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प्रश्न-पत्र पुस्तिका एवं उत्तर पत्रक के पेपर सील/पॉलिथीन बैग को खोलने पर परीक्षार्थी यह सुनिश्चित कर लें कि उसके प्रश्न-पत्र पुस्तिका पर वही प्रश्न-पत्र पुस्तिका संख्या अंकित है जो उत्तर पत्रक पर अंकित है । इसमें कोई भिन्नता हो तो परीक्षार्थी बीक्षक से दूसरा प्रश्न-पत्र प्राप्त कर लें । ऐसा सुनिश्चित करने की जिम्मेदारी अभ्यर्थी की होगी ।

On opening the paper seal/polythene bag of the Question Paper Booklet the candidate should ensure that Question Paper Booklet No. of the Question Paper Booklet and Answer Sheet must be same. If there is any difference, candidate must obtain another Question Paper Booklet from Invigilator. Candidate himself shall be responsible for ensuring this.

परीक्षार्थियों के लिए निर्देश

1. सभी प्रश्नों के उत्तर दीजिए ।

2. सभी प्रश्नों के अंक समान हैं ।

3. प्रत्येक प्रश्न का केवल एक ही उत्तर दीजिए ।

4. एक से अधिक उत्तर देने की दशा में प्रश्न के उत्तर को गलत माना जाएगा ।

5. प्रत्येक प्रश्न के चार वैकल्पिक उत्तर दिये गये हैं, जिन्हें क्रमशः 1, 2, 3, 4 अंकित किया गया है । अभ्यर्थी को सही उत्तर निर्दिष्ट करते हुए उनमें से केवल एक गोले अथवा बबल को उत्तर-पत्रक पर नीले बॉल प्वाइंट पेन से गहरा करना है ।

6. OMR उत्तर-पत्रक इस परीक्षा पुस्तिका के अन्दर रखा है । जब आपको परीक्षा पुस्तिका खोलने को कहा जाए, तो उत्तर-पत्रक निकाल कर ध्यान से केवल नीले बॉल पॉइंट पेन से विवरण भरें ।

7. प्रत्येक गलत उत्तर के लिए प्रश्न अंक का 1/3 भाग काटा जायेगा । गलत उत्तर से तात्पर्य अशुद्ध उत्तर अथवा किसी भी प्रश्न के एक से अधिक उत्तर से है । किसी भी प्रश्न से संबंधित गोले या बबल को खाली छोड़ना गलत उत्तर नहीं माना जायेगा ।

8. मोबाइल फोन अथवा इलेक्ट्रोनिक यंत्र का परीक्षा हॉल में प्रयोग पूर्णतया वर्जित है । यदि किसी अभ्यर्थी के पास ऐसी कोई वर्जित सामग्री मिलती है तो उसके विरुद्ध आयोग द्वारा नियमानुसार कार्यवाही की जायेगी ।

9. कृपया अपना रोल नम्बर ओ.एम.आर. पत्रक पर सावधानीपूर्वक सही भरें । गलत अथवा अपूर्ण रोल नम्बर भरने पर 5 अंक कुल प्राप्तांकों में से काटे जा सकते हैं ।

चेतावनी : अगर कोई अभ्यर्थी नकल करते पकड़ा जाता है या उसके पास से कोई अनधिकृत सामग्री पाई जाती है, तो उस अभ्यर्थी के विरुद्ध पुलिस में प्राथमिकी दर्ज कराते हुए विविध नियमों-प्रावधानों के तहत कार्यवाही की जाएगी । साथ ही विभाग ऐसे अभ्यर्थी को भविष्य में होने वाली विभाग की समस्त परीक्षाओं से विवर्जित कर सकता है ।

INSTRUCTIONS FOR CANDIDATES

1. Answer **all** questions.

2. All questions carry equal marks.

3. Only **one** answer is to be given for each question.

4. If more than one answers are marked, it would be treated as wrong answer.

5. Each question has four alternative responses marked serially as 1, 2, 3, 4. You have to darken only one circle or bubble indicating the correct answer on the Answer Sheet using **BLUE BALL POINT PEN**.

6. The OMR Answer Sheet is inside this Test Booklet. When you are directed to open the Test Booklet, take out the Answer Sheet and fill in the particulars carefully with **blue ball point pen** only.

7. **1/3 part of the mark(s) of each question will be deducted for each wrong answer.** A wrong answer means an incorrect answer or more than one answers for any question. Leaving all the relevant circles or bubbles of any question blank will not be considered as wrong answer.

8. Mobile Phone or any other electronic gadget in the examination hall is strictly prohibited. A candidate found with any of such objectionable material with him/her will be strictly dealt as per rules.

9. Please correctly fill your Roll Number in O.M.R. Sheet. **5 Marks** can be deducted for filling wrong or incomplete Roll Number.

Warning : If a candidate is found copying or if any unauthorized material is found in his/her possession, F.I.R. would be lodged against him/her in the Police Station and he/she would liable to be prosecuted. Department may also debar him/her permanently from all future examinations.

इस परीक्षा पुस्तिका को तब तक न खोलें जब तक कहा न जाए ।
Do not open this Test Booklet until you are asked to do so.

02-□

1. If the gray body emission of 90% of black body emission at 1200 K, then find the temperature required for the gray body.

   (1) 1788 K

   (2) 1655 K

   (3) 1830 K

   (4) 1754 K

2. The Nusselt number, in case natural convection, is a function of :

   (1) Grashoff's and Prandtl numbers

   (2) Reynold's number

   (3) Reynold's and Prandtl numbers

   (4) Weber and Mach number

3. The dimensions of a wall are 5 m long, 10 m wide & 0.25 m thick, made of material having thermal conductivity at 1 W/mK. The temperature of inner and outside wall are 25 °C and 15 °C respectively for 10 hrs. If cost of electricity is ₹ 10 per kWh, the cost of heat loss will be in rupees

   (1) 20

   (2) 200

   (3) 10

   (4) 100

4. The shape factor of a hemispherical body placed on a flat surface with respect to itself is :

   (1) 0

   (2) 0.25

   (3) 0.5

   (4) 1.0

5. In a counter flow heat exchanger, the product of specific heat and mass flow rate is same for hot and cold fluids. If NTU is equal to 0.5, then effectiveness of the heat exchanger is :

   (1) 1.0

   (2) 0.5

   (3) 0.33

   (4) 0.25

6. The measure of heat conducted through a body relative to the rate of heat storage is called as

   (1) Thermal diffusivity

   (2) Biot number

   (3) Fourier number

   (4) Nusselt number

7. A 2-stroke engine has speed of 750 rpm. A 4-stroke engine having an identical cylinder size runs at 1500 rpm. The theoretical output of the 2-stroke engine will

   (1) be twice that of the 4-stroke engine

   (2) be half that of the 4-stroke engine

   (3) be the same as that of the 4-stroke engine

   (4) depend upon whether it is a C.I. or S.I. engine

8. A case of natural convection is given by :

   (1) Cooling of billets in atmosphere

   (2) Cooling in IC engines

   (3) Flow of water inside condensers

   (4) Cooling of a hot plate in a steam of cold water

9. A four stoke single cylinder engine produces 24 kW power at engine crank shaft at 2000 rpm. The mechanical efficiency of engine at 80%, swept volume 800 cc and stroke length as 9 cm. The indicated mean effective pressure of engine will be

   (1) 6.4 bar

   (2) 10 bar

   (3) 12.8 bar

   (4) 20 bar

10. In a 4-stroke IC engine, the camshaft rotates at

    (1) same speed as crankshaft

    (2) twice the speed of crankshaft

    (3) half the speed of crankshaft

    (4) None of these

11. Which is the best option to avoid knock in S.I. engine ?

    (1) Supercharging of engine

    (2) Low delay period

    (3) Higher spark advance

    (4) Increase in engine speed

12. An engine is having clearance volume as 20 cm^3 and total volume 320 cm^3, mechanical efficiency 90% and volumetric efficiency as 80%. The volume of charge that can be available in the engine after suction.

    (1) 320 cc

    (2) 300 cc

    (3) 270 cc

    (4) 240 cc

13. A single state impulse turbine of 1.2 m diameter runs at 1000 rpm and has blade speed ratio as 0.32. The approximate inlet steam velocity is

    (1) 20 m/s

    (2) 65 m/s

    (3) 200 m/s

    (4) 375 m/s

14. At the time of starting, idling and low speed operation, the carburettor supplies a mixture, which can be termed as

    (1) Lean

    (2) Slightly leaner than stoichiometric

    (3) Stoichiometric

    (4) Rich

15. Degree of reaction of the turbine if the isentropic enthalpy drop in fixed blade is 1.5 times of the isentropic enthalpy drop in the moving blade.

    (1) 0.6

    (2) 0.5

    (3) 0.4

    (4) 0.66

16. The correct statement for Parson reaction turbine if α_1, α_2 inlet and outlet fixed blade angle β_1, β_2 are inlet and outlet moving blade angle

    (1) $\alpha_1 = \beta_2$; $\alpha_2 = \beta_1$

    (2) $\alpha_1 = \beta_1$; $\alpha_2 = \beta_2$

    (3) $\alpha_1 = \alpha_2$; $\beta_1 = \beta_2$

    (4) $\alpha_1 > \alpha_2$; $\beta_1 < \beta_2$

17. Brake Hours Power (BHP) of a diesel engine can be increased by :

(1) Increasing the pressure of intake air

(2) Increasing the temperature of intake air

(3) Decreasing the density of intake air

(4) Increasing temperature and decreasing density of intake air

18. High air-fuel ratio in gas turbine is used to

(1) Reduce exhaust temperature after combustion

(2) Improve thermal efficiency

(3) Reduce power input of compressor

(4) Improve net power output of the cycle

19. During a morse test on a 4-cylinder engine, the following measurements of brake power were taken at constant speed.

All cylinders firing   3000 kW
Number 1 cylinder not firing 2062.5 kW
Number 2 cylinder not firing 2062.5 kW
Number 3 cylinder not firing 2061.5 kW
Number 4 cylinder not firing 2063.5 kW

The mechanical efficiency of the engine is :

(1) 91.53%

(2) 85.00%

(3) 80.00%

(4) 78.00%

20. A gas turbine cycle with infinitely large number of stage during compression and expansion leads to :

(1) Stirling cycle

(2) Atkinson cycle

(3) Ericsson cycle

(4) Brayton cycle

21. For a given set of operating pressure limits of Rankine cycle, the highest efficiency occurs for :

(1) Saturated cycle

(2) Superheated cycle

(3) Reheat cycle

(4) Regenerative cycle

22. When the outside air is introduced for ventilation purpose there is a

(1) Sensible heat gain

(2) Latent heat gain

(3) Sensible and latent heat gain

(4) No heat gain

23. For an ideal gas turbine enthalpy of gas at entry and exit are 3000 kJ/kg and 2500 kJ/kg respectively. The velocity of gas are 200 m/s and 100 m/s respectively at the entry and exit. Heat loss of gas to the surrounding is 15 kJ/kg. The approximate power developed by turbine if mass flow rate of gas is 30 kg/s

(1) 16 MW

(2) 0.55 MW

(3) 15 MW

(4) 15.5 MW

24. When compared to vapour compression refrigeration, the gas cycle refrigeration system has the following feature :

(1) Higher COP

(2) Low power requirement

(3) Pressurization at high altitude difficult

(4) Light weight and compact

25. Which of the following statement is wrong ?

(1) The performance of the vapour compression refrigerator varies considerably with both vaporising and condensing temperatures.

(2) In vaopur compression cycle, the useful part of the heat transfer is at the condenser.

(3) In ammonia-hydrogen (Electrolux) refrigerator, no compressor is required.

(4) The effect of under cooling the refrigerant is to decrease the coefficient of performance.

26. When the lower temperature of refrigerating machine is fixed then the coefficient of performance can be improved by

(1) Operating the machine at high speed

(2) Operating the machine at low speed

(3) Raising the higher temperature

(4) Lowering the higher temperature

27. The flow rate of refrigerant R-12 in a refrigerator is 0.03 kg/s. The refrigerant enters the compressor as saturated at 150.9 kPa. After adiabatic compression, it entres the condenser as superheated vapour at 500 kPa and 100 ºC and leaves the condenser as saturated liquid at the same pressure.

Pressure (kPa)	Temperature (ºC)	Specific enthalpy	
		hr (kJ/kg)	hg (kJ/kg)
150.9	−20	17.82	178.74
500	15.6	50.64	195.01

For the saturated vapour at 500 kPa and 100 ºC, h = 252.05 kJ/kg.

Using the data given above, the refrigeration effect in kW will be :

(1) 3.70

(2) 3.84

(3) 4.00

(4) 3.25

28. The atmospheric air at dry bulb temperature of 15 ºC enters a heating coil maintained at 40 ºC. Air leaves the heating coil at 25 ºC. The bypass factor of heating coil is

(1) 0.376

(2) 0.60

(3) 0.40

(4) 0.67

29. The leak in a refrigeration system using Freon can be detected by

(1) Halide torch which on detection produces greenish flame light

(2) Halide torch which on detection produces white flame light

(3) Sulphur sticks which on detection gives white smoke

(4) Sulphur sticks which on detection gives greenish smoke

30. Which is/are the wrong statements for required refrigerant properties ?

(a) High latent heat of vaporisation

(b) Higher critical temperature

(c) High boiling point

(d) High specific heat of liquid

(1) (a), (b)

(2) (a), (c)

(3) (b), (d)

(4) (c), (d)

31. Air enters the compressor of an ideal gas refrigeration cycle at 10 °C and 80 kPa. The maximum and minimum temperature in cycle are 250 °C and −50 °C. Assuming the value of specific heat at constant pressure as equal 1.0 kJ/kgK, the compressor work is (nearest) :

(1) 170 kJ/kg

(2) 190 kJ/kg

(3) 240 kJ/kg

(4) 220 kJ/kg

32. The flash chamber intercooler allows the refrigerant to enter the 2nd state of compressor of vapour compression refrigeration system at the state of :

(1) Dry saturated vapour

(2) Saturated liquid

(3) Wet vapour

(4) Superheated vapour

33. If 1 kg of air having specific humidity as 0.03 kg/kg of dry air mixes with 2 kg of air having specific humidity as 0.015 kg/kg of dry air. The specific humidity of mixture in kg/kg of dry air will be approximately

(1) 0.025

(2) 0.015

(3) 0.02

(4) 0.03

34. The supply air state to the conditioned space from cooling coil with a by pass factor lies at

(1) Intersection of RSHF line with saturation curve

(2) Intersection of GSHF line with saturation curve

(3) Point divides RSHF line in proportion of BPF and (1-BPF)

(4) Intersection of RSHF line with GSHF line

35. The effects of superheating of vapour in the evaporator and sub-cooling of condensate in the condenser :

(1) Decrease the COP

(2) Increase the COP

(3) Superheating increases COP, but sub-cooling decrease COP

(4) Superheating decrease COP, but sub-cooling decreases COP

36. What is the correct combination of refrigerants ?

(a) R-11   (I)   Centrifugal compressor & large capacity system

(b) R-12   (II)   Reciprocating compressor & small capacity system

(c) R-502   (III)   Frozen food

(d) R-718   (IV)   Steam ejector

	(a)	(b)	(c)	(d)
(1)	I	II	IV	III
(2)	II	I	IV	III
(3)	I	II	III	IV
(4)	II	I	III	IV

37. A refrigerating system of ITR capacity operates between temperature range of 7 °C and 47 °C. The minimum amount of heat rejected to the surrounding will be

(1) 3 kW

(2) 3.5 kW

(3) 4 kW

(4) Not possible to determine with given data.

38. An air-air heat pump system adopted for year-round-conditioning can be achieved, if the following devices reverses its duties during summers and winters :

(1) Evaporator, Condenser

(2) Compressor, Expander

(3) Compressor, Condenser

(4) Evaporator, Expander

39. Which is the correct combinations for psychrometry processes ?

(a) Activated Alumina   (I)   Heating & Humidification

(b) Water injection   (II)   Heating & Dehumidification

(c) Steam injection   (III)   Cooling & Dehumidification

(d) Hygroscopic   (IV)   Cooling & humidification

	(a)	(b)	(c)	(d)
(1)	I	II	III	IV
(2)	III	IV	I	II
(3)	IV	III	II	I
(4)	II	IV	I	III

40. In vapour absorption refrigeration system, the refrigeration temperature is 7 °C, generator temperature 127 °C temperature of heat sink 47 °C. The maximum possible COP of the system

(1) 0.714

(2) 0.86

(3) 1.4

(4) 0.11

41. Cooling tower utilize which of the phenomenon to cool water below the dry bulb temperature of air ?

(1) Chemical Dehumidification

(2) Adiabatic Evaporative Cooling

(3) Cooling and Dehumidification

(4) Sensible Cooling

42. With increase in A/F ratio the level of HCs in engine exhaust gas
   (1) Increases
   (2) Decreases
   (3) Initially increase till chemically corrected ratio than reduces
   (4) Initially reduces till chemically corrected ratio than reduces

43. The NOx level in engine exhaust gas can be reduces by following method :
   (1) Thermal reactor
   (2) Exhaust gas recirculation
   (3) Advance spark timing or fuel injection
   (4) Use of after burner

44. The function of master cylinder hydraulic system is :
   (1) To increase pressure equally in all cylinders
   (2) To increase pressure unequally in all cylinders
   (3) To increase power equally in all cylinders
   (4) To decrease power equally in all cylinders

45. In air conditioning systems, the cooling and dehumidification can be achieved by performing the following action :
   (1) spraying chilled water to air in the form fine mist
   (2) circulating brine in a tube place across the air flow
   (3) placing the evaporator coil across the air flow
   (4) All of these

46. If the brake wheels gets locked before the vehicle stops, the vehicle is said to be :
   (1) Slipping
   (2) Skidding
   (3) Sliding
   (4) Rolling

47. Which is/are not the characteristics of wet clutch in comparison of dry clutch ?
   (a) Has more life
   (b) High torque transmitting capacity
   (c) High cost
   (d) High coefficient of friction
   (1) (a), (c)
   (2) (b), (c)
   (3) (b), (d)
   (4) (d)

48. In comparison to reverse gear, the torque obtained and speed ratio of top gear are
   (1) less, less
   (2) more, less
   (3) equal, more
   (4) less, more

49. The adjustment for backlash in a differential is provided between :
   (1) Crown wheel and sun gear
   (2) Crown wheel and the planet gear
   (3) Sun gear and the planet gear
   (4) Crown wheel and drive pinion

50. The function of the shock absorber is :

(1) to absorb the energy

(2) to release the energy

(3) to dissipate the energy

(4) to generate the energy

51. In compound gear train as shown in fig., what will be the speed of output shaft if input shaft runs at 2700 rpm ? The number of teeth on gears A, B, C, D are 16, 24, 12 & 36 respectively
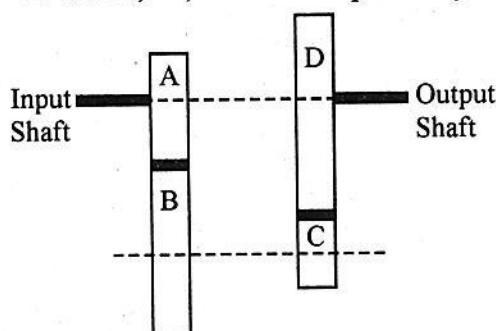
(1) 5400 rpm

(2) 2700 rpm

(3) 600 rpm

(4) 1350 rpm

52. In a simple epicyclic gear-set, the output member to increase torque in reverse is always the :

(1) Ring gear

(2) Sun gear

(3) Planet carrier

(4) None of these

53. The function of universal joint is to allow propeller shaft to :

(1) Change the length

(2) Change the inclination

(3) Transfer the torque at an angle

(4) None of these

54. The common clutch used between the engine and synchromesh gear box is :

(1) Cone

(2) Single plate (dry)

(3) Multiplate wet

(4) Electro-magnetic

55. Which is the combination for following statements for suspension system ?

(a) Antiroll bar   (I) High wheel wobbling

(b) Independent suspension   (II) High damping

(c) Rigid axle suspension   (III) Reduce rolling effect

(d) Leaf spring   (IV) High riding comfort

	(a)	(b)	(c)	(d)
(1)	III	II	IV	I
(2)	III	IV	I	II
(3)	IV	III	II	I
(4)	IV	III	I	II

56. The condition for driving and driven shafts connected by a Hooke's joint will rotate at equal speed, if driving shaft and driven shaft inclined at angle (α) and (θ) is angle of rotation of driving shaft

(1) $\tan \theta = \dfrac{1}{\cos \alpha}$

(2) $\tan \theta = \cos \alpha$

(3) $\tan \theta = \alpha^2$

(4) $\tan \theta = \pm \sqrt{\cos \alpha}$

57. The ratio of energy produced by a power plant to the installed capacity of plant is called as

   (1) Plant load factor
   (2) Plant use factor
   (3) Average load factor
   (4) Demand factor

58. Which type of Power Plant is preferred as peak load type ?

   (1) Nuclear
   (2) Gas
   (3) Hydraulic
   (4) Thermal

59. As the boiler pressure increases

   (1) the heat absorbed in the evaporator increases
   (2) the fraction of the total heat absorbed in the superheater increases
   (3) the laten heat of vaporization increases
   (4) for the given superheated steam temperature, the quality of steam at turbine exhaust decreases

60. The angle between the King-pin centre line and the vertical in the plane of the wheel is called

   (1) King-pin inclination
   (2) Caster angle
   (3) Camber angle
   (4) Included angle

61. If the enthalpy drop across the fixed blades in a turbine is zero, the degree of reaction is :

   (1) Zero
   (2) 0.5
   (3) Unity
   (4) Infinity

62. If k is the ratio of the rate of production of neutrons to the rate of loss of neutrons, the reactor is called a critical reactor when :

   (1) $k = 1$
   (2) $0 < k < 1$
   (3) $k = 0$
   (4) $k > 1$

63. The correct sequence for radioactive isotopes in decreasing half life time :

   (1) $U^{239} \, Pu^{239} \, U^{233}$
   (2) $U^{233} \, Pu^{239} \, U^{239}$
   (3) $U^{239} \, Pu^{233} \, U^{239}$
   (4) $U^{233} \, Pu^{239} \, U^{239}$

64. Which is not a preferable property of coolant used in nuclear reactor ?

   (1) Must have low boiling point
   (2) Must have low melting point
   (3) Must not absorb neutrons
   (4) Must be non-oxidising

65. Power plant has load factor as 0.6, capacity factor as 0.4, maximum demand as 20 MW. The average load and reserve capacity over and above peak load is
   (1) 30 MW, 12 MW
   (2) 30 MW, 10 MW
   (3) 12 MW, 20 MW
   (4) 12 MW, 10 MW

66. Compared to conventional sources of power such as thermal plants, the cost of wind power is :
   (1) 100 times
   (2) 10 times
   (3) comparable
   (4) 1/10 times

67. A wind turbine extracts maximum power from wind, when the downstream wind speed reduces to :
   (1) one-third that of upstream wind
   (2) half that of upstream wind
   (3) two third that of upstream wind
   (4) zero

68. The correct combination for moderator and reactor are

   (a) Graphite   (I)   Pressurised water
   (b) Water   (II) Liquid metal cooled
   (c) No moderator   (III) Breeder

	(a)	(b)	(c)
(1)	III	I	II
(2)	I	II	III
(3)	II	III	I
(4)	II	I	III

69. Catchment area of hydroelectric power plant is 100 sq. km and annual average rainfall is 100 cm. The head drop available at power house site is 120 mt. How much approximate power can be developed by the plant if evaporation loss is 20% and load factor as unity ?
   (1) 0.30 MW
   (2) 3.0 MW
   (3) 30 MW
   (4) 300 MW

70. If the speed of a wind stream remains unchanged while passing through the rotor, then :
   (1) a large power will be generated.
   (2) zero power will be generated.
   (3) the flow is known as stalled flow.
   (4) the speed of the rotor will be extremely high.

71. Which is/are not the correct statements for hydroelectric power plant ?
   (a) Cost of electricity generation is affected by load factor.
   (b) Useful life is lower than thermal power plant.
   (c) Operating cost is low.
   (d) Quickly respond to change in load.
   (1) (b), (d)
   (2) (a), (b)
   (3) (a), (c)
   (4) Only (d)

72. Compared to a conventional steam plant, the temperature and pressure in a geothermal plant are

    (1) comparable

    (2) much higher

    (3) higher

    (4) lower

73. Which is not a correct option for thermo-electric solar power system ?

    (1) Tower type solar plant

    (2) Concentrator collector solar plant

    (3) Flat plate collector solar plant

    (4) Photo-voltaic solar plant

74. Wind mill called as 'Darriens' mill is

    (1) Flexible boom mill

    (2) Vertical axis mill

    (3) Horizontal axis single blade mill

    (4) Horizontal axis bicycle wheel mill

75. A thermal power plant of 100 MW capacity uses coal of 25 MJ/kg colorific value. If thermal efficiency of power plant is 40% and generator efficiency is 90%. What will be approximate coal consumption per hr when plant run at full load ?

    (1) 11.11 tons/hr.

    (2) 11.11 kg/hr.

    (3) 40.0 tons/hr.

    (4) 40.0 kg/hr.

76. Which of the following turbine is normally used in a tidal range plant ?

    (1) Pelton turbine

    (2) Kaplan turbine with variable pitch blades

    (3) Kaplan turbine with fixed pitch blades

    (4) Francis turbine

77. Which of the following statement is TRUE for stable equilibrium of a floating body ?

    (1) Metacentre should be below centre of gravity.

    (2) Metacentre should be above centre of gravity.

    (3) Metacentre and Centre of gravity should be considered.

    (4) Does not depends on metacentre location.

78. For a Newtonian fluid

    (1) shear stress is proportional to acceleration.

    (2) rate of shear stress is proportional to shear strain.

    (3) shear stress is proportional to density.

    (4) shear stress is proportional to rate of shear strain.

79. Compared to a conventional steam plant, the efficiency of geothermal plant is :

    (1) very high

    (2) higher

    (3) comparable

    (4) lower

80. Water is flowing through a horizontal pipe on constant diameter and the flow is laminar. If the pipe diameter is increased by 50% keeping the volume flow rate constant, then the pressure drop in the pipe due to friction will be decreased by :

(1) 33%

(2) 50%

(3) 70%

(4) 80%

81. For a laminar viscous flow the relation between the coefficient of friction 'f' and Reynolds number 'Re' can be given as

(1) $f = \dfrac{64}{Re}$

(2) $f = \dfrac{16}{Re}$

(3) $f = \dfrac{8}{Re}$

(4) $f = \dfrac{4}{Re}$

82. Oil is being pumped through a straight pipe, the pipe length, diameter and volumetric flow rate are all doubled in a new arrangement. The pipe friction factor, however, remains constant. The ratio of pipe frictional losses in the new arrangement to that of in the original configuration would be :

(1) 1/4

(2) 1/2

(3) 2

(4) 4

83. A pipe has 10 mtr velocity head at outlet. What height will be reached by fluid stream, if pipe is kept vertical ?

(1) 100 mtr

(2) 50 mtr

(3) 10 mtr

(4) 14.10 mtr

84. Which statement is correct for outside regime of the boundary layer of fluid flow ?

(1) Velocity is zero.

(2) Shear stress is zero.

(3) Velocity is not constant.

(4) Shear stress is proportional to velocity gradient.

85. A Prandtl tube (Pitot-static tube with $C_v = 1$) is used to measure the velocity of water. The differential manometer reading is 10 mm of liquid column with a relative density of 11. Assuming $g = 9.8$ m/s^2, the velocity of water (in m/s) is :

(1) 1.32

(2) 1.4

(3) 1.6

(4) 1.5

86. Which is the correct option for Froude Number ?

(1) Viscous force

(2) Elastic force

(3) Gravity force

(4) Surface tension force

87. For which of the following fluids, the apparent viscosity can be considered to be independent of the rate of shear strain and equal to the fluid's viscosity ?

(1) Ketchup

(2) Water

(3) Corn Starch Solution

(4) Blood

88. In Navier Strokes equation the considered fluid forces are

(1) Gravity, Pressure, Turbulent

(2) Viscous, Pressure, Elastic

(3) Gravity, Pressure, Elastic

(4) Gravity, Pressure, Viscous

89. What will be the drag force on an object, if object speed is doubled in fluid ?

(1) Doubled

(2) Four times

(3) Remains same

(4) Becomes zero

90. If a two-dimensional flow field has velocities along the x and y directions given by $u = x^2t$ and $v = -2xyt$ respectively, where t is the time, then the equation of streamline is :

(1) x^2y = constant

(2) xy^2 = constant

(3) xy = constant

(4) Not possible to determine.

91. Separation of boundary layer take place when

(1) pressure and velocity gradient both positive

(2) pressure and velocity gradient both negative

(3) positive pressure gradient and negative velocity gradient

(4) negative pressure gradient and positive velocity gradient

92. What is the approximate height of mountain if barometer pressure at sea level and at mountain is respectively 760 mm and 724 mm of Mercury considering air density as 1.2 kg/m^3 ?

(1) 36 m

(2) 41 m

(3) 360 m

(4) 410 m

93. The Reynold's number for the flow of a fluid in a horizontal circular tube of constant diameter is 1200. If the diameter of the tube and the kinematic viscosity of the fluid are doubled and that discharged at the pipe exit is unchanged, then the new Reynold's number for the flow in the tube will be

(1) 4800

(2) 300

(3) 1200

(4) 600

94. In impulse turbines :

   (1) water remains at atmospheric pressure before and after making contact with the runner blades

   (2) water remains at atmospheric pressure before entering the runner blades but the pressure reduces thereafter

   (3) water enters at low pressure, which increases after making contact with the runner blades

   (4) water pressure remains below atmospheric before and after making contact with the runner blades

95. Consider steady laminar incompressible axisymmetric fully developed viscous flow through a straight circular pipe of constant cross-sectional area at a Reynold's numbers of 5. The ratio of inertia force to viscous force on a fluid particle is :

   (1) 5

   (2) 1/5

   (3) 0

   (4) Infinity

96. A body weight is 392.4 N in air and 196.2 N in water, the volume of body in (m^3) is

   (1) 0.05

   (2) 0.10

   (3) 0.02

   (4) 0.20

97. Head loss due to friction in water flow through penstock can be minimised by

   (1) decreasing the diameter of penstock

   (2) increasing the diameter of penstock

   (3) increasing the length of penstock

   (4) increasing the velocity of flow

98. For a hydraulic turbine operating at two different heads, the ratio of their speeds will be 3 : 1. For the two heads, the ratio of the shaft power developed by the turbine will be :

   (1) 9 : 1

   (2) 243 : 1

   (3) 3 : 1

   (4) 27 : 1

99. A rectangular block of width = 5 m, height = 3 m and length = 10 m (into the plane of the paper) is floating in a liquid of density 1500 kg/m^3. If the centre of buoyancy is located at a vertical distance of 2.5 metres from the top edge of the block, then the density of the material making up the block is :

   (1) 1500 kg/m^3

   (2) 500 kg/m^3

   (3) 750 kg/m^3

   (4) 1700 kg/m^3

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100. Correct combinations for centrifugal pump efficiencies are

(a) Monometric efficiency (I) $\dfrac{\text{Water Power}}{\text{Shaft Power}}$

(b) Mechanical efficiency (II) $\dfrac{\text{Water Power}}{\text{Power of Impeller}}$

(c) Hydraulic efficiency (III) $\dfrac{\text{Power in fluid}}{\text{Impeller Power}}$

(d) Overall efficiency (IV) $\dfrac{\text{Impeller Power}}{\text{Shaft Power}}$

	(a)	(b)	(c)	(d)
(1)	II	IV	III	I
(2)	III	II	I	IV
(3)	I	III	IV	II
(4)	IV	I	II	III

101. Which is the correct option for specific speed of pumps and turbines respectively ?

(1) $\dfrac{NQ^{\frac{1}{2}}}{H^{\frac{3}{4}}} ; \dfrac{NP^{\frac{1}{2}}}{H^{\frac{5}{4}}}$

(2) $\dfrac{NQ^{\frac{1}{2}}}{H^{\frac{5}{4}}} ; \dfrac{NP^{\frac{1}{2}}}{H^{\frac{3}{4}}}$

(3) $\dfrac{NP^{\frac{1}{2}}}{H^{\frac{5}{4}}} ; \dfrac{NQ^{\frac{1}{2}}}{H^{\frac{3}{4}}}$

(4) $\dfrac{NP^{\frac{1}{2}}}{H^{\frac{3}{4}}} ; \dfrac{NQ^{\frac{1}{2}}}{H^{\frac{5}{4}}}$

102. For Pelton wheel turbine correct relation between nozzle efficiency (η_n) & nozzle velocity coefficient (C_v) is

(1) $\eta_n = C_v^2$

(2) $\eta_n = C_v$

(3) $\eta_n = \dfrac{C_v}{2}$

(4) $\eta_n^2 = C_v$

103. Which of the following is not a correct statement for a reciprocating pump ?

(1) The flow from a reciprocating pump may be evened out by employing properly phased out multicylinder units or by fitting air vessels close to the cylinder.

(2) Percentage of power saved by fitting air vessel is more in a double acting pump than in a single acting pump.

(3) The reciprocating pump is essentially a low speed machine and that speed is limited due to considerations of flow separation

(4) The reciprocating pumps can handle only low viscosity liquids free from impurities.

104. For the two straight conical draft tubes A and B, the head loss due to friction in the tube is equal to 0.4 times the velocity head at outlet. If the inlet to outlet diameter ratio for draft tube A is 0.56 while for draft tube B is 0.71, then which one of the following statements is only correct for the same discharge through the tubes ?

(1) Draft tube B is more efficient.

(2) Draft tube A is more efficient.

(3) Both the draft tubes have the same efficiency.

(4) Efficiency of the draft tube cannot be determined.

105. For a hydraulic turbine working of two different head, the ratio of discharges through the turbine is determined to be $1 : \sqrt{7}$, for the two head, the ratio of the shaft powers developed by the turbine will be

(1) $1 : \sqrt{7}$

(2) $1 : 49$

(3) $1 : 7$

(4) $1 : 7\sqrt{7}$

106. A hydraulic turbine is working under a head of 20 m. If the head available to the turbine is increased by 700%, then the speed of the turbine will :

(1) Increase by 700%

(2) Increase by 2162%

(3) Decrease by 64.4%

(4) Increase by 182.8%

107. If Net Positive Suction Head (NPSH) requirement of a pump is not satisfied, then correct statements are :

(a) It will not develop sufficient head to raise water.

(b) Its efficiency will be low.

(c) It will deliver very low discharge.

(d) It will be cavilated.

(1) (a), (b) and (c)

(2) (b), (c) and (d)

(3) (a) and (d)

(4) (a), (b), (c) and (d)

108. In a Francis turbine, maximum efficiency is obtained when

(1) Relative velocity is radial at the outlet.

(2) Absolute velocity is radial at the outlet.

(3) Velocity of flow is constant.

(4) Guide vane angle is 90 degree.

109. In a Pelton wheel the bucket peripheral speed is 10 m/s, the water jet velocity is 25 m/s and volumetric flow rate of the jet is 0.1 m^3/s. If the jet deflection angle is 120° and the flow is ideal, the power developed is :

(1) 7.5 kW

(2) 15.0 kW

(3) 22.5 kW

(4) 37.5 kW

110. The head available to both the Francis turbines A and B is 80 m. The mean atmospheric pressure is 101.043 kPa and the vapour pressure for water is 2.943 kPa. The height of the runner of turbine A above the tail water level is 0.5 m and for turbine B it is 0.6 m. If the critical cavitation factor is 0.1144, then which one of the following statements is only correct ?

(1) Cavitation does not occur in the turbine.

(2) Cavitation occurs in both the turbines.

(3) Cavitation occurs only in turbine A.

(4) Cavitation occurs only in turbine B.

111. Approximate head gain due to installation of a tapered draft tube after a turbine, if discharge is 9.42 m^3/s, draft tube inlet and outlet diameter respectively is 2 m and 4 m with efficiency of 90%.

(1) 0.86 m

(2) 0.38 m

(3) 0.42 m

(4) 0.95 m

112. In a reciprocating compressor the effect of increase in delivery pressure with fixed clearance volume and suction pressure will be

(1) increase in volumetric efficiency

(2) decrease in volumetric efficiency

(3) initially volumetric efficiency increases then decreases

(4) There will be no change in volumetric efficiency.

113. For a Pelton wheel turbine theoretical maximum efficiency and the speed factor for maximum efficiency can be obtained from

(1) $\frac{1}{2}\left(1 + \frac{\cos\beta_2}{2}\right); \frac{U}{V_1}$

(2) $\frac{1}{2}(1 - \cos\beta_2); \frac{U}{Vr_1}$

(3) $\frac{1}{2}(1 + \cos\beta_2); \frac{U}{V_1}$

(4) $\frac{1}{2}(1 + \cos\beta_2); \frac{U}{Vr_1}$

114. Which statement is true for the effect of blade shape on performance of a centrifugal compressor ?

(1) Forward curved blades has higher efficiency.

(2) Backward curved bladed produces higher pressure ratio.

(3) Backward curved blades has poor efficiency.

(4) Forward curved blades produces higher pressure ratio.

115. For axial flow compressor, reaction ratio in terms of rotor blade angle at inlet (β_1), at outlet (β_2) and flow coefficient (ϕ) is

(1) $2\phi (\tan\beta_1 - \tan\beta_2)$

(2) $2\phi (\tan\beta_1 + \tan\beta_2)$

(3) $\frac{\phi}{2} (\tan\beta_1 - \tan\beta_2)$

(4) $\frac{\phi}{2} (\tan\beta_1 + \tan\beta_2)$

116. Which of the following pumps is NOT a positive displacement pump ?

(1) Reciprocating pump

(2) Jet pump

(3) Sliding-vane pump

(4) Lobe pump

117. In order to have maximum power from a Pelton turbine, the bucket speed must be :

(1) Equal to the jet speed

(2) Equal to half of the speed

(3) Equal to twice the jet speed

(4) Independent of the jet speed

118. The expression $\Delta h = v\Delta p$ is utilised by which component of the steam power plant cycle ?

(1) Boiler

(2) Turbine

(3) Condenser

(4) Pump

119. An ideal gas of mass (m) and temperature (T_1) undergoes a reversible isothermal process from a initial pressure (P_1) to final pressure (P_2). The heat loss during the process is (Q). The change in entropy of gas is

(1) $mRln\left(\dfrac{P_2}{P_1}\right)$

(2) $mRln\left(\dfrac{P_1}{P_2}\right)$

(3) mRT

(4) zero

120. An absolute zero temperature, a reversible adiabatic line is also an :

(1) Isothermal Line

(2) Isobaric Line

(3) Isochoric Line

(4) Isenthalpic Line

121. Which one of the following is the extensive property of the system ?

(1) Density

(2) Volume

(3) Pressure

(4) Temperature

122. What is the rise in temperature of 80 lit. of water in 40 min. by a heater of 2 kW, if whole of heater energy used to raise the water temperature ?

(1) 1.43 ºC

(2) 2.52 ºC

(3) 14.3 ºC

(4) 25.2 ºC

123. Carnot cycle is different from Rankine Cycle in steam power plant during the following process :

(1) Heat Addition

(2) Expansion Work

(3) Heat Rejection

(4) Pump Work

124. In Vander Waals equation of state the two constant are determined from the behaviour of substance at

(1) Saturated point

(2) Triple point

(3) Critical point

(4) Never determined.

125. In a closed feed water heater used in a regenerative cycle, the temperature of the feedwater leaving a heater must be :

(1) lesser than the saturation temperature at the steam extraction pressure

(2) higher than the saturation temperature at the steam extraction pressure

(3) equal to the saturation temperature at the steam extraction pressure

(4) equal to or higher than the saturation temperature at the steam extraction pressure

126. Which is the case where low grade (heat) be more than the high grade (work) is the possibility ?
    (1) Heat Pump
    (2) Refrigerator
    (3) Heat Engine
    (4) Heat Exchanger

127. The gauge pressure in a tire before and after the journey was recorded as 200 kPa and 220 kPa respectively at the location where atmospheric pressure and temperature was 100 kPa and 27 °C respectively. How much temperature of tire air will rise after the trip ?
    (1) 20 °C
    (2) 27 °C
    (3) 47 °C
    (4) Data insufficient cannot be calculated.

128. A fan consume 200 W of electric power and discharge air from a ventilated room at the rate of 1 kg/s. What will be the possible air velocity from the fan ?
    (1) 200 m/s
    (2) 20 m/s
    (3) 42 m/s
    (4) 4.2 m/s

129. A Carnot Cycle operates between two temperature T_1 and T_2 ($T_1 > T_2$). If T_1 is increased by ΔT and T_2 is decreased by ΔT. The efficiency η_2 in the second case and the efficiency η_1 in the first case are related by :
    (1) $\eta_1 > \eta_2$
    (2) $\eta_2 > \eta_1$
    (3) $\eta_1 = \eta_2$
    (4) Unpredictable

130. Which factor leads to lower thermal efficiency of an actual Otto cycle in comparison of ideal Otto cycle ?
    (1) Increase in specific heat ratio of working fluid with rise in temperature.
    (2) Decrease in specific heat ratio of working fluid with rise in temperature.
    (3) Decrease in specific heat of working fluid with rise in temperature.
    (4) No change in specific heat with change in temperature.

131. Consider the following two processes :
    (I) A heat source at 1200 K loses 2500 kJ of heat to sink at 800 K.
    (II) A heat source at 800 K loses 2000 kJ of heat to sink at 500 K.

    Which of the following statement is TRUE ?
    (1) Process (I) is more irreversible than Process (II).
    (2) Process (II) is more irreversible than Process (I).
    (3) Irreversibility associated in both the process is equal.
    (4) Both the processes are reversible.

132. Heat transferred to a system at constant pressure is equal to :
    (1) work transfer
    (2) change in internal energy
    (3) change in enthalpy
    (4) change in entropy

133. Regeneration leads to increase in Rankine cycle efficiency due to

(1) Work done by turbine increases

(2) Pressure of boiler increases

(3) Heat added to the steam before it enters to low pressure turbine

(4) Average temperature of heat addition in boiler increases.

134. Consider the following statements :

When dry saturated steam is throttled from a higher pressure to a lower pressure, the

(a) Pressure decreases and the volume increases.

(b) Temperature decreases and the steam becomes super heated.

(c) Temperature and the dryness fraction increase.

(d) Entropy increases without any change in Enthalpy.

Which of these statements are correct ?

(1) (a) & (d)

(2) (a), (b) & (d)

(3) (a) & (c)

(4) (b) & (d)

135. The Otto cycle is more efficient than Diesel cycle for the condition

(1) Same maximum pressure and heat input

(2) Same maximum pressure and maximum temperature

(3) Same heat input and compression ratio

(4) Same heat output and maximum pressure

136. Which combination of the following statements is correct ?

P. A gas cools upon expansion only when its Joule-Thomson coefficient is positive in the temperature range of expansion.

Q. For a system undergoing a process, its entropy remains constant only when the process is reversible.

R. The work done by a closed system in an adiabatic process is a point function.

S. A liquid expands upon freezing when the slope of its fusion curve on Pressure Temperature diagram is negative.

(1) R and S

(2) P and Q

(3) Q, R and S

(4) P, Q and R

137. The critical radius is the insulation radius at which the resistance to heat flow is

(1) Maximum

(2) Minimum

(3) Zero

(4) Remain Same Throughout

138. A heat engine receives heat at the rate of 400 kW from a source at 1200 K and repeat waste heat to a sink at 300 K. If power output from the engine is 200 kW, what is the reversible power and the irreversibility rate for the process ?

(1) 200 kW; 100 kW

(2) 300 kW; 200 kW

(3) 300 kW; 100 kW

(4) 400 kW; 200 kW

139. In the process of heat transfer through fins, the entire surface area is considered at

(1) Equal to fin base temperature

(2) Equal to surrounding temperature

(3) Any temperature between base and surrounding temperature that remain constant throughout the length of fin

(4) Any temperature between base and surrounding temperature that varies throughout the length of fin

140. The automobile radiator is a heat exchanger of

(1) Parallel flow type

(2) Counter flow type

(3) Cross flow type

(4) Regenerator type

141. A 10 mm diameter electrical conductor is covered by an insulation of 2 mm thickness. The conductivity of the insulation is 0.8 W/mK and the convection coefficient at the insulation surface is 10 W/m^{2}K. Addition of further insulation of the same materials will :

(1) Increase heat loss continuously

(2) Decrease heat loss continuously

(3) Increase heat loss to a maximum and then decrease heat loss

(4) Decrease heat loss to a minimum and then increase heat loss

142. The equation of effectiveness $\varepsilon = 1 - e^{-NTU}$ of a heat exchanger is valid in the case of :

(1) Boiler and condenser for parallel flow

(2) Boiler and condenser for counter flow

(3) Boiler and condenser for both parallel flow and counter-flow

(4) Gas turbine for both parallel flow and counter-flow

143. A plastic sleeve of outer radius $r_0 = 1$ mm covers a wire (radius $r = 0.5$ mm) carrying electric current. Thermal conductivity of the plastic is 0.15 W/mK. The heat transfer coefficient on the outer surface of the sleeve exposed to air is 25 W/m^{2}K. Due to addition of the plastic cover, the heat transfer from the wire to the ambient will :

(1) Increase

(2) Remain the same

(3) Decrease

(4) Be Zero

144. In design of heat exchanger fouling factor largely depends on

(a) Operating temperature

(b) Velocity of fluid

(c) Length of service

(d) Area of surface

(1) (a), (b), (d)

(2) (b), (c), (d)

(3) (a), (c), (d)

(4) (a), (b), (c)

145. Hot fluid enters the counter flow heat exchanger at 100 °C and leaves at 60 °C. Cold fluid enters the heat exchanger at 40 °C. If the heat capacity of both fluid are equal, the mean temperature difference between two fluid will be

   (1) 30 °C
   (2) 20 °C
   (3) 40 °C
   (4) 60 °C

146. Which are the correct statements ?
   (a) Film condensation usually occur on oily surface.
   (b) Temperature of condensate gradually increases towards the liquid-vapour interface.
   (c) Suitable coating is used to promote dropwise condensation.
   (d) Dropwise condensation gives lower heat transfer rate than film condensation.

   (1) (a), (d)
   (2) (c), (d)
   (3) (a), (b)
   (4) (b), (c)

147. The ratio of thickness of thermal boundary layer to the thickness of hydrodynamic boundary layer is equal to $(Pr)^n$, where (n) is equal to

   (1) $-\left(\dfrac{1}{3}\right)$
   (2) $-\left(\dfrac{2}{3}\right)$
   (3) $\left(\dfrac{1}{3}\right)$
   (4) $-(1)$

148. The total emissive power of surface is 100 W/m^2 at temperature T_1 and 800 W/m^2 at a temperature T_2, where the temperature are in Kelvin. Assuming the emissivity of the surface to be constant, the ratio of the temperature T_2/T_1 is :

   (1) 2
   (2) 4
   (3) 6
   (4) 8

149. At the centre of hollow sphere (surface 1), of 2 m diameter a solid cylinder of 1 m diameter and length each (surface 2) is placed. The view factor (F_{11}) will be

   (1) 0.375
   (2) 1
   (3) 0.625
   (4) 0.5

150. A heat exchanger is used to heat cold water (C_p = 4.18 kJ/kgK) entering at 12 °C at a rate of 1.2 kg/s by hot air (C_p = 1.0 kJ/kgK) at 90 °C at rate of 2.5 kg/s. The highest rate of heat transfer in the heat exchangers is :

   (1) 82 kW
   (2) 195 kW
   (3) 391 kW
   (4) None of these