

QUESTIONNAIRE REPORT SHEET

iPQ5CEM.V1.1

iPQ.No	Correct Answer	Points	Explanation
5CEM001	2	8	Answer = 2 Refrigerators
5CEM002	1	8	Answer = 1 1
5CEM003	1	8	Answer = 1 USA
5CEM004	1	8	Answer = 1 8.1 bargauge (no more than a 10% drop)
5CEM005	4	8	Answer = 4 All of the above
5CEM006	1	8	Answer = 1 True
5CEM007	4	8	Answer = 4 All of the above
5CEM008	3	8	Answer = 3 Both
5CEM009	1	10	Answer = 1 $P_{xdxt}/(i+d) = (10000 \times 0.3 \times 0.5)/(0.1+0.3) = \$ 3750$
5CEM010	4	8	Answer = 4 All of the above
5CEM011	4	8	Answer = 4 All of the above
5CEM012	1	8	Answer = 1 True
5CEM013	4	8	Answer = 4 All of the above
5CEM014	1	8	Answer = 1 Combustion analyzer
5CEM015	1	8	Answer = 1 True
5CEM016	1	8	Answer = 1 True
5CEM017	4	8	Answer = 4 Space, copper
5CEM018	2	8	Answer = 2 Latent heat of vaporisation

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5CEM019	3	8	Answer = 3 All of the above
5CEM020	1	10	Answer = 1 Energy consumption = = 230 x 2 x 0.85 x 12 V x I x Cos ϕ x no. of hours = 4692 Watt hours or 4.692 kWh
5CEM021	1	10	Answer = 1 Power consumption = $\sqrt{3} \times V \times I \times \text{Cos } \phi$ (55 x 1000) = $\sqrt{3} \times 415 \times 80 \times \text{Cos } \phi$ Power factor (Cos ϕ) = (55 x 1000) / ($\sqrt{3} \times 415 \times 80$) = 0.96
5CEM022	3	13.92	Answer = 3 Pt/Pt-Rh thermocouple with indicator
5CEM023	1	8	Answer = 1 True
5CEM024	1	8	Answer = 1 Slightly inclined towards the roof
5CEM025	2	8	Answer = 2 Clinker formation
5CEM026	1	8	Answer = 1 True
5CEM027	4	8	Answer = 4 All of the above
5CEM028	4	8	Answer = 4 All of the above
5CEM029	4	8	Answer = 4 All of the above
5CEM030	3	8	Answer = 3 Conducting a power quality and harmonics analysis
5CEM031	1	10	Answer = 1 $I = 120 / (\sqrt{3} \times 0.4 \times 0.88) = 196.82$ amps
5CEM032	1	10	Answer = 1 $EUI = [(10,000 \text{ GJ/yr})(1,000 \text{ MJ/GJ}) + (2,200,000 \text{ kWh/yr})(3600 \text{ kJ/kWh})(\text{MJ}/1000 \text{ kJ})] / (10,000 \text{ m}^2) = 1,792 \text{ MJ/m}^2\text{-yr}$
5CEM033	2	13.92	Answer = 2 (UA)(HDD)(24 h/day)(1/COP) = Fuel savings(fuel unit cost) (1.36-0.556 W/m ² -°C) (1500 °C-day/yr) Save/Area(24 h/day) (1/3.5) (\$0.10 /kWh) (kWh/1000 W) = \$0.827/m ² -yr

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5CEM034	4	10	<p>Answer = 4</p> <p>Fuel = (Energy)/(eff) = (m Δh)/(eff)</p> <p>From Steam Tables</p> <p>Enthalpy (0.20 MPa, saturated liquid) h1 = 504.7 kJ/kg</p> <p>Enthalpy (10°C liquid) h2 = 42.02 kJ/kg</p> <p>Fuel = (100 kg/h)(504.7 – 42.02 kJ/kg)/(0.80) = 57,835 kJ/h</p>
5CEM035	1	8	<p>Answer = 1</p> <p>Heat pipe</p>
5CEM036	3	8	<p>Answer = 3</p> <p>Code</p>
5CEM037	1	8	<p>Answer = 1</p> <p>Raises the temperature of the water leaving the chiller</p>
5CEM038	3	8	<p>Answer = 3</p> <p>Differential</p>
5CEM039	2	8	<p>Answer = 2</p> <p>Continuously operate the chiller at a flat load</p>
5CEM040	1	13.92	<p>Answer = 1</p> <p>Heat cost = (power reduced)(operating hours/yr)(1/eff)(fuel unit cost)</p> <p>Heat cost = [(196 units)(285 W/unit) – (140 units)(185 W/unit)](1 kW/1000 W)(150 days/yr)(24 h/day)(1/0.80)(\$10.00 /GJ)(3600 kJ/kWh)(1GJ/1,000,000 kJ) = \$4,854 /yr</p>
5CEM041	3	10	<p>Answer = 3</p> <p>No. 6 Fuel Oil</p> <p>(see combustion efficiency charts for a given excess air and STR)</p> <p>Fuel oil #6 has the highest carbon to hydrogen ratio, so less water is lost from water vapor up the stack</p>
5CEM042	4	8	<p>Answer = 4</p> <p>Recover pressurised condensate and return it to the boiler in an insulated condensate return system.</p>
5CEM043	2	8	<p>Answer = 2</p> <p>Storage space requirements have been significantly reduced</p>
5CEM044	1	8	<p>Answer = 1</p> <p>Chilled water</p>
5CEM045	3	8	<p>Answer = 3</p> <p>Metal pipe</p>
5CEM046	1	10	<p>Answer = 1</p> <p>Energy = (hv, 8 MPa) – (hf, 50°C) (m) = [(2758.7) – (209.34)kJ/kg] (1000 kg/h) = 2,550 MJ/h</p>
5CEM047	1	10	<p>Answer = 1</p> <p>Heat Recovered = (75 kW)(0.90)(3600 kJ/kW-h) = 243,000 kJ/h or 243 MJ/h.</p>

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5CEM048	3	8	Answer = 3 Senses outdoor and indoor temperatures to determine the latest start time needed to heat or cool down a building to desired temperatures
5CEM049	4	8	Answer = 4 All of the above
5CEM050	2	10	Answer = 2 Best group relamping interval is ~70% of rated life for fluorescent lamps Interval = $(0.70)(15,000 \text{ h}) / (4,160 \text{ h/yr}) = 2.5 \text{ yr}$
5CEM051	1	10	Answer = 1 $A = P(A/P \text{ I, n}) = (\$100,000)(0.1295) = \$12,950 \text{ /yr}$
5CEM052	1	13.92	Answer = 1 Save = $(m \text{ Cp } \Delta T)(1/\text{eff})(\text{fuel unit cost}) = (450,000 \text{ liter/yr})(4.2 \text{ kJ/kg-}^\circ\text{C})(60 - 20^\circ\text{C})(1 \text{ kg/liter})(1/0.80)(\$10.00 \text{ /GJ})(1,000,000 \text{ kJ/GJ})$ = \$945 /yr $P = A(P/a \text{ I,n}) = (\$945)(6.8137) = \$6,439$
5CEM053	1	13.92	Answer = 1 Affinity law problem $(\text{kW1}/\text{kW2}) = (\text{Flow1}/\text{Flow2})^3$ $\text{kW2} = (\text{kW1})[(\text{Flow1}/\text{Flow2})^3] = (11 \text{ kW})[(1 - 0.3)^3] = 3.773 \text{ kW}$; must select 4-kW motor
5CEM054	1	13.92	Answer = 1 $A = P(A/P \text{ I,n})$ $(A/P \text{ I,n}) = A/P = (\$26,631) / (\$124,500) = 0.2139$ Look in tables to find the i where $(A/P \text{ i,n}) = 0.2139$, use 20% as the first guess because it is closest table to 0.2139
5CEM055	4	10	Answer = 4 The lowest wind speed at which the system can generate its rated power
5CEM056	1	8	Answer = 1 Measurement of the CO2 level in the building
5CEM057	2	8	Answer = 2 Financing information about the project

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5CEM058	1	13.92	<p>Answer = 1</p> <p>Frist find the kVAR from motor:</p> $kVA = 25 / 0.8 = 31.25$ $kVAR = \text{square root}((31.25)^2 - (25)^2) = 18.75$ <p>find new power factor after combining the two motors with incandescent lights:</p> $kW = 20 + 25 + 25 = 70$ $kVAR = 18.75 * 2 = 37.5$ $kVA = \text{square root}((45)^2 + (18.75)^2) = 79.41$ $PF = kW / kVA = 70 / 79.41 = 0.88$
5CEM059	1	13.92	<p>Answer = 1</p> $Vbz = (Rp \cdot \text{People}) + (Ra \cdot \text{Room Area})$ $2,500 = (5 \cdot \text{People}) + (0.9 \cdot 1,100)$ $2,500 = (5 \cdot \text{People}) + 990$ $2,500 - 990 = 5 \cdot \text{People}$ $1,510 / 5 = \text{People}$ $302 = \text{People}$

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5CEM060	2	13.92	<p>Answer = 2</p> <p>Find (A) yearly for standard model:</p> $P = A (P/A, 10\%, 10)$ $20000 = A (6.1446)$ $A = 20000 / 6.145 = \$3255/\text{yr}$ <p>Monthly = 271.25/monthly</p> $\text{Total} = 271.25 + 150 = \421.25 <p>For the deluxe model:</p> $P = A (P/A, 10\%, 10)$ $22000 = A (6.1446)$ $A = 22000 / 6.1446 = \$3580/\text{yearly}$ <p>Monthly = \$298</p> $\text{Total} = 298 + 120 = \418 <p>Therefore, if she buys the deluxe, she will have a slightly lower monthly cost.</p>

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5CEM061	2	13.92	<p>Answer = 2</p> <p>SIR (1):</p> $PV \text{ savings} = A (P/A, i, n) + F(P/F, i, n) = 6500 \times (6.8109) + 2000 \times (0.1827) = \$44,636.25$ $SIR (1) = PV \text{ savings} / PV \text{ cost} = \$44,636.25 / \$20000 = 2.23$ <p>SIR (2):</p> $PV \text{ savings} = A (P/A, i, n) + F(P/F, i, n) = 8500 \times (6.8109) + 3000 \times (0.1827) = \$58,440.75$ $SIR (2) = PV \text{ savings} / PV \text{ cost} = \$58,440.75 / \$28000 = 2.09$ <p>Therefore, since $BCR(1) > BCR(2)$, select option 1: the new compressor.</p> <p>But</p> $LCC (1) = \text{Purchase cost} - PV (\text{benefits } 1) = \$20,000 - \$44,636.25 = \$(24,636.25)$ $LCC (2) = \text{Purchase cost} - PV (\text{benefits } 2) = \$28,000 - \$58,440.75 = \$(30,440.75)$ <p>Therefore, the answer with the LCC is different. Since LCC (2) is more negative (less cost), select option 2: the two high efficiency heat pumps.</p>
5CEM062	1	10	<p>Answer = 1</p> <p>PF (Cos Phi) = 1.0 or 100% (since it is an AC resistive load) $PIN = V \times A \times PF (\text{Cos Phi})$</p> $= 220 \times 8 \times 1.0 = 1760W = 1.76kW$
5CEM063	2	10	<p>Answer = 2</p> <p>The larger wire has a lower resistance, and the I^2R loss in the distribution system will be lower. This reduces their cost per kWh.</p>
5CEM064	1	10	<p>Answer = 1</p> $kVA = \sqrt{3} \times kV \times A = 1.732 \times .38 \times 50 = 32.91 \text{ kVA}$ $kW = kVA \times PF (\text{Cos Phi}) = 32.91 \times 0.72 = 23.7 \text{ kW}$

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5CEM065	1	13.92	<p>Answer = 1</p> $kWe = \sqrt{3} \times kV \times A \times PF$ $24 = 1.732 \times .38 \times 40 \times PF$ $24 = 26.33 \times PF$ $PF = 24/26.33 = 91.2\%$
5CEM066	3	13.92	<p>Answer = 3</p> <p>Load factor=350000/(600*(30*24))=81%</p> <p>Average cost per kWh:</p> <p>Energy cost = 350,000 kWh x \$0.12/kWh= \$42,000</p> <p>Demand cost=600kW*8=\$4800</p> <p>Total cost= 4800+42000=\$46800</p> <p>Average cost per kWh=46800/350000= \$0.1337/kWh</p> <p>If the load factor is 0.25:</p> $kW_{peak}=350000/(0.25*720)=1944.44 \text{ kW}$ <p>Average cost per kWh:</p> <p>Demand cost=1944.44kW*8=\$4800=\$15555</p> <p>Total cost=15555+42000=\$57555</p> <p>Average cost per kWh=57555/350000= \$0.1644/kWh</p>
5CEM067	1	10	<p>Answer = 1</p> <p>Cost Savings= 1,000 lamps x 40 W/lamp x kW/1,000 W x 4 h/day x 5 days/wk x 52 wk/yr x \$0.06/kWh x 1.15= \$2,870/yr</p> <p>I would recommend an automatic timer for the 1,000 lamps and possibly occupancy sensors for the other 400 lamps.</p>
5CEM068	1	13.92	<p>Answer = 1</p> $q = U \times A \times \Delta T \times \text{time} = 1/R \times A \times \Delta T \times \text{time} =$ $q = (1/1.7) \text{ W}/(\text{m}^2\text{°C}) \times 100 \text{ m}^2 \times (1,000\text{°C} - 425\text{°C}) \times 20 \text{ h/week} \times 52 \text{ week/yr} \times (\text{kJ}/(1,000 \text{ W s})) \times 3,600 \text{ s/h} = 126,635,294 \text{ kJ/yr}$

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5CEM069	1	13.92	<p>Answer = 1</p> <p>Cost savings = $1000 \text{ W/lamp} \times 100 \text{ lamps} \times \text{kW}/1,000 \text{ W} \times 1.15 \times 365 \text{ h/yr} \times \\$0.06/\text{kWh} = \\$2,519/\text{yr}$</p> <p>$\text{SPP} = (\\$15 + \\$10)/\text{lamp} \times 100 \text{ lamps}/\\$2,519/\text{yr} = 0.99 \text{ years}$</p> <p>Since the payback period is less than one year, I would recommend this project.</p>
5CEM070	1	13.92	<p>Answer = 1</p> <p>$P_{\text{saved}} = 75 \text{ kW} \times 0.6 \times [(1/0.91) - (1/0.95)] = 2.08 \text{ kW}$</p> <p>Incentive for kW saved = $2.08 \times 150 = \\$312.32$</p> <p>Incentive for size of motor = $75 \times 8 = \\$600$</p> <p>Therefore, they should ask for the €8/kW (size of motor) incentive.</p>
5CEM071	2	8	<p>Answer = 2</p> <p>Level I energy audit</p>
5CEM072	1	8	<p>Answer = 1</p> <p>Infrared camera</p>
5CEM073	3	8	<p>Answer = 3</p> <p>Reduces the first cost of the system by 10%</p>
5CEM074	1	8	<p>Answer = 1</p> <p>Color rendering index</p>
5CEM075	1	8	<p>Answer = 1</p> <p>Convection</p>
5CEM076	4	8	<p>Answer = 4</p> <p>All of the above</p>
5CEM077	1	8	<p>Answer = 1</p> <p>Proportional; Integral</p>
5CEM078	2	8	<p>Answer = 2</p> <p>Raises the temperature setpoint of the water leaving the chiller.</p>
5CEM079	3	8	<p>Answer = 3</p> <p>Dead band</p>
5CEM080	1	8	<p>Answer = 1</p> <p>Glass wool</p>
5CEM081	3	8	<p>Answer = 3</p> <p>Steam pipes with steam and condensate</p>
5CEM082	3	8	<p>Answer = 3</p> <p>Heat wheels</p>

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5CEM083	1	8	Answer = 1 Preheating the boiler feed water
5CEM084	2	8	Answer = 2 Flash steam recovery
5CEM085	2	8	Answer = 2 Avoid the formation of scales
5CEM086	3	8	Answer = 3 Utilization of flash steam in the deaerator
5CEM087	1	8	Answer = 1 Removal of dissolved gases
5CEM088	1	8	Answer = 1 Heat and power
5CEM089	3	8	Answer = 3 Counter flow film fill cooling tower
5CEM090	1	8	Answer = 1 Average maximum wet bulb for summer months
5CEM091	3	8	Answer = 3 Vane axial
5CEM092	1	8	Answer = 1 Higher
5CEM093	3	8	Answer = 3 Backward curved centrifugal fan
5CEM094	4	8	Answer = 4 All of the above
5CEM095	1	8	Answer = 1 Power
5CEM096	1	13.92	<p>Answer = 1</p> <p>The system leakage is calculated by: System leakage in 'm³/min' = $Q \times T$</p> <hr/> <p>Where</p> <p>$(T + t)$</p> <p>Q = Actual free air being supplied during trial in m³/min T = Load time in minutes t = Unload time in minutes = 200 x 10 / (10 + 20) = 67 m³/min</p>

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5CEM097	4	8	Answer = 4 To remove remaining traces of moisture after after-cooler
5CEM098	1	8	Answer = 1 The compressor should not be operated close to the surge point
5CEM099	4	8	Answer = 4 For every 4 oC rise in the inter air temperature ,the increase in energy consumption is by1 %
5CEM100	4	8	Answer = 4 Two stage reciprocating compressors
5CEM101	2	8	Answer = 2 Centrifugal compressors
5CEM102	1	8	Answer = 1 Power
5CEM103	2	10	Answer = 2 $(\$0.06/\text{kWh}) \times (277.8 \text{ kWh/GJ}) = (\$16.67/\text{GJ})$ $= (\$ X/\text{GJ}) \times (1/0.8)$ $X = \$13.30/\text{GJ}.$
5CEM104	1	13.92	Answer = 1 Gas (500 GJ/yr)(1000 MJ/GJ) = 500,000 MJ/yr Elect (60,000 kWh/yr)(3.6 MJ/kWh) = 216,000 MJ/yr EUI = (716,000 MJ/yr)/1000 m ² = 716 MJ/ m ² yr
5CEM105	1	13.92	Answer = 1 1. $P = A \times [P/A, I, N]$ $P = 25,000 \times [P/A, 15\%, 8]$ $= 25,000 \times [4.4873] = \$112,182$ (round off) or \$112,175 (depending on tables)
5CEM106	4	13.92	Answer = 4 $P = A$ multiplied by $[P/A, \text{IRR}, (8)]$ $34,500 = 9000 \times [P/A, \text{IRR}, 8]$ $[P/A, \text{IRR}, 8] = 34500/9000 = 3.833$ From the Interest Tables, look for P/A and 8 years. $P/A = 3.83$ for $I = 20\%$ in the table, so $\text{IRR} = 20\%$
5CEM107	3	10	Answer = 3 $P = A \times [P/A, I, N]$ $40,000 = A \times [P/A, 15\%, 10]$ $A = 40,000/[5.0188] = \$7970$

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5CEM108	2	10	<p>Answer = 2</p> $\text{kVAR} = 1,000 \text{ kW} \times [\tan (\cos^{-1} 0.7) - \tan (\cos^{-1} 0.9)]$ $\text{kVAR} = 1,000 \text{ kW} \times [0.3172 \text{ (from table)}] = 536 \text{ kvar}$
5CEM109	1	10	<p>Answer = 1</p> $\text{kW} = (300 \text{ kW}) \times 0.75/0.98 = 229.6 \text{ kW}$ $\text{kvar} = 229.6 \text{ kW} \times [\tan (\cos^{-1} 0.84) - \tan (\cos^{-1} 0.95)] = 72.8 \text{ kvar}$
5CEM110	4	8	<p>Answer = 4</p> <p>All of the above</p>
5CEM111	4	10	<p>Answer = 4</p> $W = [(30 \times 192) + (10 \times 10) + (20 \times 75)]$ $= 8260 \text{ watts}$ $W/m^2 = 8260 \text{ W}/400 \text{ m}^2 = 20.67 \text{ W/m}^2$
5CEM112	1	13.92	<p>Answer = 1</p> $\text{kW saved} = 196 \text{ fix} \times (0.285 \text{ kW/fix})$ $30 \text{ kW} = 140 \text{ fix} \times 0.185 \text{ kW/fix}$ <p>Heating effect</p> $(30 \text{ kW}) \times (24 \text{ h/day}) \times (1/0.8) \times (200 \text{ days/yr}) \times (3.6 \text{ MJ/kWh}) = 648,000 \text{ MJ/yr} = 648 \text{ GJ/yr}$ $\text{Added cost} = (648 \text{ GJ/yr})(\$5/\text{GJ}) = \$3,240/\text{yr}$
5CEM113	1	13.92	<p>Answer = 1</p> $\text{kW saved} = (45) \times 1/0.9 = 50 \text{ kW}$ $\text{kWh saved} = 50 \text{ kW} \times 8,760 \text{ hours/yr} = 438,000 \text{ kWh}$ $\text{\$ saved} = 50 \text{ kW} \times \$9/\text{kW/mo} \times 12 \text{ mo/yr} + 438,000 \text{ kWh} \times \$0.055/\text{kWh} = \$29,490/\text{yr}$
5CEM114	3	10	<p>Answer = 3</p> $\text{kWn} = 20 \times (150/200)^3 = 8.44 \text{ kW}$
5CEM115	4	10	<p>Answer = 4</p> $\text{kJ/h} = (75 \text{ kW})(3600 \text{ kJ/h/kW})(0.9) = 243,000 \text{ kJ/h}$
5CEM116	3	10	<p>Answer = 3</p> $q = \text{LPS} \times 1.2 \times \text{DT} = (3185)(1.2)(32.2-20.6)$ $= 44.3 \text{ kW}$

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5CEM117	4	13.92	<p>Answer = 4</p> <p>$q = UA \Delta T$; $UA = 105 \text{ kW}/30 \text{ C} = 3.5 \text{ kW/C}$ Also, $Q = UA \times 24 \times DD$ $= (3,500) \text{ W/C} \times 24 \text{ h/day} \times 1,800 \text{ C-day/yr} \times 1/0.8$ $= 189,000 \text{ kWh/yr} = 680.4 \text{ GJ/yr}$</p>
5CEM118	3	13.92	<p>Answer = 3</p> <p>$q = LPS \times 4.2 \times \Delta T$</p> <p>$q_{in} = (2)(4.2)(90-80) = 84 \text{ kW}$</p> <p>$q_{out} = COP \times q_{in} = 0.8 \times q_{in} = 67.2 \text{ kW}$</p> <p>$67.2 = (LPS)(4.2)(5)$</p> <p>$LPS_{out} = 3.2 \text{ LPS}$</p>
5CEM119	3	13.92	<p>Answer = 3</p> <p>$Q = UA \times 24 \times DD$ $= (1/2.64) \text{ W/m}^2.\text{C} \times 24 \text{ hours per day} \times 2,500 \text{ C-days per year}$ $\times 1/0.7 \times 0.0036 \text{ MJ/Wh} \times \\$0.005/\text{MJ}$</p> <p>$= \\$0.584/\text{m}^2 \text{ yr}$</p>
5CEM120	3	10	<p>Answer = 3</p> <p>$\text{kW} = (340,000 \text{ kJ/h})/(3600 \text{ kJ/kWh})$</p> <p>$= 94.44 \text{ kW}$</p>