

BEE 2026 Sample Paper — Paper-1

General Aspects of Energy Management & Energy Audit

Full exam pattern: **Section I** 50 objective $\times 1 = 50$ · **Section II** 8 short $\times 5 = 40$ · **Section III** 6 long $\times 10 = 60$ · **Total 150, pass mark 75, 3 hours.**

Every question is a real BEE past-paper question with the official answer, chosen by chapter weightage and how often the examiner has repeated it (47 of the 64 have appeared in two or more exams). Sit it like the real thing: start the timer, answer Section I without notes, then write Sections II and III on paper before opening the model answers.

Section I — Objective type (50 $\times$ 1 = 50 marks)

Answer all 50. One mark each, no negative marking.

1. An indication of sensible heat content in air-water vapour mixture is

- a) wet bulb temperature
- b) dew point temperature
- c) density of air
- d) dry bulb temperature

2. The technique not used for scheduling the tasks and tracking of the progress of energy management projects is called ____.

- a) CPM
- b) PERT
- c) Gantt chart
- d) CUSUM

3. The number of moles in 90 kg of water is

- a) 5
- b) 18
- c) 2
- d) none of the above

4. In project financing, sensitivity analysis is applied because

- a) almost all the cash flows involve uncertainly
- b) it evaluates how sensitive the project is to change in the input parameters
- c) it assesses the impact of 'what if one or more factors are different from what is predicted'
- d) it is applicable to all the above situations

5. Transit time method is used in which of the instrument

- a) lux meter
- b) ultrasonic flow meter
- c) pitot tube
- d) fyrite

6. $\text{C}_2\text{H}_4 + x\text{O}_2 \longrightarrow 2\text{CO}_2 + y\text{H}_2\text{O}$, what is the value of $x + y$?

- a) 2
- b) 3
- c) 5
- d) 8

7. The internal rate of return is discount rate for which NPV is

- a) Positive
- b) Zero
- c) Negative
- d) All of the above

8. An activity has an optimistic time of 15 days, a most likely time of 18 days and a pessimistic time of 27 days. What is the expected time

- a) 60 days
- b) 20 days
- c) 19 days
- d) 18 days

9. If asset depreciation is considered, then net operating cash inflow would be

- a) lower
- b) higher
- c) no effect
- d) none of the above

10. The term missing in the following equation $(kVA)^2 = (kVA \cos \phi)^2 + (?)^2$ is

- a) $\cos \phi$
- b) $\sin \phi$
- c) $kVA \sin \phi$
- d) $kVArh$

11. In inductive and resistive combination circuit, the resultant power factor under AC supply will be

a) less than unity

b) more than unity

c) zero

d) unity

12. Which among the following factor(s) is most appropriate for adopting EnMS?

a) To improve their energy efficiency

b) To reduce costs

c) To increase productivity

d) Systematically manage their energy use

13. Factors influencing energy consumption in an organization include ____.

a) Operational Hours

b) Units of Production

c) Usage Behavior

d) All of the above

14. _____ is a statistical technique which determines and quantifies the relationship between variables and enables standard equations to be established for energy consumption.

a) linear regression analysis

b) time-dependent energy analysis

c) moving annual total

d) CUSUM

15. The lowest theoretical temperature to which water can be cooled in a cooling tower is

- a) Difference between DBT and WBT of the atmospheric air
- b) Average DBT and WBT of the atmospheric air
- c) DBT of the atmospheric air
- d) WBT of the atmospheric air

16. In a drying process product moisture is reduced from 60% to 30%. Inlet weight of the material is 200 kg. Calculate the weight of the outlet product.

- a) 80
- b) 120.5
- c) 114.3
- d) none of the above

17. To arrive at the relative humidity at a point we need to know _____ of air

- a) DBT
- b) WBT
- c) Dew point
- d) Both A and B

18. Bio-gas generated through anaerobic process mainly consists of

- a) only methane
- b) Methane and carbon dioxide
- c) only ethane
- d) only carbon dioxide

19. For calculating plant energy performance which of the following data is not required

- a) Current year production
- b) Capacity Utilization
- c) Reference year production
- d) Reference year Energy use

20. For an activity in a project, Latest start time is 8 weeks and Latest finish time is 12 weeks. If the earliest finish time is 9 weeks, Slack time for the activity is ____.

- a) 3 weeks
- b) 4 weeks
- c) 1 week
- d) none of the above

21. Which of the following macro factors is used in the sensitivity analysis of project finance?

- a) Change in tax rates
- b) Changes in maintenance cost
- c) Changes in debt: equity ratio
- d) Change in forms of financing

22. If feed of 100 tons per hour at 5% concentration is fed to a crystallizer, the rate in tons per hour of the product obtained at 25% concentration is equal to:

- a) 40
- b) 20
- c) 25
- d) 100

23. 2000 kJ of heat is supplied to 500 kg of ice at 0 °C. If the latent heat of fusion of ice is 335 kJ/kg then the amount of ice in kg melted will be

- a) 1.49
- b) 83.75
- c) 5.97
- d) None of the above

24. The input to a fuel cell is.

- a) Electricity
- b) Hydrogen
- c) Oxygen
- d) All of the above

25. Non-contact speed measurement can be carried out by ____.

- a) Tachometer
- b) Stroboscope
- c) Oscilloscope
- d) Speedometer

26. A dry feed contains 7% moisture was feed to a water spray chamber to increase the moisture content to 35% in the dry feed. The output feed quantity coming from the spray chamber is ____.

- a) 0.5 kg/kg of input feed
- b) 1.43 kg/kg of input feed
- c) 1.48 kg/kg of input feed
- d) 2.66 kg/kg of input feed

27. The process of capturing CO₂ from point sources and storing them is called

- a) carbon capture and sequestration
- b) carbon sink
- c) carbon capture
- d) carbon absorption

28. A gaseous mixture contains 7.50 gms of H₂ and 3.25 gms of O₂ and 5.55gms of N₂. The Mole fraction of N₂ is ____.

- a) 0.34
- b) 0.03
- c) 0.0294
- d) 0.049

29. Which of the following statements is correct regarding 'float' for an activity?

- a) Time between its earliest start time and earliest finish time
- b) Time between its latest start time and latest finish time
- c) Time between latest start time and earliest finish time
- d) Time between earliest finish time and latest finish time

30. When the evaporation of water from a wet substance is zero, the relative humidity of the air is likely to be

- a) 0%
- b) 100%
- c) 50%
- d) unpredictable

31. The force field analysis in energy action planning considers

- a) Positive forces only
- b) negative forces only
- c) Both negative and positive forces
- d) no forces

32. The power generation potential in mini hydro power plant for a water flow of 3 m³/sec with a head of 14 meters and with a system efficiency of 55% is

- a) 226.6 kW
- b) 76.4 kW
- c) 23.1 kW
- d) none of the above

33. 1 kg of wood contains 15% moisture and 7% hydrogen by weight. How much water is evaporated from wood during complete combustion of 1 kg of wood ?

- a) 0.78 kg
- b) 0.22 kg
- c) 0.15 kg
- d) 0.63 kg

34. The Specific heat is high for ____.

- a) Lead
- b) Water
- c) Mercury
- d) Alcohol

35. If we heat air without changing absolute humidity, % relative humidity will

- a) Increase
- b) Decrease
- c) No change
- d) Can't Say

36. The energy conversion efficiency of a solar cell does not depend on

- a) solar energy insolation
- b) inverter
- c) area of the solar cell
- d) maximum power output

37. The retrofitting of a variable speed drive in a plant costs Rs 2 lakh. The annual savings is Rs 0.5 lakh. The maintenance cost is Rs. 5,000/year. The return on investment is

- a) 25%
- b) 22.5%
- c) 24%
- d) 27.5%

38. The rate of energy transfer from a higher temperature to a lower temperature is measured in

- a) kcal
- b) Watt
- c) Watts per second
- d) none of the above.

39. ESCerts cannot be ____.

- a) Bought
- b) Sold
- c) Banked for next cycle
- d) Traded directly between DC's

40. A solution of common salt is prepared by adding 25 kg of salt to 100 kg of water. The weight fraction of solution is ____.

- a) 20%
- b) 25%
- c) 4%
- d) none of the above

41. Which of the following is not a part of energy audit as per the Energy Conservation Act, 2001?

- a) monitoring and analysis of energy use
- b) verification of energy use
- c) submission of technical report with recommendations
- d) ensuring implementation of recommended measures followed by review

42. Which one is not an energy consumption benchmark parameter?

- a) kcal/kWh of electricity generated
- b) kg/deg C
- c) kWh/kg of fertilizer
- d) kWh/kg of yarn

43. Producer gas consists of:

a) CO, H₂, CH₄

b) CO, CH₄

c) CO, H₂

d) Only CH₄

44. Which of the following with respect to fossil fuels is true?

a) Reserve / Production (R/P) ratio is a constant once established

b) R/P ratio varies every year with only changes in production

c) R/P ratio varies every year with only changes in reserves

d) R/P ratio varies every year with changes in both production and reserves

45. Formula for computing energy savings as part of Measurement & Verification is ____.

a) Energy Savings = Base year energy use + post-retrofit energy use +/- Adjustments

b) Energy Savings = Base year energy use - post-retrofit energy use +/- Adjustments

c) Energy Savings = post-retrofit energy use - base year energy use +/- Adjustments

d) None of the above

46. Which of the following statements are true regarding simple payback period?

a) considers impact of cash flow even after payback period

b) takes into account the time value of money

c) considers cash flow throughout the project life cycle

d) determines how quickly invested money is recovered

47. Energy intensity is the ratio of ____.

- a) Fuel consumption / GDP
- b) GDP/fuel consumption
- c) GDP/ energy consumption
- d) Energy consumption / GDP

48. Which statement is false regarding Critical path?

- a) CP is longest duration path
- b) It identifies minimum time to Complete the project
- c) Activities lies on it cannot be delay
- d) It is maximum time required to complete the project

49. Which of the following has the lowest energy content in terms of MJ/kg

- a) LPG
- b) Diesel
- c) Bagasse
- d) Furnace oil

50. Which technique takes care of time value of money in evaluation?

- a) payback period
- b) IRR
- c) NPV
- d) Both (b) & (c)

Section II — Short answer type (8 × 5 = 40 marks)

Answer all questions. Write the formula line with units first — step marks are given even if the arithmetic slips.

- S1** A 10 HP rated induction motor, with nameplate details indicating 415V, 12 amps, and a power factor (PF) of 0.9, is being audited. During the audit, the monitoring equipment displays a reactive power of 2 kVAR and a power factor of 0.758. Calculate the percentage loading of the motor at the time of the test. (5 Marks)
- S2** A continuous centrifuge separates 36,000 kg of whole milk containing 4% fat in 6-hour period into skim milk with 0.40% fat and cream with 40% fat. Find out the flow rates of whole milk, cream and skim milk using mass balance.
- S3** Calculate the net present value over a period of 3 years for a project with one investment of Rs 50,000 at the beginning of the first year and a second investment of Rs 30,000 at the beginning of the second year and fuel cost savings of Rs 40,000 each in the second and third year. The discount rate is 16%.
- S4** How does an ultrasonic flow meter work, and what is the difference between its transit-time and Doppler types?
- S5** (a) Differentiate between commercial and non-commercial energy with an example each. (b) Differentiate between renewable and non-renewable energy with an example each.
- S6** a) List at least two factors affecting external energy benchmarking of energy intensive processes. (2 Marks) b) Compute the plant energy performance of a brewery unit for the current year based on the following data (3 Marks): Reference year - Production Level 1,00,000 Barrels, Gross energy for the production level 35 Trillion Joules; Current year - Production Level 1,10,000 Barrels, Gross energy for the production level 38 Trillion Joules.

S7 A University is interested in installing a Solar Roof Top PV (SPV) system under net metering system. It has a total roof top area of 1200 sq. meters, where the shading effect is 20% of the total area. Assuming 1 kWp SPV panel requires 10 sq. meter area and the peak output is for 5 hours per day, calculate the following. a) How much kWp of Solar PV system can you suggest? (2 Marks) b) How much would be the daily generation in kWh/day/kWp? (2 Marks) c) How many kg of CO₂/year is avoided for 250 days operation, if the CO₂ emission factor is 0.82 kg/kWh. (1 Mark)

S8 What are ESCerts and explain the basis for their issuance and trading under the PAT scheme.

Section III — Long answer type (6 × 10 = 60 marks)

Answer all questions. Write the formula line with units first — step marks are given even if the arithmetic slips.

L1 An evaporator is fed with 10,000 kg/hr of a solution having 1% solids. The feed is at 38 degC and is to be concentrated to 2% solids. Steam enters at a total enthalpy of 640 kcal/kg and the condensate leaves at 100 degC. Enthalpy of feed = 38.1 kcal/kg, enthalpy of product (thick liquor) = 100.8 kcal/kg and enthalpy of vapour = 640 kcal/kg. Find (i) the mass of vapour formed per hour and (ii) the mass of steam used per hour.

L2 A company invests Rs. 12 lakhs and completes an energy efficiency project at the beginning of year 1. The firm is investing its own reserve money and expects an internal rate of return (IRR) of at least 12% on constant positive annual net cash flow of Rs. 3 lakhs, over a period of 5 years, starting with year 1. a) Will the project meet the firm's expectations? (3 Marks) b) What is the IRR of this measure? Use the interpolation formula for obtaining the nearest IRR value: $IRR = (\text{lower discount rate \%}) + \frac{[(NPV \text{ at lower discount rate}) \times (\text{higher discount rate \%} - \text{lower discount rate \%})]}{(NPV \text{ at lower discount rate} - NPV \text{ at higher discount rate})}$. (7 Marks)

L3 a) Construct a CPM diagram for the data given below (4 Marks): Activity A - Precedent Start - 4 weeks; B - A - 5; C - A - 2; D - C - 5; E - Start - 3; F - B - 4; Finish - D, E, F. b) Identify the critical path (2 Marks). c) Also compute the earliest start, earliest finish, latest start & latest finish of all activities (4 Marks). [refers to a figure in the original paper]

L4 a) Use CUSUM technique to develop a table and to calculate energy saving for 6 months period. For calculating total energy saving average production can be taken as 4500 MT per month. Field data (Actual SEC / Predicted SEC, kWh/MT): April 1301/1400; May 1308/1400; June 1315/1400; July 1320/1400; August 1325/1400; September 1355/1400. (6 Marks) b) List any two ozone depleting substances (ODS) and Green House Gases (GHG). (4 Marks)

L5 A) Fill in the blanks: 1. The current drawn by an electric kettle having resistance of 25 Ohms and receiving supply at 250 Volts is _____. 2. In three-phase system kW will be equal to kVA if the power factor is _____. 3. The specific gravity of water is _____. 4. The change in heat content of a substance, when its physical state is changed without change in temperature is called _____ heat. 5. Specific heat of water is 1 kcal/kg deg C or _____ kcal/kg deg K. (5 Marks) B) Briefly explain PAT Scheme and list 5 sectors covered under the scheme. (5 Marks)

L6 Write a short note on the following: 1. Working principle of fuel cell (4 Marks) 2. Carbon sequestration (3 Marks) 3. Availability based tariff (3 Marks)

Answer Key

Section I

- 1 **D** Confirmed vs Book-1 §3.4 — Book-1 §3.4: 'Dry bulb measures sensible heat content in air-vapour mixtures' and is not influenced by RH. Wet-bulb accounts for RH (latent effect) and dew point is the saturation temperature.
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- 2 **D** Confirmed vs Book-1 §8.3 — Book-1 Ch-8 lists Gantt chart, CPM and PERT as the project scheduling / progress-tracking techniques. CUSUM (cumulative sum of differences) belongs to energy monitoring & targeting (Ch-9), not
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- 3 **A** Moles = mass / molecular weight, with water at 18. The printed key of 5 follows only if the quantity is read as 90 GRAMS ($90/18 = 5$); as printed, 90 kg gives 5,000 moles, or 5 kmol. Note that 5 kmol is the same number wi
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- 4 **D** Confirmed vs Book-1 §7.5 — Book, Section 7.5: cash flows contain uncertainty; sensitivity analysis asks 'How sensitive is the project's feasibility to changes in the input parameters?' and 'What if one or more of the fac
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- 5 **B** The transit-time (time-of-flight) method sends ultrasonic pulses diagonally both with and against the flow; the difference in travel time is proportional to velocity. It is CLAMP-ON, so no pipe cutting and no pressure dr
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- 6 **C** Confirmed vs Book-1 §5.3 (mass of each element is conserved): $C_2H_4 + xO_2 \rightarrow 2CO_2 + yH_2O$. Hydrogen: $4 = 2y \rightarrow y = 2$. Oxygen: $2x = (2 \times 2) + 2 = 6 \rightarrow x = 3$. Therefore $x + y = 3 + 2 = 5$, option (c).
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- 7 **B** Confirmed vs Book-1 §7.3 — Book: 'The internal rate of return (IRR) of a project is the discount rate, which makes its net present value (NPV) equal to zero.' In Example 7.5 the NPV falls from +2,791 at 8% to -1,508 at 1
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- 8 **C** Working: $T_E = (15 + 4 \times 18 + 27)/6 = (15 + 72 + 27)/6 = 114/6 = 19$ days. Option (d) 18 is the most-likely time on its own and (b) 20 is the plain average of the three — both are the traps. The weighted mean sits nearer $T_$
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- 9 **B** Corrected (was a) — Book-1 §7.4: Book, Section 7.4: net operating cash inflows are the annual benefits 'after adjusting for applicable taxes and effects of depreciation'; and the depreciation box states that tax law perm
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- 10 **C** The power triangle: $kVA^2 = kW^2 + kVAR^2$, and since $kW = kVA \cos(\phi)$, the reactive leg must be $kVA \sin(\phi)$. $PF = kW/kVA = \cos(\phi)$. Note the units trap in the options — kVARh is an ENERGY (kVAR integrated over time),
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11	A	Confirmed vs Book-1 §3.3 — With both resistance and inductance present the current lags the voltage by an angle $0 < \theta < 90$ deg, so $PF = \cos\theta$ is less than unity (it is unity only for a purely resistive circuit).
12	D	Confirmed vs Book-1 §4.1 — The defining purpose of an EnMS (ISO 50001) is to give an organisation a systematic, continual framework for managing energy use — policy, targets, measurement and review. Improved efficiency,
13	D	Confirmed vs Book-1 §9.6/Table 9.4 — operational hours, units of production and usage behaviour (operating practice/housekeeping) all influence energy consumption; regression in M&T is built on such influencing variables
14	A	Regression fits the standard energy equation $E = M \cdot P + C$, where M (the slope) is the variable or specific energy per unit of production and C (the intercept) is the fixed or base-load energy that is drawn even at zero ou
15	D	Confirmed vs Book-1 §3.4 — The wet-bulb temperature of the entering air is the theoretical minimum to which evaporative cooling can cool the water; the approach (cold water temp - WBT) can be reduced but never taken to z
16	C	Confirmed vs Book-1 §5.5 (dry-solids balance, as in Ex.5.11): Bone-dry solids = $200 \times (1 - 0.60) = 80$ kg and are unchanged. Outlet product at 30% moisture is 70% solids, so outlet = $80/0.70 = 114.3$ kg. Option (c).
17	D	Confirmed vs Book-1 §3.4 — Relative humidity is obtained from both dry-bulb (DBT) and wet-bulb (WBT) temperatures. Book-1 Ch.3, Humidity — RH, specific humidity, DBT, WBT and dew point.
18	B	Confirmed vs Book-1 §11.6 Biomass Energy (Biomethanation of Biomass — Anaerobic Process) — Book: bio-methane produced by anaerobic digestion 'is composed mainly of methane and carbon dioxide'; gobar gas is 'typically co
19	B	PEP needs exactly four numbers: reference-year energy use, reference-year production, current-year production (these three give the reference-year equivalent) and current-year energy use. Capacity utilisation never enter
20	A	Confirmed vs Book-1 §8.3 — Duration $t = LF - LS = 12 - 8 = 4$ weeks. Given $EF = 9$, $ES = EF - t = 9 - 4 = 5$ weeks. Float = $LS - ES = 8 - 5 = 3$ weeks, and the cross-check $LF - EF = 12 - 9 = 3$ weeks agrees. Option (a) 3 week
21	A	Confirmed vs Book-1 §7.5 — Book lists MACRO factors as those the firm's management cannot change: changes in interest rates, CHANGES IN TAX RATES, accounting standards/depreciation methods and rates, subsidies, employmen

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- 22 **B** Confirmed vs Book-1 §5.5 Ex.5.6 method: Solids in feed = $100 \times 0.05 = 5$ t/h and are conserved. Product at 25% concentration = $5/0.25 = 20$ t/h. Option (b).
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- 23 **C** Mass melted = heat supplied / latent heat of fusion = $2,000/335 = 5.97$ kg. The 500 kg is a decoy — it only tells you there is plenty of ice available; the heat supplied is what limits the melting. Note no temperature ter
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- 24 **B** Confirmed vs Book-1 §11.8 Fuel Cell (Fuel Cell) —
Book opens §11.8 with: 'Input to a Fuel Cell is hydrogen. Hydrogen combines with oxygen to produce electricity ... with water and heat as by-products.'
Oxygen is the oxida
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- 25 **B** Confirmed vs Book-1 §4.12 — Book §4.12: the stroboscope is the "more sophisticated and safer" NON-contact speed instrument, using high-intensity flashes at a precise frequency to freeze the motion and read RPM. The tachometer
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- 26 **B** Confirmed vs Book-1 §5.5 (dry solids are unchanged): per 1 kg of input feed, bone-dry solids = $1 \times (1 - 0.07) = 0.93$ kg. In the output the moisture is 35%, so solids are 65%: output = $0.93/0.65 = 1.43$ kg per kg of input
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- 27 **A** Confirmed vs Book-1 §10.5 — Carbon sequestration is defined as removing CO₂ from large point sources (power plants, refineries, industrial processes) and storing it in geologic formations such as depleted oil/gas reservoirs
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- 28 **D** Confirmed vs Book-1 §5.5 Ex.5.7 method (moles = mass/mol. wt): H₂ = $7.50/2 = 3.75$; O₂ = $3.25/32 = 0.1016$; N₂ = $5.55/28 = 0.1982$. Total = 4.0498 moles. Mole fraction of N₂ = $0.1982/4.0498 = 0.0489 \approx 0.049$. Option (d).
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- 29 **D** Confirmed vs Book-1 §8.3 — Book-1: total float is 'the time between its earliest and latest start time, or between its earliest and latest finish time', i.e. Float = LS - ES = LF - EF.
Of the four choices only (d), the t
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- 30 **B** Confirmed vs Book-1 §3.4 — Evaporation stops when the air can hold no more moisture, i.e. when it is saturated - relative humidity = 100%. At that condition dew-point, wet-bulb and dry-bulb temperatures are equal.
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- 31 **C** Confirmed vs Book-1 §6.4 Energy Policy and Planning — The guidebook defines force field analysis as identifying the barriers (negative forces) and the positive influences (positive forces) around a goal, estimating the r
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- 32 **A** Confirmed vs Book-1 §11.7 Hydro Power (Water into Watts) —
 $P \text{ (kW)} = 9.81 \times Q \times H \times \eta = 9.81 \times 3 \times 14 \times 0.55$.
 $9.81 \times 3 = 29.43$; $\times 14 = 412.02$; $\times 0.55 = 226.6$ kW.
Answer a.
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- 33 **A** Confirmed vs Book-1 §5.5 (component mass balance): Free moisture = 0.15 kg. Water from hydrogen = $9 \times 0.07 = 0.63$ kg (9 kg water per kg H, from H₂ + $\frac{1}{2}$ O₂ → H₂O). Total water

evaporated = $0.15 + 0.63 = 0.78$ kg. Option (a).

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- 34 **B** Confirmed vs Book-1 §3.4 — Water has a very high specific heat (~ 4.187 kJ/kg degC), higher than the other listed substances. Book-1 Ch.3, Specific heat — Table 3.1 Specific heat of common substances.
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- 35 **B** Confirmed vs Book-1 §3.4 — Heating raises the saturation capacity at constant moisture, so relative humidity decreases. Book-1 Ch.3, Humidity — RH, specific humidity, DBT, WBT and dew point.
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- 36 **B** Confirmed vs Book-1 §11.4 Solar Electrical Energy (Energy conversion efficiency of a PV cell) — Book formula: $\eta = (P_m / (E \times A)) \times 100$, where P_m = maximum power output (W), E = insolation (W/m^2) and A = cell area (m^2).
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- 37 **B** Confirmed vs Book-1 §7.3 — Annual NET cash flow = $0.50 - 0.05 = \text{Rs.}0.45$ lakh/yr (maintenance Rs.5,000 = Rs.0.05 lakh must be deducted).
ROI = $(0.45 / 2.00) \times 100 = 22.5\%$. (Ignoring maintenance gives the distractor 25%.)
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- 38 **B** Confirmed vs Book-1 §3.4 — Book-1 §3.4 Heat transfer: 'The energy transferred is measured in Joules. The rate of energy transfer, more commonly called heat transfer, is measured in Watts (J/s).' kcal is a quantity, not a
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- 39 **D** Confirmed vs Book-1 §2.3.6 — The book says ESCerts issued for excess savings 'will be tradable at Power Exchanges' and that units gaining ESCerts may bank them for the next PAT cycle — so they can be bought, sold and ban
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- 40 **A** Confirmed vs Book-1 §5.5 Ex.5.5: weight fraction = weight of solute / total weight of solution = $25/(25 + 100) = 25/125 = 0.20$, i.e. % w/w = 20%. (Book's own case: $20/(100+20) = 16.7\%$.)
Option (a).
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- 41 **D** Confirmed vs Book-1 §2.1 — The statutory definition stops at verification, monitoring and analysis of energy use plus a technical report with recommendations, cost-benefit analysis and an action plan. Ensuring implementa
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- 42 **B** Confirmed vs Book-1 §4.6 — Book §4.6 benchmarks always relate energy to output: kcal/kWh (power-plant heat rate), Million kcal or kWh per MT of fertilizer, kWh/kg of yarn. 'kg/deg C' relates mass to temperature and carri
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- 43 **A** Corrected (was c) — Book-1 §11.6 Biomass Energy (Gasification of Biomass):
Book: 'The products of combustion are combustible gases like Carbon monoxide (CO), Hydrogen (H_2) and traces of Methane (CH_4)', and the chapter-e
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- 44 **D** Confirmed vs Book-1 §1.5 — R/P = reserves remaining at year end $\div$ production during that year. Reserves change with new discoveries, revisions and depletion, and production changes year to year, so the ratio varies with
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- 45 **B** Confirmed — Measurement & Verification convention (outside the Ch-9 text but consistent with §9.4 baseline practice): Energy Savings = Baseline (base-year) energy use - Post-retrofit

energy use $\pm$ Adjustments, the adjustm

- 46 **D** Confirmed vs Book-1 §7.3 — Book: 'payback' is a measure of how long it will be before the investment recovers itself', i.e. how quickly the invested money comes back. Its stated limitations are that it ignores the time value of money.
- 47 **D** Confirmed vs Book-1 §1.11 — $EI = \text{total final energy consumption} \div \text{GDP (toe per million US\$)}$, i.e. energy consumption / GDP. Option (a) 'fuel consumption/GDP' is the tempting near-miss: energy intensity uses total final energy.
- 48 **D** Confirmed vs Book-1 §8.3 — Book-1: the critical path is 'the longest-duration path through the network' and 'Critical path identifies the minimum time to complete project'; 'the activities that lie on it cannot be delayed'.
- 49 **C** Confirmed — bagasse is a wet biomass residue with roughly 2,200–2,500 kcal/kg (about 9–10 MJ/kg), far below LPG (~45 MJ/kg), diesel (~42 MJ/kg) and furnace oil (~40 MJ/kg). Its moisture content is what drags the energy cost down.
- 50 **D** Confirmed vs Book-1 §7.3 — Book: both NPV and IRR are discounted cash-flow methods whose stated advantage is 'It takes into account the time value of money.' The word 'simple' in simple payback denotes that time value of money is ignored.

S1 A 10 HP rated induction motor, with nameplate details indicating 415V, 12 amps, and a power factor (PF) of 0.9, is being audited. During the audit, the monitoring equipment displays a reactive power of 1.5 kVAR. What is the real power consumed by the motor?

S2 A continuous centrifuge separates 36,000 kg of whole milk containing 4% fat in 6-hour period into skim milk with 0.40% fat and cream with 40% fat. Find out the flow rates of whole milk, cream and skim.

S3 Calculate the net present value over a period of 3 years for a project with one investment of Rs 50,000 at the beginning of the first year and a second investment of Rs 30,000 at the beginning of the second year. The project generates a cash inflow of Rs 1,00,000 per year for the next 3 years. The discount rate is 10%.

S4 How does an ultrasonic flow meter work, and what is the difference between its transit-time and Doppler types?

S5 (a) Differentiate between commercial and non-commercial energy with an example each. (b) Differentiate between renewable and non-renewable energy with an example each.

- S6** a) List at least two factors affecting external energy benchmarking of energy intensive processes. (2 Marks) b) Compute the plant energy performance of a brewery unit for the current year based on th...
- S7** A University is interested in installing a Solar Roof Top PV (SPV) system under net metering system. It has a total roof top area of 1200 sq. meters, where the shading effect is 20% of the total area....
- S8** What are ESCerts and explain the basis for their issuance and trading under the PAT scheme....
- L1** An evaporator is fed with 10,000 kg/hr of a solution having 1% solids. The feed is at 38 degC and is to be concentrated to 2% solids. Steam enters at a total enthalpy of 640 kcal/kg and the condensate...
- L2** A company invests Rs. 12 lakhs and completes an energy efficiency project at the beginning of year 1. The firm is investing its own reserve money and expects an internal rate of return (IRR) of at lea...
- L3** a) Construct a CPM diagram for the data given below (4 Marks): Activity A - Precedent Start - 4 weeks; B - A - 5; C - A - 2; D - C - 5; E - Start - 3; F - B - 4; Finish - D, E, F. b) Identify the crit...
- L4** a) Use CUSUM technique to develop a table and to calculate energy saving for 6 months period. For calculating total energy saving average production can be taken as 4500 MT per month. Field data (Actu...
- L5** A) Fill in the blanks: 1. The current drawn by an electric kettle having resistance of 25 Ohms and receiving supply at 250 Volts is _____. 2. In three-phase system kW will be equal to kVA if the power ...
- L6** Write a short note on the following: 1. Working principle of fuel cell (4 Marks) 2. Carbon sequestration (3 Marks) 3. Availability based tariff (3 Marks)...