BS301 AcoustiBS301 Acoustics - Week 6-10-10

what reverberant sound is heard as an echo for speech?
anything over 40ms

what is the nominal sight height above any obstructions?
~90mm

raytracing angles
angle of incidence = angle of reflection

name some measures to prevent reverberant echos
1.use non-parallel walls 2.use absorbant rear wall 3.no aisle walkway along longitudinal axis 4.floor area & volume kept to a minimum

when do echos occur for speech/music
40ms for speech
100ms for music

why shouldn't use concave ceilings
creates uneven acoustic focus

define flutter echo
RAPID SMALL ECHOES following a short sound
beware of PARALLEL WALLS

avoid spaces with...
the depth exceeds twice the height - to prevent sound shadows

design rule of thumb for plant rooms
1. 5-20% of total floor area served by plant room
2.min 11m dimension on one wall

regardless of plant room size
3.1% of floor area served for cross-section of both supply & return ducts
4.boundary walls, floors, ceilings Rw50

supply and return air should not exceed...
37dB

where should silencers be positioned
as close to the fan as possible

where are 4 places that noise can be generated within ducts
1.obstructions
2.sharp bends
3. sudden enlargements or contractions
4.silencers

cross talk occurs when
two rooms are linked by common ductwork, a redesign of ductwork may be necessary

acoustic boot
an air diverter, diverts air through insulation

noise from AC can come from 2 sources
1.plant room - motors, compressors, AHUs 2.duct borne - fan noise, airflow noise

what is a true scale of loudness
SONE

one sone = _____ phons
40 phons

an articulation index of 0.00 - 0.05 would be
confidential

an articulation index of 0.50 - 1.00 would be
nil

a normal articulation index is
0.05 - 0.20

effective barriers require what surface density and cannot have...
10-20kg/m2
any gaps or holes

a barriers attentuation depends on its
PATH LENGTH DIFFERENCE

four scales of community noise measurement
Leq - equivalent continuous sound level
Ldn - day-night average sound level (weighted Leq, +10db)
Lax - single event noise exposure, eg Leq of 1 second
Lx - noise level exceeded x% of time

how long can you be exposed to 130dB
1 sec

how long can you be exposed to 100dB
15min

how long can you be exposed to 85dB
8hours

with every doubling of exposure (3db) what happens to the allowable daily exposure time
it halves

according to SABINE what is a perfect reflector
0

according to SABINE, what is a perfect absorber
1

if a sabine number is bigger it is a better...
ABSORBER

absorption of a surface is calculated by...
surface area (S) x absorption coefficient (∝)

sabine formula assumes that the sound in enclosure is...
reasonable reverberant
diffuse, sound has uniform directivity

when did sabine do his research
1895-98 at Harvard

sound reflectors are dependant on
size

reasonable minimum dimension for sound reflector
3 x wavelength

sound absorbers are dependant on...
1. porosity
2. flow resistance
3. structure factor
4. mounting condition

what is the EYRING formula for
reasonably DIFFUSE sound fields
DEAD rooms

what is the FITZROY SABINE formula for
NON-UNIFORM absorption
relatively REVERBERANT rooms

what is the FITZROY EYRING formula for
NON-UNIFORM absorption
DEAD rooms

what is the ARAU-PUCHADES formula for
NON-UNIFORM distribution of absorption

to work out the resonant frequency of a PANEL ABSORBER what formula
resonant freq = 6000/√m.d
m=mass of panel (kg/m2)
d=distance between panel & wall (m)

if a change in resonant frequency is required for a PANEL ABSORBER, what can be done
change mounting system, make tighter, less vibration

when calc traffic noise, what do you need to figure out BASE RATE
1.base rate
2.speed of traffic & heavy/light
3.correction for gradient
4.correction for surface

when calc traffic noise, what to you need for UNOBSTRUCTED
1.base rate
2.correction for surface (grass)
3.correction for angle

when calc traffic noise, what to you need for OBSTRUCTED
1.base rate
2.correction for surface (hard)
3.correction for angle
4.correction for barrier

d' is what and when is it needed
it the the DIRECT DISTANCE from OBSERVER TO ROAD
height of receiver²+distance to road² = √d'
it is need when using the correction over SOFT GROUND

how man y m/sec does sound progapate
~344m/sec

how man ydB increase is needed for a sound to become significantly lounder
8dB

a sound which has only ONE FREQUENCY is known as a
PURE TONE

with sound propagation in air, when the
DISTANCE DOUBLES
the AMPLITUDE DROPS BY HALF - 6dB

formula for RESONATOR ABSORBERS
resonator freq = $c/(2 \times \pi) \times \sqrt{s/(l \times V)}$
where
c = speed of sound (m/s)
s = cross secitonal neck area (m^2)
l = length of neck (m)
V = volume of cavity (m^3)

when is an ideal use for RESONATOR ABSORBERS
where there is a LONG REVERBERATION in a SINGLE FREQUENCY

RESONATOR ABSORBERS are most efficient at
LOW FREQUENCIES

PERFORATED PANEL ABSORBERS are different than HELMHOLTZ RESONATORS because
they are not as selectively absorbant

define PERFORATED PANEL ABSORBERS
a PUNCHED PANEL w an ENCLOSED AIR SPACE between the panel and the wall

what is dependant on a SOUND REFLECTORS size
they have a LOW FREQUENCY CUT OFF dependant on their size, below which they act as DIFFUSES

name types of SOUND ABSORBERS
1.porous
2.PANEL ABSORBERS (thin membrane)
3.fissured ceiling tile on solid backing
4.RESONATOR ABSORBERS (helmholtz)
5.PERFORATED PANEL ABSORBERS

NOISE WITHIN AN ENCLOSURE
SPL = SWL + $(10\log_{10}[(Q\text{ø}/4\pi r^2)+4/Rc])$
where
r = distance from the source (m)
Qø = directivity of source in direction r
S = surface area of room (m^2)
Rc = room constant = Rc = Sa/(1-a)

when you put a sound source close to ONE REFLECTING SURFACE, how much dB increase
+3dB

when you put a sound source close to TWO reflecting surfaces, how much dB increase
+6dB

when you put a sound source close to THREE reflecting surfaces, (trihedral corner) how much dB increase
+9dB

how much attenuation is there for each DOUBLING of the distance from the source up to 2m for OPEN PLAN offices
6dB
$-20\log_{10}(r)$

how much attenuation is there between 2-6m distance for OPEN PLAN offices
3dB
$-10\log_{10}(r)$

how much attenuation is there AFTER 6m distance for OPEN PLAN offices
6dB per DOUBLING OF DISTANCE
$-20\log_{10}(r)$

UNIDIRECTIONAL SPHERICAL SOURCE has whatdB attenuation at the end
-11dB

UNIDIRECTIONAL HEMISPHERICAL SOURCE has whatdB attenuation at the end
-8dB

sound waves at GROUND LEVEL travel
SLOWER

SPEED of SOUND _____ with temperature
INCREASES

In DAYTIME - HIGH temperature at ground level so
sound travels FASTER at ground level, SLOWER HIGH UP

in NIGHT - LOW temp at ground level so
sound travels LOWER at ground level, FASTER high up

the ARTICULATION INDEX is a measure of 0-1. What is 0 and what is 1
0 - CONFIDENTIAL, can hardly hear conversation
1 - NO PRIVACY, can hear everything

SPEECH PRIVACY depends on 3 things
1.SPEECH LEVEL of the SOURCE
2.NOISE REDUCTION achieved between source-receiver locations
3.BACKGROUND noise level at the receiver location

there are two methods to ascertain
ARTICULATION INDEX
1.with people
2.with computers

community noise can be assessed by
TWO METHODS
1.sound level assessment
2.a police officer