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CONFIDENTIAL

SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION
JULY 2010 SESSION

SUBJECT CODE	:	FCD 20402
SUBJECT TITLE	:	ACOUSTIC AND VIBRATION
LEVEL	:	DIPLOMA
TIME / DURATION	:	3.00pm – 5.00 pm (2 HOURS)
DATE	:	12 NOVEMBER 2010

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. Please write your answers on the answer booklet provided.
4. Answer should be written in blue or black ink except for sketching, graphic and illustration.
5. This question paper consists of TWO (2) sections. Section A and B. Answer all questions in Section A. For Section B, answer two (2) question only.
6. Answer all questions in English.
7. Fomula is appended.

THERE ARE 6 PAGES OF QUESTIONS AND 4 PAGES OF APPENDIX, EXCLUDING THIS PAGE.

SECTION A (Total: 60 marks)

INSTRUCTION: Answer ALL questions.
Please use the answer booklet provided.

Question 1

a) What is the airborne sound?

(6 marks)

b) What is the direct airborne sound?

(7 marks)

c) What is the structure – borne sound?

(7 marks)

Question 2

a) What is "Speed and Wavelength"?

(4 marks)

b) What are the general characteristics of sound?

(8 marks)

c) A compressor is radiating a pure tone of 1000Hz.
What is the wavelength of 1000 Hz?
If speed of sound is 1125ft/s and 343 m/s.

(8 marks)

Question 3

a) What is "sound Power "?

(2 marks)

b) What is "sound pressure"?

(2 marks)

c) Referring to figure Q3, determine the value of radius (r_1) when Sound pressure level (L_p) is 60dB and sound power level (L_w) at the source for free field condition

(16 marks)

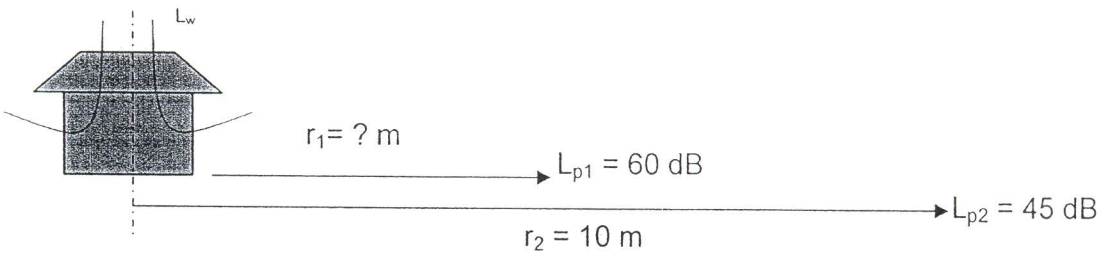


Figure Q3: Sound pressure distance

SECTION B (Total: 40 marks)

INSTRUCTION: Answer only TWO questions.
Please use the answer booklet provided.

Question 4

Refer to figure Q4,

Calculate the Sound Pressure Level (Lp) radiating from an Air Conditioning unit received by a worker at the distance of 4m from the Air Conditioner. The Air Conditioner is installed at the top corner of the room. The Air Conditioner manufacture specification of the Sound power level (L_w) = 90 dB. The background noise of the room is 80dB.

<Note>

The room is constructed by concrete wall, ceiling and floor absorption coefficient of

$\alpha_{wall/ceiling}=0.1$

$\alpha_{floor}=0.2$

Calculate:

a) Total absorption area

(4 marks)

b) Average absorption coefficient

(4 marks)

c) Room constant

(4 marks)

d) Reverberation time

(4 marks)

e) Total Lp

(4 marks)

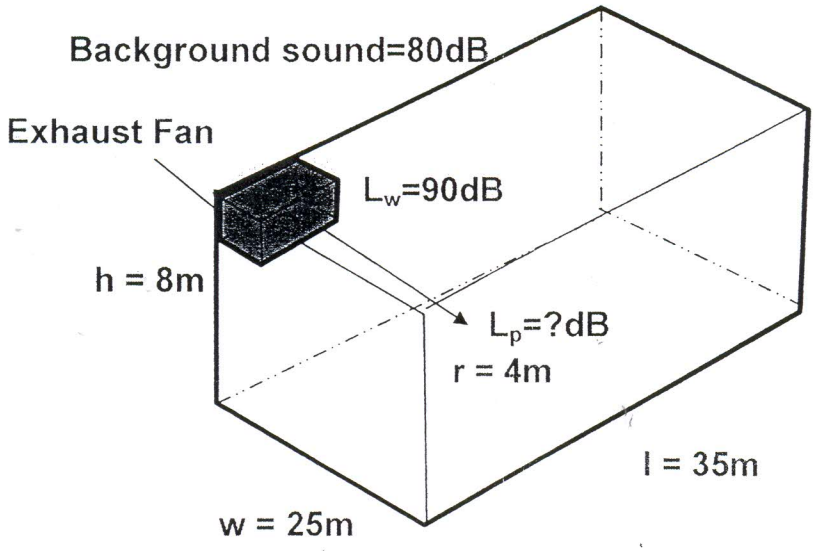


Figure Q4: Indoor unit location

Question 5

A 20kg block moves vertically as shown. The block is pulled 30mm downward from its equilibrium position and released. For each (A) and (B), determine:

a) the Natural Frequency

(10 marks)

b) The Force (F) to pull it down

(10 marks)

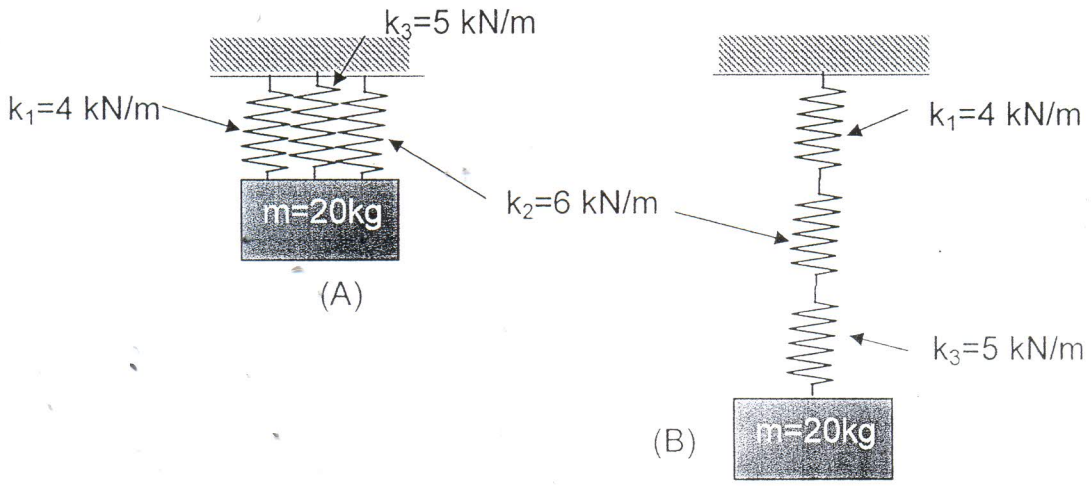


Figure Q5: Spring arrangement

Question 6

Refer to Figure Q6:

AHU Fan motor c/w specification: 240V – 1 – 50Hz

: η_{motor} = 90%

: 4 poles

: Wight of Fan = 20kg

: Weight of Motor = 40kg

: Weight of Frame (plinth) = 15kg

: safety factor = 20% (for the final weight)

Calculate α_{st} of the spring A and select the closest suitable spring for corner A.

Model of spring to selection at appendix of Spring selection.

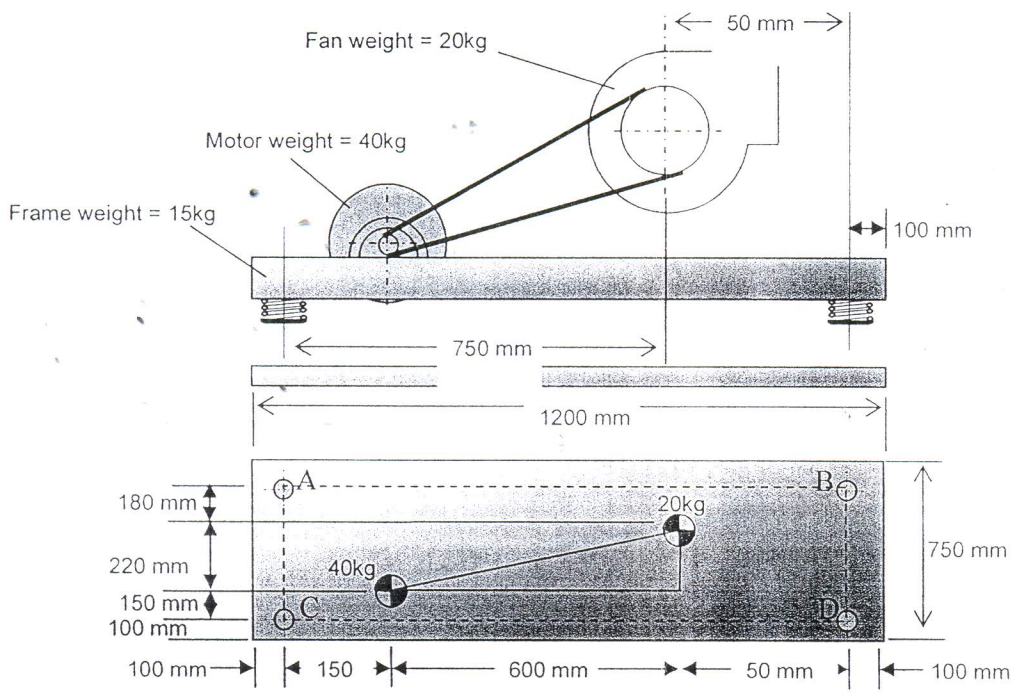
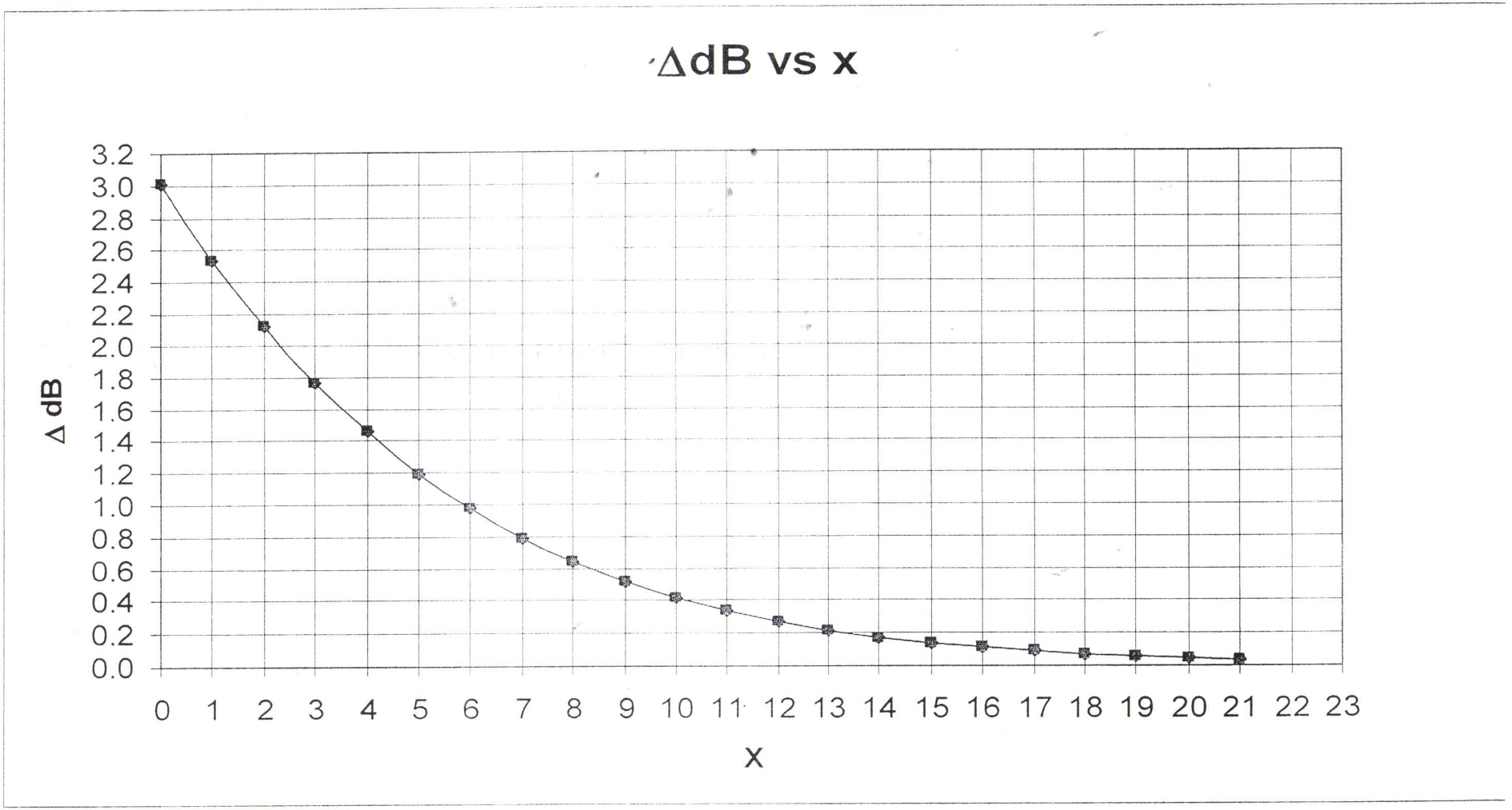


Figure Q6: Location of Fan at AHU unit.

END OF QUESTION

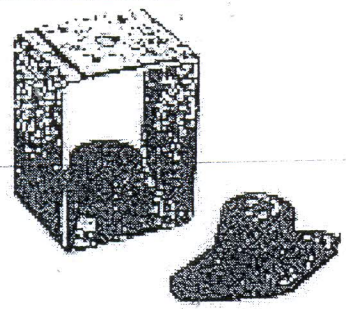
Appendix Technical Document



Appendix of spring selection

Manufacturer Data

VIBRATION ISOLATORS
RUBBER-IN-SHEAR



FEATURES

These mounts provide effective isolation of noise and vibration from equipment speeds of 15 rps (900 rpm) upwards.

Types R and RD only

- ❑ threaded insert in the top for equipment fastening.
- ❑ rated static deflection from 5-12mm.
- ❑ non-skid ribbed base; bolting-down not normally required.
- ❑ moulded in oil-resistant materials, colour-coded for easy identification of the load range.
- ❑ corrosion-proof elements: metal parts embedded in the elastomer.

Types RH and RHD only

- ❑ rated static deflection from 5-12mm.
- ❑ moulded in oil-resistant materials
- ❑ colour-coded for easy identification of the load range.
- ❑ corrosion-proof element: metal parts embedded in the elastomer
- ❑ heavy-duty steel cage.
- ❑ if mechanical or fire damage occurs, the metal plates in the hanger element interlock so that complete loss of support is unlikely.
- ❑ fully weatherproofed.

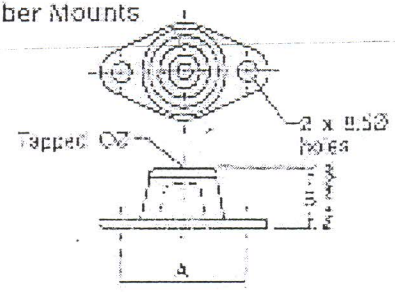
If features or ratings are required beyond that shown, please contact Fantech.

HOW TO ORDER

When selecting vibration isolators, divide the weight of the unit being isolated by the number of mounts being used to determine the kg/mount required. Then select the mount with the next highest weight loading and deflection required. Vibration isolators are generally used in sets of four.

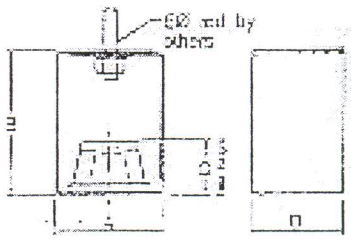
DIMENSIONS & SELECTION TABLES

Rubber Mounts



Model No.	Colour	Max. Load kg/mt	Static Defl. mm	Dimensions, mm A	B	ØZ
Single deflection						
R-1	Blue	15	5	60	28	M8
	Black	25	5			
	Red	40	5			
R-2	Blue	60	6	76	32	M10
	Black	75	6			
Double deflection						
RD-1	Blue	15	10	60	36	M8
	Black	25	10			
	Red	40	10			
RD-2	Blue	60	12	76	44	M10
	Black	75	12			

Hanger Mounts



Model No.	Colour	Max. Load kg	Static Defl. mm	Dimensions, mm A	B	C	D	ØZ
Single deflection								
RH-1	Blue	15	5	60	75	31	50	10
	Black	25	5					
	Red	40	5					
RH-2	Black	75	6	75	100	41	65	10
Double deflection								
RHD-1	Blue	15	10	60	75	36	50	10
	Black	25	10					
	Red	40	10					
RHD-2	Black	75	12	75	100	64	55	15

Formula:

- *Log (ab) = log a + log b*
- *Log (a/b) = log a – log b*
- *Log a^b = b log a*
- *Log_a a = 1*
- *Log_a 1 = 0*
- *Log_a b = $\frac{log_c\, b}{log_c a}$*

ACOUSTICS:

- $\lambda = \frac{v}{f}$ where λ= wavelength, *v*= speed (m/s); *f*=frequency (Hz)
- $v = \sqrt{\gamma RT}$

  Where $R = \frac{\overline{R}}{M}$, M= Molar Mass; $\overline{R}$ = Universal Gas constant (8.314 kJ/kmol.K)

- For Air : $v = \sqrt{\gamma RT} \approx 20.04\sqrt{T}$ where T in Kelvin
- T(K) = 273 + □C
- $L_w = 10\log\left(\frac{W}{W_{ref}}\right)$ where W_{ref} = 10^{-12} watt
- $L_p = 20\log\left(\frac{P}{P_{ref}}\right)$ where P_{ref} = 20 □Pa
- $L_I = 10\log\left(\frac{I}{I_{ref}}\right)$ where I_{ref} = 10^{-12} watt/m^2
- $L_{TOTAL} = 10\log\left[\sum_{i=1}^{n} 10^{\frac{L_i}{10}}\right]$
- $L_{P1} - L_{p2} = 20Log\left(\frac{r_2}{r_1}\right)$
- <u>Free Field :</u> $L_p = L_w + 10\log\left(\frac{Q}{4\pi r^2}\right)$ where Q=Directivity (1,2,4,8)
- <u>Closed Room :</u> $L_p = L_w + 10\log\left(\frac{Q}{4\pi r^2} + \frac{4}{R}\right)$

where R =Room constant; $R = \frac{S - \alpha}{(1 - S\bar{\alpha})}$; absorption coeff. $\alpha_{abs} = \frac{I_{abs}}{I_{inc}}$;

- S= $S_1+S_2+S_3+....+S_n$, $\bar{\alpha} = \frac{S_1\alpha_1 + S_2\alpha_2 + ...+ S_n\alpha_n}{S}$
- Reverberation time in sec $T_{60} = \frac{0.16V}{A}$, where V= Room volume,

  Total absoption area (TSA) $A = \sum S_i\alpha_i$