

ASSOCIATION OF ENERGY ENGINEERS
STUDY GUIDE
CERTIFIED BUSINESS
ENERGY PROFESSIONAL (BEP®)
Updated January 1, 2017

Preparing for the BEP Examination / Study Recommendations:

The following three practice exams are provided to assist Candidates in their preparation for the BEP Examination. Also included are suggested resource materials for the BEP Examination. To get the most out of the practice exams please adhere to the following items:

- a. Review the topics and material that could be asked.
- b. Attempt all of the problems as if you are taking the real BEP Certification Examination.
- c. Do not flip back and forth to check your answers.
- d. Do the easiest (To You) questions first and come back to the ones you may have had difficulty with or trying to find an answer.
- e. Remember the goal of the practice exams is to not only give you representative questions but also to try as much as possible to place you in the certification exam scenario.
- f. We recognize that some questions may be challenging and seem as if there are two possible answers, choose the one you think is the most accurate or the answer that is most current.
- g. When taking one of the BEP Courses, Your Instructors will be more than happy to walk you through each of the problems you have questions with.
- h. DO NOT WAIT until the final week or nights prior to the exam to either prepare or have questions answered.
- i. And Good Luck – Mark, Rich, Barney & Ismael

Suggested Resource Material:

The BEP is a very broad course. It brings all of the components of energy management together. This makes it somewhat difficult to pin down just a few resources. Here are some outstanding resources that will help you prepare for the BEP Examination as well as serve as excellent resources utilized in the energy business today.

1. **BEP Seminar 5-Day Course Workbook.** (only available to attendees of the course)
2. **Business Energy Professional CD.** CD Order code 0556. Available online from AEE.
3. College Text book on **Accounting & Management Accounting.**
4. **Dictionary of Energy Efficient Technologies.** ISBN 0-88173-455-1. Available online from AEE.
5. **Encyclopedia of Energy Engineering and Technology,** 3 Volume Set. ISBN 0849336538. Available online from AEE.
6. **Energy Management Handbook, 7th Edition.** ISBN 0-88173-609-0. (Great Resource – it should be on your work shelf if you work in the energy industry). Available online from AEE.
7. **Energy Management Reference Library CD, 3rd Edition.** CD Order Code 0636. Available online from AEE.
8. **Guide to Energy Management, 6th edition.** ISBN 0-88173-605-8. Available online from AEE.
9. **Investment Grade Energy Audit.** ISBN 0-88173-362-8. Available online from AEE.
10. **Maximizing energy savings and minimizing costs.** ISBN 0-88173-392-X. Available online from AEE.
11. **Megatrends for Energy Efficiency and Renewable Energy.** ISBN 0-88173-632-5. Available online from AEE.
12. **Green Facilities Handbook.** Available online from AEE.
13. **Management, Measurement and Verification of Performance Contracting.** ISBN 0-88173-451-9. Available online from AEE.

14. Managing Energy from the Top Down. ISBN 0-88173-625-2. Available online from AEE.

15. Manual of Intelligent Energy Services. ISBN 0-88173-380-6. Available online from AEE.

16. Handbook of Web Based Energy Information & Control Systems. ISBN 0-88173-669-4. Available online from AEE.

Welcome Message by the BEP Board Chairman

I first want to thank you for taking interest in this Professional Certification Program. The program was designed around putting the emphasis on the decision making aspect of energy management. Corporate Energy Managers and Utility Account Managers need to understand the fundamental uses of energy all the way to understanding what technology could be utilized to conserve energy or reduce the energy costs to an organization. The BEP course was developed to complement the Certified Energy Manager Program along with expanding the areas of study to include all facets of energy management and the resultant required decision making. The BEP course is written with a focus on the business side of energy management with less focus on the technical/calculation based course as is the CEM Program. With this focus it allows the energy manager to align all energy management goals/programs toward reaching the organization energy targets regardless of what that might be. The course topic offerings are guided by our well experiences and recognized Board Members. The course as well as the certification exam is written and revised about every two years to ensure the program stays current with the needs and demands of Professionals focused on the Business side of Energy. Since its inception in 2003, the program continues to grow and has become a requirement for several energy management positions. I look forward to seeing your application and wish you best of luck with your career as a Business Energy Professional

Sincerely,

Mark R Roche - Certified Business Energy Professional Chairman
Helen Johnson – BEP Certification Director
Valerie Oviatt – BEP Seminar and Webinar Director

The written BEP examination deals with such subjects as:

- A. Need for Energy Management
 - a. Active Energy Management
 - b. Environmental Impacts/Requirements
 - c. Energy Policy Act 2005

- d. Establishing an Energy Management Program
- e. ANSI/MSE 2000 Georgia Technical Institute
- f. ISO 50001
- g. Resources: US DOE, EIA, US EPA, FEMP, OIT, Energy Star
- B. Codes and Standards
 - a. Basic Energy Codes
 - b. How codes are developed
 - c. How standards are adopted
 - d. EPACT 2005 / 1992
 - e. ASHRAE Standards 90.1, 90.2, & 62.1
- C. Green Buildings Programs
 - a. What are green buildings?
 - b. Energy Star, LEED for commercial buildings
 - c. LEED NC and EB
 - d. Other LEED certifications
 - e. Site and Source energy
 - f. Certifications
 - g. Energy Star
 - h. Energy Star Portfolio Manager
- D. Energy Fundamentals
 - a. Energy Conversions
 - b. Load Factor
 - c. Heating and Cooling Degree Days
 - d. Point of Use Costs
 - e. Energy Formulas - Resource
- E. Utility Rate Structures
 - a. Knowledge of different types of costs recovered in rates (commodity, distribution, fixed vs. variable, power cost adjustments, etc.)
 - b. Primary vs. Secondary Service
 - c. Power Factor Adjustments
 - d. Interruptible and Firm Power
 - e. Block Rates, Time of Use Rates, Real Time Pricing
 - f. Rate Analysis (comparing alternatives)
 - g. Green Power
 - h. Transportation vs. Bundled Service
 - i. Rate Development
 - j. DSM programs and their impacts to rates
- F. Electric and Gas Procurement
 - a. Electric Restructuring Overview
 - b. Electric Utility Structure
 - c. Gas Restructuring Overview
 - d. Energy Procurement
 - e. Risk identification in procurement
 - f. Natural gas procurement
 - g. Electric procurements
 - h. Understanding price discovery of fuels
 - i. Detailed procurement process

- j. Overall procurement strategies
- k. Fuel choices
- G. Energy Accounting
 - a. Collecting and Organizing Utility Data
 - b. Spreadsheet Tools
 - c. Calculating the Energy Use Index
 - d. Sources of data
 - e. Comparison of facilities
 - f. Limitations of data
 - g. End Use Analysis
 - h. Charts and Graphs
 - i. Benchmarking
 - j. Forecasting energy usage
 - k. Energy Interval Data
- H. Energy Audits and Instrumentation
 - a. Role of Energy Audits
 - b. Types of Energy Audits
 - c. Common Energy Audit Deficiencies
 - d. Analysis of Operations and Maintenance
 - e. Audit Equipment
 - f. Audit Report
 - g. Incorporating the Goals
- I. Energy Economics and Financing
 - a. Importance of knowing finance
 - b. Basic Finance
 - i. Statements & Individual Components
 - c. Energy Budgeting
 - i. Development & Reporting
 - d. Economic Evaluations
 - i. Life Cycle Costing, Simple Payback, Net Present value, Annual Worth, Internal Rate of Return, After Tax Cash Flows
 - ii. Energy efficiency versus renewable economic evaluations
 - iii. Spreadsheet Analysis
 - e. Alternative Financing
 - i. Direct Purchase Methods
 - ii. Leasing Methods
 - iii. Performance Contracting
- J. Commissioning
 - a. Is Commissioning Necessary and Cost Effective?
 - b. Associated Costs
 - c. Phases of Commissioning
 - d. Guidance for the Commissioning RFP
 - e. Documentation
- K. Measurement and Verification (M&V)
 - a. Reasons for M&V
 - b. M&V Targets
 - c. Minimizing Risk

- d. M&V Options
- e. International Performance Measurement and Verification Protocol (IPMVP)
 - i. IPMVP History
 - ii. Importance in Financing Energy and Water Efficiency
 - iii. Concepts and Methodology
- L. Metering
 - a. Revenue Meters - Gas & Electric Meters
 - b. Meter reading systems, Manual, MV90, Cellnet, MetraTek
 - c. High level understanding of meter components - index, AMR module, electronic correctors, etc
 - d. Components metered (kWh, kW, kVARh; turnup vs. therms vs. CCF)
 - e. Pressure and Temperature Correction – (high pressure gas meters)
 - f. Read Terminology (estimate, actual, pro-rate)
 - g. Power Factor
 - h. Interval Data Systems and Analysis
 - i. Sub-metering
 - j. Cost Center Metering, Reporting and Budgeting
 - k. IT and Web based Systems
- M. Building Systems Overview
 - a. Operation & Maintenance
 - b. Building Envelope
- N. Lighting
 - a. Basics (lumens, foot candles, efficacy, CRI, Color Temp, CU)
 - b. Types of Lamps
- O. HVAC Systems
 - a. Chillers
- P. Control Fundamentals
- Q. Industrial Systems Overview
 - a. Electric utility System
 - i. Generation
 - ii. Transmission
 - iii. Distribution
 - iv. Power Quality & Reliability
 - v. Smart grid
 - b. Gas Utility System
 - i. Gas Processing Plant
 - ii. Transmission
 - iii. Local Distribution Company
 - iv. Gas main Distribution
 - c. Steam Systems
 - i. Boilers, Turbines, Heat Exchangers
 - d. Motors and Pumps
 - i. Motor Basics
 - ii. Importance of Motor Management
 - iii. Energy Savings
 - iv. Variable Volume Options

- v. Selecting / Replace Motors
- vi. Pump Types
- e. Compressed Air Systems
 - i. Components of Air Systems
 - ii. System Efficiency Improvements
- f. Industrial Processes
- R. Energy Efficient Equipment, Applications, New Technologies
 - a. Energy Recovery Ventilation (ERV)
 - b. HVAC – VAV, Demand Ventilation, CEE Tier II
 - c. Motors - ECM Motors
 - d. Lighting – Super T8s vs. T5, Daylighting Systems
 - e. Boilers – Condensing, AutoFlame Control
 - f. Transformers – Energy Star Rated
 - g. Utility scale batteries
 - h. Future fuels
 - i. Carbon trading
 - j. Emissions tracking
- S. Onsite Generation
 - a. Distributed Generation; and On-Site Combined Heat and Power Systems
 - i. Benefits and Potential
 - ii. Fuel Cells, Solar PV, Winds turbines
 - iii. Microturbines, Engines
 - iv. Flywheels, Energy Storage

Practice Tests:

Business Energy Professional Practice Test #1

1. Which of the following is the incorrect conversion factor:
 - a. 1 HP = 3412W
 - b. 1therm = 100,000 Btu
 - c. 1MBtu = 1,000 Btu
 - d. 1MMBtu= 1,000,000 Btu

2. Calculate the point of use cost in MMBtu for natural gas at \$0.78/therm and at 72% combustion efficiency:
 - a. \$6.83 per MMBtu
 - b. \$7.80 per MMBtu
 - c. \$10.83 per MMBtu
 - d. \$11.80 per MMBtu

3. In the 2012 CBECS study performed by BOMA and the Energy Information Administration, what was the average EUI of all buildings surveyed in the United states:

- a. 79,212
- b. 88,483
- c. 109,061
- d. 142,857

4. An electric utility bases its billing on the rate schedule shown below. Calculate the monthly bill for an industrial firm that consumes 450,000 kWh per month with an actual demand of 890 kW. The plant's power factor is 85% and there is no ratchet clause:

Customer charge: \$760 per month

Electrical consumption:

First 10,000 kWh \$0.06 per kWh

All over 10,000 kWh \$0.0446 per kWh

Demand:

All demand \$7.50 per kW per month

Power Factor:

Demand is increased 0.5% for each 1% that the power factor is less than 75%. If the power factor is greater than 75%, there is no penalty, or reward.

- a. \$18,224
- b. \$24,443
- c. \$27,659
- d. \$28,227

5. Why is there a difference between a fuel's HHV and LHV:

- a. HHV takes into consideration the energy required by the development of water vapor from the combustion of hydrogen
- b. HHV ignores the energy required by the development of water vapor from the combustion of hydrogen
- c. There is no difference between LHV and HHV, provided the same fuel is being measured for its energy content
- d. None of the above

6. Which FERC order required pipelines to stop offering city gate prices:

- a. 500
- b. 636
- c. 888
- d. 889

7. How many therms of energy are in 3,675 gallons of gasoline:

- a. 3,675
- b. 4,275
- c. 4,594
- d. 5,275

8. What is the typical cut off point for saying a facility has very little opportunity for demand savings when looking at only the Load factor:

- a. <10%
- b. >10%
- c. <90%
- d. >90%

9. Which of the following is used to assist in maintaining voltage level on a utility electrical utility distribution system:

- a. Regulator
- b. Flywheel
- c. Capacitor bank
- d. a and c only
- e. all of the above

10. What instrument is used to measure the voltage in an AC circuit:

- a. Ammeter
- b. Barometer
- c. Cyclometer
- d. Voltmeter

11. Over the life expectancy of 100,000 hours from an induction lamp, how much, in percent of its initial value, will its lumen output depreciate:

- a. 10%
- b. 20%
- c. 30%
- d. 40%

12. What is another name for a checklist type energy audit:

- a. Type I
- b. Type II
- c. Investment Grade
- d. Baseline Audit

13. An energy saving device costs \$34,994 and will save \$4,685 per year for its full life of 20 years. What is the approximate internal rate of return:

- a. 10%
- b. 12%
- c. 15%
- d. 20%
- e. 25%

14. A new device costs \$40,000 installed. The device will last 10 years at which time it will have to be replaced. How much will it have to save each year to obtain a 15% return on investment before taxes:

- a. \$4,600
- b. \$6,450
- c. \$7,970
- d. \$9,460

15. What would be the preferable order for selection from the following three fuel sources that could be used in a boiler given the fuel type, fuel cost, and efficiency:

Natural Gas = \$0.86 per therm, boiler with natural gas is 72% efficient

Light fuel oil = \$1.56 per gallon, boiler with light fuel oil is 68% efficient

Electric = \$0.08 per kWh (blended cost), boiler with electric is 96% efficient

- a. Natural gas, Light fuel oil, Electric
- b. Natural gas, Electric, Light fuel oil
- c. Light fuel oil, Natural gas, Electric
- d. Electric, Light fuel oil, Natural gas

16. A facility has \$20,000 to invest in energy efficiency projects. Project One has a NPV of \$18,000. Project Two returns \$8000 per year for 20 years. With a discount rate of 20%, which project is preferable: (both project life times are the same)

- a. Project One
- b. Project Two

17. What are the three main reasons for performing M&V:

- a. Cost savings, emissions reduction, reduce environmental impacts
- b. Cost savings, performance verification, reduce environmental impacts
- c. Energy savings, cost savings, performance verification
- d. Cost Savings, performance verification, emissions reduction

18. What is Retro Commissioning:

- a. Repeating commissioning periodically
- b. Evaluating past commissioning activities
- c. Comparing past and current commissioning activities
- d. None of the above

19. A lighting survey of a 4000 square foot office building identified the following fixtures:

30 - 4 tube troffers @ 192 watts/fixture

10 - 100 watt incandescent floodlights

20 - 75 watt plug-in task lamps

What is the lighting watt density of this facility:

- a. 2.07
- b. 4.67
- c. 5.64
- d. 8.26

20. When a large insurance call center has an unmanned server room, it produces 340,000 Btu per hour of heat from equipment and lights. How many tons of air conditioning is needed just to remove this heat from the equipment and lights:
- 17.0
 - 24.0
 - 28.3
 - 34.0
21. Which of the following is not on a motor's nameplate:
- nominal efficiency
 - running efficiency
 - service factor
 - FLRPM
22. How much will an air leak cost a facility annually if it has a leak hole that is 1/8 in diameter at a pressure of 100 PSI and it goes unrepaired for six months: (based upon 10.5 cents per kWh)
- \$654
 - \$1,213
 - \$1,489
 - \$2,489
23. When connecting a CT to a panel to measure current flow, it is important to connect the CT on the correct phase and to ensure the polarity of the CT is correct. To assist with this connection, an arrow is labeled on the CT, when the CT is installed correctly the Arrow should point in which direction:
- Upward
 - Downward
 - Toward the supplying energy
 - Toward the load
 - It doesn't matter
24. What percentage of building failures will have major consequences and occur infrequently:
- 5%
 - 10%
 - 15%
 - 25%
25. Which higher learning organization facilitates the program Management System for Energy:
- University of Oklahoma
 - University of Texas
 - Georgia Institutes of Technology
 - University of Florida

26. Which of the following is not a typical delay in siting, permitting a DG installation:
- a. Air permitting approval
 - b. Water use permitting approval
 - c. Environmental plan approval
 - d. Zoning permitting approval
 - e. None of the above, all are typical delays
27. ANSI standard C12.21 covers what operation:
- a. Gaining access to meters via a direct linkage connect
 - b. Gaining access to meters via an optical port
 - c. Gaining access to meters via a telephone
 - d. Gaining access and then adjusting network connections to a meter
28. LEED awards energy efficiency points based upon:
- a. Reduction of energy costs
 - b. Reduction of energy usage
 - c. Reduction of environmental emissions
 - d. All of the above
29. What is the generally accepted standard life expectancy for roof top HVAC units:
- a. 5 year
 - b. 10 year
 - c. 15 year
 - d. 20 year
30. A dimmer is considered to be what type of control device:
- a. Automatic
 - b. Manual
 - c. Basic Automatic – closed loop
 - d. Basic Automatic – open loop
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Answer Key Practice Test 1:

- | | | |
|-------|-------|-------|
| 1. a | 14. c | 27. c |
| 2. c | 15. a | 28. a |
| 3. c | 16. b | 29. c |
| 4. c | 17. c | 30. b |
| 5. a | 18. a | |
| 6. b | 19. a | |
| 7. c | 20. c | |
| 8. d | 21. b | |
| 9. d | 22. b | |
| 10. d | 23. d | |
| 11. c | 24. b | |
| 12. a | 25. c | |
| 13. b | 26. e | |

Business Energy Professional Practice Test #2

Hints:

1. To get the most out of this practice test, the attendee should attempt all of the problems as if they were taking the real BEP Certification Examination.
 2. Do not flip back and forth to check your answers.
 3. Do the easiest (to You) questions first and come back to the ones you may have had difficulty with or trying to find the answer.
 4. Remember – the goal of this exam is to try as much as possible to place you in the certification exam scenario.
 5. We recognize that some of these questions may be challenging. Where questions may seem like they have multiple correct answers, choose the one you think is the most accurate or the answer that is most current.
 6. As always, after completing the practice exam your instructors will be more than happy to walk you through each of the problems you have questions with. (I'll emphasize – do not wait until the night prior to the exam to get your questions answered – get them explained as soon as possible)
 7. And Good Luck – Mark, Rich, Barney & Ismail
-
1. Which of the following is the correct conversion factor for Barrels of Crude oil to Million Btu:
 - a. 1 Barrel = 2.6 MBtu
 - b. 1 Barrel = 2.6 MMBtu
 - c. 1 Barrel = 5.1MBtu
 - d. 1 Barrel = 5.1 MMBtu

 2. To obtain a LEED-NC Certification level of Gold, the minimum criteria that must be met is:
 - a. 40 points
 - b. 50 points
 - c. 60 points
 - d. 80 points

3. Calculate the point of use cost in therms for natural gas at \$8.95/MMBtu and at 68% combustion efficiency:
 - a. \$.61 per therm
 - b. \$.92 per therm
 - c. \$1.32 per therm
 - d. \$1.48 per therm

4. Once the Department of Energy (DOE) has determined that commercial building's energy efficiency would be improved and it would be better for the United States, DOE gives each state how long to adopt the version of ASHRAE 90.1 for its jurisdiction:
 - a. 1 year
 - b. 2 years
 - c. The adoption length will provided in the approval instructions
 - d. The length of time depends on if the state uses ASHRAE 90.1 for its commercial building code

5. When burned, which of the following fuel types produces the smallest amount of CO₂:
 - a. Light fuel oil
 - b. #6 fuel oil
 - c. Coal
 - d. Methane

6. Which entity regulates the terms and conditions of wholesale power sold in interstate commerce?
 - a. FERC
 - b. NERC
 - c. The individual States Public Service Commission
 - d. Power Marketer

7. A facility has a FLF of 60%. Which of the following items would need to be looked at further to determine if the facility had a potential for demand savings:
 - a. Facility Operating Hours
 - b. Billed Demand KW
 - c. Billing kWh
 - d. Current Utility Rate

8. When performing an energy audit, which instrument uses a CT?
 - a. Voltmeter
 - b. Cyclometer
 - c. Ammeter
 - d. Footcandle meter

9. Which of the following utility scale battery installations will have the lowest operating cost in kWh:

- a. Lead Acid
- b. Lithium Ion
- c. Sodium Sulfur
- d. Vanadium Redox
- e. Zinc Bromine

10. An EMP that costs \$19,150 and is projected to save \$6,000 annually over its 12 year life. If the Company doing this project requires a MARR of 20%. Should the Company invest in the EMP?

- a. Yes, the IRR is >20%
- b. No, the IRR is <20%

11. A Company is comparing 2 projects. The first Project has a NPV of \$23,000. The second project costs \$140,000. Both projects have a estimated life of 15 years, if the second project will save \$32,000 annually, which project should the Company invest in if their discount rate is 20%?

- a. The first project
- b. The second project

12. An electric utility bases its billing on the rate schedule shown below. Calculate the monthly bill for an industrial firm that uses 395,000 kWh per month with an actual demand of 612 kW. The highest demand in the previous 11 months is 459 kW. The plant's power factor is 85% and the facility has a ratchet clause:

Customer charge: \$532 per Month

Electrical consumption:

First 100,000 kWh \$0.075 per kWh

All over 100,000 kWh \$0.045 per kWh

Demand:

80% Demand ratchet, based on the highest demand recorded during the previous 11 months Demand charge \$9.50 per kW per month

Power Factor:

Demand is increased 0.5% for each 1% that the power factor is less than 75%. If the power factor is greater than 75%, there is no penalty, or reward.

- a. \$20,775
- b. \$25,136
- c. \$27,121
- d. \$28,886

13. When assembling information for an RFP for the purchase of electricity, interval information obtained from a local utility will be provided by the utility:

- a. Free of charge
- b. Always at a cost
- c. For a cost with some providing for free
- d. Free if obtained through a power broker association
- e. Free if obtained through an affiliate marketer

14. During which phase of commissioning would overseeing testing occur:
- Testing phase
 - Balancing phase
 - Proposal phase
 - Construction phase
 - a and b
15. According to ISO 50001, which of the following is not required by top management to meet the requirements of the standard:
- Appoint an energy management representative
 - Appoint an energy management team
 - Consider energy performance when performing long term planning
 - Maintain an energy policy which is communicated to those in the organization
 - None of the above, all are required
16. Under the Energy Star program, what is the typical range of savings seen in lighting energy usage from installing occupancy sensors in an office:
- 15 – 30%
 - 25 – 50%
 - 40 – 55%
 - 50 – 60%
17. How many therms are there in a gallon of light fuel oil:
- .71
 - .91
 - 1.4
 - 1.71
18. A Company Energy Manager purchases 20 gas futures at NYMEX for a determined amount of cash. The facility is located near Minneapolis, Minnesota. Should the Energy Manager budget any more dollars for the transaction to use the gas at their facility:
- No, when this gas is purchased, the price includes delivery to the facility
 - Yes, when this gas is purchased, the price does not include delivery to the facility
19. An Energy Manager is making plans to achieve their facility energy efficiency requirements by the Energy Cost Budget Method. Which of the following items could he/she use to meet the requirements:
- Shift to TOU rates
 - Shift to a Flat rate
 - Shift to an economic development rate
 - Sign up for a standby generator program
 - All of the above

20. An Energy Manager is preparing to perform an economic analysis. The analysis will be performed comparing two boilers. The first boiler has a life expectancy of 15 years and costs \$35,000. The second boiler has a life expectancy of 18 years and costs \$45,000. Which of the following economic evaluation methods would provide the most accurate economic analysis:

- a. Simple Payback
- b. Net Present Value
- c. Annual Value
- d. Any of the above

21. In a study performed in California, what is the premium range per square foot for a “Green” building:

- a. \$2.00 - \$4.00 per square foot
- b. \$3.00 - \$5.00 per square foot
- c. \$4.00 - \$6.00 per square foot
- d. \$5.00 - \$7.00 per square foot

22. A Utility Account Representative for a hospital prepares some benchmarking information for a Customer. In the packet of information the Representative included the facility’s annual 1999 energy consumption of 8.6 million kWh. The facility is all conditioned space and has 150,000 square feet. The facility had an annual average load factor of 65%. Based upon this information, when compared to other hospitals, does this hospital use more than or less energy per year than the national average:

- a. The facility energy use is lower than the national average for like facilities
- b. The facility energy use is higher than the national average for like facilities
- c. Not enough information

23. In the LEED program, the supporting information for the award levels takes into consideration Transmission and Distribution losses:

- a. True
- b. False

24. One of the main goals of M&V is to provide information that is more valuable than it costs to obtain:

- a. True
- b. False

25. An Energy Manager wants to better understand the energy consumption characteristics of large loads within one of the organization’s facilities. To do this, which one of the following would be a method to obtain the needed information:

- a. Regression modeling
- b. Energy Use Index comparison
- c. Load research provided by sub-metering
- d. All of the above

26. Which legislation enabled that the first sale of natural gas was to be free of any federal pricing:
- FERC Order 436
 - FERC Order 772
 - FERC Order 888
 - FERC Order 889
 - Natural Gas Wellhead Decontrol Act
27. A lighting ballast does all of the following except:
- Prepares the lamp to start by reducing the voltage applied and subsequently cools the filaments
 - Provides a spike of high voltage to start the gas discharge process
 - Provides a reduction in current flow by inserting a current limiter for safe and sustained operation of the lamp after starting
 - None of the above
28. During combustion in a gas boiler, water vapor is formed from the combustion of hydrogen. What type of boiler allows enough time for this vapor to collapse back to water in the boiler exhaust:
- Natural draft boiler
 - Forced draft boiler
 - Balanced draft boiler
 - Condensing boiler
 - All of the above
29. How many therms of energy are in a 20 gallon tank of propane: (use a propane Btu content of 95,000 per gallon)
- 9.5 therms
 - 19 therms
 - 21 therms
 - 42 therms
30. An energy audit that includes obtaining equipment operating and maintenance procedures is:
- Type I
 - Type II
 - Type III
 - Investment grade
 - Master audit
31. An energy saving device costs \$45,000 and will save \$227,500 over the life of the project. The savings will be obtained evenly for each of the 20 years of operation. What is the approximate internal rate of return:
- 10%
 - 12%
 - 15%
 - 20%
 - 25%

32. A new device costs \$72,000 installed. The device will last 15 years at which time it will have to be replaced. How much will it have to save each year to obtain a 20% return on investment before taxes:

- a. \$3,600
- b. \$7,200
- c. \$15,400
- d. \$18,000

33. What would be the preferable order (with cost per MMBtu) for selection from the following three fuel sources that could be used in a boiler given the fuel type, fuel cost, and efficiency (for Propane use 1 gallon of propane = 95,000 Btu):

Natural Gas = \$1.2 per therm, boiler with natural gas is 68% efficient

Propane = \$1.86 per gallon, boiler with propane is 66% efficient

Electric = \$0.09 per kWh (blended cost), boiler with electric is 96% efficient

- a. Natural gas(\$8.16/MMBtu), Propane (\$27.40/MMBtu), Electric (\$29.55/MMBtu)
- b. Electric (\$8.16/MMBtu), Natural gas (\$16.32/MMBtu), Propane (\$25.25/MMBtu)
- c. Propane (\$9.85/MMBtu), Natural gas (\$16.32/MMBtu), Electric (\$29.55/MMBtu)
- d. Natural gas(\$17.65/MMBtu) , Electric (\$27.40/MMBtu), Propane (\$29.55/MMBtu)

34. A facility has \$100,000 to invest in energy efficiency projects. Project One has a NPV of \$24,000. Project Two returns \$21,206 per year for 20 years. With a discount rate of 15%, which project is preferable: (both project life times are the same)

- a. Project One
- b. Project Two
- c. Either project, their NPV's are the same

35. During an energy assessment, a project is identified to replace a specific system. The replacement system has a calculated simple payback of five years. When comparing only the current systems annual energy usage with the new proposed system, what should be the expected range of energy savings:

- a. 5 to 15%
- b. 15+ to 30%
- c. 30+ to 45%
- d. 45+ to 60%

36. A lighting survey of a 5000 square foot office building identified the following fixtures:

40 - 4 tube troffers @ 192 watts/fixture

20 - 100 watt incandescent floodlights

20 - 75 watt plug-in task lamps

What is the lighting watt density of this facility:

- a. 2.24
- b. 4.48
- c. 6.72
- d. 8.96

37. A 911 call center has an unmanned computer support/server room that produces 240,000 Btu per hour of heat from the equipment and lights. How many tons of air conditioning is needed just to remove the heat from the equipment and lights from this room:

- a. 15.4
- b. 20.0
- c. 25.4
- d. 30.4

38. A motor nameplate indicates the HP rating is 50 HP of an energy efficient motor. This indicates the motor will use 50 HP of electrical power over its entire load curve:

- a. True
- b. False

39. How much will an air leak cost a facility annually if it has a leak hole that is 1/16 in diameter at a pressure of 110 PSI and it goes unrepaired for three months: (based upon 7 cents per kWh)

- a. \$110.25
- b. \$146.42
- c. \$586.25
- d. \$438.75

40. An Energy Manager purchases a motor with a NEMA efficiency marking of 87.5%. Which of the following statements is true regarding the actual efficiency of the motor:

- a. The efficiency will be exactly 87.5%
- b. The actual efficiency will always be at least 87.5%
- c. The actual efficiency will not be less than 85.5%
- d. None of the above

41. What percentage of building failures will typically have low consequences and occur frequently:

- a. 5%
- b. 10%
- c. 90%
- d. 95%

42. Which higher learning organization facilitates the Continuous Commissioning Program:

- a. University of Oklahoma
- b. Texas A&M University
- c. Georgia Institute of Technology
- d. University of Florida

43. Which of the following standards is IEEE developing for Distributed Resources Interconnected with Electric Power Systems:

- a. IEEE P 1343
- b. IEEE P 1547
- c. IEEE P 1639
- d. IEEE P 1823

44. CHP stands for:
- Cooling, Heating and Power
 - Combined Heat and Power
 - Cogenerated Heat and Power
 - Cooling and Heat Procurement
45. What is the efficacy of an induction lamp:
- 40 L/W
 - 50 L/W
 - 60 L/W
 - 70 L/W
 - 80 L/W
46. This type of motor has the best torque properties:
- Direct Current
 - Induction
 - Synchronous
 - Squirrel cage
 - None of the above, it solely depends on voltage and the AC frequency
47. Which of the following is not a server-side program application:
- Fox web
 - Cold Fusion
 - Cold Fission
 - Java Servlets
 - Java Server Page
48. After performing a benchmarking survey, a 12 month rolling summary graph is constructed analyzing whole facility energy consumption. The graph looks like a shark tooth pattern. What does this pattern tell us regarding the operations of the facility:
- Energy usage is decreasing
 - Energy usage is increasing
 - The facility operates differently in its daily operations from day to day
 - The facility could lower energy costs by changing to TOU rates
 - Cannot tell any of the above
49. The IPMVP was established from which M&V Protocol:
- North American Energy Measurement & Verification Protocol
 - American Measurement & Verification Protocol
 - World Energy Measurement & Verification Protocol
 - None of the above

50. Which of the following is considered a non-routine adjustment in an M&V Plan:
- An adjustment made when energy usage changes by more than 10%
 - An adjustment made annually due to degree day changes
 - An adjustment made when energy usage changes dramatically but predicted
 - An adjustment made when energy usage changes dramatically but was unpredicted
 - All of the above

Answer Key Practice Test 2:

1. D	11. A	21. B	31. E	41. C
2. C	12. C	22. B	32. C	42. B
3. C	13. C	23. B	33. D	43. B
4. B	14. D	24. A	34. B	44. B
5. D	15. E	25. C	35. B	45. C
6. A	16. B	26. E	36. A	46. A
7. A	17. C	27. A	37. B	47. C
8. C	18. B	28. D	38. B	48. C
9. C	19. D	29. B	39. A	49. A
10. A	20. C	30. E	40. C	50. D

Business Energy Professional Practice Test #3

1. Which of the following is not one of the items needed to control to have good indoor air quality:
 - a. Relative humidity
 - b. Good filtration of $MERV < 6$
 - c. Good moisture control
 - d. HEPA filters on cleaning devices
 - e. None of the above – they are all needed
2. How many kWh's are in 2.6 MMBtu:
 - a. 76.2
 - b. 762
 - c. 1498
 - d. 2198
 - e. 2898
3. In the LEED NC Certification, how many different categories are there for points:
 - a. Five
 - b. Six
 - c. Seven
 - d. Eight
 - e. Nine
4. Which of the following is the chemical symbol for methane:
 - a. CH_2
 - b. CH_2O_4
 - c. CH_3
 - d. CH_4
 - e. C_2H_4
5. Fuel costs can be measured and tracked within the EPA's portfolio manager program:
 - a. True
 - b. False
6. If a particular HVAC system has its EER increased by 20%, by what percentage does the kW/ton rating change:
 - a. 17%
 - b. 20%
 - c. 37%
 - d. 58%
 - e. 83%

7. A lighting survey of a 15,000 square foot facility identified the following fixtures:
160 – T8 - 4 tube troffers @ 108 watts/fixture
120 - 8 watt LED directional lamps
80 - 23 watt induction task lamps

What is the lighting watt density of this facility:

- a. 1.339
 - b. 2.211
 - c. 2.403
 - d. 3.303
 - e. 3.411
8. What is the operating cost in MMBtu for a fuel oil fired oven that has an efficiency of 67%, a fuel oil cost of \$3.68 per gallon, and operates 6,700 hours in a given year:
- a. \$39.23/MMBtu
 - b. \$49.10/MMBtu
 - c. \$102,000/MMBtu
 - d. \$152,100/MMBtu
 - e. \$262,857/MMBtu
9. Which governmental agency develops energy standards:
- a. Department of Energy
 - b. Environmental Protection Agency
 - c. Department of Energy Affairs
 - d. Department of Energy Standards
 - e. None of the above
10. The most valuable result of benchmarking is:
- a. Provides how well you're doing against like facilities
 - b. Provides how well you're doing against your competition
 - c. Provides a starting point for future changes
 - d. Provides a reporting mechanism for results and future action
 - e. Provides a reporting mechanism to meet regulatory requirements
11. Tracking the occupancy of a facility for benchmarking is considered:
- a. Tracking a dependent variable
 - b. Tracking occupancy for cost allocation
 - c. Tracking occupancy for growth forecasting
 - d. Tracking an independent variable
 - e. Tracking occupancy for cost assignment
12. Over the life of an induction lamp, the light output will diminish by what percentage:
- a. 15%
 - b. 20%
 - c. 25%
 - d. 30%
 - e. 35%

13. The application of technical and economic principles to the control of energy use and energy costs is:
- Energy management
 - Basis for an energy management program (EMP)
 - Basis for a sustainable program
 - The first requirement for LEED Certification
 - The first step in filling out the Energy Star Portfolio Manager
14. A heat exchanger which can be used for multiple purposes is:
- Shell and tube
 - Split shell and tube
 - Plate and frame
 - Spiral tube
 - Nixie tube
15. During an energy assessment, a project is identified to replace a specific system. The replacement system has a calculated simple payback of two years. When comparing only the current systems annual energy usage with the new proposed system, what should be the expected range of energy savings:
- 5 to 15%
 - 15+ to 30%
 - 30+ to 45%
 - 45+ to 60%
16. Which technology is referred to as the 4th utility:
- Motors
 - Compressed air
 - Boilers
 - Lighting
 - Building envelope
17. An HVAC unit has a COP of 5.6, what is the equivalent EER to this unit:
- 0.63
 - 5.6
 - 17.1
 - 19.1
 - 24.1
18. Calculate the point of use cost in MMBtu for electricity at \$0.125/kWh and at 96% combustion efficiency:
- \$11.61 per MMBtu
 - \$13.92 per MMBtu
 - \$35.17 per MMBtu
 - \$36.64 per MMBtu
 - \$38.16 per MMBtu

19. A facility just installed a large HVAC unit and they believe the unit is over-sized. The facility has a maximum daily heat load of 875,000 Btu/hr that occurs each day for 4 hours. The HVAC unit has a capacity of 100 tons. Is the HVAC unit over- sized for this facility:
- Yes
 - No
20. Which FERC rule covers the rate regulation of certain natural gas storage facilities:
- 436
 - 500
 - 636
 - 678
 - 888
21. Efficacy of a lighting system is measure in:
- Lumens
 - Foot candles
 - Lux
 - Lumens per Watt
 - Foot candles per Watt
22. A motor has a nameplate that lists the speed at 1780. During an energy audit the motor was measured at an actual speed of 1785. What is the amount of load on the motor in percent:
- 25%
 - 50%
 - 75%
 - 100%
 - Need more data to determine
23. A 100 HP was slowed down by 15%, what is the new HP required by the motor:
- 100.00 HP
 - 85.00 HP
 - 75.00 HP
 - 61.41 HP
 - 50.00 HP
24. An energy saving device costs \$133,000 and will save \$27,000 each year that the unit is operation. The device is projected to last 12 year. If the discount rate is 15%, would you recommend this project:
- Yes
 - No

25. A new device costs \$98,000 installed. The device will last 10 years at which time it will have to be replaced. How much will it have to save each year to obtain a 25% return on investment:
- \$18,750
 - \$20,225
 - \$24,500
 - \$25,750
 - \$27,450
26. Two projects that have the same expected life are being evaluated for purchase, but only one can be chosen. The first project has a NPV of \$45,000 while the second project cost \$350,000 and will save \$65,000. The hurdle rate for the organization is 12% and the projects last 15 years. Which project would you recommend:
- Project One
 - Project Two
 - Neither
27. A new device will save \$72,000 each year that is installed. The device will last 15 years at which time it will have to be replaced. How much can the company spend on the new device and still meet the financial requirements to obtain a 20% return:
- \$193,111
 - \$213,998
 - \$285,900
 - \$336,636
 - \$433,666
28. As a financial best practice when ranking projects by simple payback, which of the following should be done:
- Display the life of the project next to the ranking
 - Display the simple payback of all projects, even if they are combined
 - Display the cost and savings of the project next to the ranking
 - All of the above
 - None of the above
29. Energy audit(s) that is (are) considered investment grade include:
- Type I
 - Type II
 - Type III
 - All of the above
 - B and C only
30. In the Energy Star program, the supporting information for the award levels takes into consideration Transmission and Distribution losses:
- True
 - False

31. Btu/square foot/year is a measure of:
- Energy usage index
 - Energy utilization index
 - Energy use index
 - All of the above
 - A and B only
32. An Energy Manager is reviewing their electrical bill for Facility "A". They notice that the demand listed on the bill is 250 kW, the load factor is 74%, and the power factor is 80%. What is the average demand over the entire billing period she is reviewing:
- 185
 - 250
 - 338
 - 385
 - 450
33. In 2015, What percentage did renewables contribute to the overall Energy Supply in the United States:
- 9.45%
 - 10.88%
 - 11.36%
 - 12.35%
 - 26.23%
34. Why do utilities charge a power factor charge:
- The utility has to deliver more current for the same kW billed
 - The utility has to install capacitors to compensate
 - The utility has to install inductors to compensate
 - The utility has to install load shedding equipment
 - All of the above
35. Which on the following statements most accurately explains how an electric utility measures demand kW:
- Monthly kWh divided by the hours in the month
 - The kilowatt load averaged over a short specified interval of time
 - The measurement of the largest instantaneous kW usage
 - The measurement of the longest instantaneous kW usage
 - The measurement of the shortest instantaneous kW usage
36. During commissioning, which of the following is primarily completed during the design phase:
- Conducting pre-bid meetings
 - Defining the selection process for the request for proposals
 - Developing the budgeting guidance for commissioning
 - Determine if retro-commissioning will be cost effective
 - Putting together the construction checklists for observation

37. Following the refrigeration flow path in a vapor compression cycle, what component immediately follows the compressor:
- Condenser
 - Evaporator desuperheater
 - Evaporator
 - Expansion valve
 - Flow limiting coil
38. Why are evaporative heat exchangers so more energy efficient than other heat exchangers:
- They utilize sensible heat change
 - The utilize phase change
 - They utilize multiple baffle heat exchange coil arrangement
 - They do not have heat exchanger coils
 - They have a higher area for heat transfer
39. In August, the average temperature during the week was 81 degrees, how many cooling degree days were added during this time frame:
- 6
 - 16
 - 32
 - 48
 - 112
40. What operational function is performed in the controller in a closed feedback control system:
- Comparison of the actual measurement to the set point
 - Development of the error signal
 - The error signal is sent to the actuator
 - Provide the ability to change the set point
 - All of the above
41. IPMVP stand for:
- International protocol for measurement and verification professionals
 - International protocol for measurement and verification performance
 - International performance measurement verification protocol
 - International protocol for measurement and verification protocols
 - International proposed meaningful verification protocols
42. A transmission system is designed for 138,000 volts. This voltage would make this transmission line classified as:
- Bulk transmission
 - Distribution
 - Distribution transmission
 - Sub-transmission
 - Zero-transmission

43. A facility has the following information, Calculate the utility bill for the given month (ignore taxes):

Billing period:	30 days
Month energy:	300,000 kWh
Monthly demand:	550 kW
Highest demand in last year:	726 kW
Customer charge:	\$45.00
Energy charge:	4.2 cents/kWh
Fuel charge:	3.5 cents/kWh
Demand charge:	\$18.43/kW-Month

- a. \$13,422
 - b. \$25,698
 - c. \$33,281
 - d. \$45,754
 - e. \$52,998
44. From problem 43, what is the facilities Load Factor:
- a. 24.2
 - b. 55.0
 - c. 62.2
 - d. 75.8
 - e. Cannot determine, inadequate information
45. From problem 43, what is the facilities power factor:
- a. 24.2
 - b. 55.0
 - c. 62.2
 - d. 75.8
 - e. Cannot determine, inadequate information
46. From problem 43, what was the average demand over the entire month:
- a. 133
 - b. 276
 - c. 332
 - d. 417
 - e. 726
47. Which electric rate contains the least price risk:
- a. Flat rate
 - b. Real time pricing rate
 - c. Real time fixed rate
 - d. Real time dynamic rate
 - e. Dynamic pricing rate

48. A bakery that only makes icing filled sponge cakes operates on a 24/7 basis. This past year they made 11.5 million of these products and in doing so used 9.6 million kWh. This past year was considered a base year since the year prior they did many total quality management and LEAN activities. Next year, they are projecting to produce 14 million of their products. If their blended energy cost is \$0.12/kWh. How much would you recommend them to budget for electricity this next year:
- \$1,402,435
 - \$1,802,200
 - \$2,012,500
 - \$2,412,500
 - \$2,887,500
49. A facility has \$250,000 to invest in energy efficiency projects. Both projects are estimated to last the same time. Project One has a NPV of \$24,000. Project Two has a NPV of \$26,500. With a discount rate of 15%, which project is preferable:
- Project One
 - Project Two
 - Cannot differentiate projects, not enough given data
50. Which of the following is not an individual component of an enthalpy wheel ERV:
- Heat exchanger
 - Belt
 - Motor
 - Inlet fan
 - None of the above, all are components

Answer Key Practice Test 3:

1. B	11. D	21. D	31. D	41. C
2. B	12. D	22. C	32. A	42. D
3. E	13. A	23. D	33. B	43. C
4. D	14. C	24. A, NPV = \$13,356	34. A	44. D
5. A	15. A	25. E	35. B	45. E
6. A	16. B	26. B, Project 2 NPV = \$92,709	36. E	46. D
7. A	17. D	27. D	37. A	47. A
8. A	18. E	28. D	38. B	48. A
9. E	19. A	29. E	39. E	49. B
10. C	20. D	30. A	40. E	50. D

Business Energy Professional Practice Test #4

1. A facility in Oregon has a total square footage of 23,000 ft². The facility is converting 30 office and cubical areas into a reception area. The new reception area will be 2,000 ft² and is being designed to accommodate 90 attendees. This new area will require how much outdoor air flow rate per minute:
 - a. 570
 - b. 690
 - c. 990
 - d. 1,710
 - e. 1,830
2. Which of the following is considered a future fuel:
 - a. Nanotechnology
 - b. Nanobit Technology
 - c. Globatechnology
 - d. Titan exploration and capture
 - e. Carbon exploration and capture
3. A university campus facility with just classrooms during the 4 weeks of school in September used 265,000 kWh of energy. The average temperature in September was 88°. During the 4 weeks of school in October the average temperature was 82°. What would the energy consumption be in the month of October:
 - a. 113,872 kWh
 - b. 132,320 kWh
 - c. 195,870 kWh
 - d. 246,932 kWh
 - e. 283,068 kWh
4. What is the EUI of a facility which has 113,000 square feet of conditioned floor space and used the following fuel amounts in 2013:

Electricity:	824,000 kWh
Natural gas:	46,987 therms
Light heating oil:	26,000 gallons

 - a. 91,256.22 Btu/ft²/yr
 - b. 98,674.23 Btu/ft²/yr
 - c. 112,989.84 Btu/ft²/yr
 - d. 126,983.34 Btu/ft²/yr
 - e. 142,532.32 Btu/ft²/yr

5. An energy manager is evaluating the potential switching of one fuel to another. The current fuel used in the technology is propane. The propane has a Btu/gal content equal to 91,600 Btu/gal. When the technology uses propane the efficiency of the equipment is 81%. The current contract price for propane is \$2.53/gal. If the technology can be switched to natural gas its efficiency will increase to 85%. What would the current price of natural gas have to be under to make this project attractive:
- \$0.89/Therm
 - \$1.43/Therm
 - \$2.90/Therm
 - \$11.43/Therm
 - \$21.71/Therm

6. An energy audit of a large hotel has just been performed. During the audit one of the areas for ECM identification was the large centrifugal chiller and its associated components. Several measurements were taken during the audit including the following:

Chill water supply temperature:	43°
Chill water return temperature:	54°
Condenser water supply temperature:	97°
Condenser water return temperature:	88°

If the chill water supply temperature was increased to 46°, what would the approximate efficiency gain in efficiency be for the chiller:

- 1.5%
 - 3.0%
 - 4.5%
 - 6.0%
 - 7.5%
7. An energy audit of an industrial complex is in progress. One of the energy analysts has just reported to you that there is a compressed air system that has several leaks. One of the leaks is on an air supply hose. The leak on the hose was caused by a forklift that drove over it and crimped it making a hole that is approximately $\frac{1}{4}$ inch in diameter. The hose is 100 feet long and will cost \$250 to replace it. If the compressed air system operates at 110 psi and the blended cost of energy is \$0.11/kWh. What is the simple payback in years to replace this hose:
- 0.023 years
 - 0.46 years
 - 1.21 years
 - 2.23 years
 - 3.45 years
8. How many kWh's are in 140,000 gallons of #2 fuel oil:
- 3,412 kWh
 - 10,000 kWh
 - 140,000 kWh
 - 1,140,000 kWh
 - 5,744,431 kWh

9. In LEED NC, what is the maximum number of points that a facility can earn toward this certification:

- a. 101
- b. 105
- c. 110
- d. 115
- e. 116

10. A facility has the following information, Calculate the utility bill for the given month (ignore taxes):

Billing period:	30 days
Month energy:	421,900 kWh
Monthly demand:	900 kW
Monthly kVA:	1,008 kVA
Customer charge:	\$1,200.00
Energy charge:	3.8 cents/kWh
Fuel charge:	3.2 cents/kWh
Demand charge:	\$11.50/kW-Month

- a. \$19,422
- b. \$25,698
- c. \$27,582
- d. \$30,116
- e. \$41,083

11. From problem 10, what is the facilities Load Factor:

- a. 39.3
- b. 49.4
- c. 65.1
- d. 89.3
- e. Cannot determine, inadequate information

12. From problem 10, what is the facilities power factor:

- a. 39.3
- b. 49.4
- c. 65.1
- d. 89.3
- e. Cannot determine, inadequate information

13. From problem 10, what was the average demand over the entire month:

- a. 133
- b. 276
- c. 332
- d. 417
- e. 586

14. From problem 10, what was the facilities blended cost:
- \$0.0700
 - \$0.0780
 - \$0.0831
 - \$0.0973
 - Cannot determine, inadequate information
15. A utility is preparing for a rate hearing. The first order being discussed is determining what the appropriate amount to charge a specific customer class for the infrastructure required of the utility to support them. Which of the following rate components is being discussed:
- Capacity charge
 - Customer charge
 - Demand charge
 - Energy charge
 - A and C
16. An energy manager is exploring installing induction lamps for their facility to replace their existing metal halide lamps. What is the rated life of a 154 Watt induction lamp:
- 15,000 hours
 - 18,000 hours
 - 21,000 hours
 - 23,000 hours
 - 100,000 hours
17. A facility manager is researching whether or not they should replace their existing compressed air compressor. The facility has found an air compressor she would like to purchase and it will cost \$78,000. This air compressor requires an annual maintenance cleaning which costs \$2,500. If the compressor will last 10 years and the hurdle rate of the organization is 15%, how much will this air compressor have to save annually in order to meet the financial requirements of the organization:
- \$13,338
 - \$14,822
 - \$15,838
 - \$16,732
 - \$18,045
18. A micro modulation control system uses up to four channels to control which of the following devices:
- Control actuators
 - Control line feedback synchronizers
 - Independent servomotors
 - Feedback set point comparison protocols
 - Commissioning control chains

19. Which of the following is not a type of fuel cell:
- Alkaline
 - Solid Oxide
 - Stack type
 - Phosphoric Acid
 - None of the above, they are all types of fuel cells
20. Natural gas that comes from a processing plant is measured by adjusting the temperature of the gas to 60 degrees then adjusting it for the pressure it will be under when it gets to the local distribution company:
- True
 - False
21. Which piece of legislation created the single natural gas market:
- ASHRAE 90.1
 - Energy Policy Act 1992
 - Natural Gas Policy Act
 - IECC 1991
 - None of the above
22. A project that has been in place for a couple of years is performing exactly how it was projected in its LCC justification. The technology is saving on an annual basis \$313,000 annually on energy and demand expenditures. The technology will last 15 years. If the technology cost \$1,023,000 to install. What is the true rate of return on this project?
- 10%
 - 12%
 - 15%
 - 20%
 - 30%
23. An energy project has been determined to have a NPV of \$23,900. If the numbers used to determine this value were changed to ATCF numbers and the MARR was held constant, what would happen to the NPV:
- It would decrease
 - It would stay the same
 - It would increase
 - It could decrease or increase depending on the overall tax rate
 - It could decrease or increase depending on the amount of depreciation

24. A project is being considered for an unknown company that will cost \$100,000 and has an annual savings of \$23,850 each year that it is in operation. If the project will last 10 years. In order for this project to be feasible what is the minimum MARR level that would make this attractive:
- 10%
 - 12%
 - 15%
 - 20%
 - 25%
25. Given the following information below regarding the three projects, which evaluation method would provide the most accurate life cycle cost analysis:
- Annual Value
 - Future Value
 - Internal Rate of Return
 - Net Present Value
 - Simple Payback

	Project 1	Project 2	Project 3
Cost	\$200,000	\$185,000	\$365,000
Annual Savings	\$45,000	\$46,625	\$97,125
MARR	20%	15%	25%
Annual Maintenance	\$0.00	\$5,000	\$15,000
Project Life	10 years	10 years	10 years
Project Maturity	Very Mature	Mature	Not Mature
Salvage Value	\$0.00	\$0.00	\$0.00

26. A project is predicted to save \$875,000 on an annual basis. If the organization's discount rate is 15% and the project will last 20 years, how much can the organization spend on the new project:
- \$56,988
 - \$149,711
 - \$289,856
 - \$1,497,110
 - \$5,476,888
27. Which of the following would cause the NPV of a project to become more positive:
- Increasing MARR
 - Increasing purchase price
 - Increasing electric rates
 - Decreasing the project life
 - None of the above, all of these would cause NPV to become less positive

28. In 2015, an area of the United States experienced 2,920 cooling degree days for the year. Assuming that there were no heating degree days, what was the average temperature at this location for the year:
- 63°
 - 67°
 - 71°
 - 73°
 - 77°
29. When performing risk management and mitigation during the decision making process for a specific project, when looking at the depth and breadth of skills required by this specific project is considered what type of characteristic:
- Project characteristic
 - Financial characteristic
 - Technology characteristic
 - Team characteristic
 - Team member characteristic
30. Which executive order required federal facilities to reduce their water consumption by 2% per year through 2025 as compared to their 2007 water usage:
- EPACT 2005
 - EISA 2007
 - EO 13693
 - EO 200415
 - NECPA 2005
31. An energy manager is performing an inspection of a large boiler. Looking through the viewing glass on the boiler, they can see the flame as it heats the gases before flowing through the tubes. The boiler operates for approximately 7,000 hours per year and operates for heating domestic hot water. Which of the following types would this boiler be categorized by:
- Fire tube boiler
 - Power boiler
 - Power coupled boiler
 - Water tube
 - Water lancing
32. In 2015, what net percentage of natural gas was imported into the United States:
- 4.3%
 - 8.3%
 - 11.4%
 - 12.4%
 - 14.4%

33. An energy manager is considering the installation of an energy recovery ventilation unit for their facility. According to the Department of Energy, what is the typical HVAC energy savings for a facility that installs one of these pieces of equipment:
- 11%
 - 15%
 - 20%
 - 24%
 - 30%
34. FERC Order 888 specifically addressed two components within the regulation of utilities. The first was that it proposed that regional transmission operations would be more effective than local governed operations. Which of the following was the second component addressed:
- Open access and stranded cost recovery
 - Voltage planning on a regional scale
 - Formally documented that the operating frequency in the United States will be 60 hz
 - Required the establishment of the OASIS system
 - Required the establishment of the NOPR rulemaking system
35. A 200 HP motor that turns a pump that is pumping water has its speed slowed down by 22%. By what percentage does the flow rate change:
- 22.00
 - 49.88
 - 94.91
 - 105.09
 - 200.00
36. A lighting survey of a 25,000 square foot office facility identified the following fixtures:
160 – T8 - 4 tube troffers @ 108 watts/fixture
120 - 8 watt LED directional lamps
80 - 23 watt induction task lamps
- What is the minimum lighting levels that should be in the facility at the working surface:
- 30 fc
 - 40 fc
 - 50 fc
 - 60 fc
 - None of the above
37. A heat exchanger that is designed for oils and other viscous fluids would be classified as which of the following types:
- Shell and tube
 - Spiral
 - Round about
 - Plate and frame
 - Plate and oil core

38. In an industrial plant the power factor is measured at 87%, if kW was measured at 1,500 kW. What was the amount of kVA being delivered by the utility to the customer at this point:
- 1,274 kVA
 - 1,500 kVA
 - 1,724 kVA
 - 1,900 kVA
 - Cannot determine, need facility load factor to solve

39. A facility energy manager of an 8,000 square foot warehouse operation in 1999 wants to know how they are doing in regards to energy efficiency against their peers across the United States. The facility manager has logged the following annual energy usages:

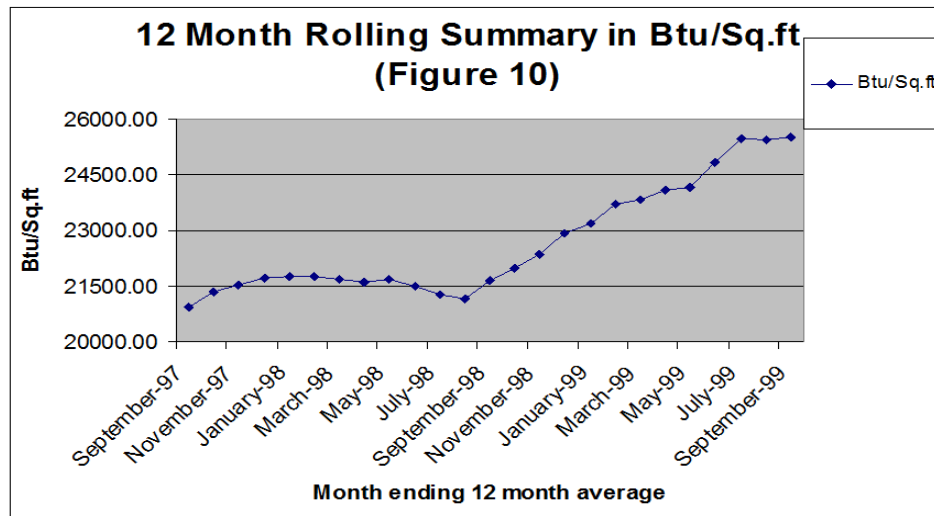
Electricity from bills:	66,882 kWh
Propane for lift trucks:	900 gallons (Btu content = 94,000 Btu/gal)
Diesel for generator:	280 gallons

How is this facility performing in regards to its energy usage per square foot on an annual basis:

- Their energy usage is lower
 - Their energy usage is the same
 - Their energy usage is higher
 - Cannot determine, inadequate information
40. A heating oven with 25 kW resistive elements is being checked for energy and electrical usage, which of the following would NOT be a realistic measurement for this oven:
- Demand measured at 25 kW during the initial heat up cycle
 - Instantaneous power measured at 25 kW
 - Energy measured at 300 kWh for one day of operation
 - Power factor measured 95% during the initial heat up cycle
 - None of the above, all measurements are realistic
41. If a particular HVAC system had an EER of 25, what is the equivalent COP:
- 2.52
 - 7.33
 - 18.28
 - 28.52
 - 85.30
42. A study was conducted in 2003 to determine the premium for a green building. At this time the average premium was evaluated as what percentage:
- $\leq 2\%$
 - 3 – 5%
 - 6 – 7%
 - 8 – 10%
 - 11 – 13%

43. Following the refrigeration flow path in a vapor compression cycle, what happens to the refrigerant as it goes through the compressor:
- Pressure decreases and temperature lowers
 - Pressure decrease and temperature increases
 - Pressure increases and temperature lowers
 - Pressure increases and temperature increases
 - The refrigerant expands through compression
44. \$/square foot/year is a measure of:
- Energy usage index
 - Energy utilization index
 - Energy cost index
 - All of the above
 - A and B only
45. CRI stands for what:
- Combined rate of increase in a controller
 - Color rendering index for lighting
 - Calibrated rate of interest in life cycle costing
 - Correlated rendering increase for kitchen equipment
 - All of the above
46. Two projects that have the same expected life are being evaluated for purchase, but only one can be chosen. The first project has a NPV of \$45,000 while the second project cost \$100,000 and will save \$5,000. Both projects will last 10 years. Which project would you recommend:
- Project One
 - Project Two
 - Neither
 - Cannot answer question, inadequate information

47. You have just been given the following chart from one of your energy engineers that reports to you and he asks you to explain what happened in this graph. Which of the following answers below would be Most correct:



- a. In September 98 there was a rate increase
 - b. In September 98 the outside temperature started to increase
 - c. In September 98 we added a piece of energy efficient piece of equipment to the facility
 - d. In September 98 we replaced an old piece of equipment with a new one
 - e. In September 98 we stopped using natural gas
48. Performing M&V is also considered a method to:
- a. Mitigate risk with a project
 - b. Measure the physical characteristics of a piece of equipment
 - c. Measure the non-tangible benefits of a project
 - d. Perform measurement and verification of similar projects
 - e. All of the above
49. A new device will cost \$512,000 when is installed. The device will last 14 years at which time it will have to be replaced. How much will the technology have to save annually and still meet the financial requirements to obtain a 15% return:
- a. \$69,478
 - b. \$77,261
 - c. \$87,552
 - d. \$89,446
 - e. \$3,173,478

50. A facility just installed a large addition of work space. The new area of the facility can hold over 500 people and has various areas which support office, warehouse, production, and even a small fitness area. If the maximum heat load expected from people, equipment, etc. from the new space 1,444,000 Btu/hr, what size of HVAC unit would be required to cool this new areas:
- 86.0 tons
 - 114.0 tons
 - 120.3 tons
 - 144.0 tons
 - 620.3 tons
51. A facility is installing some instrumentation to log a 3-phase electrical system. Which of the following is considered another name for this logging operation:
- Large load metering
 - Poly-phase metering
 - Ring bus metering
 - 4-wire metering
 - Multiplexing metering
52. An energy manager is walking through a facility and taking high level notes regarding the operation and maintenance of their equipment, this walkthrough would be considered which type of energy audit:
- Type I
 - Type II
 - Type III
 - Benchmarking
 - Master
53. Which governmental agency monitors and approves energy standards to become energy codes:
- Department of Energy
 - Environmental Protection Agency
 - Department of Energy Affairs
 - Department of Energy Standards
 - None of the above

54. From the motor nameplate, what is the maximum motor load this motor can be continuously overloaded to, so that damage will not occur to the motor:
- 100%
 - 105%
 - 110%
 - 115%
 - 120%



55. From the nameplate above, what is the synchronous speed of the motor:
- 1725
 - 1800
 - 3600
 - 4500
 - 5350
56. Calculate the point of use cost in MMBtu for natural gas at \$0.78/therm and at 72% combustion efficiency:
- \$0.11 per MMBtu
 - \$5.62 per MMBtu
 - \$10.83 per MMBtu
 - \$25.17 per MMBtu
 - \$32.90 per MMBtu
57. A project costs \$1,786,000 and is projected to last 20 years. The equipment will serve as a heat exchanger capturing waste heat. Because of this design, the heat exchanger will need to be cleaned on an annual basis of a cost of \$25,000. The annual savings of the equipment is \$740,258. What is the true rate of return on this equipment:
- 10%
 - 15%
 - 20%
 - 25%
 - 40%
58. The following two project are being evaluated against each other for implementation, which of the projects would you select as the one to move forward with:

	<u>Project 1</u>	<u>Project 2</u>
Cost:	\$190,000	\$340,000
Annual Savings:	\$55,525	\$123,906
Life:	10 years	5 years
Marr:	20%	20%

- Project 1
 - Project 2
 - Either project
 - Neither project
 - Cannot determine, need more information
59. Which of the following is not considered a method for data collection in metering:
- Direct analog
 - Indirect analog
 - Pulse output
 - Network based digital
 - None of the above, they are all methods of data collection

60. In what step(s) of commissioning is it especially critical to have facility staff involved in the process:
- Pre-design phase
 - Design phase
 - Systems tryout and testing
 - Warranty phase, including contacting vendors
 - Writing and documenting the RFP

Answer Key Practice Test 4

1. A	11. C	21. C	31. A	41. B	51. B
2. A	12. D	22. E	32. B	42. A	52. A
3. C	13. E	23. A	33. A	43. D	53. A
4. B	14. D	24. D	34. A	44. C	54. A
5. C	15. E	25. D	35. A	45. B	55. B
6. C	16. E	26. E	36. C	46. A	56. C
7. A	17. E	27. C	37. B	47. C	57. E
8. E	18. C	28. D	38. C	48. A	58. C
9. C	19. E	29. A	39. B	49. D	59. B
10. E	20. B	30. C	40. D	50. C	60. C