Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION

SEMESTER II

SESSION 2016/2017

COURSE NAME	:	AIR CONDITIONING SYSTEM DESIGN
COURSE CODE	:	BDE40103
PROGRAMME	:	BDD
EXAMINATION DATE	:	JUNE 2017
DURATION	:	3 HOURS
INSTRUCTION	:	**PART A**: ANSWER **FOUR (4)** QUESTIONS **ONLY** FROM **FIVE (5)** QUESTIONS. **PART B**: ANSWER **ALL** QUESTIONS.

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

PART A

Q1 (a) Second law of thermodynamics explains that energy has quality as well as quantity and energy move with the direction. Co-efficient of Performance (COP) for air conditioning system also must comply with the definition of this law. Please explain Kelvin-Planck Statement for 2nd Law of Thermodynamic and Clausius Statement for 2nd law of thermodynamic in the air conditioning process (show in figure in your explanations).

(8 marks)

(b) Split air conditioning unit, window air conditioning unit and centralize air condition system are the example of air conditioning system. All of these systems have the basic working principles. Show in the diagram the basic air conditioning systems with the explanations about temperature, pressure and phase of working fluid.

(12 marks)

Q2 (a) Industry Code of Practice on Air Indoor Air Quality 2010 is one of the references in Malaysia to design air conditioning systems. There are three (3) specific physical parameters need to be comply. Explain three (3) specific physical parameters.

(8 marks)

(b) Thermal comfort is that condition of mind which expresses satisfaction with the thermal environment. Because there are large variations, both physiologically and psychologically, from person to person, it is difficult to satisfy everyone in a space. The environmental conditions required for comfort are not the same for everyone. However, extensive laboratory and field data has been collected that provide the necessary statistical data to define conditions that a specified percentage of occupants will find thermally comfortable. Please state six (6) primary factors that must be addressed when defining conditions for thermal comfort and explain detail

(12 marks)

Q3 (a) Explain the Psychometrics and Coil process line?

(4 marks)

(b) What are the difference between sensible heat changes and latent heat changes?

(4 marks)

(c) A cooling coil handles 26,000 CFM (ft^3/min) of air entering at 89 F dry bulb (DB) and 75 F wet bulb (WB). The air leaves the coil at 59 F dry bulb (DB) and 55 F wet bulb (WB), using **Figure Q3 (c)** determine the coil capacity (total heat content).

(12 Marks)

Q4 (a) Explain, the following terms for Cooling Load calculation and equations:

i. conduction through exterior structure
ii. corrected value of cooling load temperature different
iii. conduction through interior structure
iv. solar radiation through glass
v. lighting and people (10 marks)

(b) Determine the cooling load for each problems:

i. a room has ten 50 W fluorescent lighting fixtures in use. The cooling system operates only during occupied hours. What is the solar cooling load from lighting, if ballast factor is 1.25 and cooling load factor for lighting is 1?

(2.5 marks)

ii. what is the cooling load (heat gain) from 500 people at balling alley if sensible heat is 580 BTU/hr, latent heat is 870 BTU/hr and cooling load factor is 1?

(2.5 marks)

iii. a 50 ft. by 60 ft. roof of a building in Johor Bahru is constructed of 4 in. heavy weight concrete with 1 in. insulation and a suspended ceiling. The inside temperature is 76 F. Find the roof cooling load in BTU/hr, if cooling load temperature different for roof is 29 F, correction for latitude and month is 1 F, outside design dry bulb temperature is 95 F, daily temperature design range is 18 F, overall heat transfer coefficient for roof is 0.128 BTU/(hr-ft2-F).

(5 marks)

Q5 (a) Using **Figure Q5 (a)**, show that the equation for pressure added by pump or fan (Hp) as knowing the flow energy equation:

$$H_p = (H_{s2} - H_{s1}) + \frac{(V_2^2 - V_1^2)}{2g} + (H_{e2} - H_{e1}) + H_f$$

(10 marks)

(b) The piping system shown in **Figure Q5 (b)** is to deliver water from the basement to the roof storage tank, x ft. above in ABC apartments. The friction loss in the piping, valves and fitting is 14 ft. The water enters the pump at the gauge pressure of 15 ft., and is delivered at atmospheric pressure (all values are gauge pressure). The velocity at the pump suction is 4 ft/sec and at the piping exits 20 ft/sec and pump pressure is 200 ft. w g. Determine the value of x.

(5 marks)

(c) The pressure loss in straight lengths of duct, there is a pressure loss when the air flows through duct fitting such as elbows, tees, reducers etc. It is also called the loss coefficient method. Find the pressure lost (H_f) in **Figure Q5 (c)** is handling 10,000 CFM. Using **Table Q5(c)** to find a loss coefficient.

(5 marks)

PART B

Q6 (a) Explain the typical Paths of Noise and Vibration Propagation in heating ventilation air conditioning (HVAC) systems as below:

i. structure-borne path through floor.
ii. airborne path through supply air system.
iii. duct breakout from supply air duct.
iv. airborne path through return run air system
v. airborne path through mechanical equipment room wall.

(10 marks)

(b) ABC apartment have chiller and fan with cooling capacity 150 ton and 30 horsepower (hp) fan separately are installed outdoors .Distance chiller and fan to apartment is 35 meter (m) and 25 m. The noise from both equipment's are affected to residential apartment. The Correction for Acoustic Reflection is 6(dB (A)), Summed noise level is 2(dB (A)) and Acceptable Noise Levels (ANL) is 60 (dB (A)). Estimate for Sound Pressure Level (SPL) at the residential flat contributed by the two equipment.

The statement below is a noise data of chiller and fan:

i. chiller

- Cooling capacity 150 ton the Sound pressure level (SWL) is 103 (dB (A)).
- Distance Attenuation at 30 m is 39 (dB (A)).

ii. fan

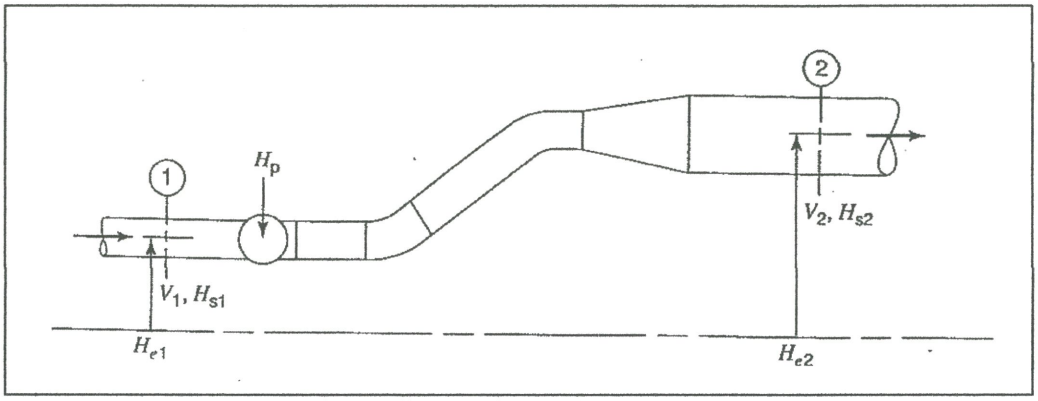
- Horsepower of fan is 30 hp with the Sound pressure level (SWL) is 101 (dB (A)).
- Distance Attenuation at 30 m is 36 (dB (A)).

END OF QUESTION

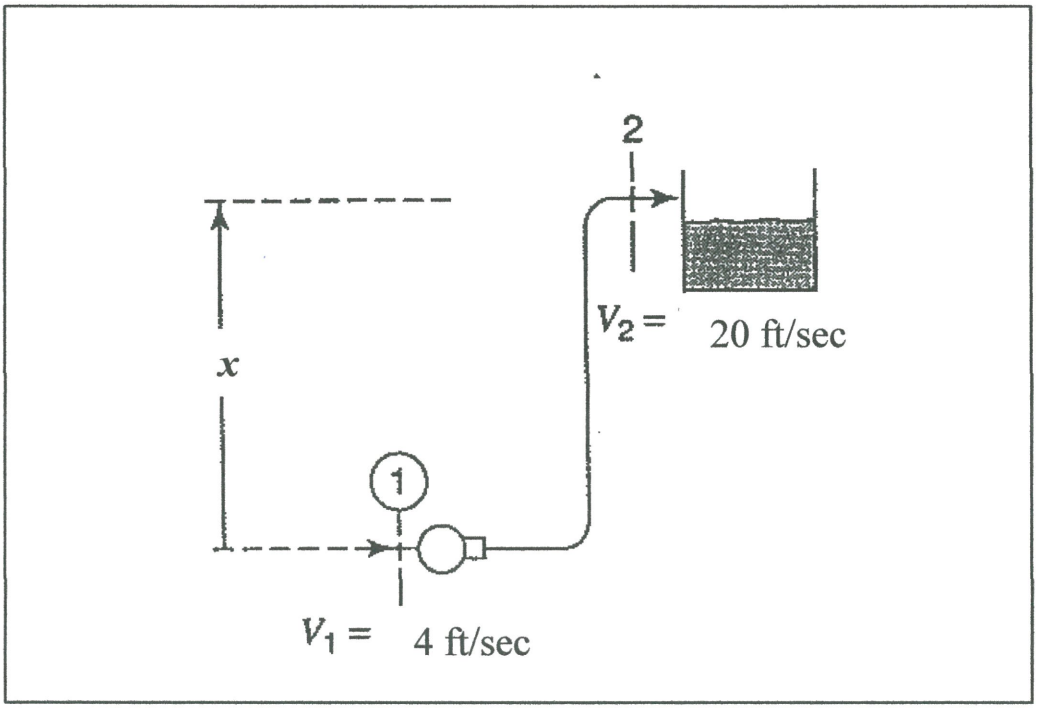
FINAL EXAMINATION

SEMESTER / SESSION : SEM 2 / 2016-2017 PROGRAMME : 4 BDD

COURSE : AIR CONDITIONING SYSTEM DESIGN COURSE CODE : BDE40103



FIGURES Q5 (a): A duct or piping system

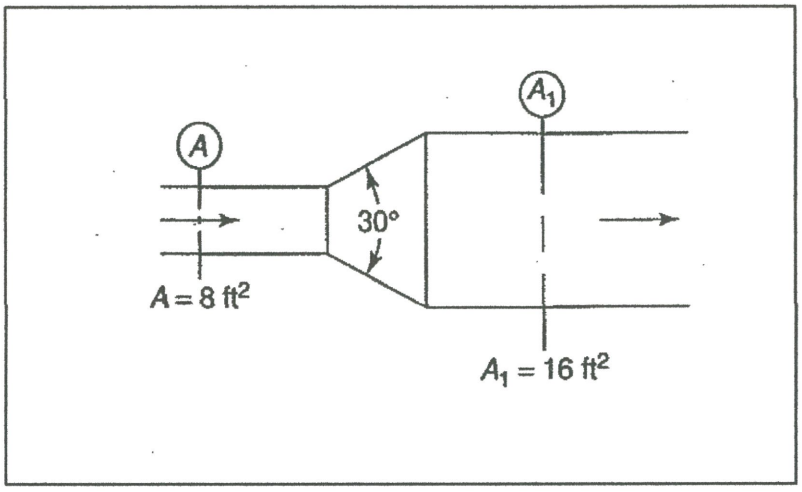


FIGURES Q5 (b): Pump system

FINAL EXAMINATION

SEMESTER / SESSION : SEM 2 / 2016-2017 PROGRAMME : 4 BDD

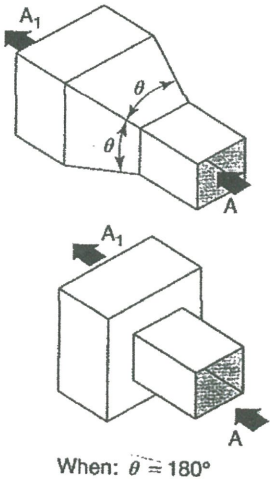
COURSE : AIR CONDITIONING SYSTEM DESIGN COURSE CODE : BDE40103



FIGURES Q5 (c): Air flow in the ducting

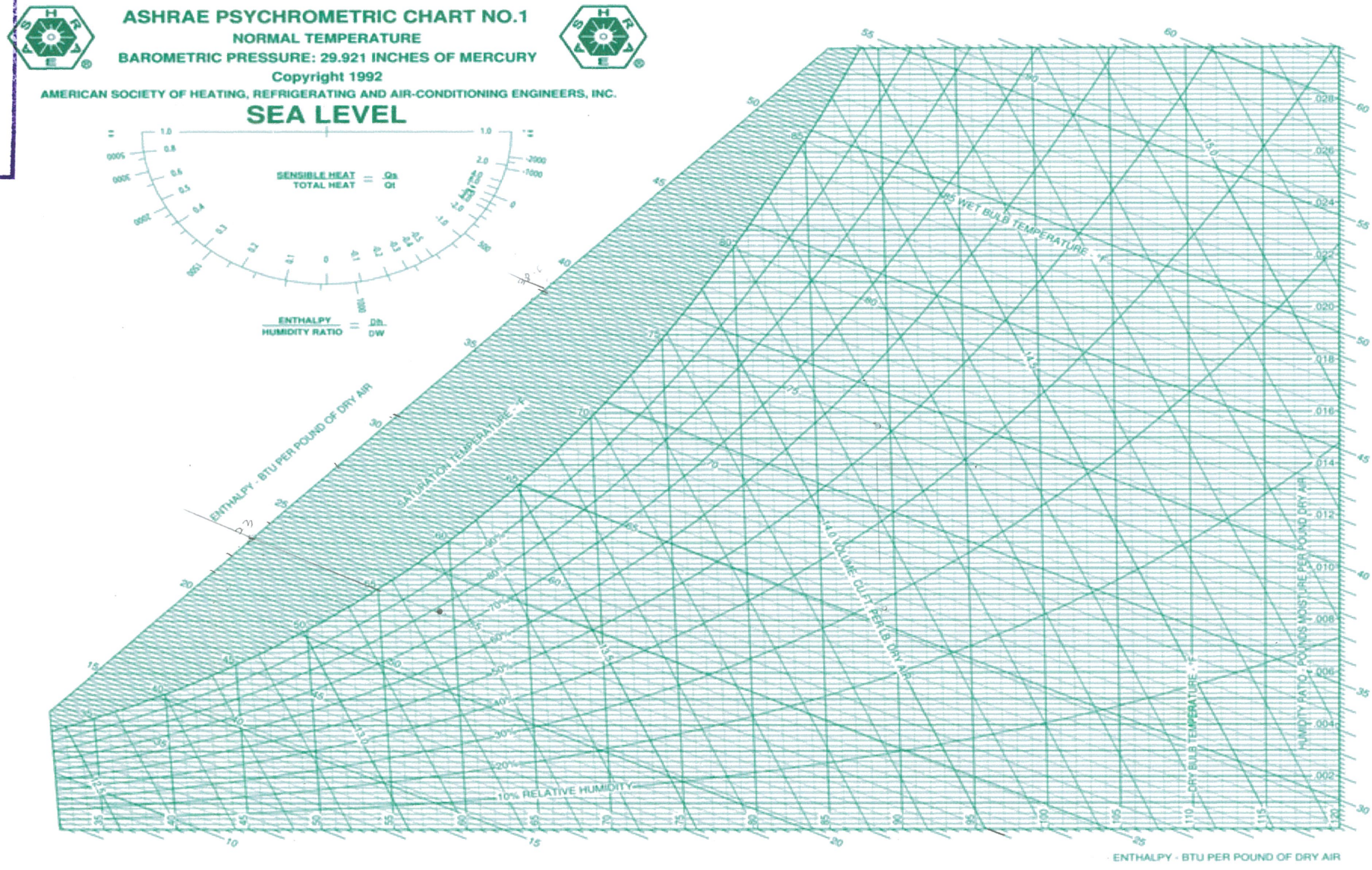
TABLE Q5 (c): Loss coefficient, transition for ducting

B. Transition, Rectangular, Pyramidal



A_1/A	Coefficient C (See Note 1) θ							
	16°	20°	30°	45°	60°	90°	120°	180°
2	0.18	0.22	0.25	0.29	0.31	0.32	0.33	0.30
4	0.36	0.43	0.50	0.56	0.61	0.63	0.63	0.63
6	0.42	0.47	0.58	0.68	0.72	0.76	0.76	0.75
≥10	0.42	0.49	0.59	0.70	0.80	0.87	0.85	0.86

Note: A = Area (Entering airstream), A_1 = Area (Leaving airstream)


ASHRAE PSYCHROMETRIC CHART NO.1
NORMAL TEMPERATURE
BAROMETRIC PRESSURE: 29.921 INCHES OF MERCURY
Copyright 1992
AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS, INC.
SEA LEVEL
SENSIBLE HEAT / TOTAL HEAT = Qs / Qt
ENTHALPY / HUMIDITY RATIO = Dh / Dw
ENTHALPY - BTU PER POUND OF DRY AIR
SATURATION TEMPERATURE - °F
WET BULB TEMPERATURE - °F
VOLUME CU FT PER LB DRY AIR
10% RELATIVE HUMIDITY
DRY BULB TEMPERATURE - °F
HUMIDITY RATIO - POUNDS MOISTURE PER POUND DRY AIR
ENTHALPY - BTU PER POUND OF DRY AIR