Sustainable and Renewable Energy Development Authority (SREDA)

Power Division, Ministry of Power, Energy and Mineral Resources

3rd Energy Auditor Certification Examination-2022

Paper- 1

Candidate's Roll No. 2 0 2 2 1 1

Examinee's Name _____

Invigilator's Signature

A

Paper 1: Fundamentals of Energy Management and Energy Audit

Total Marks- 150, Time- 3.00 Hours, Date: 25 November 2022

- **Important Instruction:**

1. This Paper has 50 MCQs + 8 Short Questions + 6 Long Questions = Total 64 Questions.
2. Mark indicated on the right side of each question.
3. Fill in correct circle with permanent ink ballpoint pen shown on the top sheet only corresponding to the MCQ given in Section A.
4. Answer in the blank space provided after each question (short/long).
5. Do not put any sign or write anything on the answer script except written answer.
6. Any unfair means, peer talking, keeping any communication device and misbehavior will lead to cancellation of examination.

Invigilator's Signature

MCQ Answer (Section A):

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

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MCQ	:	[ ]	
Short Question	:	[ ]	
Long Question	:	[ ]	
Total Marks	:	[ ]	Signature of Examiner

Do not write or mark anything in this page

Section A: MCQ

Fill the appropriate circle in the OMR answer sheet at the top page.

1 x 50 =50

1 Direct Current (DC) is

A) A measure of electric potential or electromotive force

B) Current reverses in regular and recurring intervals of time

C) Product of volt and power

D) Non-varying unidirectional current

2 Power factor is unity for

A) Inductive circuit

B) Capacitive circuit

C) Resistive circuit

D) Inductive-Capacitive circuit

3 In an electrical circuit, KVA unit can be

A) Only for real power

B) Only for inductive power

C) Only for capacitive power

D) Both real and inductive and, or capacitive power

4 Kelvin Scale is the temperature standard for

A) Scientific purpose

B) Engineering purpose

C) Both scientific and engineering purpose

D) Measurement of human body temperature

5 In Fahrenheit Scale, freezing and boiling temperature in degree at air pressure are

A) 0 & 100

B) 32 & 212

C) 100 & 212

D) 0 & 32

6 1 kCal can raise the temperature of water by 1 degree centigrade of

A) 0.5 kg

B) 1.5 kg

C) 2 kg

D) 1 kg

7 Specific heat of water is

A) 2400 Jules per kg degree centigrade

B) 2300 Jules per kg degree centigrade

C) 3200 Jules per kg degree centigrade

D) 4200 Jules per kg degree centigrade

8 Change of state of a material from one state to another is known as

A) Phase change

B) Melting point

C) Boiling point

D) Vaporization

9 The latent heat of fusion of a substance is the heat required to convert 1kg solid into liquid

A) With increasing temperature

B) With decreasing temperature

C) Without changing temperature

D) None of the above

10 Relative Humidity affects

A) Saturation condition
C) Unsaturated condition
B) Comfort condition
D) Uncomfortable condition

11 The viscosity of a fluid is decreasing with

A) Increasing pressure
C) Increasing temperature
B) Decreasing temperature
D) None of the above

12 Broadly, energy can be classified as

A) Potential, chemical and stored mechanical energy
C) Kinetic, gravitational and nuclear energy
B) Potential and kinetic energy.
D) Radiant, motion, sound and electrical energy

13 Heat is transferred from hot to cold body by

A) 5 primary modes
C) 3 primary modes
B) 4 primary modes
D) None of the above

14 Conduction is the primary mode of heat transfer through

A) Air
C) Gas
B) Solid
D) Liquid

15 For the transport of heat, Radiation Mode requires

A) Gas
C) Solid
B) Liquid
D) None of the above

16 Temperature change while heat transferred to a substance, is often referred to as

A) Latent heat
C) Superheat
B) Sensible heat
D) Specific heat

17 Renewable energy sources are

A) Exhaustible
C) Depletionable
B) Limited
D) Inexhaustible

18 Electric conductance is measured in

A) Watt
C) Mho
B) Volt
D) Amp

19 Solar insolation is the greatest when the surface is

A) Normal to the Sun
C) Inclined to the Sun by 45°
B) Inclined to the Sun by 23°
D) None of the above

20 Grid connected solar systems may have

A) Only PV modules
C) PV modules and inverters
B) PV modules and batteries
D) All of the above except PV modules

21 Renewable energy sources include

A) Sunlight, bio-mass, sea-tide, wave etc.

C) Geothermal, potential difference of sea-level, diesel etc

B) Nuclear, wind, hydro, HFO etc.

D) Natural gas, falling water, crude oil etc.

22 The wattage output of a PV module is rated in term of

A) Peak voltage

C) Peak kVAR

B) Peak Ampere

D) Peak Watt

23 Mandatory devices for grid connected solar system are

A) Bidirectional meter and ac inverter

C) Solar generation meter and consumer meter

B) Inverter and battery

D) Solar generation meter and charge controller

24 Average speed of wind to run a wind turbine in average rotation is

A) 15 km/h

C) 29 km/h

B) 25 km/h

D) 22 km/h

25 A wind turbine can produce usable energy in Cut-in Speed

A) Reliably

C) Exactly

B) Moderately

D) Poorly

26 Which of the following is the concept of material balance based upon?

A) Conservation of mass

C) Conservation of momentum

B) Conservation of energy

D) Conservation of Volume

27 Theoretical flame temperature is defined for which process?

A) Isothermal

C) Isobaric

B) Adiabatic

D) Isochoric

28 If the difference between dry bulb and wet bulb temperature of air increases, the humidity of the air

A) increases

C) remains constant

B) decreases

D) none of the above

29 In a manufacturing plant, following data are gathered for a given month: Production - 100 pieces; specific energy consumption - 100 kWh/piece; variable energy consumption - 95 kWh/piece. The fixed energy consumption of the plant for the month is

A) 500 kWh

C) 10,000 kWh

B) 9, 500 kWh

D) None of the above

30 What is the average molecular weight of air containing 79% N_2 (molecular wt. = 28) and the balance O_2 (molecular wt. = 32)?

A) 30.4

C) 24.4

B) 56.8

D) 28.9

31 If the accumulation in a system is zero, the state of the system is

A) Transition state
C) Unsteady state
B) Steady state
D) None of the above

32 The lumen depreciation factor of a lighting system is 0.9 and the dirt depreciation factor is 0.8. What is the overall light loss factor?

A) 0.82
C) 0.9
B) 0.72
D) 1.7

33 An electricity rate structure charged by a utility that varies for different hours of the day is called a

A) Demand ratchet
C) Time of use rate
B) Demand charge
D) Tiered rate

34 Which of the following is a potential application for an infrared camera

A) Finding faulty electrical connections or overloaded circuits
C) Identifying mechanical faults such as excessive bearing friction
B) Determining area of heat loss from a building
D) All of the above

35 Which of the following systems would be most suitable to have measurements taken with a bourdon gauge?

A) Lighting
C) Building envelope
B) Electrical supply
D) Boiler

36 When a capacitor bank is added to an electrical system with a lagging current, the power factor is increased because

A) total reactive power is increased
C) total real power is increased
B) total reactive power is decreased.
D) total real power is decreased

37 At 100% load what is typically the largest type of loss within an AC motor?

A) Friction and windage losses
C) Stray load losses
B) Resistive losses
D) Core losses

38 Which of the following can be used to assess both HVAC systems and the building envelope during an energy audit?

A) Psychrometer
C) Chemical Smoke
B) Draft Gauge
D) Anemometer

39 Which of the following descriptions of an energy audit process is most likely an ASHRAE Level 1 audit?

A) An analysis of historical utility bills and benchmarking of the Energy Use Index to other similar buildings
C) Field testing and measurement of systems is carried out to calculate the potential savings of energy conservation measures and determine their costs
B) An analysis of current energy use and cost with a walk-through of the building to identify low and no cost energy efficiency measures
D) A detailed survey of the building with an analysis of energy end-uses

40 Energy is consumed by all sectors of the economy but at different proportions. Which sector in Bangladesh is currently the largest consumer?

A) Agriculture
C) Industrial
B) Commercial
D) Domestic

41 Energy Intensity is the ratio of

A) Fuel Consumption / GDP
C) GDP/ Energy Consumption
B) GDP/Fuel Consumption
D) Energy Consumption / GDP

42 In an industry the billed electricity consumption for a month is 5.3 lakh kWh. The fixed electricity consumption of the plant is 30000 kWh and with a variable electricity consumption of 20 kWh/ton. Calculate the production of the industry

A) 25000 tonnes
C) 26500 tonnes
B) 30000 tonnes
D) None of the above

43 Diagrammatic representation of input and output energy streams of an equipment or system is known as

A) Mollier diagram
C) Psychrometric chart
B) Sankey diagram
D) Balance diagram

44 As the “approach’’ increases while other parameters remain constant, the effectiveness of a cooling tower

A) increases
C) decreases
B) remains unchanged
D) none of the above

45 Which of the following statistical technique determines and quantifies the relationship between variables and enables to find standard equations for energy consumption.

A) linear regression analysis
C) moving annual total
B) time-dependent energy analysis
D) CUSUM

46 Which of the following is false?

A) electricity is high-grade energy
C) low grade energy is better used for applications like melting of metals rather than heating water for bath
B) high grade forms of energy are highly ordered and compact
D) the molecules of low grade energy are more randomly distributed than the molecules of carbon in coal

47 Which of the following releases large amount of heat per kg during combustion?

A) Hydrogen
C) Sulphur
B) Carbon
D) Nitrogen

48 In a boiler, air preheater is installed

A) Before the economizer
C) Before superheater
B) after the economizer
D) after Electrostatic Precipitator (ESP)

49 Which one of the following is utilized when a fuel is burned in an engine?

A) Gross Calorific Value
C) Higher Heating Value
B Lower Heating Value
D) All of the above

50 What would be the best purpose of an anemometer during an energy audit?

A) Measure the wet bulb temperature
C) Measure the humidity in the outside air supply
B) Measure the air pressure in a supply air duct
D) Measure the velocity from a vent

Section B: Short Question

		Marks
01	A machine needs force to move. If work done by the machine is 6 kJ and distance moved is 100 m, find out the required force. In addition, find out the average power is utilized if the machine moved for 1 minute.	5
02	A 1.15 kW cooker (PF=1) is taking 5A from supply line. What is the supply line voltage and consumed energy when switched on for 45 minutes?	5

03	What is landfill gas? How is it formed?	5
04	What is Energy intensity and what it indicates?	5

05	A water pumping station fills a tank at a fixed rate. The head and flow rate are constant and hence the power drawn by the pump is always same. The pump delivers 80 litres per second. The power consumption was measured as 84 kW. Calculate the cost of the energy consumption for pumping 28,80,000 litres of water to the reservoir. Assume, the average cost of one unit energy is 8 taka.	5

06	A home-owner plans to replace all his lighting and cooling appliances with energy efficient products. In his home, there are 10 tube-lights (40 watt each) and 5 electric fans (100 watt each). He would like to replace them with LED lights (8 watt bulb costing 250 taka each) and 5-star rating fans (60 watt 5-star rating fan costing 3000 taka each). What will be the payback period to recover his investment if he implements his plan? Assume, all other required data considering Bangladesh environmental conditions and energy costs.	5
07	In a textile plant, the monthly energy consumption is 7,00,000 kWh of electricity, 40 kL of furnace oil (specific gravity = 0.92) for thermic fluid heater, 360 tonne of coal for steam boiler and 10 kL of HSD (specific gravity = 0.885) for material handling equipment. Compute the annual energy consumption in terms of Metric Tonne of Oil Equivalent (MTOE) for the plant. Given Data: (1 kWh = 860 kcal, GCV of coal = 3450 kcal/kg, GCV of furnace oil = 10,000 kcal/kg, GCV of HSD = 10,500 kcal/kg, GCV of rice husk = 3100 kcal/kg, 1 kg oil equivalent = 10,000 kcal)	5

08	Explain Plan-Do-Check-Act (PDCA) cycle in the context of Energy Management System (EnMS)	5

Section C: Long Question

		Marks
01	An evaporation is to be fed with 10,000 kg/h of a solution having 1% solids at 38°C and to be concentrated to 2% solids. Steam is entering at a total enthalpy of 640 kcal/kg and the condensate leaves at 100°C. If enthalpies of feed are 38.1 kcal/kg, product solution is 100.8 kcal/kg and vapor is 640 kcal/kg, find the mass of the vapor formed and the steam used per hour.	10

02	Describe EE&C potentials by different sectors in Bangladesh.	10

03	In a Chlor-Alkali plant, an evaporator was designed to concentrate 500 kg/h of liquor containing solids of 7 % w/w (weight by weight) to 45 % solids w/w in the output. Presently the output from evaporator has 30 % solids w/w. The energy manager suggested overhauling the evaporator to achieve the design rate of solids w/w in the output. Calculate the percentage improvement in water removal in the evaporator after overhauling of the evaporator.	10

04	A process plant is planning to implement a waste heat recovery project. The various activities from procurement to commissioning are given in the table below along with their duration and dependency. a) Construct a PERT/CPM network diagram for the above project. b) Compute the earliest start, earliest finish, latest start, latest finish and slack for all the activities. c) Compute the project duration. d) Identify the critical activities and the critical path(s).	10

Activity	Predecessor	Time in Week
A	-	3
B	-	5
C	A	4
D	A	6
E	C	5
F	C	3
G	B & D	2
H	D & E	1
I	F,G,H	2

05	A medium size chemical plant receives electricity from grid and also generates electricity from coal based Captive Power Plant (CPP). Coal is also used for process requirements. The fine coal from CPP is sold to neighbouring plant. The annual energy details are given below: **Electricity purchased from grid** — **5 MU** **Electricity exported to grid** — **11 MU** **Power generation from CPP** — **36 MU** **Power Supplied from CPP to Process plant** — **25 MU** **Fine coal sold to neighboring unit** — **1000 ton** **Coal used for process plant** — **5000 ton** **GCV of coal** — **4500 kcal/kg** **Heat rate of CPP** — **3500 kcal/kWh** **Annual Operating Hours** — **7200** Calculate the following: a) Energy usage in TOE (Tons of Oil Equivalent) b) Coal used in CPP c) Calculate the CPP operating power in MW	10

06	a) Write down the steps for computing energy saving using CUSUM over a period. b) Develop a table using a CUSUM technique to calculate energy savings for 8 months period for a production level of 2000 MT per month. Refer to field data given in the table below.	2 x 5

Month	Actual SEC kWh/MT	Predicted SEC kWh/MT
May	1225	1250
June	1227	1250
July	1240	1250
Aug	1245	1250
Sep	1238	1250
Oct	1257	1250
Nov	1248	1250
Dec	1264	1250