Civil Service Examination: Mechanical Engineering question paper 2009

1. Which one of the following can be completely represent a force graphically?
   (a) Magnitude, time of application and direction
   (b) Time of application, point of application and direction
   (c) Point of application, direction and magnitude
   (d) Magnitude, time of application and point of application

2. The x - y plane is the plane of a couple of 25 Nm magnitude and $\hat{i}$, $\hat{j}$, $\hat{k}$ are unit vectors along x, y and z directions respectively. Which one of the following represents the couple vector?
   (a) $\frac{25}{12}\hat{i} + \frac{25}{12}\hat{j}$
   (b) $25\hat{i}$ Nm
   (c) $25\hat{j}$ Nm
   (d) $25\hat{k}$ Nm

3. A particle is projected vertically upward with an initial velocity u. If g is the acceleration due to gravity, then which one of the following is the greatest height h attained by it?
   (a) $h = \frac{2u^2}{g}$
   (b) $h = \frac{u^2}{g}$
   (c) $h = \frac{1}{2}\frac{u^2}{g}$
   (d) $h = \frac{1}{4}\frac{u^2}{g}$

4. Consider the following statements in the case of perfectly plastic impact of two particles:
   1. There is no period of restitution.
   2. Both the particles are together after impact.
   3. Total momentum of the particles is conserved.
   4. Kinetic energy of the particles is conserved.

   Which of these statements are correct?
   (a) 1 and 2 only
   (b) 1, 2 and 3 only
   (c) 2 and 3 only
   (d) 2, 3 and 4

5. A free bar of length ι is heated uniformly from 0° C to a temperature T° C. α is the coefficient of linear expansion and E is the modulus of elasticity. Which one of the following is the stress induced in the bar?
   (a) $\frac{\alpha TE}{4}$
   (b) $\frac{\alpha TE}{2}$
   (c) α T E
   (d) Zero

6. If material has numerically the same values for its modulus of rigidity and bulk modulus, then what is its Poisson's ratio?
   (a) 0.25
   (b) 0.2
   (c) 0.15
   (d) 0.125

7. A simply supported beam of span L and flexural rigidity EI carries a unit point load at its centre. What is the strain energy in the beam due to bending?
   (a) $\frac{L^3}{16EI}$
   (b) $\frac{L^3}{48EI}$
   (c) $\frac{L^3}{96EI}$
   (d) $\frac{L^3}{192EI}$

8. Consider the following statements, in connection with a metallic rod of a circular section being subjected to equal and opposite torque T within elastic limit:
   1. The transverse section of the rod does not experience warping.
   2. The diameter of rod does not alter.
   3. Angle of relative twist between two sections is proportional to the lengths between these sections.
   4. A surface element of the rod is under pure shear state of stress.

   Which of these statements are correct?
   (a) 1 and 2 only
   (b) 1, 2 and 3 only
   (c) 2 and 3 only
   (d) 2, 3 and 4 only

9. Which one of the following is true for torsional shear stress at the axis of a circular shaft?
   (a) Minimum
   (b) Maximum
   (c) Negative
   (d) Zero

10. Which on e of the following is the correct, expression for hoop stress, if P is internal pressure in a thin walled cylinder of diameter d and thickness t?

Civil Service Examination: Mechanical Engineering question paper 2009

(a) $\frac{pd}{t}$

(b) $\frac{pd}{2t}$

(c) $\frac{pd}{4t}$

(d) $\frac{pd}{8t}$

11. Consider the following statements in respect of thin cylindrical pressure vessels subjected to internal fluid pressure:
    1. State of stress along the vessel thickness is biaxial except in the inside surface.
    2. Circumferential stress is twice the magnitude of longitudinal stress.
    3. Hoop stress and longitudinal stress remain constant along the vessel thickness.
    4. Circumferential welded seam is likely to be weaker as compared to longitudinal seam.

    Which of these statements are correct?
    (a) 1 and 2 only
    (b) 1, 2 and 3 only
    (c) 2 and 3 only
    (d) 2, 3 and 4

12. Which one of the following columns gas effective length twice the value of actual length?
    (a) Hinged-Hinged column
    (b) Fixed-Fixed column
    (c) Fixed-Hinged column
    (d) Fixed-Free column

13. Critical Euler buckling load for a ling column of diameter D was educed as P. If the diameter of the section is reduced to D/2, what is the load carrying capacity of the modified column?

    (a) $\frac{P}{2}$

    (b) $\frac{P}{4}$

    (c) $\frac{P}{8}$

    (d) $\frac{P}{16}$

14. What property of a material enables it to be drawn into wires with the application of tensile force?
    (a) Plasticity
    (b) Elasticity
    (c) Ductility
    (d) Malleability

15. By inversion of which one of the following can a Whitworth quick return mechanism be obtained?
    (a) Four bar chain only
    (b) Single slider crank chain only
    (c) Both four bar chain and single slider crank chain
    (d) Neither four bar chain nor single slider crank chain

16. Which one of the following holds true for a quadric cycle chain?
    (a) Each of the four pairs is a turning pair
    (b) One is a turning pair and three are sliding pairs
    (c) Three turning pairs and one sliding pair
    (d) Each of the four pairs is a sliding pair

17. Which one of the following refers to miter gears?
    (a) Spur gears of equal diameter and pitch
    (b) Helical gears having same pitch
    (c) Gears having different modules
    (d) Right-angled bevel gears having the same number of teeth

18. Match List I with List II and select the correct answer using the code given below the lists:

List I Type of gears		**List II** Characteristics
A.	Herringbone gears	1. Non-interchangeable
B.	Worm gears	2. Quiet motion
C.	Helical gears	3. Zero axial thrust
D.	Hypoid gears	4. Extreme speed reduction

Code:

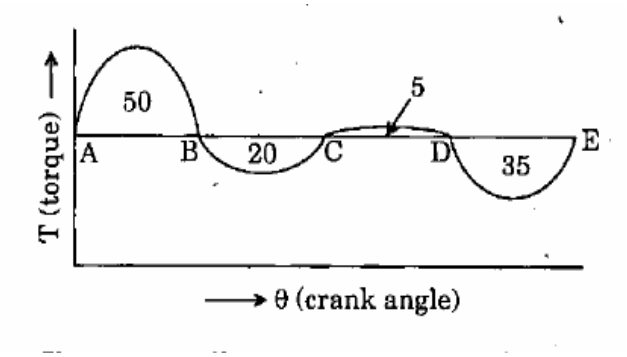
	A	**B**	**C**	**D**
(a)	3	2	4	1
(b)	1	2	4	3
(c)	3	4	2	1
(d)	1	4	2	3

19. Which one of the following is true regarding the fatigue life of a set of identical ball bearings?
    (a) Directly proportional to load
    (b) Inversely proportional to load
    (c) Inversely proportional to the square of load
    (d) Inversely proportional to the cube of load

20. Which one of the following governors cannot be isochronous?
    (a) Hartnell
    (b) Hartung
    (c) Porter
    (d) Watt

Civil Service Examination: Mechanical Engineering question paper 2009

21.



The crank-effort diagram of an engine running a machine is showing the areas above and below the mean line (in joules). What is the maximum fluctuation of energy in the above diagram?
(a) 0 J
(b) 30 J
(c) 50 J
(d) 55 j

22. Which one of the following does a flywheel control?
(a) The mean speed of an engine, when the load may vary
(b) The cyclic fluctuation of speed while delivering constant output
(c) Variation of load demand of the engine
(d) Mean torque developed by an engine

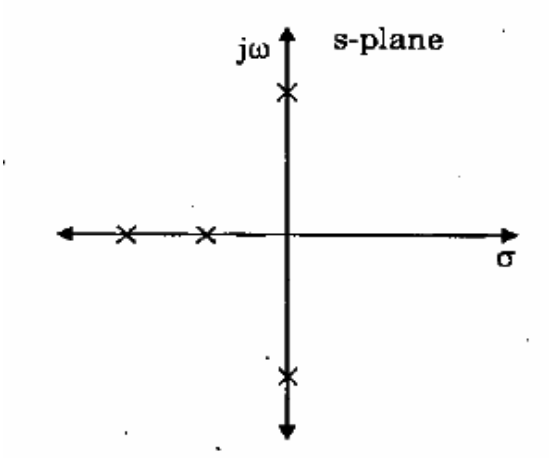
23. If a shaft carries a series of unbalanced masses in different parallel planes, then what is the minimum number of arbitrary planes that can be chosen and will be sufficient for placement of balancing masses for complete dynamic balance of the system?
(a) 2
(b) 3
(c) 4
(d) 1

24. Which one of the following statements is true for static balancing of a shaft?
(a) The net dynamic force acting on the shaft is zero.
(b) The net couple due to dynamic forces acting on the shaft is zero.
(c) Both (a) and (b)
(d) Neither (a) nor (b)

25. What type of progression will be followed by the amplitudes of free oscillations with coulomb damping?
(a) Harmonic
(b) Arithmetic
(c) Logarithmic
(d) Exponential

26. Which one of the following is the curve traced by a point in the connecting rod of double slider crank chain?
(a) Hyperbola
(b) Circle
(c) Parabola
(d) Ellipse

27.



The roots of the characteristic equation of a linear control system are shown in the figure as above with cross (x) marks. What can be said of the system?
(a) Robust
(b) Asymptotically stable
(c) Marginally stable
(d) Unstable

28. Which one of the following systems whose transfer functions are given below, will have the fastest transient response?
(a) $\frac{1}{s+1}$
(b) $\frac{25}{s+25}$
(c) $\frac{\sqrt{2}}{s+\sqrt{2}}$
(d) $\frac{10}{s+10}$

29. If ϕ = shear angle, α = rake angle, the shear strain in orthogonal cutting will be equal to which one of the following?
(a) $\cot\phi + \tan(\phi - \alpha)$
(b) $\tan\phi + \cot(\phi - \alpha)$
(c) $\cos\phi + \sin(\phi - \alpha)$
(d) $\sin\phi + \cos(\phi - \alpha)$

30. Which one of the following is the wear land criterion for tool life according to ISO recommendations for roughing cuts?
(a) 0.1 mm
(b) 0.2 mm
(c) 0.3 mm
(d) 0.4 mm

Civil Service Examination: Mechanical Engineering question paper 2009

31. Which one of the following is the sequence of tool materials with increasing hot hardness?
(a) HSS, Cast alloys, Cemented carbides and Ceramic
(b) HSS, Cast alloys, Ceramic and Cemented carbides
(c) Cast alloys, HSS, Cemented carbides and Ceramic
(d) Cast alloys, HSS, Ceramic and Cemented carbides

32. If V_{mc} = cutting speed for the minimum cost and V_{mt} = cutting speed for the minimum time, then for high efficiency range, which one of the following is true for cutting speed?
(a) Between V_{mt} and V_{mc}
(b) $\leq V_{mc}$
(c) $\geq V_{mt}$
(d) $\leq V_{mt}$

33. Consider the following operations of a universal dividing head in a milling machine:
1. It sets the word piece in a desired position in relation to the machine table.
2. After each cut it rotates the job through a desired angle.
3 It provides a continuous rotary motion to the job during milling of helical grooves

Which of these statements is/are correct?
(a) 1, 2 and3
(b) 1 only
(c) 1 and 2 only
(d) 2 and 3 only

34. Consider the following statements:
Flutes are made in the drill:
1. To guide the chips upwards.
2. To enable the cutting fluid to reach the cutting edged.
3. To break the chips.

Which of these statements are correct?
(a) 1, 2 and 3
(b) 1 and 2 only
(c) 1 and 3 only
(d) 2and 3 only

35. What does 36 denote in the following marking of the grinding wheel?
5 1 A 36 L 5 V 2 3
(a) Structure
(b) Manufacturer's reference
(c) Nature of abrasive
(d) Abrasive grain size

36. Match List I with List II and select the correct answer using the code given below the lists:

List I (Type)		List II (Advantage)	
A.	Open die	1.	Good dimensional accuracy, high production rates and good reproducibility
B.	Closed die	2.	Close tolerances, machining often unnecessary
C.	Conventional	3.	Simple, inexpensive dies, useful for small quantities
D.	Precision	4.	Requires much less machining, good utilization of mateia

Code:

	A	B	C	D
(a)	2	1	4	3
(b)	3	1	4	2
(c)	2	4	1	3
(d)	3	4	1	2

37. Which on of the following is correct?
In metal forming processes, the magnitude of stresses encountered is
(a) less than the yield strength of the material.
(b) between the yield strength and the fracture strength of the material.
(c) less than the elastic limit of the material.
(d) greater than the ultimate strength of the material,

38. Which one of the following is correct?
In rolling, the metal would not enter the space between the rolls automatically if the angle of contact
(a) $< \tan^{-1} \mu$
(b) $> \tan^{-1} \mu$
(c) $> \frac{1}{2} \tan^{-1} \mu$
(d) $< \frac{1}{2} \tan^{-1} \mu$
Where μ is the coefficient of friction between the metal and roll surfaces.

39. Which one of the following metal forming processes is used for manufacture of steel wire?
(a) Deep drawing
(b) Forging
(c) Spinning
(d) Drawing

40. Welding of aluminium is normally difficult due to which one of the following reasons?
(a) Low melting temperature of aluminium
(b) Formation of oxide film
(c) Chance of cracking
(d) Formation of carbide film

Civil Service Examination: Mechanical Engineering question paper 2009

41. Consider an electrode coating, performing the following functions:
1. Stabilize the are
2. Control the rate at which the electrode melts
3. Control the flow of current
4. Enhance the quality of the joint

Which of these statements are correct?
(a) 1 and 2 only
(b) 1, 2 and 3 only
(c) 2 and 3 only
(d) 2, 3 and 4 only

42. Which one of the following cutting tool bits are made by powder metallurgy processes?
(a) Carbon steel tool bits
(b) Stellite tool bits
(c) Tungsten carbide tool bits
(d) HSS tool bits

43. Which one of the following materials is best processed by injection moulding?
(a) All types of plastics
(b) Thermoplastics
(c) Non-ferrous materials
(d) Thermo-setting plastics

44. Time study of an operator with a performance rating of 120% yields a time of 2 minutes. If the allowances of 10% of the total available time are to be given, then what is the standard time of operation?
(a) 2.00 minutes
(b) 2.40 minutes
(c) 2.64 minutes
(d) 2.67 minutes

45. Which on of the following is feasible for study of medium and ling-cycle operations?
(a) Micro-motion study
(b) memo-motion study
(c) PMTS
(d) MTM

46. Which one of the following is a listing of all activities or responsibilities of every person in a department or group?
(a) Operation process chart
(b) Work distribution chart
(c) Multiple activity chart
(d) Gantt chart

47. The low break even point is due to which one of the following factors?
(a) High productivity
(b) Low revenue
(c) Large angle of incidence
(d) High revenue

48. Through an efficient layout, an organization can attain the following objectives:
1. Economy in handling of materials, work-in-process and finished goods.
2. Efficient utilization of available space.
3. Adoption of new safety standards.
4. Changes in product design.

Select the correct answer from the codes given below:
(a) 1 and 2 only
(b) 1, 2 and 3 only
(c) 2 and 3 only
(d) 2, 3 and 4

49. Consider the following statements:
The product layout is used for
1. Large quantity.
2. Standardized parts.
3. Steady demand.

Which of these statements are correct?
(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

50. The monthly demand for a product is Rs. 3,000 of sales. Annual carrying cost is Rs. 2,000. The ordering cost per order is Rs. 500. What is the EOQ?
(a) One month of sales
(b) Three months of sales
(c) Four months of sales
(d) Six months of sales

51. Which one of the following statements is correct?
(a) Route sheet helps in assessing the quantity of materials remaining in store.
(b) The operation sheet gives complete details of the manufacturing operations.
(c) Routing helps in calculating quantity of materials required for each part and lot.
(d) The process sequence cannot be assessed from route card.

52. Work done between the state 1 and 2 in a flow process is given by which one of the following expressions?
(a) $-\int_1^2 v\,dp$
(b) $\int_1^2 p\,dv$
(c) $\int_1^2 v\,dp + \int_1^2 p\,dv$
(d) $\int_1^2 v\,dp - \int_1^2 p\,dv$

Civil Service Examination: Mechanical Engineering question paper 2009

53. On a T – S diagram the slope of constant pressure line (m_p) and the slope of constant volume line (m_v) can be related by which one of the following relations?
(a) $m_p = m_v$
(b) $m_v > m_p$
(c) $m_p > m_v$
(d) $m_p - m_v = 1$

54. Match List I with List II and select the correct answer using the code given below the lists:

	List I		List II
A.	Constant volume gas thermometer	1.	Length
B.	constant pressure gas thermometer	2.	Resistance
C.	Electrical resistance thermometer	3.	Pressure
D.	Mercury-in-glass thermometer	4.	Volume

Code :

	A	B	C	D
(a)	1	2	4	3
(b)	3	4	2	1
(c)	1	4	2	3
(d)	3	2	4	1

55. On which laws of thermodynamics is the measurement of temperature based?
(a) Zeroth
(b) First
(c) Second
(d) Third

56. Which one of the following pairs is correctly matched?
(a) Cetane : $C_{16}H_{32}$
(b) Ethanol : C_2H_5OH
(c) Iso-octane : C_8H_{16}
(d) Tetraethyl lead : $(CH_3)_4$ Pb

57. Which of the following is an intensive thermodynamic property?
(a) Density
(b) Energy
(c) Entropy
(d) Volume

58. Which one of the following equations of state takes into account volume of gas molecules alone?
(a) Clausius equation
(b) Van der Walls equation
(c) Redlich - Kwong equation
(d) Virial equation

59. An air compressor compresses air with an enthalpy of 100 kJ/kg to a pressure and temperature that have an enthalpy of 200 kJ/kg. There is 60 kJ/kg heat lost from the compressor as the air passes through it. Neglecting kinetic and potential energies, what is the power required for an air mass flow of 1 kg/s?
(a) 60 kW
(b) 160 kW
(c) 260 kW
(d) 360 kW

60. Match List I with List II and select the correct answer using the code given below the lists:

	List I		List II
A.	Keenan fuction	1.	$H - T_0S + mV^2/2+mgZ$
B.	Helmholtz	2.	$U + P_0 \cdot v - T_0 \cdot S$
C.	Availability functions for a closed system	3.	$U - T_0 \cdot S$
D.	Availability functions for a steady flow process	4.	$H - T_0 \cdot S$

Code:

	A	B	C	D
(a)	1	2	3	4
(b)	4	2	3	1
(c)	1	3	2	4
(d)	4	3	2	1

61. Which one of the following statements is incorrect?
(a) Availability follows the law of conversion.
(b) Availability is a function of states of matter under consideration and environment.
(c) Availability always depends upon pressure.
(d) Availability increases with temperature drop at low temperature.

62. A diesel engine has a compression ratio of 14 and cut off takes place at 6% of the stroke. What is the value of cut off ratio?
(a) 1.25
(b) 2
(c) 2.15
(d) 1.78

63. At a given compression ratio, what is the relation among the Otto cycle efficiencies for the working fluids having γ = 1.2, 1.4 and 1.67?
(a) $(\eta_\gamma = 1.2) > (\eta_\gamma = 1.4) > (\eta_\gamma = 1.67)$
(b) $(\eta_\gamma = 1.2) < (\eta_\gamma = 1.4) < (\eta_\gamma = 1.67)$
(c) $(\eta_\gamma = 1.2) = (\eta_\gamma = 1.4) = (\eta_\gamma = 1.67)$
(d) $(\eta_\gamma = 1.2) \geq (\eta_\gamma = 1.4) \leq (\eta_\gamma = 1.67)$

Civil Service Examination: Mechanical Engineering question paper 2009

64. What is the difference between the temperature of feed water outlet and saturation temperature of steam entering the heater called?
(a) Pinch point
(b) Terminal temperature difference
(c) LMTD
(d) Terminal point

65. Mean temperature of heat addition gets increased resulting in an increase in cycle thermal efficiency. What is this cycle called?
(a) Regenerative cycle
(b) Reheat cycle
(c) Carnot cycle
(d) Brayton cycle

66. Which one of the following characterizes the Brayton cycle?
(a) Isobaric heat addition
(b) Isothermal heat release
(c) Isochoric heat addition
(d) Isothermal heat addition

67. Which one of the following statements is correct?
High air-fuel ratio is gas turbines
(a) increases power output.
(b) improves thermal efficiency.
(c) reduces exhaust gas temperature.
(d) does not damage turbine blades.

68. Consider the following statements:
The nozzle efficiency depends on
1. Material of the nozzle
2. Size and shape of the nozzle.
3. Mach number of flow.
4. Reynolds number of flow.
Which of these statements are correct?
(a) 1 and 2 only (b) 1 and 3 only
(c) 1, 2 and 4 (d) 2, 3 and 4

69. Consider the following statements:
Supersaturation in nozzle flow causes
1. Reduced dryness fraction of steam.
2. Increased nozzle friction.
3. Increased mass flow of steam.
4. Increased exit velocity.
Which of these statements are correct?
(a) 1 and 2 only (b) 2 and 4 only
(c) 3 only (d) 1, 2 and 4

70. If the cross-section of a nozzle is decreasing in the direction of flow in subsonic flow, then what will happen in the downward direction?
(a) Pressure will decrease and velocity increase
(b) Velocity will decrease and pressure increase
(c) Both pressure and velocity increase
(d) Both pressure and velocity decrease

71. At engine inlet of a supersonic aircraft, a diffuser is provided to decrease the velocity of air form supersonic to subsonic. What is the type of diffuser?
(a) Diverging duct
(b) Converging duct
(c) Diverging (inlet), converging (outlet) duct
(d) Converging (inlet), diverging (outlet) duct

72. Consider the following statements:
1. Induced draught fan is used to handle exhaust flue gases.
2. For maximum discharge, height of chimney should be higher than the height of hot gas column producing draught.
3. Air preheater heats the primary air and secondary air.
4. In big power plants draught is created by induced draught fans.
5. Blow-cock is used to empty the boiler.
Which of these statements are correct?
(a) 1, 2 and 3
(b) 2, 3 and 4
(c) 1, 3, 4 and 5
(d) 1, 2, 3 and 4

73. In steam generators, a stoker acts as one of the following devices. What is this device?
(a) Air preheating device
(b) Steam superheating device
(c) Air superheating device
(d) Fuel feeding device

74. Which one of the following defines the degree of reaction for steam turbines?
(a) $\frac{\Delta h_f}{\Delta h_m}$
(b) $\frac{\Delta h_m}{\Delta h_f}$
(c) $\frac{\Delta h_m}{\Delta h_m + \Delta h_f}$
(d) $\frac{\Delta h_f}{\Delta h_f + \Delta h_m}$

75. Which of the following components improves the plant efficiency?
1. Economizer
2. Air preheater
3. Condenser
4. Forced draught fan
Select the correct answer from the codes given below:
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1, 2 and 3
(d) 1, 2 and 4

Civil Service Examination: Mechanical Engineering question paper 2009

76. Consider the following statements with respect to Deriaz Turbine:
1. It is intermediate between the mixed flow and the axial flow turbine.
2. It is known as Diagonal turbine.
3. It can be used as turbine as well as pump.

Which of these statements are correct?
(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

77. Which one of the following statements is correct?
The centrifugal pump will start delivering water if the pressure rise in the impeller is
(a) less than manometric head (H_m)
(b) more than or equal to manometric head (H_m)
(c) less than suction head (H_s)
(d) more than or equal to suction head (H_s)

78. A turbine is to operate under a head o f25 m at 200 rpm. The discharge is 9 m^3/s. If the efficiency is 90%, then which one of the following turbines is suitable?
(a) Francis turbine
(b) Pelton turbine
(c) Kaplan turbine
(d) Deriaz turbine

79. What is known for an open waterway excavated in natural ground following its contour?
(a) Panels
(b) Flume
(c) Canal
(d) Tunnel

80. Which one of the following equations is correct for the heterogeneous thermal reactor?
(a) Rate of neutron production = Rate of neutron leakage - Rate of neutron absorption
(b) Rate of neutron production = Rate of neutron absorption - Rate of neutron leakage
(c) Rate of neutron production = Rate of neutron leakage + Rate of neutron absorption
(d) Rate of neutron production = Rate of neutron absorption ÷ Rate of neutron leakage

81. In a nuclear reactor, what is the purpose of control rod?
(a) To reduce the speed of fast moving neutrons
(b) To absorb excess neutrons in the reactor
(c) To control fission temperature
(d) To control emission of Beta and Gamma rays

82. In which one of the following equipments used in vapour absorption refrigeration system, is the final separation of water vapour from ammonia executed by further cooling?
(a) Heat exchanger
(b) Rectifier
(c) Analyzer
(d) Generator

83. A two-stage compressor compresses air with perfect inter cooling and same index of compression for both cylinders. Which one of the following is the correct expression for minimum work done? (With usual notations)

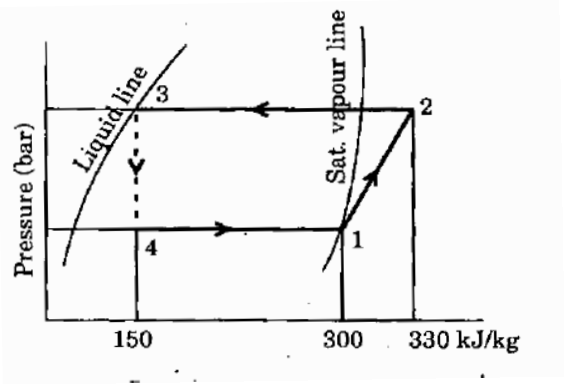
(a) $W = \frac{2n}{n-1} mRT_1 \left[\left(\frac{p_3}{p_2} \right)^{\frac{n-1}{2n}} - 1 \right]$

(b) $W = \frac{2n}{n-1} mRT_1 \left[\left(\frac{p_2}{p_3} \right)^{\frac{n-1}{2n}} - 1 \right]$

(c) $W = \frac{2n}{n-1} mRT_1 \left[\left(\frac{p_3}{p_1} \right)^{\frac{n-1}{n}} - 1 \right]$

(d) $W = \frac{2n}{n-1} mRT_1 \left[\left(\frac{p_3}{p_1} \right)^{\frac{n-1}{2n}} - 1 \right]$

84. A vapour compression refrigerator has a COP o f3, if the work absorbed by the compressor is 25 kW. What would be the amount of heat rejection in the condenser?
(a) 25 kW
(b) 50 kW
(c) 75 kW
(d) 100 kW

85. 

A vapour compression refrigeration cycle is as shown in the pressure - enthalpy diagram above. What will be its COP?
(a) 3
(b) 4
(c) 5
(d) 6

Civil Service Examination: Mechanical Engineering question paper 2009

86. High condenser pressure in a refrigeration system can occur due to which of the following reasons?
1. Cooling tower is inefficient or the water flow rate is less than the designed value.
2. Non-condensable gases are present in the system.
3. Accumulation of lubrication oil in the condenser.
4. Low charge of refrigerant in the system.

Select the correct answer from the codes given below:
(a) 2 only (b) 1 or 2 or 3
(c) 1 or 2 or 4 (d) 2 or 3 or 4

87. Match List I with List II and select the correct answer using the code given below the lists:

	List I Refrigerant		**List II** Colour
A.	Ammonia	1.	Purple
B.	Freon 12	2.	Green
C.	Freon 22	3.	Light blue
D.	Methyl chloride	4.	White
		5.	Orange

Code :

	A	B	C	D
(a)	1	2	4	3
(b)	3	2	4	5
(c)	1	4	2	3
(d)	3	4	2	5

88. Which one of the following refrigeration systems uses oil separator operating at $-10^{\circ}C$?
(a) System using NH_3
(b) System using R-12
(c) System using R-22
(d) System using R-502

89. Match List I with List II and select the correct answer using the code given below the lists:

	List I Designation of refrigerant		**List II** Chemical formula and name
A.	R-11	1.	SO_2 - Sulphur Dioxide
B.	R-12	2.	CHF_2Cl - Difluoro Monochloro Methane
C.	R-22	3.	Pressure
D.	Mercury-in-glass thermometer	4.	$CFCl_3$ - Monofluoro Trichloro Methane

Code :

	A	B	C	D
(a)	1	3	2	4
(b)	4	3	2	1
(c)	1	2	3	4
(d)	4	2	3	1

90. In winter comfort air conditioning, the following changes may take place:
1. Temperature and humidity ratio both rise.
2. The final relative humidity can be lower or higher than the initial value.
3. Both dry bulb and wet bulb temperatures will increase.

Which of these statements is/are correct?
(a) 1, 2 and 3
(b) 1 and 2 only
(c) 2 and 3 only
(d) 3 only

91. The barometer pressure is 1.03 bar, the partial pressure of air is 1 bar, and the saturation partial pressure of water vapour at the same dry bulb temperature is 0.05 bar. What is the relative humidity?
(a) 5%
(b) 50%
(c) 60%
(d) 97%

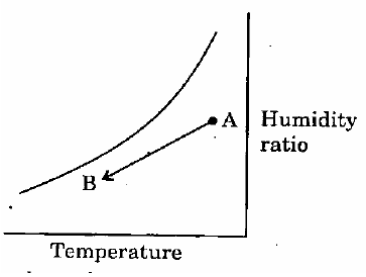
92. Moist air is a mixture of air and water vapour. Hence three independent thermodynamic properties are required to fix its thermodynamic state. Psychrometric chart however uses only two thermodynamic properties to fix the state. What is the reason?
(a) Psychrometric chart is an approximation to actual properties.
(b) Psychrometric chart assumes thtt water vapour and air behave like perfect gases.
(c) Psychrometric chart is drawn for fixed atmospheric pressure.
(d) Psychrometric chart does not consider thermodynamic equilibrium states.

93. Consider the following statements:
In measurement with a wet bulb thermometer
1. The wet bulb depression is an index of relative humidity.
2. The thermometer bulb should be wrapped by moist cloth and it is necessary to dip the end of the cloth in water.
3. Air is to flow at sufficiently low velocity past the thermometer bulb.
4. Dry bulb temperature will be equal to the wet bulb temperature when the air is completely dry.

Which of these statements is/are correct?
(a) 1 and 2
(b) 2 and 3
(c) 3 and 4
(d) 1 only

Civil Service Examination: Mechanical Engineering question paper 2009

94.



What does the line AB as shown on the psychrometric chart represent?
(a) Sensible cooling with moisture addition
(b) Sensible heating with dehumidification
(c) Sensible cooling with moisture removal
(d) Sensible heating with moisture addition

95. Consider the following statements:
1. Effective temperature is an empirical index of warmth that takes into account the effect of temperature, humidity and air movement.
2. Effective temperature is not a true comfort index as it does not consider the radiation effect of surrounding surfaces.
3. It is the best comfort index for still air condition with 30% to 70% relative humidity.

Which of these statements is/are correct?
(a) 1, 2 and 3
(b) 1 and 2 only
(c) 2 and 3 only
(d) 3 only

96. The supply air temperature is 15°C and apparatus dew point is 12°C for the cooling coil with bypass factor of 0.15. What is the temperature at inlet of cooling coil?
(a) 30° C (b) 15.53°C
(c) 14.45°C (d) 12.45°C

97. Consider the following statements:
Indoor design conditions for air-conditioning system for energy conservation are
1. The lowest condition of temperature, relative humidity and maximum air velocity are 20°C, 25% and 10 m/min respectively.
2. The maximum condition in summer is 25°C, 55% and 15 m/min.
3. When the building is not occupied during night, the temperature may be lowered in winter and increased in summer.

Which of these statements is/are correct?
(a) 1, 2 and 3 (b) 1 and 2 only
(c) 2 and 3 only (d) 3 only

98. What is the centre of buoyancy?
(a) The point of intersection of the buoyant force and the centre line of the body
(b) Centre of gravity of the body
(c) Centroid of displaced volume of fluid
(d) Midpoint between C.G. and metacentre

99. A cube with 1.0 m sides and of specific gravity 2.26 is placed vertically upright in a tank which contains water over mercury of specific gravity 13.6. Which one of the following is correct?
(a) It will float at free surface of water
(b) It will sink to the bottom of tank
(c) 0.1 m of its height will be dipped in mercury
(d) 0.9 m of its height will be dipped in mercury

100. The velocity field in a fluid is given by $V = (3x + 2y)\,i + (2z + 3x^2)\,j + (2t - 3z)$. What is the velocity at time t = 2s at (0, 0, 2)?
(a) 2.25 units/s
(b) 3.25 units/s
(c) 4.01 units/s
(d) 4.47 units/s

101. For an irrotational flow the equation is
$$\frac{\partial^2\phi}{\partial x^2} + \frac{\partial^2\phi}{\partial y^2} = 0$$
What is the name of the equation?
(a) Bernoulli's equation
(b) Reynolds equation
(c) Cauchy Riemann's equation
(d) Laplace equation

102. On which one of the following is the Euler's equation of motion based?
(a) Mass conservation
(b) Energy conservation
(c) Momentum conservation
(d) Total head conservation

103. The vertically upward jet of water 7.5 cm in diameter issuing from a nozzle with a velocity of 9 m/s strikes the normal to a flat circular plate of mass 30 kg and diameter 50 cm and supports it. What would be the vertical distance above the nozzle where the plate is held in equilibrium?
(a) 50 cm (b) 15 cm
(c) 73 cm (d) 33 cm

104. What would be the momentum correcting factor when the velocity distribution is uniform over a cross-section?
(a) 0 (b) 1
(c) 2 (d) 3

Civil Service Examination: Mechanical Engineering question paper 2009

105. The rate of flow through V-notch is proportional to which one of the following?
(a) H
(b) $H^{1/2}$
(c) $H^{3/2}$
(d) $H^{5/2}$

106. Which one of the following is correct?
Minor losses through valves, fittings, bends, contractions etc. are commonly modelled as proportional to
(a) Total head
(b) Static head
(c) Velocity head
(d) Dynamic head

107. Which one of the following statements is correct?
Intensity of turbulence is
(a) the frequency of turbulent fluctuations
(b) the violence of turbulent fluctuations and is measured by the root mean square value of velocity fluctuations.
(c) the mean time interval between reversals in the sign of velocity fluctuation.
(d) random movement of molecules.

108. Which of the following represents a possible two-dimensional incompressible flow?
(a) $u = 5x^3 + y^2$; $v = -15x^2y + 30$
(b) $u = 4x + y^3$; $v = x^2 - y^2$
(c) $u = x^2 + y$; $v = 4xy + 10$
(d) $u = xt^2$; $v = xyt + y^2$

109. What is the velocity profile for turbulent boundary layer on a flat surface?
(a) $\frac{u}{u_\infty} = \sin\left(\frac{y}{\delta}\right)^{1/7}$
(b) $\frac{u}{u_\infty} = \left(\frac{y}{\delta}\right)^{1/7}$
(c) $\frac{u}{u_\infty} = \left(\frac{y}{\delta} - \frac{y}{8}\right)^{1/2}$
(d) $\frac{u}{u_\infty} = \frac{3}{2}\left(\frac{y}{\delta}\right) - \frac{1}{2}\left(\frac{y}{\delta}\right)^3$

110. A plate 0.5 m long is placed at zero angle of incidence and moving with 1.5 m/s. What is the maximum boundary layer thickness? (Assume for water at 20°C, Γ = 1.205 kg/m^3, μ = 6, γ = 20×10^{-6} m^2/s)
(a) 08.5 mm
(b) 10.7 mm
(c) 12.9 mm
(d) 14.2 mm

Directions: Each of the next ten (10) items consists of two statements, one labelled as the 'Assertion (A)' and the other as 'Reason (R)'. You are to examine these two statements carefully and select the answers to these items using the codes given below:

Codes:
(a) Both A and R are individually true and R is the correct explanation of A
(b) Both A and R are individually true but R is not the correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

111. **Assertion (A):** A man pushes a stationary truck to the utmost of his power but does not move it; he does no work.
Reason (R): The work done necessarily implies motion.

112. **Assertion (A):** Hunting of a governor is due to its poor sensitivity.
Reason (R): Hunting is due to resonance condition arrived at when the frequency of fluctuations in engine speed happens to coincide with the natural frequency of oscillations of the governor.

113. **Assertion (A):** In a Swiss type automatic lathe, the turret is given longitudinal feed for each tool in a specific order with suitable indexing.
Reason(R): A turret is a multiple tool holder to facilitate machining with each tool by indexing without the need to change tools.

114. **Assertion (A):** Workability is a term applied to forging, rolling and extrusion.
Reason (R): These processes are sheet forming processes in which the forces applied are primarily tensile.

115. **Assertion (A):** Indirect cost is more difficult to assess than direct cost.
Reason (R): Overhead cost apportioning is approximate and time consuming.

116. **Assertion (A):** The manufacturing cell typically reduces the material handling cost of product going through the process.
Reason (R): Machines for a process are not located in sequences, one next to another.

117. **Assertion (A):** Capital budgeting is a technique for using the resources more efficiently.
Reason (R): Time value of money is to be taken into account when various options are considered.

Civil Service Examination: Mechanical Engineering question paper 2009

118. **Assertion (A):** Job shop production uses general purpose machine tools and other related equipment.

Reason (R): The general purpose machine tools have lot of non-productive time during operations and thus the output results into high cost per piece.

119. **Assertion (A):** Reducing set-up time decreases economic batch size.

Reason (R): Flexibility of production increases customer satisfaction.

120. **Assertion (A):** In turbulent flow through a commercial concrete pipe, the friction factor is practically independent of Reynolds number but depends on the surface roughness.

Reason (R): In a commercial pipe, pressure drop is primarily governed by flow separation at the roughness length scales of the wall.