NOISE POLLUTION PROBLEMS –

ENGR – 9601
ENVS – 6004

10 – 3

10 – 4

10 – 5

10 – 6

10 – 7

10 – 8

10 – 14

10 – 16.

10-3) Sound levels (in dB) of 68, 82, 76, 68, 74 and 81 are to be summed.

Comment: Sound pressure levels (in dB) need to be differentiated from sound levels (in dBA, dBB or dBC) through dBA is most often used.

The problem does not say "sound pressure levels" and the units given are not in the units expected when a weighting network is used.

Therefore, by process of elimination it appears that sound intensity levels or sound power levels are intended.

I would have preferred if the more details had been provided in the problem description.

$$L_I = 10 \log \sum 10^{68/10} + 10^{82/10} + 10^{76/10} + 10^{68/10} + 10^{74/10} + 10^{81/10}$$

$$= 10 \log (6{,}309{,}573 + 158{,}489{,}320 + 39{,}810{,}717 + 6{,}309{,}573 + 25{,}118{,}864 + 125{,}892{,}541)$$

$$= 10 \log (361.4 \times 10^6)$$

$$= 85.6 \text{ dB}$$

10-4) 200 m from meter, motorcycle is 56 dBA

Add 15 more motorcycles at same location so 16 total.

Assume the 16 are a point source.

$L_p \cong L_w - 20\log r - 11 - A_e$ (here $A_e = 0$)

$56\ dBA \cong L_w - 20\log(200\ m) - 11$

$L_w = 56 + 46.0 + 11 = 113.\ dB$

L_w = sound power level at source. for 1 motorcycle

Adding sound powers levels for 16 motorcycles:

$$L_w = 10\log \sum_{j=1}^{N} 10^{(L_j/10)}$$

$$= 10\log \sum \left(10^{113/10} + 10^{113/10} \ldots\ldots\right) \quad (16\ \text{times})$$

$$= 10\log(199.5\times10^{9}\times16)$$

$$= 10\log(3.192\times10^{12})$$

$$= 10(12.5) = 125\ dB \quad (\text{sound power at source})$$

To get meter reading for 16 motorcycles at 200 m distance:

$$L_p \cong L_w - 20\log(\overset{r}{200}\ m) - 11$$

$$= 125\ dB - 46.0 - 11$$

$$= 68\ dBA.$$

10-5. $L_w = 127$ dB x clippers in use

$L_w = 120$ dB   1 clipper in use

$$L_w = 10 \log \left(10^{120/10}\right)(x) = 127 \text{ dB}$$

$$\log \left(10^{120/10}\right)(x) = 12.7$$

$$\log 10^{120/10} + \log x = 12.7$$

$$12 \log 10 + \log x = 12.7$$

$$\log x = 12.7 - 12 \log 10$$

$$x = 10^{(12.7 - 12 \log 10)}$$

$$x = 10^{(0.7)}$$

$$x = 5$$

10-6 80 dBA   84 dBB   90 dBC

The noise is low frequency, probably around 150 Hz since the dBA reading is lower than the dBB reading and the dBB reading is lower than the dBC reading.

10-7 109 dBA, 110 dBB, 111 dBC.

According to Table 15-1, the frequence is about 631 Hz.

Middle C has a frequency of 261 Hz.

Therefore the singer is a soprano.

10-8

Hz	dB	add or subtract	dBA
31.5	78	− 39.4	38.6
63	76	− 26.2	49.8
125	78	− 16.1	61.9
250	82	− 8.6	73.4
500	81	− 3.2	77.8
1000	80	+ 0	80
2000	80	+ 1.2	81.2
4,000	73	1.0	74
8,000	65	− 1.1	63.9

$$L_{eq} = 10 \log \sum 10^{38.6/10} + 10^{49.8/10} + 10^{61.9/10}$$
$$+ 10^{73.4/10} + 10^{77.8/10} + 10^{80/10} + 10^{81.2/10}$$
$$+ 10^{74/10} + 10^{63.9/10}$$

↳ 131.8×10^6

Anything below 10^6 is negligible by comparison.

$$L_{eq} = 10 \log \sum 1.5 \times 10^6 + 21.9 \times 10^6 + 60.3 \times 10^6$$
$$+ 100 \times 10^6 + 131.8 \times 10^6 + 25.1 \times 10^6 + 2.5 \times 10^6$$
$$= 10 \log (343.1 \times 10^6)$$
$$= 85.4 \text{ dBA}$$

10-14.

Time h	dBA		
0000 - 0600	42	6 hr.	0.25
0600 - 0800	45	2	0.0833̇
0800 - 0900	50	1	0.0412
0900 - 1500	47	6	0.25
1500 - 1700	50	2	0.0833̇
1700 - 1800	47	1	0.0412
1800 - 0000	45	6	0.25
	Total.	24 hr.	fraction of time

$$L_{eq} = 10 \log \sum_{i=1}^{N} 10^{(L_i/10)} t_i$$

$$= 10 \log \sum (10^{42/10})(0.25) + (10^{45/10})(0.0833\dot{3}) + (10^{50/10})(0.0412)$$

$$+ (10^{47/10})(0.25) + (10^{50/10})(0.0833\dot{3})$$

$$+ (10^{47/10})(0.0412) + (10^{45/10})(0.25)$$

$$= 10 \log \sum 3962 + 2{,}635 + 4120 + 12{,}530 + 8{,}333$$

$$+ 2065 + 7906$$

$$= 10 \log (41{,}551)$$

$$L_{eq} = 46.2 \text{ dB.}$$

10-16.

Time	dBA	time (s)	dBA +10 for night	$(10^{Li/10})t$
0000 - 0500	52	18000	62	2.85×10^{10}
0500 - 0700	78	7200	88	4.54×10^{12}
0700 - 1130	90	16,200	90	1.62×10^{13}
1130 - 1200	70	1800	70	1.80×10^{10}
1200 - 1530	90	12,600	90	1.26×10^{13}
1530 - 1800	52	9000	52	0.14×10^{10}
1800 - 2200	60	14,400	60	1.44×10^{10}
2200 - 0000	52	7200	62	1.14×10^{10}
		86,400		$3,341 \times 10^{10}$

$3600 \frac{s}{hr.} \times 24 = 86400 \frac{s}{day}$

log = 13.52

×10 135.2

− 49.4 85.8

or 86 dBA