Paper-1: Fundamentals of Energy Audit

Section A

Tick appropriate answer of the following questions on the top page. 1 x 50 =50

1. Which one of the following is not an essential element of energy monitoring and targeting system?
   A. recording C. controlling
   B. forecasting D. reporting
2. By achieving 20% efficiency improvement by 2030, Bangladesh will save
   A. 10 GW C. 7GW
   B. 5GW D. 9GW
3. Power and Harmonic analyzer is not used to measure
   A. power factor C. motor speed
   B. voltage D. frequency
4. Parabolic mirrors are used for
   A. solar heating C. solar cooking
   B. solar cooling D. solar electricity
5. Which one of the following is not a project planning technique?
   A. WBS C. START
   B. CPM D. PERT
6. If heat rate of power plant is 860 kcal/kWh then the cycle efficiency of power plant will be
   A. 41 % C. 100%
   B. 55 % D. 86%
7. The difference between CPM and PERT is
   A. network structure C. time estimation of a task
   B. differentiating critical task assignment D. slack time calculation process
8. Which one of the following is not a direct cost of a project?
   A. salary C. training cost
   B. equipment rental D. lease/rent of the office building
9. If a 1 KW immersion heater is used to heat 10 liters of water at 25°C, what would be the temperature of water after 10 minutes? Assume no losses in the system
   A. 82.3ºC C. 66.3ºC
   B. 39.3ºC D. none of these
10. Which one in the following is a greenhouse gas?
    A. Sulphur Dioxide C. NO_2
    B. Carbon Monoxide D. Methane
11. The ratio of wind power in the wind actually converted into mechanical power and the power available in the wind is about

A. 10%
B. 44%
C. 59%
D. 75%

12. Doppler Effect principle is used in the following instrument
A. lux meter
B. ultrasonic flow meter
C. infrared thermometer
D. flue gas analyze

13. A three phase induction motor is drawing 16 ampere at 440 volts. If the operating power factor of the motor is 0.90 and the motor efficiency is 92%, then the mechanical shaft power output of the motor is
A. 12.04 kW
B. 10.97 kW
C. 10.09 kW
D. none of these

14. Which one of the following terms does not refer to specific energy consumption
A. kWh/ton
B. kCal/ton
C. kJ/kg
D. kg/kCal

15. The major share of energy loss in a thermal power plant is in the
A. generator
B. boiler
C. condenser
D. turbine

16. A 400W lamp was switched on for 10 hours per day. The supply volt is 230V (current= 2 amps & PF= 0.8). What is the energy consumption per day?
A. 3.68 kWh
B. 6.37 kWh
C. 0.37 kWh
D. 4.0kWh

17. Hydrometer is used for the measurement of
A. viscosity
B. density
C. water content
D. humidity

18. Furling speed of wind turbine indicates
A. cut-out speed
B. cut in speed
C. rated speed
D. none of these

19. One Silicon cell in a PV module typically produces
A. 0.5 V
B. IV
C. 2V
D.12V

20. A geothermal field may yield
A. dry steam
B. hot air
C. wet steam
D. all of these

21. Bio-gas generated through anaerobic process mainly consists of
A. only methane
B. only ethane
C. methane and carbon dioxide
D. none of these

22. For a cement plant the parameter, 'kWh/MT of clinker' indicates
A. energy Index parameter
B. utility factor
C. production factor
D. load factor

23. The network model that allows for randomness in activity completion times is called
A. CUSUM
B. CPM
C. PERT
D. Gantt chart

24. In Critical Path of CPM used in project planning techniques indicates
    A. time require for the completion of the project
    B. delays in the project
    C. early start and late end of the project
    D. none of these
25. Which of the following does not belongs to project planning technique?
    A.CPM C. Gantt chart
    B. PERT D. IRR (internal rate of return)
26. Energy balance of a process is based on the principle of
    A. 1st law of thermodynamics C. 3rd law of thermodynamics
    B. 2nd law of thermodynamics D. none of these
27. In material balance of a process, recycle product is always considered as
    A. output to process C. both (A) and (B)
    B. input to process D. none of these
28. One kilowatt hour electrical energy (kWh) is equal to:
    A. 3600 Joules C. 360000 Joules
    B. 36000 Joules D. 3,600,000 Joules
29. Which one of the following instrument is not used in energy audit?
    A. Lux meter C. Thermometer
    B. Leak detector D. Pyranometer
30. Which value in the following is the energy conversion efficiency of a 175 watt peak solar panel that measures 0.75 X 1.50 meters, if the solar insolation is 1000 W/m^2?
    A. 12% C. 13.6%
    B.15% D.15.6%
31. One kg of wood contains 20% moisture and 5% Hydrogen by weight. How much water is evaporated during complete combustion of one kg of wood?
    A. 0.2 kg C. 0.65 kg
    B. 250 gram D. none of these
32. Which one of the following requires the largest amount of oxygen/kg of substance for combustion?
    A. carbon C. sulphur
    B. hydrogen D. nitrogen
33. In the given tank, there are two feeds and one output. Consider a 2 hour operation; the feed rates are 4000 kg/hr and 6000 kg/hr. The accumulated material inside the tank is 2000 kg. What is the output rate kg/hr of the material?
    A. 9000 C.7000
    B. 8000 D.6000
34. Petajoule means
    A. 10^6 J C. 10^9 J

B. 10^{15} J D. 10^{18} J

35. Doubling the wind speed increases the power generation from wind turbine by
    A. two times C. six times
    B. four times D. eight times
36. A material balance is based on
    A. mass C. concentration
    B. volume D. temperature
37. Inflating the tire of a car is a
    A. batch process C. continuous process
    B. semi-batch process D. steady process
38. The average molecular weight of air is approximately
    A. 20 C.30
    B. 29 D.28
39. If a fuel contains equimolar amount of methane and ethane, how many moles of oxygen will be needed to burn two moles of such fuel with 20% excess oxygen?
    A. 5.5 moles C. 6.6 moles
    B. 4.5 moles D. 4 moles
40. For general balance equation, which one of the following is not correct?
    A. Input = Output
    B. Input + Generation = Output + Consumption
    C. Accumulation + Consumption = Input + Generation
    D. Accumulation + Input + Generation = Output + Consumption
41. Which of the following in the flue gas serves as a good indicator of combustion quality of fuel in a furnace?
    A. percentage of oxygen C. percentage of carbon monoxide
    B. percentage of carbon dioxide D. percentage of nitrogen
42. The collection efficiency of flat plate collectors can be improved by
    A. selective coating C. both (A) and (B)
    B. evacuating space above the absorber· D. none of these
43. Landfill gas constitutes mainly
    A. methane and carbon-dioxide C. methane and hydrogen
    B. methane and carbon-monoxide D. hydrogen and carbon-monoxide
44. The industrial sector in Bangladesh accounts for _ % of the final energy consumption in the country.
    A. 45% C.43%
    B. 39% D.41%
45. Currently, which one of the following device accounts for the highest energy consumption amongst the individual appliance category in Bangladesh?
    A. lighting C. fans
    B. air-conditioner D. refrigerators

46. Air velocity in a duct can be measured by
    A. Anemometer C. Psychrometer
    B. Tachometer D. Thermometer
47. Energy management system promotes energy performance through a process of
    A. regimented system and procedure
    B. energy audit
    C. continuous improvement
    D. periodic administrative direction from top management
48. Energy performance indicators in a facility can be expressed as
    A. absolute value of energy consumed during a specified period
    B. ratio of energy consumption to the production
    C. specific energy consumption per unit of floor area in a building
    D. all of these
49. Energy baseline can be computed for
    A. the facility as a whole
    B. individual equipment in a facility
    C. individual system (for example lighting) in a facility
    D. all of these
50. 'D' in the PDCA cycle means
    A. design C. develop
    B. do D. discuss

Section B: Short Question

1. What are the advantages of CPM method? 05
2. Estimate the expected 'output of a wind turbine with 6 m diameter rotor, a coefficient of performance of 0.30, generation efficiency of 0.8, a gearbox 5efficiency of 0.95 and a wind speed of is m/s. 05
3. What is a fuel cell? Where can they be used? 05
4. What are the roles of ESCO? 05
5. To make strawberry jam, strawberries containing 15 wt% solid and 85% water are crushed and mixed with sugar in a ratio of 45:55. The mixture is heated to evaporate water. The residue contains one-third water by mass. Draw a Process Block Diagram and calculate the amount of strawberries needed to make 1 kg of jam. 05
6. Estimate the resistance of the element of an incandescent bulb rated 100 watt at 230 V. 05

7. For complete combustion of 1 kg of a typical coal 12 kg of air is required. Calorific value of coal is 25 MJ/kg with ash content of 22%. What is the quantity (in kg) flue gas generated by burning 5 kg coal? 05
8. Within the activity of monitoring and targeting, what are the differences between data and information? 05

Section C: Long Descriptive Question

1. What is an energy audit report? Name the contents of an ideal audit report. 10
2. Define a project. To be considered a viable energy project what should be the essential elements of a technical design. 10
3. Give 10 examples of key instruments used in energy audit. 10
4. What are the key steps in a project development cycle (PDC)? 10
5. Describe the functions of the three solar water heating system with suitable illustration. 10
6. A mixture of gas contains 80% CH_4, 12% C_2H_6, 6% C_3HSand the balance N_2 by volume. Calculate the mass composition of the gas. What is the average Molecular weight of the gas mixture? 10