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T.B.C. : XDRF-B-MCH

Test Booklet Series

A

Serial 1000157

TEST BOOKLET

MECHANICAL ENGINEERING

Time Allowed : Two Hours ***Maximum Marks : 300***

INSTRUCTIONS

1. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET ***DOES NOT*** HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS, ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.
2. **Please note that it is the candidate's responsibility to encode and fill in the Roll Number and Test Booklet Series Code A, B, C or D carefully and without any omission or discrepancy at the appropriate places in the OMR Answer Sheet. Any omission/discrepancy will render the Answer Sheet liable for rejection.**
3. You have to enter your Roll Number on the Test Booklet in the Box provided alongside. ***DO NOT*** write ***anything else*** on the Test Booklet.
4. This Test Booklet contains **120** items (questions). Each item comprises four responses (answers). You will select the response which you want to mark on the Answer Sheet. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose ***ONLY ONE*** response for each item.
5. You have to mark all your responses ***ONLY*** on the separate Answer Sheet provided. See directions in the Answer Sheet.
6. All items carry equal marks.
7. Before you proceed to mark in the Answer Sheet the response to various items in the Test Booklet, you have to fill in some particulars in the Answer Sheet as per instructions sent to you with your Admission Certificate.
8. After you have completed filling in all your responses on the Answer Sheet and the examination has concluded, you should hand over to the Invigilator ***only the Answer Sheet***. You are permitted to take away with you the Test Booklet.
9. Sheets for rough work are appended in the Test Booklet at the end.
10. **Penalty for wrong answers :**

    THERE WILL BE PENALTY FOR WRONG ANSWERS MARKED BY A CANDIDATE.

    (i) There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, **one-third** of the marks assigned to that question will be deducted as penalty.

    (ii) If a candidate gives more than one answer, it will be treated as a **wrong answer** even if one of the given answers happens to be correct and there will be same penalty as above to that question.

    (iii) If a question is left blank, i.e., no answer is given by the candidate, there will be **no penalty** for that question.

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1. The specific gravity of blood at 0°C is

(a) 13·6

(b) 1·025

(c) 1·05

(d) 0·7

2. What is the specific gravity of the air in a room whose dimensions are 4 m × 5 m × 6 m at 100 kPa and 25°C ?

(a) 0·00117

(b) 0·00246

(c) 0·00349

(d) 0·00456

3. At a given pressure, the temperature at which a pure substance changes phase is called

(a) Superheated temperature

(b) Saturation temperature

(c) Saturation pressure

(d) Vapour pressure

4. Consider the following statements :

Cavitation must be avoided (or at least minimized) in flow systems because

1. It reduces performance.
2. It generates annoying vibrations and noise.
3. It causes damage to equipment.

Which of the above statements are correct ?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

5. Fluids for which the apparent viscosity increases with the rate of deformation are referred as

(a) Shear thickening fluids

(b) Shear thinning fluids

(c) Bingham plastic fluid

(d) Newtonian fluid

6. In practice, the capillary effect is usually negligible in tubes whose diameter is

(a) less than 1 cm

(b) greater than 1 cm

(c) equal to 1 mm

(d) less than 1 mm

7. A 0·6 mm diameter glass tube is inserted into water at 20°C in a cup. What is the capillary rise of water in the tube ? (Take the surface tension of water at 20°C as 0·073 N/m and the density of water as 1000 kg/m^3)

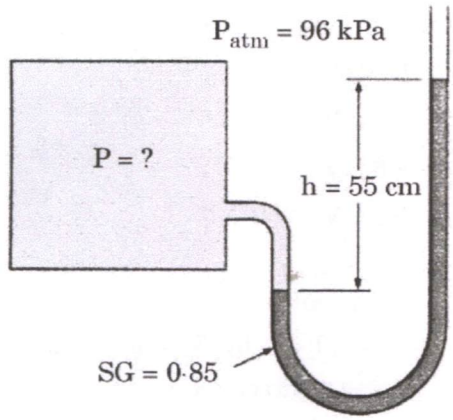
(a) 0·050 m

(b) 0·089 m

(c) 0·096 m

(d) 0·072 m

8. A manometer is used to measure the pressure in a tank. The fluid used has a specific gravity of 0·85 and the manometer column height is 55 cm. If the local atmospheric pressure is 96 kPa, what is the absolute pressure within the tank ?



(a) 200·8 kPa
(b) 312·2 kPa
(c) 100·6 kPa
(d) 112·6 kPa

9. The piston of a vertical piston cylinder device containing a gas has a mass of 60 kg and a cross-sectional area of 0·04 m^2. The local atmospheric pressure is 0·97 bars, and the gravitational acceleration is 9·81 m/s^2. What is the pressure inside the cylinder ?
(a) 1·12 bars
(b) 5·62 bars
(c) 6·58 bars
(d) 8·52 bars

10. A floating body is said to be in stable condition, where M is metacentre and G is centre of gravity, if
(a) M is above G
(b) M is equal to G
(c) M is below G
(d) M is not equal to G

11. The frictional resistance for turbulent flow is
(a) proportional to the density of fluid
(b) reciprocal to the area of surface in contact
(c) dependent on pressure
(d) reciprocal to the nature of surface in contact

12. For laminar flow (Re < 2000), the coefficient of friction which is a function of Reynolds number (Re) is
(a) 0·029/Re
(b) 64/Re
(c) 0·079/Re
(d) 16/Re

13. Maximum efficiency of transmission of power through a pipe is
(a) 66·7%
(b) 77·7%
(c) 33·3%
(d) 99·9%

14. For a sphere, critical thickness of insulation is given by (where 'k' is thermal conductivity and 'h' is convective heat transfer coefficient)
(a) h/2k
(b) 2k/h
(c) k/3h
(d) 3k/h

15. Thermal conductivity of sawdust at 0°C is
(a) 0·059 W/m.°C
(b) 2·22 W/m.°C
(c) 1·073 W/m.°C
(d) 0·175 W/m.°C

16. Air at 20°C blows over a hot plate 50 cm × 75 cm maintained at 250°C. The convection heat transfer coefficient is 25 $W/m^2.°C$. What is the rate of heat transfer ?

(a) 4·256 kW

(b) 2·156 kW

(c) 1·982 kW

(d) 5·342 kW

17. An electric current is passed through a wire 1 mm in diameter and 10 cm long. The wire is submerged in liquid water at atmospheric pressure, and the current is increased until the water boils. For this situation h = 5000 $W/m^2.°C$, and the water temperature will be 100°C. How much electric power must be supplied to the wire to maintain the wire surface at 114°C ?

(a) 21·99 W

(b) 24·46 W

(c) 28·62 W

(d) 29·23 W

18. A current of 200 A is passed through a stainless steel wire [k = 19 W/m.°C] 3 mm in diameter. The resistivity of the steel may be taken as 70 μΩ.cm, and the length of the wire is 1 m. The wire is submerged in a liquid at 110°C and experiences a convection heat transfer coefficient of 4 k $W/m^2.°C$. What is the resistance of the wire ?

(a) 0·052 Ω

(b) 0·046 Ω

(c) 0·064 Ω

(d) 0·099 Ω

19. Two 3 cm diameter 304 stainless-steel bars, 10 cm long, have ground surfaces and are exposed to air with a surface roughness of about 1 μm. If the surfaces are pressed together with a pressure of 50 atm and the two bar combination is exposed to an overall temperature difference of 100°C, what is the axial heat flow across the contact surface ?

(a) 5·52 W

(b) 7·24 W

(c) 8·64 W

(d) 9·24 W

20. A small cubical furnace 50 cm by 50 cm by 50 cm on the inside is constructed of fireclay brick [k = 1·04 W/m.°C] with a wall thickness of 10 cm. The inside of the furnace is maintained at 500°C, and the outside is maintained at 50°C. What is the heat loss through the walls ?

(a) 2·684 kW

(b) 8·592 kW

(c) 4·654 kW

(d) 6·254 kW

21. Consider the following statements :

Lumped heat capacitance analysis is assumed to be valid if

1. surface-convection resistance is large.
2. thermal conductivity of the body is low.
3. internal conductive resistance of the body is negligible.

Which of the above statements are correct ?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

22. Consider the following parameters that apply to the bodies considered in the Heisler charts :

1. $(A/V)_{inf\ plate} = 1/L$
2. $(A/V)_{inf\ cylinder} = 2/r_0$
3. $(A/V)_{sphere} = 3/r_0$

Which of the above parameters are correct ?

(a) 1 and 3 only

(b) 1 and 2 only

(c) 2 and 3 only

(d) 1, 2 and 3

23. Consider the following assumptions in the derivation of equation of motion for the boundary layer :

1. The fluid is compressible and the flow is steady.
2. The viscosity is constant.
3. Viscous shear forces in the y directions are negligible.

Which of the above assumptions are correct ?

(a) 2 and 3 only

(b) 1 and 2 only

(c) 1 and 3 only

(d) 1, 2 and 3

24. An empirical formula for the turbulent friction factor up to Reynolds numbers of about 2×10^5 for the flow in smooth tubes is

(a) $f = \frac{0{\cdot}316}{Re_d^{1/4}}$

(b) $f = \frac{0{\cdot}586}{Re_d^{1/4}}$

(c) $f = \frac{0{\cdot}724}{Re_d^{1/4}}$

(d) $f = \frac{0{\cdot}184}{Re_d^{1/4}}$

25. When no incident radiation is transmitted through the body, it is called

(a) Black body

(b) White body

(c) Opaque body

(d) Gray body

26. What is the pressure difference shown by the manometer deflection of 30 cm of mercury ? (Take local acceleration of gravity as 9·78 m/s^2 and density of mercury at room temperature as 13550 kg/m^3)

(a) 39755·70 Pa

(b) 49755·70 Pa

(c) 29755·70 Pa

(d) 19755·70 Pa

27. 1 kg of water falls from an altitude of 1000 m above ground level. What is the change in the temperature of water at the foot of fall, if there are no losses during the fall ? (Take specific heat of water as 1 kcal/kg.K)

(a) 2·35°C

(b) 4·35°C

(c) 5·35°C

(d) 6·35°C

28. What is the molecular weight of gas if its specific heats at constant pressure and volume are $C_p = 2{\cdot}286$ kJ/kg.K and $C_v = 1{\cdot}768$ kJ/kg.K ?

(a) 19·05 kg/k.mol

(b) 21·06 kg/k.mol

(c) 16·05 kg/k.mol

(d) 23·06 kg/k.mol

29. In an unknown temperature scale, freezing point of water is 0°X and boiling point of water is 1000°X. What is the conversion relation between degrees X and degree Celsius ?

(a) X = 10.C

(b) X = 15.C

(c) C = 10.X

(d) C = 15.X

30. What is the internal energy of steam if its enthalpy, pressure and specific volumes are 2848 kJ/kg, 12 MPa and 0·017 m^3/kg ?

(a) 2644 kJ/kg

(b) 3482 kJ/kg

(c) 4624 kJ/kg

(d) 3962 kJ/kg

31. Consider the following values :

One technical atmosphere (i.e., ata) is

1. 1 kgf/cm^2

2. 980655 N/m^2

3. 14·22 lbf/in^2

4. 736 torr

Which of the above values are correct ?

(a) 2, 3 and 4 only

(b) 1, 3 and 4 only

(c) 1 and 2 only

(d) 1, 2, 3 and 4

32. The performance test of an air conditioning unit rate as 140·7 kW (40 TR) seems to be indicating poor cooling. The test on heat rejection to atmosphere in its condenser shows the following :

Cooling water flow rate : 4 L/s;

Water temperature : in 30°C; out 40°C;

Power input to motor : 48 kW (95% efficiency).

What is the actual refrigerating capacity of the unit ?

(a) 34·7 TR

(b) 42·8 TR

(c) 48·2 TR

(d) 44·6 TR

33. 100 kg of ice at – 5°C is placed in a bunker to cool some vegetables. 24 hours later, the ice has melted into water at 10°C. What is the average rate of cooling in TR provided by the ice ? (Take specific heat of ice, C_{ps} = 1·94 kJ/kg.K; specific heat of water, C_{pf} = 4·1868 kJ/kg.K; latent heat of fusion of ice at 0°C, h_{sf} = 335 kJ/kg)

(a) 0·127 TR

(b) 0·346 TR

(c) 0·248 TR

(d) 0·442 TR

34. Efficiency of Stirling cycle is same as

(a) Ericsson cycle

(b) Carnot cycle

(c) Diesel cycle

(d) Otto cycle

35. The mean effective pressure of Otto cycle

(a) is proportional to square root of pressure ratio

(b) does not depend on pressure ratio

(c) is directly proportional to pressure ratio

(d) is inversely proportional to pressure ratio

36. For dual combustion cycle for fixed value of heat addition and compression ratio, mean effective pressure

(a) will be greater with increase in pressure ratio and decrease in cut-off ratio

(b) will be greater with decrease in pressure ratio and decrease in cut-off ratio

(c) remains the same with increase in pressure ratio and decrease in cut-off ratio

(d) does not depend on pressure ratio and cut-off ratio

37. Lenoir cycle is used in

(a) Ramjet engines

(b) Gas turbines

(c) Pulse jet engines

(d) CI engines

38. An engine working on Otto cycle has the following conditions : Pressure at the beginning of compression is 1 bar and pressure at the end of compression is 11 bars. What is the air standard efficiency of the engine ? (Take γ = 1·4)

(a) 55·6%

(b) 35·4%

(c) 49·6%

(d) 51·2%

39. With dissociation, peak temperature is obtained

(a) at the stoichiometric air-fuel ratio

(b) when the mixture is slightly lean

(c) when the mixture is slightly rich

(d) in no effect

40. Consider the following statements :

Dissociation effects are not so pronounced in a CI engine as in an SI engine. This is mainly due to

1. the presence of a heterogeneous mixture.
2. excess air to ensure complete combustion.
3. increase in the peak gas temperature attained in the CI engine.

Which of the above statements are correct ?

(a) 2 and 3 only

(b) 1 and 3 only

(c) 1, 2 and 3

(d) 1 and 2 only

41. Which one of the following represents general chemical formula of the normal paraffin hydrocarbons ?

(a) C_nH_{2n+2}

(b) C_nH_n

(c) C_nH_{2n}

(d) C_nH_{2n-2}

42. The constant enthalpy process is termed as

(a) Throttling process

(b) Adiabatic process

(c) Isothermal process

(d) Isobaric process

43. The function of compressor in vapour compressor refrigeration system is performed in vapour absorption refrigeration system by

(a) Generator only

(b) Absorber only

(c) Generator, absorber and liquid pump

(d) Generator and liquid pump only

44. If specific speed of a Francis turbine is 400 rpm, what is the speed ratio ?

(a) 0·64

(b) 0·71

(c) 0·82

(d) 0·96

45. If specific speed of a Kaplan turbine is 690 rpm, what is the flow ratio ?

(a) 0·65

(b) 0·77

(c) 0·86

(d) 0·92

46. The following data are available for a Francis turbine : peripheral velocity at inlet = 30 m/s, whirl velocity at inlet = 25 m/s. Assuming a hydraulic efficiency of 90%, what is the net head available to the turbine ? (Take acceleration due to gravity 9·81 m/s^2)

(a) 73·82 m

(b) 65·74 m

(c) 55·47 m

(d) 84·95 m

47. A Francis turbine has the speed ratio of 0·80 and its flow ratio is 0·25. The width of the runner at the outer periphery is 1/4 times the outer diameter. What is the specific speed of the turbine ? (Take the overall efficiency as 0·85 and acceleration due to gravity 9·81 m/s^2)

(a) 182·1

(b) 105·7

(c) 204·2

(d) 157·3

48. Which one of the following is the first nuclear power station in India ?

(a) Kalpakkam nuclear power station

(b) Tarapur nuclear power station

(c) Rana Pratap Sagar nuclear power station

(d) Narora nuclear power station

49. Consider the following statements regarding qualities of a good boiler :

1. The boiler should have maximum joints to avoid leaks which may occur due to expansion and contraction.
2. The boiler must be able to meet the fluctuating demands without pressure fluctuations.
3. The water and flue gas velocities should be high for high heat transfer rates with minimum pressure drop through the system.
4. The boiler should be heavy in weight, and should occupy small floor area.

Which of the above statements are correct ?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 3 and 4 only

(d) 1 and 4 only

50. In a steam power plant, what is the purpose of steam desuperheater ?

(a) To increase the steam temperature

(b) To decrease the steam temperature

(c) To control the direction and flow of hot combustion gases

(d) To control the degree of superheat

51. The specific speed of a single jet Pelton wheel (N_s) in terms of diameter of runner (D) and diameter of jet (d) in metric units is given by

(a) $N_s = 144{\cdot}75\frac{d}{D}$

(b) $N_s = 244{\cdot}75\frac{d}{D}$

(c) $N_s = 344{\cdot}75\frac{d}{D}$

(d) $N_s = 444{\cdot}75\frac{d}{D}$

52. Consider the following statements regarding intercoolers and heat exchangers in gas turbines :

1. The intercooler is generally used in gas turbine plant when the pressure ratio used is sufficiently large and the compression is completed with two or more stages.
2. The intercooler is generally used in gas turbine plant when the pressure ratio used is sufficiently small and the compression is completed with two or more stages.
3. In a recuperative type of heat exchanger, the air and hot gases are made to flow in counter direction.
4. In a recuperative type of heat exchanger, the air and hot gases are made to flow in parallel direction.

Which of the above statements are correct ?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 3 and 4 only

(d) 1 and 3 only

53. The effective multiplication factor (K) in a nuclear reactor is given by (where P = rate of production of neutrons, A = combined rate of absorption of neutrons and E = rate of leakage of neutrons)

(a) $K = \frac{P}{A + E}$

(b) $K = \frac{E}{A + P}$

(c) $K = \frac{A}{P + E}$

(d) $K = \frac{A + P}{E}$

54. The slow formation of semisolid hydrocarbons, sometimes of an acidic nature, which are deposited on windings and tank walls, is known as

(a) Acidity

(b) Corrugation

(c) Sludging

(d) Condensation

55. Match the following lists :

	List I (Type of turbine)		*List II (Flow direction of water)*
P.	Propeller and Kaplan turbines	1.	Axial flow
Q.	Francis turbine	2.	Tangential flow
R.	Pelton turbine	3.	Radial inward or mixed flow

Select the correct matching using the codes given above :

	P	**Q**	**R**
(a)	3	1	2
(b)	1	3	2
(c)	2	1	3
(d)	1	2	3

56. Which one of the following apparatus is used to determine the volumetric analysis of products of combustion ?

(a) Syphon apparatus

(b) Calibrating tube

(c) Orsat apparatus

(d) Tattler jar apparatus

57. Which one of the following materials is ***not*** used as thermo electric material in power plants ?

(a) Lead telluride

(b) Bismuth sulphide

(c) Cesium sulphide

(d) Copper telluride

58. "Net work done on shaft per stage per kg of steam flowing" to "adiabatic heat drops per stage" is known as

(a) Overall efficiency

(b) Stage efficiency

(c) Net efficiency

(d) Internal efficiency

59. "All the pressure drop and enthalpy drop of steam takes place in a single row of nozzles and resultant kinetic energy of steam is absorbed by the wheel in a number of rows of moving blades with guide blades in between two such rows." This is called

(a) Rateau staging

(b) Curtis staging

(c) Reaction turbine

(d) Pressure and velocity compounding

60. In a steam power plant, the ratio of "power available at the generator terminals" to "rate of energy released by the combustion of fuel" is called

(a) Boiler efficiency

(b) Generator efficiency

(c) Overall efficiency

(d) Turbine efficiency

61. Consider the following statements regarding heat transfer modes :

1. Thermal conduction is the transfer of heat by the vibrations of atoms, molecules and electrons without bulk movement.

2. Thermal conduction is the transfer of heat to or from a moving fluid, which may be liquid or gas.

3. Convection produces more rapid heat transfer than conduction through the stationary fluid.

Which of the above statements is/are correct ?

(a) 1 only

(b) 2 and 3 only

(c) 3 only

(d) 1, 2 and 3

62. Consider the following statements regarding solar systems :

1. For solar energy systems, if the insolation is absorbed and utilized without significant mechanical pumping and blowing, the solar system is said to be passive.

2. If the solar heat is collected in a fluid, usually water or air, which is then moved by pumps or fans for use, the solar system is said to be active.

3. The focusing collectors absorb only beam radiation, and therefore still function when beam radiation is cut off by cloud.

Which of the above statements are correct ?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

63. Irradiance is normally expressed in

(a) Watts per meter square (W/m^2)

(b) Watts per meter cube (W/m^3)

(c) Watts per meter (W/m)

(d) Watts per meter-second (W/m-s)

64. The measurement of the position of a star in the sky is

(a) Zenith

(b) Azimuth

(c) Declination

(d) Ascension

65. At the surface of the Sun, the intensity of the solar radiation is about

(a) $3{\cdot}33 \times 10^7$ W/m^2

(b) $4{\cdot}33 \times 10^7$ W/m^2

(c) $5{\cdot}33 \times 10^7$ W/m^2

(d) $6{\cdot}33 \times 10^7$ W/m^2

66. The flux density radiation on the horizontal is a function of the angle between the surface normal and the direction of the ray and is defined by

(a) Fourier's law

(b) Lambert's cosine law

(c) Kepler's law

(d) Morgan's law

67. In solar ponds, the salt water naturally forms a vertical salinity gradient also known as

(a) Halocline

(b) Desalination

(c) Salt crystallization

(d) Salt decrystallization

68. Active cavity radiometer is used to measure

(a) Conduction

(b) Convection

(c) Solar radiation

(d) Corrosion behaviour

69. The tip speed ratio in a wind turbine is

(a) the speed of the tip of the blade divided by the wind speed

(b) the wind speed divided by the speed of the tip of the blade

(c) the wind speed divided by the power output

(d) the power output divided by the wind speed

70. Biodiesel is produced from oils or fats using the process of

(a) Distillation

(b) Transesterification

(c) Fermentation

(d) Gasification

71. The average distance of the Sun from the Earth is approximately

(a) $2{\cdot}821 \times 10^{11}$ m

(b) $2{\cdot}256 \times 10^{11}$ m

(c) $1{\cdot}982 \times 10^{11}$ m

(d) $1{\cdot}495 \times 10^{11}$ m

72. The efficiency of molten carbonate fuel cell is equal to

(a) 25%

(b) 37%

(c) 50%

(d) 75%

73. The state of rest or motion of the rigid body in mechanics is unaltered; if a force acting on the body is replaced by another force of the same magnitude and direction, but acting anywhere on the body along the line of action of the replaced force, is known as

(a) Varignon's theorem

(b) Law of transmissibility

(c) Polygon law of forces

(d) Triangle law of vectors

74. Two equal forces are acting at a point with an angle of 60 degrees between them. If the resultant is equal to $20\sqrt{3}$ N, what is the magnitude of each force ?

(a) 10 N

(b) 20 N

(c) 30 N

(d) 40 N

75. Consider the following statements regarding trusses :

1. In most of the trusses, the self-weight is really small compared to the loads they carry. Hence, self-weight of the members may be neglected.

2. A truss is said to be redundant if the number of members in it is more than that required in a perfect truss.

3. The relationship between number of joints j, and the number of members m, in a perfect truss is $m = 2j - 1$.

Which of the above statements are correct ?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

76. The centre of gravity of a solid hemisphere from its diametral axis of radius r is at a distance of

(a) $\frac{1}{8}r$

(b) $\frac{3}{8}r$

(c) $\frac{3}{5}r$

(d) $\frac{2}{5}r$

77. Consider the following statements regarding friction laws :

1. Till the limiting value is reached, the magnitude of frictional force is exactly equal to the tangential force which tends to move the body.
2. The magnitude of the limiting friction bears a constant ratio to the normal reaction between the two contacting surfaces.
3. The force of friction is dependent on the area of contact between the two surfaces.

Which of the above statements are correct ?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

78. In a lifting machine in which velocity ratio is 30, a load of 5000 N is lifted with an effort of 360 N. What is the percentage of efficiency ?

(a) 26·3

(b) 36·3

(c) 46·3

(d) 56·3

79. The relation between linear acceleration (a) and angular acceleration (α) is given by (where r is a constant)

(a) $\alpha = \frac{a}{r}$

(b) $\alpha = a \times r$

(c) $\alpha = \frac{1}{a \times r}$

(d) $\alpha = \frac{r}{a}$

80. The coefficient of restitution for perfectly elastic impact is

(a) 0

(b) 1

(c) -1

(d) 0·5

81. The equation of a path followed by a particle when it is projected into space making a certain angle with the horizontal is

(a) $y = x \tan \alpha - \frac{1}{2}\frac{gx^2}{u^2 \cos^2 \alpha}$

(b) $y = x \tan \alpha - \frac{1}{2}\frac{gx^3}{u^2 \cos^2 \alpha}$

(c) $y = x \tan \alpha + \frac{1}{2}\frac{gx^2}{u^2 \cos^2 \alpha}$

(d) $y = x \tan \alpha + \frac{1}{2}\frac{gx^3}{u^2 \cos^2 \alpha}$

82. If a body is having a combined motion of translation and rotation, then the body is assumed to be rotating about a certain point which is known as

(a) Relative motion

(b) Instantaneous centre of rotation

(c) Rigid body rotation

(d) Rectilinear motion

83. If a body is having motion of translation as well as motion of rotation, then total kinetic energy is given by

(a) Total K.E. = $\frac{1}{2}mv^2 - \frac{1}{2}I\omega^2$

(b) Total K.E. = $\frac{1}{2}mu^2 - \frac{1}{2}I\omega^2$

(c) Total K.E. = $\frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$

(d) Total K.E. = $\frac{1}{2}mu^2 + \frac{1}{2}I\omega^2$

84. The elongation per unit length of a body is known as

(a) Linear stress

(b) Unit strain

(c) Strain

(d) Lateral strain

85. The ratio of stress to strain is constant and is known as

(a) Modulus of rigidity

(b) Elasticity constant

(c) Elasticity ratio

(d) Modulus of elasticity

86. The materials having same elastic properties at all the points of the body and in all directions are called

(a) Ideal materials

(b) Uniform materials

(c) Isotropic materials

(d) Elastic materials

87. Composite with molybdenum fibres and alumina matrix do ***not*** exhibit good strength because

(a) molybdenum fibres develop micro cracks.

(b) molybdenum is weaker than alumina.

(c) molybdenum does not form any bond with alumina.

(d) molybdenum dissolves in alumina.

88. The relationship between the lattice parameter 'a' and the atomic radius 'r' for FCC structures is

(a) $a = \sqrt{2}\,r$

(b) $a = 2\sqrt{2}\,r$

(c) $a = 2r$

(d) $a = 4r$

89. Consider the following statements regarding crystal geometry :

1. Atoms in crystalline solids are positioned in an orderly and repeated pattern.

2. In atoms in non-crystalline or amorphous materials there is random and disordered atomic distribution.

3. A crystal structure is obtained by combining a space lattice with a basis. The basis must give the number of atoms per lattice point, their types, mutual orientations and distances of separation.

Which of the above statements are correct ?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

90. Which one of the following materials has maximum value of yield point strength ?

(a) High-carbon spring steel

(b) Medium-carbon steel

(c) Copper

(d) Duralumin

91. In ceramic matrix composite, which one of the following processes retards the crack propagation ?

(a) Precipitation hardening

(b) Strain hardening

(c) Transformation toughening

(d) Shear tractions

92. The production of a hard wear-resistant layer on metals by welding is known as

(a) Hardening

(b) Metallizing

(c) Carburising

(d) Hardfacing

93. Consider the following statements regarding mechanical behaviour of Iron-Carbon alloys :

1. Martensite is hard and brittle, and because of its brittle behaviour it cannot be used for most engineering applications.

2. Bainite steels have finer structure (structure contains α-ferrite matrix with cementite particles). They are harder and stronger than pearlite steels; even then they exhibit desirable combination of strength and ductility, i.e. toughness.

3. Spheroidized steels are extremely ductile, much more than either fine or coarse pearlite.

Which of the above statements are correct ?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

94. Bronze is the name given to represent a copper-base alloy with which one of the following materials as alloying element ?

(a) Tin

(b) Zinc

(c) Lead

(d) Pure aluminium

95. The corrosion penetration rate is calculated by using (where k is a constant, w is the weight loss in exposure time t, ρ is the density and A is the area of specimen exposed. CPR less than 0·5 mm/year is acceptable)

(a) $\frac{w\rho}{kAt}$

(b) $\frac{\rho k}{wAt}$

(c) $\frac{kw}{\rho At}$

(d) $\frac{w}{\rho Atk}$

96. Which one of the following processes occur where carbon and nitrogen are added to the surface layer of the steel to increase its hardness, wear-resistance and fatigue limit ?

(a) Induction hardening

(b) Flame hardening

(c) Nitriding

(d) Cyaniding

97. What is the atomic radius of copper metal that has the FCC crystal structure at room temperature (20°C) ?

(a) 0·175 nm

(b) 0·144 nm

(c) 0·128 nm

(d) 0·086 nm

98. What is 'c/a' ratio of titanium metal that has the HCP crystal structure at room temperature (20°C), where 'a' and 'c' is lattice constant ?

(a) 1·162 nm

(b) 1·587 nm

(c) 1·854 nm

(d) 1·912 nm

99. Damping factor is defined as

(a) the ratio of the critical damping coefficient to the actual damping coefficient.

(b) the ratio of the critical damping speed to the actual damping speed.

(c) the ratio of the actual damping speed to the critical damping speed.

(d) the ratio of the actual damping coefficient to the critical damping coefficient.

100. Which of the following gears are used to connect two non-intersecting and non-parallel i.e. non-coplanar shafts ?

(a) Bevel gears

(b) Spiral gears

(c) Helical gears

(d) Spur gears

101. In which type of gear train, may the axes of the shafts, over which the gears are mounted, move relative to a fixed axis ?

(a) Simple gear train

(b) Compound gear train

(c) Epicyclic gear train

(d) Reverted gear train

102. Failure will occur in the parts joined together by the weld, if the components are made of mild steel with

(a) less than 0·3% carbon

(b) more than 1·2% carbon

(c) more than 2·8% carbon

(d) less than 3·6% carbon

103. The angle which the line of action makes with the common tangent to the pitch circles is called

(a) Base angle

(b) Pinion angle

(c) Pitch angle

(d) Pressure angle

104. A straight line joining yield strength of the material on mean stress axis and endurance limit of the component on stress amplitude axis is called

(a) Gerber line

(b) Goodman line

(c) Soderberg line

(d) Yield line

105. Which one of the following processes involves giving up a certain amount of hardness but shedding a great deal of brittleness acquired in the process of hardening in steels ?

(a) Case Hardening

(b) Tempering

(c) Normalizing

(d) Annealing

106. Which one of the following alloys contains Nickel, Chromium and Iron, mostly used in electrical industry ?

(a) Monel metal

(b) Nichrome

(c) Inconel

(d) German silver

107. Consider the following statements regarding cold and hot rolling process in metal forming :

1. Severe internal stresses are induced in the metal during hot working. If these stresses are not relieved, the component manufactured may fail prematurely in service.

2. In hot working, there are no residual internal stresses and the mechanically worked structure is better than that produced by cold working.

3. Due to limited ductility at room temperature, production of complex shapes is not possible by cold working processes.

Which of the above statements are correct ?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

108. Which one of the following light hammers is powered by an electric motor and gives repeated blows when it is operated by a foot operated treadle ?

(a) Power hammer

(b) Spring hammer

(c) Steam hammer

(d) Pneumatic power hammer

109. Which one of the following extrusion processes is used for producing small thin walled seamless tubes of aluminium and copper ?

(a) Hooker extrusion

(b) Hydrostatic extrusion

(c) Impact extrusion

(d) Cold extrusion forging

110. The term Alligatoring is a defect associated with

(a) Forging process

(b) Casting process

(c) Extrusion process

(d) Rolling process

111. What is the difference between right hand and left hand turning operations ?

(a) When turning is done from right to left and left to right respectively.

(b) Right hand turning means that the cross slide is moved forward.

(c) Right hand turning is done by a right handed operator.

(d) Right hand turning means when job is supported on the right end by tailstock.

112. The rake angle (α), cutting ratio (r) and shear plane angle (φ) are related by the equation as

(a) $\tan \varphi = \dfrac{r \cos \alpha}{1 - r \sin \alpha}$

(b) $\tan \varphi = \dfrac{r \sin \alpha}{1 - r \cos \alpha}$

(c) $\tan \varphi = \dfrac{1 - r \cos \alpha}{r \sin \alpha}$

(d) $\tan \varphi = \dfrac{1 - r \sin \alpha}{r \cos \alpha}$

113. A cup of 25 mm diameter and 10 mm height is to be produced by drawing from a 1·5 mm thick sheet metal. Assume ultimate strength of the sheet metal to be 650 MN. What is the blank diameter ?

(a) $\sqrt{1350}$ mm

(b) $\sqrt{1450}$ mm

(c) $\sqrt{1525}$ mm

(d) $\sqrt{1625}$ mm

114. Which one of the following types of testing has generation of transient elastic waves during the rapid release of energy from localized sources within a material ?

(a) Eddy current testing

(b) Liquid colour penetrant testing

(c) Ultrasonic testing

(d) Acoustic emission testing

115. PERT stands for

(a) Programme Equivalent Review Technique

(b) Planning Evaluation Review Technology

(c) Programme Evaluation Review Technique

(d) Planning Equivalent Review Technology

116. Which one of the following means to produce a conical surface by gradual reduction in diameter from a cylindrical workpiece ?

(a) Boring

(b) Facing

(c) Drilling

(d) Taper turning

117. Performance rating is equal to

(a) $\frac{\text{normal performance}}{\text{observed performance}} \times 100$

(b) $\frac{\text{normal performance} - \text{observed performance}}{\text{observed performance}} \times 100$

(c) $\frac{\text{observed performance}}{\text{normal performance}} \times 100$

(d) $\frac{\text{observed performance}}{\text{normal performance} - \text{observed performance}} \times 100$

118. What is the abbreviation of ADC ?

(a) Analog-to-Digital Conversion

(b) Analog-to-Direct Conversion

(c) Analog-to-Digital Connection

(d) Analog-to-Direct Change

119. Hall effect is defined as

(a) the magnetic effect due to current carrying conductor in electric field.

(b) the transverse effect due to current carrying conductor in magnetic field.

(c) the rectilinear effect due to current carrying conductor in electric field.

(d) the transverse effect due to current carrying conductor in electric field.

120. Which one of the following problems is to determine the motion parameters of a particular point on the mechanism from the knowledge of the motion parameters of the linkages ?

(a) Forward kinematics problem

(b) Inverse kinematics problem

(c) Converse kinematics problem

(d) Robot kinematics problem

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