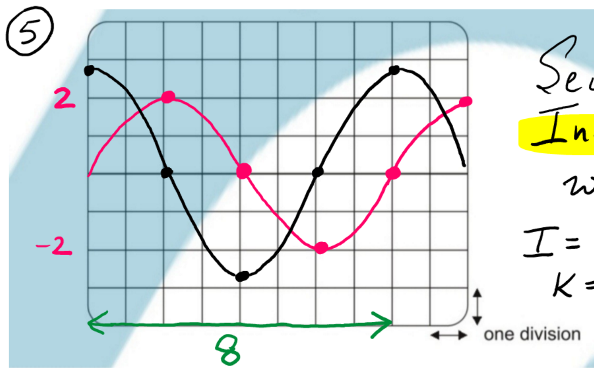
↳ shift Right or Left



Second wave same Intensity but it Lags behind the first wave by 60°

Construct the Second wave (RIGHT SHIFT)

On a time scale, if something lags behind then it must start at a LATER TIME.



Second wave Twice Intensity but it Leads the first wave by 90°. Construct 2nd wave

↳ LEFT SHIFT

$I = K(2)^2$

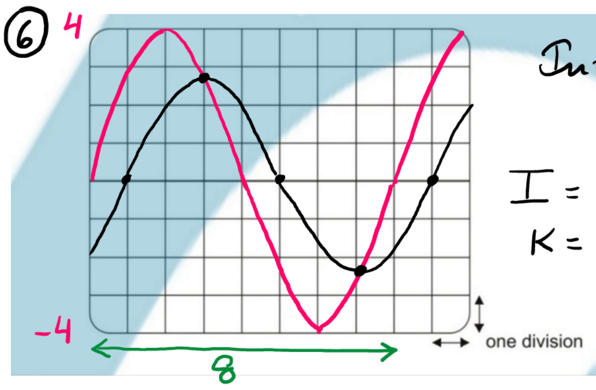
$K = \frac{I}{4}$

$2I = K(A)^2$

$\therefore$ A = 2.8

8 box ⟶ 360°

2 box ⟵ 90°



Intensity ONE THIRD

New graph lags behind by 45°.

↳ RIGHT SHIFT.

$I = K(4)^2$

$K = \frac{I}{16}$

$\frac{1}{3}I = K(A)^2$

$A = 2.3$

8 box ⟶ 360°

1 box ⟵ 45°