

QUESTIONNAIRE REPORT SHEET

iPQ3CEM.V1.1

iPQ.No	Correct Answer	Points	Explanation
3CEM001	1	15.25	Answer = 1 Leakage = $V \cdot (P_1 - P_2) / (DT \cdot 1.01) = 80 \text{ m}^3/\text{min.}$, $P_1 = 9.0 \text{ bar}$, $P_2 = 6.5 \text{ bar}$, $DT = 45 \text{ minutes}$ Leakage = $80 (9.0 - 6.5) / (45 \cdot 1.01) = 4.4 \text{ m}^3/\text{min}$
3CEM002	2	10	Answer = 2 Interval between group lamping = $18,000 \cdot 0.65 / 6,000 = 1.95$ years = approximately 24 months.
3CEM003	2	8	Answer = 2 Predictive
3CEM004	1	8	Answer = 1 Vibration Analysis
3CEM005	2	10	Answer = 2 $q = LPS \cdot 1.2 \cdot \Delta T = 10 \cdot 1.2 \cdot (35 - 10) = 300W$
3CEM006	2	8	Answer = 2 No, "ReCommissioning" would be the more accurate term.
3CEM007	1	10	Answer = 1 Option A
3CEM008	4	8	Answer = 4 All of the above
3CEM009	3	8	Answer = 3 10%
3CEM010	3	10	Answer = 3 Option C, whole facility metering Due to a mixture or combination of many measures to be installed effectively all at once, energy savings are expected to be large (> 10%). Other options are technically feasible, but the cost would be prohibitive.
3CEM011	4	10	Answer = 4 Option D, "calibrated simulation," is the only option because there is no baseline (pre-upgrade) facility to measure anything. Adjusted baseline energy consumption must be calculated using actual operating parameters measured during the reporting period and simulating consumption as if the baseline (less efficient) equipment had been installed. Reporting Period measurements would include (at a minimum) electric power consumption, gas flows, and weather data. The correct answer is d.

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3CEM012	1	8	Answer = 1 True. The guiding principles for M&V (ACCCRT) include the principle of being conservative. An M&V analyst should always apply assumptions and make analysis choices that tend to underestimate energy savings. However, in applying this principle, it is important not to make analysis choices or assumptions that result in reported energy savings that are unrealistically pessimistic.
3CEM013	1	10	Answer = 1 $1000 \times 37000 \text{ kJ} = 37,000,000 \text{ kJ} = 37 \text{ GJ}$
3CEM014	3	8	Answer = 3 Air-Conditioning and Lighting
3CEM015	1	8	Answer = 1 Control by occupancy
3CEM016	1	8	Answer = 1 Artificial intelligence is used in buildings and integrated into the BAS.
3CEM017	1	8	Answer = 1 Alternating current induction motors are the most popular motor type for buildings.
3CEM018	4	8	Answer = 4 90% is a typical efficiency for a motor that is properly loaded.
3CEM019	1	15.25	Answer = 1 Use the "Fan Laws": $HP2 = HP1 (RPM2/RPM1)$. Therefore, if the new speed (RPM2) is 80% of the old speed (RPM1), the new power load (HP2) will be: $HP2 = HP1 (.8)^3$; $HP2 = 200 \text{ HP} (0.512)$; $HP2 = 102.4 \text{ HP}$
3CEM020	3	10	Answer = 3 65 degrees F is the "target" outside temperature. If the average temperature is 75, then we are 10 degrees "off target." The "cooling degree days" for a year would be: $(10)(365)$ $CDD \text{ per year} = 3,650$

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3CEM021	4	15.25	<p>Answer = 4</p> <p>The coefficient of performance is the power moved or power input. With a 250-tonne chiller, this machine is capable of moving 250 tonnes of cooling, therefore the power input would be:</p> $4.2 = P_m / P_i$ $4.2 = 250 \text{ tons} / P_i$ $P_i = 59.52 \text{ tonnes}$ <p>But "tons" must be converted into kW to answer the question. A "ton" is a rate of energy flow equal to 12,000 BTUs per hour, and we also know that 1 kW = 3412 BTUs/hour. Thus, the amount of kW can be calculated as follows:</p> $= (59.52 \text{ tons}) (12,000 \text{ BTU/hr/ton}) (1 \text{ kW} / 3412 \text{ BTU/hr})$ $= 209 \text{ kW}$
3CEM022	3	15.25	<p>Answer = 3</p> <p>Use the equation for "sensible heat transfer" (actually a "short cut" equation endorsed by ASHRAE):</p> $q = 1.08(\text{CFM})\Delta T \text{ [q units are in Btu/hour]}$ $q = 1.08 (\text{Btu} \cdot \text{min} / \text{ft}^3 \cdot \text{hour} \cdot \text{oF})(6,750 \text{ ft}^3/\text{min})(21 \text{ oF})$ $q = 153,090 \text{ Btu/hour}$
3CEM023	2	8	<p>Answer = 2</p> <p>False. For this type of motor, if the load is less than 20%, the power factor and ensuing efficiency are drastically reduced.</p>
3CEM024	3	10	<p>Answer = 3</p> <p>Ratchet penalties are effective measures to encourage energy consumers to reduce kW spikes, because if you have a ratchet penalty, you will pay the ratchet percent for the next 11 months (even if you don't use any demand during that period). In this case, if you set a new peak 700kW above your normal operating load (old peak), you will pay:</p>
3CEM025	1	10	<p>Answer = 1</p> $L/s = C_v \sqrt{PD} = 0.01 \sqrt{100} = 0.1 \text{ L/s}$
3CEM026	2	8	<p>Answer = 2</p> <p>False</p>
3CEM027	3	8	<p>Answer = 3</p> <p>Axial compressor</p>
3CEM028	2	10	<p>Answer = 2</p> $\text{Input} = 300 \text{ kW} \times (1/0.8) = 375 \text{ kW} = 375,000 \text{ J/s}$
3CEM029	2	8	<p>Answer = 2</p> <p>Essentially base load the chiller (i.e., operate at a high load most of the time)</p>

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3CEM030	3	15.25	Answer = 3 From combustion chart $\text{EffOLD} = 80.5\%$ $\text{EffNEW} = 82.7\%$ $\% \text{ savings} = (\text{EffNEW} - \text{EffOLD})/\text{EffNEW}$ $= (82.7 - 80.5)/82.7 = 2.65\%$
3CEM031	2	8	Answer = 2 No
3CEM032	2	8	Answer = 2 Essentially base load the chiller (i.e., operate at a high load most of the time)
3CEM033	2	10	Answer = 2 $\% = (\text{RAT} - \text{MAT})/(\text{RAT} - \text{OAT})$ $= (22 - 18.3)/(22 - 5) = 21.8\%$
3CEM034	3	10	Answer = 3 $kW = (340,000 \text{ kJ/h})/(3600 \text{ kJ/kWh})$ $= 94.44 \text{ kW}$
3CEM035	1	10	Answer = 1 $q = \text{LPS} \times 1.2 \times \text{DT}$ $= 5000 \times 1.2 \times 10 = 48,000 \text{ W} = 48 \text{ kW}$
3CEM036	2	8	Answer = 2 BACnet/IP Protocol
3CEM037	3	10	Answer = 3 $1000 \times 37000 \text{ kWh}/3600 = 10,278 \text{ kWh}$
3CEM038	1	10	Answer = 1 $100 \text{ L} \times 39 \text{ MJ} / (1 \text{ L} \times 1000) = 3.9 \text{ GJ}$
3CEM039	3	10	Answer = 3 $P = V \times I \times \text{PF} = 220 \times 10 \times 1.0 = 2200 \text{ watts}$ The power factor of any resistive load is 1.0
3CEM040	3	10	Answer = 3 $P = \sqrt{3} \times V \times I \times \text{PF} = \sqrt{3} \times 380 \times 20 \times 0.9 = 11.85 \text{ kW}$
3CEM041	1	10	Answer = 1 The average voltage is equal to $(220+215+210)/3 = 215 \text{ volts}$.
3CEM042	2	10	Answer = 2 $kWe = (kWm \times LF)/\text{efficiency} = (75 \times 1)/.927 = 80.9 \text{ kW}$ $kW = \sqrt{3} \times kV \times I \times \text{PF}$ $\text{PF} = 80.9 / (\sqrt{3} \times .4 \times 131) = 89.1\%$
3CEM043	1	15.25	Answer = 1 As (h) is the height from lamp to top of working surface $h = 3.4 - 0.76 = 2.64 \text{ m}$ $\text{RCR} = 2.5 \times h \times [(L+L+W+W)/(L \times W)] = 2.5 \times 2.64 \times$ $[(20+20+10+10)/(20 \times 10)] = 2.5 \times 2.64 \times [60/200] = \text{RCR} = 1.98$

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3CEM044	3	15.25	<p>Answer = 3</p> <p>Electricity = (200 lamp) x (32-22 W/lamp) x (4,000 h/yr) = 8,000 kWh/yr.</p> <p>\$ savings = (8,000 kWh/yr) x (\$0.15/kWh) = \$ 1,200/yr.</p> <p>New lamps cost = (200 lamps) x (\$12/lamp) = \$ 2,400</p> <p>Simple Payback = (\$2,400)/(\$1,200/yr) = 2 years</p>
3CEM045	1	15.25	<p>Answer = 1</p> <p>$W = (800 \text{ fixtures}) \times (0.455 \text{ kW/fixture}) \times (2) - (800 \text{ fixt.}) \times (0.465 \text{ kW/fixt.}) = 356 \text{ kW}$</p> <p>Demand \$ savings = (356 kW) x (\$6/kW-mo) x (12 mo/yr) = \$25,632/yr.</p> <p>Energy \$ savings = ((356 kW) x (8000 hr/yr)) x (\$0.05/kWh) = \$ 142,400/year</p> <p>Total \$ savings = (\$25,632 + \$ 142,400)/yr = \$ 168,032/yr</p>
3CEM046	3	10	<p>Answer = 3</p> <p>$N = (500 \times 12 \times 10) / (3000 \times 7 \times .65) = 44$</p> <p>The number of two lamps fixtures needed is 22.</p>
3CEM047	3	10	<p>Answer = 3</p> <p>To calculate the efficacy for a lamp that requires a ballast, you must add the ballast power to the lamp power to get the correct total wattage input.</p>
3CEM048	1	10	<p>Answer = 1</p> <p>Efficacy = 1,100 lu / 80 watts = 13.75 lu/W</p>
3CEM049	2	10	<p>Answer = 2</p> <p>$P = S \times PF = 200 \times 0.8 = 160 \text{ kW}$, $Q = \sqrt{(200^2 - 160^2)}$ q = 120 kVAR</p>
3CEM050	1	15.25	<p>Answer = 1</p> <p>The required kVARs to bring the power factor back to unity is</p> <p>$kVAR = \sqrt{(kVA^2 - kW^2)} = \sqrt{(2500^2 - 2000^2)} = 1500 \text{ kVARs}$</p>
3CEM051	1	15.25	<p>Answer = 1</p> <p>From the table of the power factor, the value of the intersection between 0.7 and 0.9 is found to be 0.536</p> <p>$kVAR \text{ (Capacitance needed)} = \text{Table Factor} \times \text{Real Power} = 0.536 \times 2000 = 1072 \text{ kVAR}$</p>
3CEM052	2	10	<p>Answer = 2</p> <p>Group re-lamping interval = 25,000 x 0.7/4,000 = 17,500/4,000 = 4.4 years = 53 months (approximately)</p>
3CEM053	3	8	<p>Answer = 3</p> <p>Both</p>
3CEM054	4	8	<p>Answer = 4</p> <p>All of the above</p>
3CEM055	4	8	<p>Answer = 4</p> <p>All of the above</p>

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3CEM056	3	8	Answer = 3 Both
3CEM057	4	8	Answer = 4 Capacitor based control
3CEM058	4	8	Answer = 4 They have high operational losses and high temperature rise
3CEM059	2	8	Answer = 2 Enables no-load start-up of prime-move
3CEM060	3	8	Answer = 3 Amorphous core - metallic glass alloy
3CEM061	1	8	Answer = 1 Provide variable speed with high efficiency
3CEM062	2	8	Answer = 2 Reduces the reactive power drawn from grid
3CEM063	1	10	Answer = 1 Efficiency = 10 kW / 12 kW = 83.3%
3CEM064	4	10	Answer = 4 LF = 30 kW/50 kW = 60%
3CEM065	2	10	Answer = 2 $kW_e = (kW_m \cdot LF) / \text{efficiency} = (50 \cdot .7) / .89 = 39.33 \text{ kW}$
3CEM066	1	15.25	Answer = 1 $55 \cdot .7((1/.87) - (1/.94)) \cdot .1 \cdot 4000 = \$1318.17/\text{year}$ SPP = Cost/Savings = 1200/1318.17 = 0.9 years
3CEM067	2	15.25	Answer = 2 $kW_{\text{new}} = 10 \text{ kW} \times (1300/1450)^3 = 7.2 \text{ kW}$ kW Saved = (10-7.2) kW = 2.8 kW Savings = (2.8/.9) * 2000 * .1 = \$622.2/year

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3CEM068	2	15.25	<p>Answer = 2</p> <p>$(\text{Head} * \text{Flow} *) / (102 * _motor * _drive * _pump) = \text{kW electrical}$</p> <p>With this given formula, we are calculating the electrical power input to the motor. Here we are only given the kW rating of the pump, or, in other words, the kW mechanical input into the pump (or the shaft power). Pump mechanical input is the fluid power output divided by the pump's efficiency. We therefore do not take the motor's efficiency into consideration. (Assume density of one kilogramme per liter.)</p> <p>As a result, kWmechanical (pump kW input) = "Head Flow ")/ ("102 " _pump)</p> <p>Thus, _pump=(Head * (Flow in LPS) *)/(102 * kW) = (15.5 * 400 * 1)/(102 * 75) = 0.81 = 81% of the time.</p>
3CEM069	1	15.25	<p>Answer = 1</p> <p>$Q = 24 \text{ U A DD}$</p> <p>$Q _savings = 88 \text{ 1170 } (4.2 - 0.525)$</p> <p>Q-savings = 9,081 kWh saved per year.</p> <p>\$ saved equals 9,081 kWh\$0.12/kWh saved per year</p> <p>\$ _savings=\$1,089.73/year</p> <p>Annual Net Gain / Total Cost = Return on Investment.</p> <p>Return on Investment = \$1,089.73/\$186</p> <p>Return on Investment = 586 percent</p>
3CEM070	3	15.25	<p>Answer = 3</p> <p>$E = 1,000,000 \text{ kWh/yr. kJ/s/kW } 3,600 \text{ s/h} = 3,600,000,000 \text{ kJ/yr.}$</p> <p>$39 \text{ MJ/L } 1,000 \text{ kJ/MJ} = 468,000,000 \text{ kJ/yr. } E(\#2 \text{ fuel}) = 12,000 \text{ L/yr.}$</p> <p>$E = 4,068,000,000 \text{ kJ/yr.}$</p> <p>$EUI = 4,068,000,000 \text{ kJ/yr/4,000 m}^2 = 1,017,000 \text{ kJ/m}^2\text{/yr, which is less than the average office building.}$</p>

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3CEM071	2	10	<p>Answer = 2</p> <p>The average voltage is calculated as $(400 + 385 + 409)/3 = 398$.</p> <p>The largest voltage differences are 13</p> <p>The voltage imbalance is $13/398 =$, or 3.3%.</p>
3CEM072	3	8	<p>Answer = 3</p> <p>Both</p>
3CEM073	4	8	<p>Answer = 4</p> <p>All of the above</p>
3CEM074	1	8	<p>Answer = 1</p> <p>Throughout the project</p>
3CEM075	1	8	<p>Answer = 1</p> <p>Owner's design intent, project specifications, industry guidelines, and approved submittals</p>
3CEM076	1	8	<p>Answer = 1</p> <p>It is necessary to put the details of the issue and how it will be handled in writing.</p>
3CEM077	4	8	<p>Answer = 4</p> <p>All of the above</p>
3CEM078	4	8	<p>Answer = 4</p> <p>All of the above</p>
3CEM079	3	8	<p>Answer = 3</p> <p>Both</p>
3CEM080	4	8	<p>Answer = 4</p> <p>All of the above</p>
3CEM081	1	8	<p>Answer = 1</p> <p>Throughout the construction period</p>
3CEM082	4	8	<p>Answer = 4</p> <p>All of the above</p>
3CEM083	3	8	<p>Answer = 3</p> <p>Both</p>
3CEM084	1	8	<p>Answer = 1</p> <p>Increases</p>
3CEM085	2	8	<p>Answer = 2</p> <p>Problems with mechanical commutation</p>
3CEM086	4	8	<p>Answer = 4</p> <p>All of the above</p>
3CEM087	1	8	<p>Answer = 1</p> <p>Operating in Star mode</p>

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3CEM088	4	8	Answer = 4 All of the above
3CEM089	4	8	Answer = 4 All the above
3CEM090	2	8	Answer = 2 Proportional to the square of the rotor current
3CEM091	3	8	Answer = 3 Both
3CEM092	1	10	Answer = 1 $kW_e = (75 \times .8) / .938 = 63.97 \text{ kW}$
3CEM093	3	10	Answer = 3 $kW_e = 45 \times .8((1/.917) - (1/.942)) = 1.04 \text{ kW}$
3CEM094	1	10	Answer = 1 The new air flow rate is half of the old L/s , Thus new L/s= 0.5 old L/s $kW_{new} = 10 \times (.5)^3 = 1.25 \text{ kW}$
3CEM095	1	10	Answer = 1 The new flow rate is half of the old L/s , Thus new L/s= 0.5 old L/s $kW_{new} = 45 \times (.5)^3 = 5.625 \text{ kW}$
3CEM096	1	10	Answer = 1 $kW = 800000 / 3600 = 222.22. \text{ kW}$
3CEM097	1	10	Answer = 1 $340000 / 3600 = 94.44 \text{ kW}$ (7 COP = $94.44 \text{ kW} / 23 = 4.1$)
3CEM098	1	10	Answer = 1 COP = $95 / 23 = 4.13$
3CEM099	2	10	Answer = 2 Annual savings = $30 \times 0.1 \times 2000 \times ((1/2) - (1/3.5)) = \1285.71
3CEM100	1	10	Answer = 1 $Q = U \times A \times DD \times 24 = 1.4 \times 10 \times 2000 \times 24 = 672 \text{ kWh/year}$
3CEM101	2	10	Answer = 2 Less than 1.1
3CEM102	3	8	Answer = 3 Both
3CEM103	1	8	Answer = 1 Ammonia refrigerant based absorption systems operate at above atmospheric pressures and are capable of low temperature operation (below 0 °C)

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3CEM104	1	8	Answer = 1 The efficiency of screw compressors operating at part load is generally higher than either centrifugal compressors or reciprocating compressors, which may make them attractive in situation, where part-load operation is common.
3CEM105	4	8	Answer = 4 All of the above
3CEM106	4	8	Answer = 4 All of the above
3CEM107	2	8	Answer = 2 1 to 1.5 TR
3CEM108	2	8	Answer = 2 Higher evaporator temperature and lower condenser temperature
3CEM109	2	8	Answer = 2 Full load
3CEM110	2	8	Answer = 2 Wet bulb temperature
3CEM111	4	8	Answer = 4 All of the above
3CEM112	1	8	Answer = 1 Load Factor Average Annual Consumption
3CEM113	3	8	Answer = 3 Both
3CEM114	1	15.25	Answer = 1 Transformer losses = $2 + (0.6)^2 \times 25$ No load losses + (% loading) ^{2} x Full load losses = 11 kW
3CEM115	3	8	Answer = 3 Both
3CEM116	1	8	Answer = 1 Turns ratio
3CEM117	2	8	Answer = 2 1/6 times
3CEM118	3	8	Answer = 3 Voltage and current distortions with 250 Hz & 350 Hz
3CEM119	2	8	Answer = 2 Diversity Factor
3CEM120	4	8	Answer = 4 All of the above