

## CMGT 235 – Electrical and Mechanical Systems

Department of Construction Management ☻ California State University, Chico

Exam #1 [100 points]

**You may work together as a group or individually.**

**Every student SHALL complete their own answer sheet. Use your own paper.**

**Keep all answers in the same numerical order as the exam.**

Name: \_\_\_\_\_

- 15 pts 1. How much energy must be removed to turn a two-gallon jug filled with water from a faucet that is at 50°F into ice at -15°F?
- 10 pts 2. How much heat is required to heat a 1 ft<sup>3</sup> block of aluminum from 50°F to 105°F?  
For the same amount of heat energy and temperature conditions what volume (ft<sup>3</sup>) of steel is required?
- 15 pts 3. A 3000 ft<sup>2</sup> building has an annual heating requirement of 30,000 Btu/ft<sup>2</sup>/yr. Compare the cost of heating by propane at \$2.00/gallon in an 85% efficient furnace versus heating by an 100% efficient electric furnace at \$0.06/kWh.
- 10 pts 4. A wall is constructed as follows:  
4" face brick  
1" air space  
Nominal 1" foil-faced polyisocyanurate sheathing  
2 x 4 wood studs 16" on center with R13 batt insulation  
1/2" drywall
- A. If the wall is 80% insulated area, 20% framed area, what will be the U-factor of the wall?  
B. What is the heat load for a wall 8 ft high by 200 ft long if the outside temperature is 42°F and the inside temperature is 78°F using this construction?
- 10 pts 5. An LED lamp produces 800 lumens and uses 8W. An incandescent lamp produces 800 lumens and uses 60W.
- A. Determine the BTUs per hour for each lamp.  
B. If both lamps are on for 12 hours, determine the total amount of heat produced by each lamp.
- 20 pts 6. Complete the following:
- A. What size (kw) electric heater is required to heat a space from 60°F DB to 80°F DB, assuming the electric heater has a 1000 CFM blower?  
B. If the initial RH is 60%, use a psychrometric chart to determine the final RH.  
C. What is the change in enthalpy ( $\Delta$  enthalpy, Btu)?  
D. Using the formula, Heat Load = 4.45 x CFM x ( $\Delta$  enthalpy, Btu), calculate the heat load and compare your result to the solution in A.
- 10 pts 7. Estimate infiltration and ventilation air quantities for a 2900 sq. ft. movie theater. The conditioned space has an average height of 20 feet, and the theater seats 200 people. The ACH = 8.0. The required ventilation per person is 20 CFM. Inside temperature is 72°F outside temperature is 48°F.
- 10 pts 8. For a 3.5-ton 8" air conditioner supply duct use the Residential Duct Sizing Chart (attached) to determine:
- A. The rectangular duct height size (inches) required  
B. The equivalent round duct size (inches) required

### Residential Duct Sizing Chart

Air Volume CFM	Rectangular Duct Height (inches)					Equivalent Round Duct (inches)	Air Volume CFM
	4"	6"	8"	10"	12"		
50	6 x 4					5	50
75	6 x 4					6	75
100	8 x 4	6 x 6				6	100
125	10 x 4	6 x 6				7	125
150	10 x 4	8 x 6				7	150
175	12 x 4	8 x 6				8	175
200	14 x 4	8 x 6				8	200
225	16 x 4	10 x 6				8	225
250	16 x 4	10 x 6				9	250
275		12 x 6	8 x 8			9	275
300		12 x 6	8 x 8			9	300
400		14 x 6	10 x 8			10	400
500		18 x 6	12 x 8	10 x 10		11	500
600		20 x 6	14 x 8	12 x 10		12	600
700		24 x 6	16 x 8	12 x 10		12	700
800		26 x 6	18 x 8	14 x 10	12 x 12	13	800
900		30 x 6	20 x 8	16 x 10	12 x 12	14	900
1000			22 x 8	16 x 10	14 x 12	14	1000
1100			24 x 8	18 x 10	16 x 12	15	1100
1200			26 x 8	20 x 10	16 x 12	15	1200
1300			28 x 8	20 x 10	18 x 12	16	1300
1400			30 x 8	22 x 10	18 x 12	16	1400
1500				24 x 10	20 x 12	16	1500
1600				24 x 10	20 x 12	17	1600
1700				26 x 10	22 x 12	17	1700
1800				28 x 10	22 x 12	18	1800
1900				30 x 10	22 x 12	18	1900
2000					24 x 10	18	2000