

पुस्तिका में पृष्ठों की संख्या /  
Number of Pages in Booklet : 16

पुस्तिका में प्रश्नों की संख्या /  
Number of Questions in Booklet : 100

**14** Mechanical  
Engineering  
बुकलेट  
सीरीज

1401317

समय / Time : 2.00 घंटे / Hours

पूर्णांक / Maximum Marks : 200

**INSTRUCTIONS**

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. 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.)
7. The candidate should ensure that Series Code of the Question Paper Booklet and Answer Sheet must be same after opening the envelopes. In case they are different, a candidate must obtain another question paper of the same series. Candidate himself shall be responsible for ensuring this.
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 will be deducted for filling wrong or incomplete Roll Number.
10. If there is any sort of ambiguity/mistake either of printing or factual nature then out of Hindi and English Version of the question, the English Version will be treated as standard.

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**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 चाइंट पेन से गहरा करना है।
6. 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।
7. प्रश्न-पत्र पुस्तिका एवं उत्तर पत्रक के लिफाफे की सील खोलने पर परीक्षार्थी यह सुनिश्चित कर लें कि उसके प्रश्न-पत्र पुस्तिका पर वही सीरीज अंकित है जो उत्तर पत्रक पर अंकित है। इसमें कोई भिन्नता हो तो वीक्षक से प्रश्न-पत्र की ही सीरीज वाला दूसरा प्रश्न-पत्र का लिफाफा प्राप्त कर लें। ऐसा न करने पर जिम्मेदारी अभ्यर्थी की होगी।
8. मोबाईल फोन अथवा इलेक्ट्रॉनिक यंत्र का परीक्षा हॉल में प्रयोग पूर्णतया वर्जित है। यदि किसी अभ्यर्थी के पास ऐसी कोई बर्जित सामग्री मिलती है तो उसके विरुद्ध आयोग द्वारा नियमानुसार कार्यवाही की जायेगी।
9. कृपया अपना रोल नम्बर ओ.एम.आर. पत्रक पर सावधानी पूर्वक सही भरें। गलत अथवा अपूर्ण रोल नम्बर भरने पर 5 अंक कुल प्राप्तांको में से अनिवार्य रूप से काटे जाएंगे।
10. यदि किसी प्रश्न में किसी प्रकार की कोई मुद्रण या तथ्यात्मक प्रकार की त्रुटि हो तो प्रश्न के हिन्दी तथा अंग्रेजी रूपान्तरों में से अंग्रेजी रूपान्तर मान्य होगा।

**चेतावनी :** अगर कोई अभ्यर्थी नकल करते पकड़ा जाता है या उसके पास से कोई अनधिकृत सामग्री पाई जाती है, उस अभ्यर्थी के विरुद्ध पुलिस में प्राथमिकी दर्ज कराई जायेगी और आर. पी. ई. (अनुचित साधनों की रोकथाम) अधिनियम, 1992 के नियम 3 के तहत कार्यवाही की जायेगी। साथ ही आयोग ऐसे अभ्यर्थी को भविष्य में होने वाली आयोग की समस्त परीक्षाओं से विवर्जित कर सकता है।



- 1 If the elements of a kinematic pair make surface contact when in motion, then it is called a :
- (1) Lower pair (2) Closed pair  
(3) Higher pair (4) Surface pair
- 2 A six-link mechanism is required to have mobility or degree of freedom equal to one. All the pairs in the mechanism are single degree of freedom pairs. Pick the correct statement about the mechanism :
- (1) It will have six pairs.  
(2) It will have 7 pairs and all the links will be binary links.  
(3) It will have 7 pairs and two of the six links will be ternary links.  
(4) It is not possible to have a mechanism with six links.
- 3 Which of the following is an exact straight line mechanism employing at least one sliding pair ?
- (1) Peaucillier mechanism (2) Scott-Russel mechanism  
(3) Hart's mechanism (4) Watt's mechanism
- 4 A straight link has a straight slot along the length of the link in which a sliding block is free to slide. The slotted link is rotating at uniform angular velocity of 10 rad/s about one of its ends. The sliding block in the link is also moving outwards at a uniform speed of 5 m/s relative to the slotted link. What is the magnitude of acceleration of the slider in a direction perpendicular to the link ?
- (1) 100 m/s<sup>2</sup> (2) 50 m/s<sup>2</sup>  
(3) 200 m/s<sup>2</sup> (4) Zero
- 5 Which of the following gears is not employed to connect non-parallel and non-intersecting shafts ?
- (1) Worm and worm gear (2) Hypoid gears  
(3) Double helical gears (4) Crossed helical gears
- 6 Which of the following is not correct for involute gears ?
- (1) The path of contact of two gears during mesh is along a straight line.  
(2) Slight change of centre distance does not affect correct tooth action.  
(3) The pressure angle remains constant.  
(4) Interference is inherently absent.
- 7 The gear train in which the axes of the first and the last gear in the train coincide, is called a :
- (1) Simple gear train (2) Reverted gear train  
(3) Epicyclic gear train (4) Compound gear train
- 8 A block weighing 100 N is resting on a surface. The coefficient of friction between the block and surface is 0.3. A horizontal force of 20 N is applied on the block. What is the magnitude of force of friction acting on the block ?
- (1) 30 N (2) 100 N  
(3) 50 N (4) 20 N

- 9 A machine requires torque increasing linearly from 0 to 100 N.m during its cycle of operation of one revolution. The mean speed of the shaft is  $10\sqrt{\pi}$  rad/s. Assuming the hub and arms do not contribute to the moment of inertia, what will be the mass of rim of a rim type flywheel of 1 m mean diameter, if the total fluctuation of speed has to be limited to 1% ?
- (1) 25 kg (2) 50 kg  
(3) 100 kg (4) 250 kg
- 10 Balancing of inertia forces due to reciprocating parts in a single cylinder engine is done by extending the crank to the opposite side and placing a counter-mass there. Pick the correct statement about balancing of inertia forces in this way :
- (1) Only primary inertia force can be completely balanced.  
(2) Only secondary inertia force can be completely balanced.  
(3) The primary inertia force can never be completely balanced in this way.  
(4) If only a fraction of reciprocating part's mass is balanced, then the primary inertia force can be completely balanced.
- 11 A rotating shaft carries a single rotor and the static deflection of the shaft at the rotor is 0.1 m. What will be transverse natural frequency of the shaft in Hertz, if the acceleration due to gravity is  $10 \text{ m/s}^2$  ?
- (1)  $5\pi$  (2)  $5/\pi$   
(3)  $10\pi$  (4) None of the above.
- 12 When does the phenomenon of necking become prominent in a simple tension test ?
- (1) After elastic limit (2) After yield point  
(3) After proportional limit (4) From around the ultimate stress
- 13 The endurance limit is found by testing specimen of standard size, usually 7.5 mm, in a standard rotating beam test. What will be the actual endurance limit of parts with size greater than that used in the test ?
- (1) less than the value determined with standard test.  
(2) more than the value determined with standard test.  
(3) same as the value determined with standard test.  
(4) less than the value determined with standard test upto certain size than it will increase with the increasing size.
- 14 Few statements about creep in materials are given below :
- (a) Creep means regaining the original shape after removal of stresses.  
(b) Creep implies development of additional strains when the material is loaded for prolonged period of time.  
(c) Creep is more at elevated temperatures.  
(d) Creep means loading the material in plastic range.
- Which of the above statements are all correct ?
- (1) (a), (b) and (c) (2) (a) and (d)  
(3) (b) and (c) (4) (b) and (d)

- 15 With the usual sign convention for bending moment, i.e., a positive bending moment causes compression in top fibre, what is sign, magnitude and location of numerically largest bending moment in the beam shown in the figure?

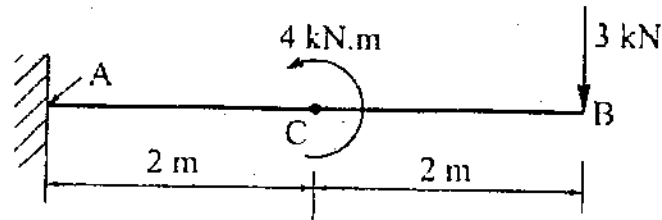


Fig.

- (1) (+) 10 kN.m at C                      (2) (-) 8 kN.m at A  
 (3) (-) 16 kN.m at A                      (4) (+) 4 kN.m at A
- 16 For a material with the Poisson's ratio  $\nu$ , the modulus of elasticity (E) and the bulk modulus of elasticity (K) are same. Which of the following is correct ?
- (1) The material has  $\nu = 0$   
 (2) The material has  $\nu = 1/2$   
 (3) The material has  $\nu = 1/3$   
 (4) The material has  $\nu = 3/4$
- 17 The normal stresses on two perpendicular planes through a point in a stressed material are 80 MPa (tensile) and 20 MPa (tensile) respectively. A shear stress of 40 MPa is also acting on these planes. What is the value of maximum shear stress at the point ?
- (1) 50 MPa                                      (2) Zero  
 (3) 40 MPa                                      (4) 60 MPa
- 18 Pick the correct statement about the maximum bending stress in the various leaves of a leaf or laminated spring, assuming it has been designed ideally :
- (1) It increases uniformly from the shortest leaf to the longest leaf.  
 (2) It is largest in the longest leaf.  
 (3) It is largest in the shortest leaf.  
 (4) It is same in all leaves.
- 19 A closely coiled helical spring is cut into two equal parts. What will be the ratio of the deflection of any of the resulting spring to the deflection of the original spring for the same load ?
- (1) 2    (2) 1/2  
 (3) 1    (4) 3/4
- 20 A solid shaft is replaced by a hollow shaft with outer diameter same as the diameter of the solid shaft. The internal diameter of the hollow shaft is kept as  $3/4^{\text{th}}$  of its outer diameter. What is the ratio of torque transmitting capacity of hollow shaft to that of the solid shaft ?
- (1) 175/256                                      (2) 3/4  
 (3) 9/16    (4) 27/64

- 21 Pick the correct statement about the hoop stress in a thick cylinder subjected to internal pressure :
- (1) It varies linearly from zero at the outer surface to maximum at the inner surface.
  - (2) It varies parabolically from a minimum stress at the outer surface (with non-zero magnitude) to a maximum value at the inner surface.
  - (3) It varies parabolically from zero at the outer surface to a maximum at the inner surface.
  - (4) It remains constant across the thickness.

Which of the following pairs describe the correct coordination number for body centred cubic and face centred cubic unit cell structures respectively ?

- |             |              |
|-------------|--------------|
| (1) 8 and 6 | (2) 12 and 8 |
| (3) 6 and 8 | (4) 8 and 12 |

- 3 Which of the following unit cells are arranged in ascending order of atomic packing factor ? (The abbreviations used are: BCC = Body Centred Cubic, FCC = Face Centred Cubic, SC = Simple Cubic, HCP = Hexagonal Close Packed)
- |                   |                   |
|-------------------|-------------------|
| (1) BCC, FCC, SC  | (2) BCC, FCC, HCP |
| (3) HCP, FCC, BCC | (4) FCC, HCP, BCC |

- 24 Consider the following statements about edge dislocations in crystal structures :

- (a) The Berger vector is perpendicular to the dislocation line.
- (b) The Berger vector is parallel to the dislocation line.
- (c) Only shear stress field exists.
- (d) It can exhibit both climb and glide motions.

Which of the above statements are all correct ?

- |                 |                      |
|-----------------|----------------------|
| (1) (a) and (d) | (2) (a), (c) and (d) |
| (3) (b) and (d) | (4) (c) and (d)      |

- 25 Which of the following is a false statement about work hardening ?



- (1) It increases hardness.
- (2) It increases yield strength.
- (3) It increases ductility.
- (4) It involves plastic deformations at temperature lower than the recrystallization temperature.

- 26 Which of the following is not the purpose of annealing ?

- |                             |                          |
|-----------------------------|--------------------------|
| (1) Increasing hardness     | (2) Increasing ductility |
| (3) Improving machinability | (4) Refining grain size  |

- 27 What is the theoretical limit of carbon content in iron-carbon alloys upto which they can be called as steel ?

- |        |        |
|--------|--------|
| (1) 6% | (2) 3% |
| (3) 1% | (4) 2% |

- 28 Which of the following is a thermosetting plastic ?  
 (1) Polyethylene (2) Bakelite  
 (3) Polyvinyl chloride (4) Nylon
- 29 What is the corrosion that occurs in certain materials where the loaded surfaces are in contact and have relative motion called ?  
 (1) Fretting corrosion (2) Stress corrosion  
 (3) Hertzian corrosion (4) Galvanic corrosion
- 30 Which of the following is not a constituent of babbitts ?  
 (1) Tin (2) Antimony  
 (3) Nickel (4) Copper
- 31 What do the symbols  and  represent in work study ?  
 (1) Delay and storage respectively  
 (2) Processing and storage respectively  
 (3) Storage and inspection respectively  
 (4) Inspection and storage respectively
- 32 For a certain cycle of operations on a job, the observed time is 10 minutes. The performance rating of the worker is 120% and total allowances are 10% of normal time. What will be the standard time for the worker ?  
 (1) 9.17 minutes (2) 13.0 minutes  
 (3) 13.2 minutes (4) 14.0 minutes
- 33 A company requires 9000 units of a product annually. It costs Rs. 3 per unit. The cost per purchase order is Rs. 300 and the inventory carrying cost per unit per year is 20% of the unit cost. The economic order quantity (EOQ) for the company is :  
 (1) 4000 units (2) 3500 units  
 (3) 3000 units (4) 5000 units
- 34 In PERT analysis a critical activity has :  
 (1) Maximum float (2) Zero float  
 (3) Maximum cost (4) Minimum cost
- 35 Which of the following actions will not reduce break-even point ?  
 (1) Reducing fixed cost (2) Reducing variable cost  
 (3) Increasing sales price (4) Decreasing sales price
- 36 Military organization is known as :  
 (1) Line organization (2) Line and Staff organization  
 (3) Functional organization (4) Matrix organization
- 37 Which of the following material handling systems will be most suitable for transporting a large number of discrete items on continuous basis in a factory ?  
 (1) Overhead cranes (2) Trucks  
 (3) Hoists (4) Conveyors

- 38 Which of the following is not included in prime cost ?  
 (1) Direct overheads (2) Factory overheads  
 (3) Direct labour cost (4) Direct material cost
- 39 Vehicle manufacturing assembly line is an example of :  
 (1) product layout (2) process layout  
 (3) manual layout (4) fixed layout
- 40 Which of the following is not a technique for plant layout ?  
 (1) Process charts (2) Travel charts  
 22 (3) Man-machine charts (4) Relationship charts
- 41 Which of the following materials, usually added to moulding sand, does not act as binder ?  
 (1) Kaolinite (2) Bentonite  
 (3) Illite (4) Dextrin
- 2  
 42 What is the function of 'skim-bob' provided in the gating system of moulds ?  
 (1) To trap heavier and lighter impurities.  
 (2) To promote directional solidification.  
 (3) To control the flow of molten metal.  
 (4) To smoothen the flow of molten metal.
- 43 Which one among the following welding processes uses non-consumable electrode ?  
 (1) Gas metal arc welding (2) Submerged arc welding  
 (3) Gas tungsten arc welding (4) Flux coated arc welding
- 44 Pick the wrong statement about AC and DC power sources for arc welding :  
 (1) The problem of magnetic blow is greatly reduced with AC power source.  
 (2) Arc stability is higher with DC power source.  
 (3) The DC power source provides high efficiency.  
 (4) AC power sources are considerably less expensive.
- 45 What is the process in which a flat shape is cut out from a sheet, the cut out portion being the desired part, called ?  
 (1) Blanking (2) Piercing  
 (3) Notching (4) Perforating
- 46 Which of the following is a feature of forging process ?  
 (1) Cost of tooling is less.  
 (2) Mechanical properties of parts are improved.  
 (3) Even intricate shapes with cavities can be forged.  
 (4) The product has very good surface finish.

- 47 Which of the following statements is not correct about climb or down milling ?
- (1) It gives poorer surface finish than up milling.
  - (2) The work is fed in the same direction as the cutter rotation.
  - (3) The chip thickness is maximum at the beginning of the cut.
  - (4) Power required is less.
- 48 Clapper block (or box) is used in which machine tool ?
- (1) Lathe
  - (2) Shaper
  - (3) Milling
  - (4) Turret lathe
- 49 In taper turning method by swivelling the compound slide, the feed motion is given by :
- (1) moving the carriage.
  - (2) moving the cross slide.
  - (3) engaging the half nut.
  - (4) moving the compound slide.
- 50 A larger rake angle will result in :
- (1) Higher shear plane angle and lower cutting force
  - (2) Lower shear plane angle and lower cutting force
  - (3) Higher shear plane angle and higher cutting force
  - (4) Lower shear plane angle and higher cutting force
- 51 Which of the following is not a constituent of high speed steel tool material ?
- (1) Tungsten
  - (2) Molybdenum
  - (3) Titanium
  - (4) Chromium
- 52 A company claims to have developed a revolutionary fan that consumes 25 W and delivers 0.8 kg/s of air at a velocity of 10 m/s. The claim has to be verified using appropriate law of thermodynamics. Which of the following combinations of conclusion and the law employed for the same is correct ?
- (1) Invalid – First law
  - (2) Invalid – Second law
  - (3) Valid – First law
  - (4) Valid – Second law
- 53 During a process involving one kg of working fluid in an insulated cylinder-piston arrangement the temperature of the fluid decreases from 350°C to 250°C. The specific heat of the fluid at constant volume is 0.8 kJ/kg.°C. Considering the contents of the cylinder as the system, what will be the work done and its nature ?
- (1) 80 kJ (on the system)
  - (2) Zero
  - (3) 80 kJ (by the system)
  - (4) 125 kJ (by the system)
- 54 Heat is supplied to a cylinder containing perfect gas and fitted with a frictionless piston loaded with a constant weight. What will be the process called ?
- (1) Isothermal process
  - (2) Isobaric process
  - (3) Adiabatic process
  - (4) Isochoric process



- 55 Heat and work are :
- (1) Intensive properties                      (2) Extensive properties  
(3) Point functions                              (4) Path functions
- 56 Three engines A, B and C operate between same temperature heat source and sink. The engines A, B and C use ideal gas, air and steam respectively as the working fluid. Also, the heat input to the engine A is highest and that to the engine C is the lowest. Choose the correct statement about the thermal efficiencies of the engines :
- (1) Engine A will have highest efficiency.  
(2) Engine C will have highest efficiency.  
(3) Engine B will have highest efficiency.  
(4) All the engines will have same efficiency.
- 57 The lowest and highest temperatures in Otto cycle are  $T_1$  and  $T_3$  respectively. If the temperatures at the end of compression and expansion processes are  $T_2$  and  $T_4$  respectively, then what will be values of these temperatures for maximum work done in the cycle ?
- (1)  $T_2 = T_4 = \text{mean of } T_1 \text{ and } T_3$   
(2)  $T_2 > T_4$   
(3)  $T_2 = T_3$  and  $T_4 = T_1$   
(4)  $T_2 = T_4 = \sqrt{T_1 T_3}$
- 58 The air standard efficiencies of Otto cycle, Diesel cycle and dual cycle are represented by  $\eta_{otto}$ ,  $\eta_{diesel}$  and  $\eta_{dual}$  respectively. Pick the correct statement about their relative values for the same compression ratio and heat input :
- (1)  $\eta_{otto} > \eta_{dual} > \eta_{diesel}$                       (2)  $\eta_{diesel} > \eta_{dual} > \eta_{otto}$   
(3)  $\eta_{dual} > \eta_{diesel} > \eta_{otto}$                       (4)  $\eta_{otto} > \eta_{diesel} > \eta_{dual}$
- 59 Choose the wrong statement about the regenerative vapour power cycle employing bled steam for feed water heating :
- (1) It increases the thermodynamic efficiency of the cycle.  
(2) The thermal stresses in the boiler are reduced.  
(3) Work done per kg of steam is increased.  
(4) It requires boiler of large capacity for same level of power output as compared to a simple Rankine cycle.
- 60 Which of the following gas power cycles has unequal expansion and compression strokes ?
- (1) Stirling cycle                                      (2) Atkinson cycle  
(3) Joule cycle                                        (4) Ericsson cycle

- 61 Which of the following gas power cycles has, in ideal conditions, thermodynamic efficiency equal to a Carnot cycle operating between the same temperature limits ?
- (1) Ericsson cycle                      (2) Joule cycle  
(3) Atkinson cycle                      (4) Dual cycle
- 62 What is the specific name of the equation governing three-dimensional steady state heat conduction with self-heat generation ?
- (1) Fourier equation                      (2) Laplace equation  
(3) Poisson equation                      (4) Diffusion equation
- 63 A pipe carrying hot fluid is to be insulated by two layers of insulators, A and B, having thermal conductivities  $k$  and  $2k$  respectively and of equal radial thickness. If the heat transfer coefficient from the outer surface to the air remains constant, how the two insulators must be placed to minimise the heat transfer ?
- (1) Material A must be outside  
(2) Material B must be outside  
(3) The heat transfer will be same regardless of their relative placement.  
(4) The order of placement will depend upon the outside heat transfer coefficient.
- 64 A pipe of 40 mm outside radius carrying hot fluid in a factory is to be insulated by a layer of insulator having thermal conductivity  $0.5 \text{ W/m}\cdot^\circ\text{C}$ . The heat transfer coefficient for convection from pipe surface (bare as well as insulated) to the air is  $10 \text{ W/m}^2\cdot^\circ\text{C}$ . The objective of providing insulation is to reduce the heat loss from the pipe. Choose the correct statement about the thickness of insulation to be provided :
- (1) Any thickness of insulator will always reduce heat loss.  
(2) Any thickness of insulation will always increase heat loss in this case.  
(3) Heat loss will be minimum if the outside radius of insulation is 50 mm.  
(4) In order to achieve a heat loss less than that obtained with the bare pipe, the outside radius of insulation has to be more than a certain value that requires calculations but it will be definitely greater than 50 mm.
- 65 Following ways have been suggested to increase the effectiveness of an infinitely long fin :
- (a) Using fin material of high thermal conductivity.  
(b) Increasing the ratio of area to parameter of cross section of the fin.  
(c) Increasing the convective heat transfer coefficient.  
(d) Increasing the ratio of parameter to area of cross section of the fin.
- Which of the above actions will all increase the effectiveness of the fin ?
- (1) (a) and (d) only                      (2) (a), (b) and (c)  
(3) (b) and (c) only                      (4) (a) and (b) only

66. A smaller sphere (1) of radius 50 mm is inside a larger sphere (2) of radius 100 mm. What will be the value of the radiation shape factor  $F_{22}$  :
- (1)  $3/4$  (2)  $4/3$   
 (3) 1.0 (4) Zero
67. In a counter flow heat exchanger, the cold fluid enters at  $20^\circ\text{C}$  and leaves at  $40^\circ\text{C}$ . The hot fluid enters at  $140^\circ\text{C}$  and leaves at  $120^\circ\text{C}$ . What is the heat transferred per unit area per unit heat transfer coefficient ?
- (1) 20 W (2) 80 W  
 (3) 100 W (4) 60 W
68. In a counter flow heat exchanger with effectiveness of 0.75, the properties and flow rate are such that the both fluids have thermal capacity equal to  $1000 \text{ W}/^\circ\text{C}$ . What will be the area of heat exchanger required, if the heat transfer coefficient is  $100 \text{ W}/\text{m}^2 \cdot ^\circ\text{C}$  ?
- (1)  $40 \text{ m}^2$  (2)  $30 \text{ m}^2$   
 (3)  $20 \text{ m}^2$  (4) None of the above
69. A 2 m long vertical pipe of 400 mm diameter is placed in a fluid with dynamic viscosity, thermal conductivity and specific heat of  $1/1200 \text{ N}\cdot\text{s}/\text{m}^2$ ,  $100 \text{ W}/\text{m}\cdot^\circ\text{C}$  and  $120 \text{ J}/\text{kg}\cdot^\circ\text{C}$  respectively. If the Grashoff number is  $10^9$  and the empirical relation governing the free convection in this case is known to be  $N_u = 0.1 (G_r \cdot P_r)^{1/3}$ , where the symbols have standard or usual meaning. The curvature effect of pipe may be neglected. What will be the value of heat transfer coefficient due to free convection at the pipe surface ?
- (1)  $125 \text{ W}/\text{m}^2 \cdot \text{K}$  (2)  $100 \text{ W}/\text{m}^2 \cdot \text{K}$   
 (3)  $25 \text{ W}/\text{m}^2 \cdot \text{K}$  (4)  $500 \text{ W}/\text{m}^2 \cdot \text{K}$
70. The heat transfer coefficient in laminar film condensation on a vertical plate is maximum at :
- (1) Upper edge of the plate. (2) Lower edge of the plate.  
 (3) Middle of the plate. (4) It remains constant over the plate.
71. A body placed in all enclosure (which may be assumed black body) is in thermal equilibrium with it. Which of the following is true for emissivity - ( $\epsilon$ ) and absorptivity ( $\alpha$ ) of the body ?
- (1)  $\alpha > \epsilon$  (2)  $\alpha < \epsilon$   
 (3)  $\alpha = \epsilon$  (4)  $\alpha = \epsilon/2$
72. The ratio of temperatures at the beginning and end of isentropic expansion process in Bell-Coleman air refrigeration cycle is 1.25. What is the COP of the cycle ?
- (1) 0.25 (2) 4.0  
 (3) 5.0 (4) The data are insufficient.

- 73 Choose the correct statement about the effect of changing various operating conditions of a vapour compression refrigeration cycle :
- (1) Lowering the evaporator pressure will always increase the COP.
  - (2) Increasing the condenser pressure will always result in increased COP.
  - (3) Superheating the suction vapour always increases the COP.
  - (4) Lowering the evaporator always decreases the COP.
- 74 Which of the following statements about using capillary tube as expansion device in vapour compression refrigeration system is not correct ?
- (1) It can work efficiently only at design load.
  - (2) Its cost is too high.
  - (3) It requires frequent maintenance.
  - (4) It puts high starting load on the compressor.
- 75 What is the function of rectifier in a practical vapour absorption refrigeration system ?
- (1) To convert AC supply to DC supply.
  - (2) To condense the weak ammonia solution.
  - (3) To remove the water vapours from the ammonia coming out from the analyser.
  - (4) To control the pressure of vapours entering the condenser.
- 76 In the following refrigerants x represents any digit. Which of these is a hydrocarbon refrigerant ?
- |           |           |
|-----------|-----------|
| (1) R-xx1 | (2) R-xx0 |
| (3) R-7xx | (4) R-x2  |
- 77 Consider the following psychrometric terms :
- |                          |                       |
|--------------------------|-----------------------|
| (a) Degree of saturation | (b) Specific humidity |
| (c) Humidity ratio       | (d) Relative humidity |
- Which of the above terms have the same meaning ?
- (1) (a) and (b)
  - (2) (b) and (c)
  - (3) (a), (b) and (c)
  - (4) (c) and (d)
- 78 Which of the following psychrometric properties is not shown as straight inclined lines on the psychrometric chart ?
- |                          |                       |
|--------------------------|-----------------------|
| (1) Wet bulb temperature | (2) Enthalpy          |
| (3) Specific volume      | (4) Relative humidity |
- 79 Which of the following property remains constant during sensible heating and cooling of air ?
- |                       |                          |
|-----------------------|--------------------------|
| (1) Enthalpy          | (2) Wet bulb temperature |
| (3) Specific humidity | (4) Relative humidity    |
- 80 What is the full form of the term ADP employed in air conditioning ?
- |                          |                                   |
|--------------------------|-----------------------------------|
| (1) Apparatus dew point  | (2) Adiabatic dew point           |
| (3) Ambient design point | (4) Air conditioning design point |

- 81 What is the line on the psychrometric chart joining the state of mixture of fresh air and re-circulated air entering the cooling coil to the state of ADP of cooling coil called ?
- (1) Mean SHF line (2) Room SHF line  
(3) Effective SHF line (4) Grand SHF line
- 82 Which of the following is true for a Newtonian fluid ?
- (1) Viscous shear stress is independent of velocity gradient.  
(2) Viscous shear stress depends linearly on velocity gradient.  
(3) Viscous shear stress is zero at all velocity gradients.  
(4) Viscous shear stress decreases with velocity gradient.
- 83 The stream function for a 2 dimensional flow is given by  $\psi = 4xy$ . Choose the wrong conclusion about the nature of the flow ?
- (1) The flow satisfies continuity equation  
(2) The flow is a rotational flow.  
(3) The flow is a potential flow.  
(4) The flow is irrotational flow.
- 84 Water is flowing in an inclined pipe of uniform diameter and 100 m length with its outlet being 10 m above the inlet. If the pressure at the outlet is 100 kPa, assuming the specific weight of water as  $10,000 \text{ N/m}^3$ , what is the pressure at the inlet ?
- (1) 150 kPa (2) 50 kPa  
(3) 75 kPa (4) 200 kPa
- 85 Which of the following non-dimensional numbers is not correctly defined ?
- (1) Reynolds number = inertia force / viscous force  
(2) Froude number = (inertia force / gravity force)<sup>1/2</sup>  
(3) Weber number = inertia force / pressure force  
(4) Euler number = pressure force / inertial force
- 86 Which of the following is not correct for laminar flow in circular pipes ?
- (1) Velocity is maximum at the centre of the pipe.  
(2) The variation of velocity from the pipe surface to the centre of pipe is parabolic.  
(3) The average velocity is half the maximum velocity.  
(4) The velocity equals the average velocity at a distance of 0.75 time radius from the centre of the pipe.
- 87 In which type of the impeller of centrifugal pump, the head remains constant with variation in discharge ?
- (1) Forward curved vanes  
(2) Radial vanes  
(3) Backward curved vanes  
(4) Both forward and backward curved vanes

- 88** Select the wrong statement about the clearance volume and volumetric efficiency of a reciprocating, air compressor :
- (1) The volumetric efficiency decreases with increased clearance volume.
  - (2) The volumetric efficiency decreases with increased pressure ratio.
  - (3) The volumetric efficiency increases with increased pressure ratio.
  - (4) The clearance volume has no effect on work done per kg of air delivered.
- 89** In an impulse steam turbine, the steam enters at a rate of 2 kg/s with a velocity of 500 m/s with an axial component of 300 m/s. The peripheral speed of blades is 200 m/s. The steam leaves the blades in axial direction. What is the power developed by the turbine ?
- (1) 160 kW
  - (2) 200 kW
  - (3) 100 kW
  - (4) Insufficient data
- 90** Which of the following is not an advantage of gas turbines over IC engines ?
- (1) The weight of turbines per unit power is much less.
  - (2) There is no problem of knocking or other abnormal combustion.
  - (3) No or greatly reduced cooling requirements.
  - (4) Better part load efficiency.
- 91** What is the speed of the cam shaft in four stroke engines ?
- (1) Double the crankshaft speed
  - (2) Half the crankshaft speed
  - (3) Equal to the crankshaft speed
  - (4) Three-fourth the crankshaft speed
- 92** Which of the following actions will not reduce the tendency of knocking in an SI engine ?
- (1) Reducing compression ratio
  - (2) Reducing load
  - (3) Retarding spark timing
  - (4) Reducing engine speed
- 93** Which of the following is a desired quality of SI engine fuel for reduced knocking ?
- (1) Higher octane number
  - (2) Lower octane number
  - (3) Higher cetane number
  - (4) Higher Aniline point

- 94 The valve of a CI engine nozzle has a cylindrical or conical projection protruding through the mouth of the nozzle and the nozzle body has an auxiliary hole. What is this type of nozzle called ?
- (1) Multihole nozzle                      (2) Pintle nozzle  
(3) Pintaux nozzle                        (4) Open nozzle
- 95 Which of the following is a fire tube type high pressure boiler ?
- (1) Velox boiler                            (2) Benson boiler  
(3) Loeffler boiler                        (4) Lancashire boiler
- 96 Which of the following boiler accessories utilizes the waste heat of flue gases to heat the feed water ?
- (1) Water preheater                        (2) Economiser  
(3) Feed heater                            (4) Superheater
- 97 Which of the following is a function of surge tank provided in hydroelectric power plants ?
- (1) To provide backup storage of water to meet demand in the months when the water level in the dam reduces.  
(2) To increase the efficiency of the turbine.  
(3) To avoid cavitation in the turbine.  
(4) To reduce water hammer effect due to sudden closing of water supply to turbine in the event of reduced load.
- 98 In which of the following methods, the available energy is directly converted to electrical energy without the aid of a turbine or engine ?
- (1) Magneto Hydro Dynamic system  
(2) Tidal power plant  
(3) Geothermal power plant  
(4) Solar thermal power plant
- 99 From the view point of moderating ratio only, which of the following is best moderator ?
- (1) Ordinary water                        (2) Carbon  
(3) Heavy water                            (4) Beryllium
- 100 The peak load on a power plant is 40 MW and a group of four loads having maximum demand of 15 MW, 12 MW, 18 MW and 5 MW respectively are connected to the plant. The capacity of the plant is 60 MW. What is diversity factor of the plant ?
- (1) 1.5                                        (2) 1.25  
(3) 0.8                                        (4) 0.75

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