

- (A) The transfer functions of the measuring element and the process is represent by  $H$  and  $G_2$  respectively
- (B) The overall transfer function for the change in load ( $X = 0$ ) is given by  $Y/X_1 = (G_c \cdot G_1 \cdot G_2)/(1 + G_c \cdot G_1 \cdot G_2 \cdot H)$
- (C) The overall transfer function for the change in set point ( $X_1 = 0$ ) is given by  $Y/X = (G_c \cdot G_1 \cdot G_2)/(1 + G_c \cdot G_1 \cdot G_2 \cdot H)$
- (D) Manipulated variable is represented by  $C$
- Answer: Option D

**09. A bolometer is**

- (A) Used for the measurement of thermal radiation
- (B) An element which senses optical input and delivers thermal output
- (C) Both (A) & (B)
- (D) Neither (A) nor (B)
- Answer: Option C

**10. The frequency at which maximum amplitude ratio is attained is called the \_\_\_\_\_ frequency.**

- (A) Corner
- (B) Resonant
- (C) Cross-over
- (D) Natural
- Answer: Option B

**11. The time constant of a first order process with resistance  $R$  and capacitance  $C$  is**

- (A)  $R + C$
- (B)  $R - C$
- (C)  $RC$
- (D)  $1/RC$
- Answer: Option C

**12. Thermocouple is suitable for measuring**

- (A) Liquid temperatures only
- (B) Very high temperatures only
- (C) Very low temperatures only
- (D) Both high and low temperatures
- Answer: Option D

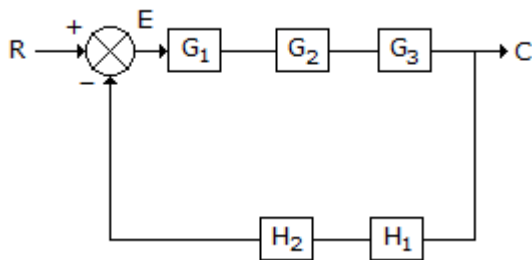
**13. Very low pressure is expressed in microns ( $\mu$ ), which is equal to \_\_\_\_\_ mm of Hg column (absolute) at  $0^\circ\text{C}$ .**

- (A) 0.0001
- (B) 0.001
- (C) 0.01
- (D) 0.1
- Answer: Option B

**14. For the time domain function  $f(t) = t$ , the Laplace transform of  $\int_0^t f(t) dt$  is given by**

- (A)  $1/2 S^3$
- (B)  $2/S^3$
- (C)  $1/S^3$
- (D)  $2/S^2$
- Answer: Option C

**15. What is the overall transfer function ( $C/R$ ) of the following block diagram if  $G = G_1 \cdot G_2 \cdot G_3$  and  $H = H_1 \cdot H_2$ .**



- (A)  $1/(1 + GH)$
- (B)  $G/(1 + GH)$
- (C)  $H/(1 + GH)$
- (D)  $G/(1 - GH)$

Answer: Option B

16. Phase margin is equal to

- (A)  $180^\circ - \text{phase lag}$
- (B)  $\text{Phase lag} - 180^\circ$
- (C)  $\text{Phase lag} + 180^\circ$
- (D)  $\text{Phase lag} + 90^\circ$

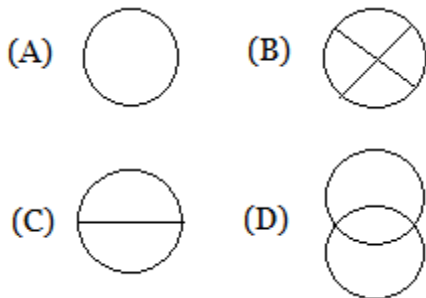
Answer: Option A

17. Working principle of mercury in glass thermometer is based on the \_\_\_\_\_ of mercury with increase in temperature.

- (A) Increase of pressure
- (B) Increase of thermal conductivity
- (C) Volumetric expansion
- (D) Differential linear expansion

Answer: Option C

18. Pick out the symbol for "locally mounted instrument" in instrumentation diagram.



Answer: Option A

19. Continuous flue gas analyser makes use of paramagnetic properties of some of its constituents, which move towards the strongest part of the magnetic field thus displacing diamagnetic gases. Which of the following gases is diamagnetic?

- (A)  $\text{CO}_2$
- (B)  $\text{O}_2$
- (C)  $\text{NO}$
- (D)  $\text{NO}_2$

Answer: Option A

20. Change of angle of refraction with composition comprises the working principle of a

- (A) Polarimeter
- (B) Polarograph
- (C) Spectrometer
- (D) Refractometer

Answer: Option D

21. A non-linear chemical system is exemplified by a/an

- (A) Isothermal CSTR
- (B) Mixer
- (C) Non-isothermal CSTR
- (D) None of these

Answer: Option C

22. Mcleod gauge is used to measure the

- (A) Point velocity
- (B) Flow rate
- (C) Vacuum
- (D) Pressure

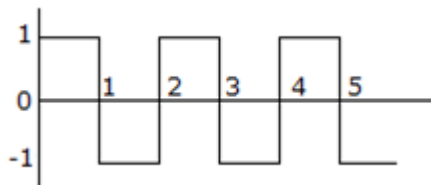
Answer: Option C

23. All the thermocouples used for temperature measurement use dissimilar metal

- (A) Strips
- (B) Bars
- (C) Wires
- (D) Beads

Answer: Option C

24. Find the Laplace transform of the following input function shown in figure.



- (A)  $(1 - e^{-s})/[S(1 - e^{-2s})]$
- (B)  $2(1 - e^{-s})/S$
- (C)  $(1 - e^{-s})/[S(1 + e^{-s})]$
- (D)  $e^{-s}(1 - e^{-s})/[S(1 + e^{-2s})]$

Answer: Option A

25. Dead zone is the

- (A) Same as time constant
- (B) Same as transportation lag
- (C) Maximum change in the variable that does not change the reading of the instrument
- (D) None of these

Answer: Option C

26. A non-linear system will have \_\_\_\_\_ steady state values.

- (A) One
- (B) More than one
- (C) Two
- (D) Three

Answer: Option B

27. The time constant of a unity gain, first order plus time delay process is 5 min. If the phase lag at a frequency of 0.2 rad/min is  $60^\circ$ , then the dead time (in minutes) is

- (A)  $5\pi/12$
- (B)  $\pi/6$
- (C)  $\pi/12$
- (D)  $\pi/3$

Answer: Option A

28. On-off control which is a special case of proportional control, has a band width of about \_\_\_\_\_ percent.

- (A) 100
- (B) 75
- (C) 25
- (D) 0

Answer: Option D

29. The transfer function for a P-D controller is

- (A)  $K_c(1 + \tau_D s)$
- (B)  $K_c(1 + 1/\tau_D s)$
- (C)  $K_c \tau_D s$
- (D)  $K_c/\tau_D s$

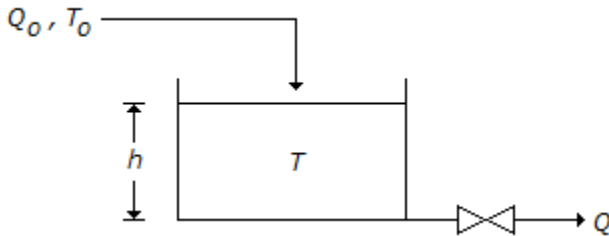
Answer: Option A

30. In a feed-back control system  $G$  and  $H$  denote open loop and close loop transfer functions respectively. The output-input relationship is

- (A)  $G/(1 + H)$
- (B)  $H/(1 + G)$
- (C)  $G/H$
- (D)  $H/G$

Answer: Option B

31. Water is entering a storage tank at a temperature  $T_0$  and flow rate  $Q_0$  and leaving at a flow rate  $Q$  and temperature  $T$ . There are negligible heat losses in the tank. The area of cross-section of the tank is  $A_0$ . The model that describes the dynamic variation of temperature of water in the tank with time is given as:



- (A)  $Q_0(T_0 - T) = A_c \cdot h (dT/dt)$
- (B)  $Q_0T_0 - QT = A_c \cdot h (dT/dt)$
- (C)  $Q(T_0 - T) = A_c \cdot h (dT/dt)$
- (D)  $Q(T_0 - T) = A_c \cdot (dT/dt)$

Answer: Option A

32. The root locus plot of the roots of the characteristics equation of a closed loop system having the open loop transfer function  $K(s + 1)/[2(2s + 1)(3s + 1)]$  will have a definite number of loci for variation of  $K$  from 0 to  $\infty$ . The number of loci is

- (A) 1
- (B) 2
- (C) 3
- (D) 4

Answer: Option C

33. Nitrogen gas constant volume thermometer is suitable for measuring a temperature of \_\_\_\_\_ °C.

- (A) 0-100
- (B)  $< 0$
- (C)  $> 100$
- (D)  $> 50$

Answer: Option C

34. Which of the following filled system expansion thermometers has the lowest positive temperature measurement capability?

- (A) Mercury in glass thermometer
- (B) Alcohol in glass thermometer
- (C) Fused metal (Na or K) in steel thermometer
- (D) Nitrogen in steel thermometer

Answer: Option B

35. Mercury thermometer can be used to measure the temperature upto \_\_\_\_\_ °C.

- (A) 100
- (B) 250
- (C) 350
- (D) 750

Answer: Option C

36. Working principle of mercury in glass thermometer is

- (A) Volumetric expansion
- (B) Pressure rise with temperature
- (C) Linear expansion
- (D) None of these

Answer: Option A

**37. In a closed loop system, the process to be controlled is an integrating process with transfer function  $1/2s$ . The controller proposed to be used is an integral controller with transfer function  $1/T_1s$ . When a step change in set point is applied to such a closed loop system, the controlled variable will exhibit**

- (A) Overdamped response
- (B) Underdamped response
- (C) Undamped response
- (D) Unstable response

Answer: Option B

**38. The Laplace transform of  $\exp(at)$ , where  $a > 0$ , is defined only for the Laplace parameter,  $s > a$  since**

- (A) The function is exponential
- (B) The Laplace transform of integral of  $\exp(at)$  has finite values only for  $s > a$
- (C) The Laplace transform integral of  $\exp(at)$  has initial values only for  $s > a$
- (D) The function  $\exp(at)$  is piece-wise continuous only for  $s > a$

Answer: Option B

**39. A typical example of a physical system with under damped characteristic is a**

- (A) U-tube manometer
- (B) Spring loaded diaphragm valve
- (C) CSTR with first order reaction
- (D) Thermocouple kept immersed in a liquid filled thermowell

Answer: Option B

**40. Temperature of \_\_\_\_\_ cannot be measured by an optical or radiation pyrometer.**

- (A) Hot blast (air) from stoves
- (B) Molten slag flowing out of blast furnace
- (C) Combustion space in boilers
- (D) Rotary limestone calcination kiln

Answer: Option A

**41. "A control system is unstable, if the open loop frequency response exhibits an amplitude ratio exceeding unity at the crossover frequency." This is \_\_\_\_\_ criterion.**

- (A) Bode stability
- (B) Nyquist
- (C) Routh stability
- (D) None of these

Answer: Option A

**42. Platinum resistance thermometer can be used upto antimony point which is \_\_\_\_\_ °C, and is the temperature of equilibrium between solid antimony & liquid antimony at normal atmospheric pressure.**

- (A) 961.93
- (B) 630.74
- (C) 1064.43
- (D) 1261.93

Answer: Option B

**43. In a second order under damped system, the**

- (A) Time required for the response of first reach its ultimate value is called the response time
- (B) Overshoot (which is a measure of how much the response exceeds the ultimate value) increase with the decrease of damping co-efficient
- (C) Decay ratio (which is the ratio of the sizes of successive peaks) is equal to the reciprocal of overshoot
- (D) None of these

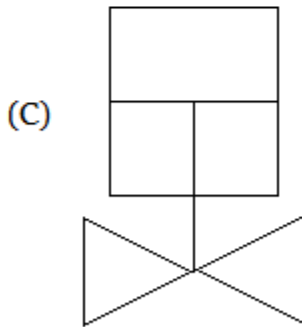
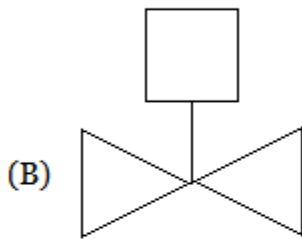
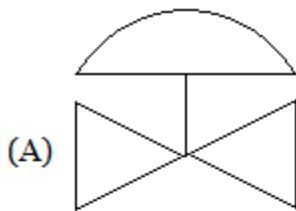
Answer: Option B

**44. Which of the following thermocouples has the least temperature measurement range?**

- (A) Copper-constantan
- (B) Chromel-alumel
- (C) Platinum-platinum/rhodium
- (D) Iron-constantan

Answer: Option A

45. Which is the symbol for 'pneumatic control valve'?



(D) None of these

Answer: Option A

46. Which of the following cannot measure a temperature of 1600°C?

- (A) Platinum resistance thermometer
- (B) Thermocouple
- (C) Photo-electric pyrometer
- (D) Radiation pyrometer

Answer: Option A

47. Radiation thermometer cannot measure the temperature

- (A) Inside a pressure vessel
- (B) Of an object without coming in contact with it
- (C) Of liquid oxygen
- (D) Of moving objects at high temperature

Answer: Option C

48. Which of the following instruments is not used for measuring sub-zero (<0°) temperatures?

- (A) Platinum resistance thermometer
- (B) Mercury in glass thermometer
- (C) Vapor pressure thermometer
- (D) Radiation pyrometer

Answer: Option D

49. The transfer function for an ideal proportional plus reset controller (reset time T) is

- (A)  $K_c[1 + (1/TS)]$
- (B)  $K_c(1 + TS)$
- (C)  $K_c/(1 + TS)$
- (D)  $K_c/[1 + (s/T)]$

Answer: Option A

50. Maximum differential pressure in liquid manometer is \_\_\_\_\_ psi.

- (A) 20
- (B) 30
- (C) 40
- (D) 50

Answer: Option B

**51. A pyranometer is an instrument used for measuring the**

- (A) Beam radiation
- (B) Global radiation
- (C) Bright sunshine period
- (D) None of these

Answer: Option B

**52. Which is the strongest paramagnetic gas?**

- (A) CO<sub>2</sub>
- (B) O<sub>2</sub>
- (C) NO
- (D) NO<sub>2</sub>

Answer: Option B

**53. Thermistors are made of**

- (A) Ultra pure metals
- (B) Metal oxides
- (C) Iron-copper alloys
- (D) Nickel-chromium alloys

Answer: Option B

**54. Liquid column manometers are used for measuring the pressure \_\_\_\_\_ kgf/cm<sup>2</sup>.**

- (A) > 2 (gage)
- (B) < 3 (gage)
- (C) < 10 (gage)
- (D) < atmospheric

Answer: Option B

**55. Stabilising time for the controllers is the time required for the response to reach \_\_\_\_\_ percent of its ultimate value.**

- (A) 63.2
- (B) 87.5
- (C) 95
- (D) 100

Answer: Option C

**56. Continuous measurement of moisture content of paper in paper industry is done by measuring the**

- (A) Thermal conductivity through the paper
- (B) Electrical resistance through the paper
- (C) Magnetic susceptibility
- (D) None of these

Answer: Option B

**57. The initial value ( $t = 0$ ) of the unit step response of the transfer function  $[(s + 1)/(2s + 1)]$  is**

- (A) 0
- (B)  $\frac{1}{2}$
- (C) 1
- (D) 2

Answer: Option B

**58. Mcleod gauge measures the \_\_\_\_\_ pressure.**

- (A) Positive
- (B) Sub-atmospheric
- (C) Very high
- (D) Atmospheric

Answer: Option B

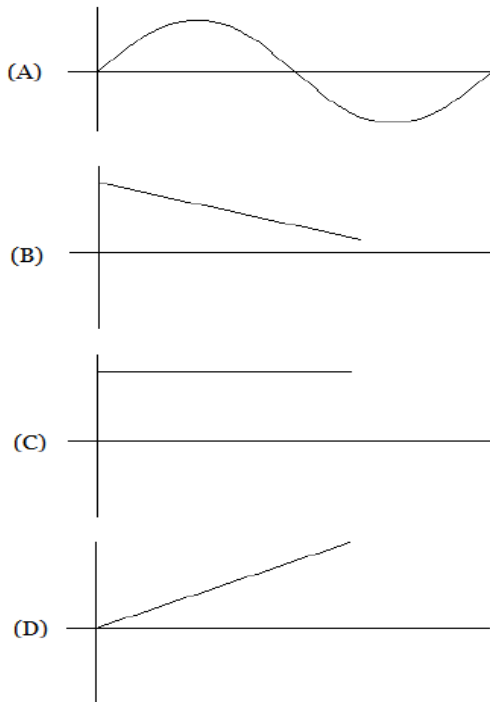
**59. Normal mercury thermometer can be used to measure a temperature of about 300°C.**

**However, its maximum temperature measurement range can be increased upto about 500°C by**

- (A) Filling nitrogen under pressure in the stem
- (B) Increasing the diameter of the tube
- (C) Using steel tube in place of glass tube
- (D) Accounting for the tube expansion

Answer: Option A

60. The Laplace transform of a sinusoidal function (e.g.;  $\sin at$ ) is represented by the curve



Answer: Option A

61. According to Bode stability criterion, a system is unstable, if the open loop frequency response exhibits an amplitude ratio exceeding unity at frequency for which phase lag is

- (A)  $0^\circ$
- (B)  $45^\circ$
- (C)  $90^\circ$
- (D)  $180^\circ$

Answer: Option D

62. Find the ultimate gain and frequency for a proportional controller in the case of a process having the transfer function  $G_p(s) = 1/(4s + 1)(2s + 1)(s + 1)$ .

- (A)  $w = 1/\sqrt{14}$ ,  $K_c = 45/7 \sqrt{14}$
- (B)  $w = \sqrt{(7/6)}$ ,  $K_c = 46/3$
- (C)  $w = 1$ ,  $K_c = 13$
- (D)  $w = \sqrt{(7/8)}$ ,  $K_c = 45/4$

Answer: Option B

63. The transfer function of a first order system is

- (A)  $1/(Ts + 1)$
- (B)  $1/Ts$
- (C)  $s/(Ts + 1)$
- (D) None of these

Answer: Option A

64. Ordinary mercury in glass thermometer is used for measuring temperature upto  $120^\circ\text{C}$ . However, for measuring higher temperature upto \_\_\_\_\_  $^\circ\text{C}$ , thermometer is made by filling nitrogen under pressure above the mercury, which stops the evaporation of mercury and reduces the chance of broken thread of mercury.

- (A) 250
- (B) 350
- (C) 550
- (D) 700

Answer: Option C

65. Identify an unbounded input from inputs whose transfer functions are given below

- (A) 1
- (B)  $1/S$
- (C)  $1/S^2$
- (D)  $1/(S^2 + 1)$

Answer: Option C



66. Pyrometry refers to the measurement of temperature

- (A) With the mercurial thermometer upto  $350^{\circ}\text{C}$
- (B) Directly
- (C) Which is of higher magnitude
- (D) All (A), (B) & (C)

Answer: Option C

67. Which of the following does not figure in the list of seven substances selected for international temperature scale?

- (A) Ice (F.P) and steam (B.P)
- (B) Oxygen and sulphur (B.P)
- (C) Antimony and silver (F.P)
- (D) Zinc (B.P) and mercury (F.P)

Answer: Option D

68. Which of the following is not suitable for measuring the temperature of a red hot object in the range of  $800 - 1600^{\circ}\text{C}$ ?

- (A) Optical pyrometer
- (B) Radiation pyrometer
- (C) Photoelectric pyrometer
- (D) Thermocouples

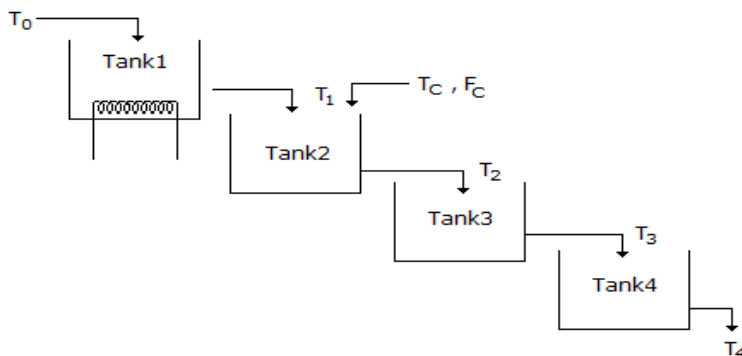
Answer: Option D

69. In a single tank system, the transfer function of \_\_\_\_\_ to inlet flow rate is  $1/(TS+1)$ .

- (A) Outlet flow rate
- (B) Level
- (C) Both (A) & (B)
- (D) Neither (A) nor (B)

Answer: Option A

70. Water is flowing through a series of four tanks and getting heated as shown in figure. It is desired to design a cascade control scheme for controlling the temperature of water leaving the tank 4 as there is a disturbance in the temperature of a second stream entering the tank 2. Select the best place to take the secondary measurement for the second loop.



- (A) Tank 1
- (B) Tank 2
- (C) Tank 3
- (D) Tank 4

Answer: Option C

71. Bode diagram are generated from output response of the system subjected to which of the following input?

- (A) Impulse
- (B) Step
- (C) Ramp
- (D) Sinusoidal

Answer: Option D

72. A first order system with unity gain and time constant  $\tau$  is subjected to a sinusoidal input of frequency  $\omega = 1/\tau$ . The amplitude ratio for this system is

- (A) 1
- (B) 0.5
- (C)  $1/\sqrt{2}$

(D) 0.25  
Answer: Option C

**73. The frequency response of a first order system, has a phase shift with lower and upper bounds given by**

- (A)  $-\infty, \pi/2$
- (B)  $-\pi/2, \pi/2$
- (C)  $-\pi/2, 0$
- (D)  $0, \pi/2$

Answer: Option D

**74. Silver point temperature is \_\_\_\_\_ °C.**

- (A) 760.5
- (B) 860.5
- (C) 960.5
- (D) 1060.5

Answer: Option C

**75. A photo electric device in which the resistance of the metal is directly proportional to the light striking on it, is known as photo-conductive cell. Photoelectric transducers are used for the measurement of those parameters, which can be used to produce variation in**

- (A) Light intensity
- (B) Current
- (C) Flux density
- (D) Voltage

Answer: Option A

**76. What is the Laplace transform of  $\sin t$ ?**

- (A)  $1/(s^2 + 1)$
- (B)  $s/(1 + s^2)$
- (C)  $1/(s^2 - 1)$
- (D)  $s/(s^2 - 1)$

Answer: Option A

**77. A barometer measures the \_\_\_\_\_ pressure.**

- (A) Absolute
- (B) Gauge
- (C) Absolute as well as gauge
- (D) dynamic

Answer: Option A

**78. Thermistors which have a very high temperature co-efficient of resistivity belong to the class of solid called**

- (A) Dielectrics
- (B) Insulators
- (C) Semi conductors
- (D) Conductors

Answer: Option C

**79. The inverse Laplace transform of the function  $f(S) = 1/S (1 + S)$  is**

- (A)  $1 + e^t$
- (B)  $1 - e^t$
- (C)  $1 + e^{-t}$
- (D)  $1 - e^{-t}$

Answer: Option D

**80. Gain margin is equal to the**

- (A) Amplitude ratio
- (B) Reciprocal of amplitude ratio
- (C) Gain in  $P$  controller
- (D) Gain in  $P-I$  controller

Answer: Option B

**81. A sinusoidal variation in the input passing through a linear first order system**

- (A) Becomes more oscillatory (frequency increases)

- (B) Becomes less oscillatory (frequency decreases)
  - (C) Gets amplified (magnitude increases)
  - (D) Gets attenuated (magnitude decreases)
- Answer: Option D

**82. Which of the following shows maximum dip effect (indicating reverse direction of temperature change)?**

- (A) Mercury thermometer
- (B) Radiation pyrometer
- (C) Bimetallic thermometer
- (D) Thermocouple

Answer: Option A

**83. Composition of alloys can be determined by**

- (A) Polarograph
- (B) Chromatograph
- (C) Refractometer
- (D) None of these

Answer: Option A

**84. Composition of natural gas is determined by the**

- (A) Haldane apparatus
- (B) Mass spectrometer
- (C) Chromatograph
- (D) Both (B) and (C)

Answer: Option D

**85. Measurement of pressure in ammonia reactor is done by**

- (A) Bourdon gauge
- (B) U-tube manometer
- (C) Inclined tube manometer
- (D) Pirani gauge

Answer: Option A

**86. Photoelectric pyrometers are suitable in the temperature range of \_\_\_\_\_ °C.**

- (A) 400-1600
- (B) 800-1600
- (C) 800-2500
- (D) 400-1000

Answer: Option B

**87. A constant volume gas thermometer employing \_\_\_\_\_ is used to measure sub-zero (i.e., < 0°C) temperature.**

- (A) Helium
- (B) Hydrogen
- (C) Nitrogen
- (D) None of these

Answer: Option A

**88. Flame photometry is used for the determination of compositional analysis of**

- (A) Solids
- (B) Alkali metals
- (C) Natural gas
- (D) Isotopes

Answer: Option B

**89. Concentration of sugar solution can be determined by the**

- (A) Polarimetry
- (B) Flame photometry
- (C) Emission spectroscopy
- (D) Oscillometry

Answer: Option A

**90. In a shell and tube heat exchanger, the outlet temperature of heating/cooling fluid is the \_\_\_\_\_ variable.**

- (A) Load
  - (B) Manipulated
  - (C) Controlled
  - (D) None of these
- Answer: Option C

**91. Vapour actuated pressure spring thermometer does not require ambient temperature compensation. Ambient temperature compensation is provided in gas or liquid expansion pressure spring thermometer by**

- (A) Making the volume of thermometer bulb as large as conveniently possible
  - (B) Reducing the volume of the capillary to a minimum
  - (C) Reducing the volume of the receiving element to a minimum
  - (D) All 'a', 'b' & 'c'
- Answer: Option D

**92. Continuous measurement of specific gravity of a liquid is done by**

- (A) Hydrometer
  - (B) Contact-type electric indicators
  - (C) Displacement meter
  - (D) Both (A) and (C)
- Answer: Option D

**93. Gas chromatography is used for the measurement of**

- (A) Temperature
  - (B) Pressure
  - (C) Concentration
  - (D) Flow rate
- Answer: Option C

**94. Which of the following is not classified as a thermo electric pyrometer?**

- (A) Resistance thermometer
  - (B) Thermocouple
  - (C) Optical pyrometer (disappearing filament type)
  - (D) Radiation pyrometer
- Answer: Option C

**95. A system with a double pole at the origin is unstable since the corresponding term in the time domain**

- (A) Is a constant
  - (B) Grows exponentially with time
  - (C) Grows linearly with time
  - (D) Decays linearly with time
- Answer: Option C

**96. If response of a control system is to be free of offset and oscillation, the most suitable controller is**

- (A) Proportional controller
  - (B) Proportional-derivative (PD) controller
  - (C) Proportional-integral (PI) controller
  - (D) Proportional integral-derivative (PID) controller
- Answer: Option D

**97. Working principle of disappearing filament type optical pyrometer is based on the**

- (A) Wien's law
  - (B) Seebeck effect
  - (C) Kirchoff's law
  - (D) Peltier effect
- Answer: Option A

**98. Temperature measurement range of iron-constantan thermocouple is 0 to 870°C. It can be used to measure sub zero temperature, because at lower temperature**

- (A) Emf produced is very low of the order of microvolt
- (B) Embrittlement of iron occurs
- (C) Rusting of iron takes place
- (D) Both (B) and (C)

Answer: Option D

**99. Dilatometer is used to measure**

- (A) Stress
- (B) Strain
- (C) Deflection
- (D) Contraction/expansion due to changes in temperature

Answer: Option D

**100. For two non-interacting first order systems connected in series, the overall transfer function is the \_\_\_\_\_ of the individual transfer functions.**

- (A) Product
- (B) Ratio
- (C) Sum
- (D) Difference

Answer: Option A

**101. Relationship between absorption/evolution of heat at the thermocouple junctions and the current flow in the circuit is given by \_\_\_\_\_ effect.**

- (A) Peltier
- (B) Thomson
- (C) Seebeck
- (D) None of these

Answer: Option A

**102. Which of the following thermocouples is capable of measuring a temperature of  $-50^{\circ}\text{C}$ ?**

- (A) Platinum-platinum + rhodium
- (B) Chromel-Alumel
- (C) Iron-constantan
- (D) Copper-constantan

Answer: Option A

**103. pH meter has**

- (A) One cell
- (B) Two cells
- (C) Three cells
- (D) No cell

Answer: Option B

**104. Reference points i.e., ice point and steam point in Reaumer temperature scale are respectively**

- (A)  $-273^{\circ}$  &  $80^{\circ}$
- (B)  $0^{\circ}$  &  $80^{\circ}$
- (C)  $32^{\circ}$  &  $460^{\circ}$
- (D)  $32^{\circ}$  &  $80^{\circ}$

Answer: Option B

**105. Flow rate of those fluids which are insensitive to changes in their density, viscosity or flow velocity profile can be best measured by a**

- (A) Magnetic flowmeter
- (B) Pitot tube
- (C) Flow nozzle type flowmeter
- (D) Turbine flowmeter

Answer: Option A

**106. Non-metallic diaphragm used as pressure sensor in instruments is generally made of**

- (A) Teflon
- (B) Synthetic rubber
- (C) Bakelite
- (D) Thick paper

Answer: Option B

**107. Working principle of mercury in glass thermometer is based on volumetric expansion of mercury with increase in temperature. Which of the following undergoes minimum volumetric expansion for a given temperature change?**

- (A) Water
- (B) Mercury
- (C) Methyl alcohol
- (D) Carbon-tetrachloride

Answer: Option B

**108. In second order underdamped system,**

- (A) Decay ratio = overshoot
- (B) Decay ratio = (overshoot)<sup>2</sup>
- (C) Overshoot increases for increasing damping co-efficient
- (D) Large damping co-efficient means smaller damping

Answer: Option B

**109. Which of the following filled system expansion thermometer has the capability to measure the lowest temperature?**

- (A) Mercury in glass thermometer
- (B) Mercury in steel thermometer
- (C) Alcohol in glass thermometer
- (D) Fused metal (Na or K) in steel thermometer

Answer: Option C

**110. Bimetal strips are not used in**

- (A) Bimetallic thermometers
- (B) Thermocouples
- (C) Thermostats
- (D) Relays for opening & closing of electrical circuits

Answer: Option B

**111. Emf generated in a thermocouple depends on the temperature**

- (A) Of cold junction only
- (B) Of hot junction only
- (C) Difference between hot and cold junctions
- (D) Difference between cold junction and atmospheric temperature

Answer: Option C

**112. A manometer measures the \_\_\_\_\_ pressure.**

- (A) Atmospheric
- (B) Absolute
- (C) Gauge
- (D) None of these

Answer: Option C

**113. Which of the following thermocouples can measure the maximum temperature?**

- (A) Platinum-rhodium
- (B) Tungsten-molybdenum
- (C) Chromel-alumel
- (D) Iron-constantan

Answer: Option B

**114. Compositional analysis of flue gas coming out of a furnace in respect of O<sub>2</sub> and CO<sub>2</sub>% can be continuously done by a/an**

- (A) Orsat apparatus
- (B) Thermal conductivity cell
- (C) Zirconia probe
- (D) Chromatograph

Answer: Option B

**115. Optical activity of a solution can be determined using a**

- (A) Polarimeter
- (B) Polarograph
- (C) Dilatometer
- (D) Refractometer

Answer: Option A

**116. Mercury thermometer is commonly used for low temperature measurement. The freezing point and boiling point of mercury are respectively \_\_\_\_\_ °C.**

- (A) - 39 and 350
- (B) - 51 and 439
- (C) - 79 and 395
- (D) - 10 and 425

Answer: Option A

**117. Strain gage uses an electrical conductor wire, which when elastically stretched increases in length and reduces in diameter. Both these dimensional changes result in \_\_\_\_\_ in the electrical resistance of the wire.**

- (A) No change
- (B) Decrease
- (C) Increase
- (D) Exponential decrease

Answer: Option C

**118. A stable system is the one**

- (A) For which the output response is bounded for all bounded input
- (B) Which exhibits an unbounded response to a bounded input
- (C) Which satisfies the conditions for a servo problem
- (D) None of these

Answer: Option A

**119. Routh test**

- (A) Criterion provides information about the actual location of roots
- (B) Cannot be used to test the stability of a control system containing transportation lag
- (C) Criterion is not applicable to systems with polynomial characteristic equation
- (D) Cannot determine as to how many roots of the characteristics equation have positive real roots

Answer: Option B

**120. Which of the following is not a composition measuring instrument?**

- (A) Thermal conductivity cell
- (B) Mass spectrometer
- (C) Polarograph
- (D) Hot wire anemometer

Answer: Option D

**121. Thermodynamic Celsius scale of temperature measurement is**

- (A) Defined on the basis of melting point of ice and evaporation temperature of water vapor
- (B) Defined on the basis of melting point of ice and condensation temperature of water vapor
- (C) Having an interval of 100° between ice point to steam point
- (D) Both (B) and (C)

Answer: Option D

**122. Response of a linear control system for a change in set point is called**

- (A) Frequency response
- (B) Transient response
- (C) Servo problem
- (D) Regulator problem

Answer: Option C

**123. Bourdon gauges are used for measuring pressure (kg/cm<sup>2</sup>)**

- (A) < atmospheric
- (B) > 2 (gauge)
- (C) < 2 (gauge)
- (D) > 10 (absolute)

Answer: Option B

**124. Stroboscope is used for the measurement of**

- (A) Rpm of a flywheel
- (B) Frequency of light
- (C) Depression of freezing point
- (D) Liquid level under pressure

Answer: Option A

**125. Radiation pyrometers as compared to thermocouples**

- (A) Has a slower speed of response
- (B) Can measure higher temperature
- (C) Can't measure the temperature of moving objects
- (D) Is more affected by corrosive atmosphere

Answer: Option B

**126. Nickel percentage in invar which is an iron-nickel alloy, and is used as a thermocouple material is**

- (A) 12
- (B) 36
- (C) 54
- (D) 68

Answer: Option B

**127. Number of poles in a system with transfer function  $1/(s^2 + 2s^2 + 1)$  is**

- (A) 2
- (B) 5
- (C) 3
- (D) 1

Answer: Option C

**128. Conversion formula for converting amplitude ratio (AR) into decibels is**

- (A) Decibel =  $20 \log_{10} (AR)$
- (B) Decibel =  $20 \log_e (AR)$
- (C) Decibel =  $20 \log_{10} (AR)^{0.5}$
- (D) Decibel =  $20 \log_e (AR)^{0.5}$

Answer: Option A

**129. Thermocouple in a thermal well behaves as a true**

- (A) First order system
- (B) Second order system (overdamped)
- (C) Multiple first order system
- (D) Second order system (underdamped)

Answer: Option C

**130. Liquid flow rate in an open channel cannot be measured by a/an**

- (A) Orifice meter
- (B) Cipolletti weir
- (C) Rectangular weir
- (D) V-notch

Answer: Option A

**131. Stability of a control system containing a transportation lag can be best analysed by**

- (A) Routh test
- (B) Root locus methods
- (C) Frequency response methods
- (D) None of these

Answer: Option C

**132. Temperature of molten pig iron (1450°C) and molten slag (1500°C) flowing out of a blast furnace is measured by a/an**

- (A) Chromel-alumel thermocouple
- (B) Optical pyrometer
- (C) Radiation pyrometer
- (D) Either (B) or (C)

Answer: Option D

**133. Accurate temperature measurement performance of a radiation pyrometer cannot be affected, if the**

- (A) Enhancement or attenuation of radiation occurs in the sighting path
- (B) Object and surrounding are at almost the same temperature
- (C) Object has varying emissivity
- (D) Object is transparent



Answer: Option B

**134. Which of the following is never used as an element of industrial resistance thermometer?**

- (A) Lead
- (B) Nickel
- (C) Copper
- (D) 30% iron + 70% nickel

Answer: Option A

**135. The open loop transfer function of a process is  $K \frac{(s + 1)(s + 4)}{(s + 2)(s + 3)}$ . In the root locus diagram, the poles will be at**

- (A) -1, -4
- (B) 1, 4
- (C) -2, -3
- (D) 2, 3

Answer: Option C

**136. Emf developed by a thermocouple while measuring a temperature of 800°C is about 31 mV. The type of thermocouple used is**

- (A) Chromel-alumel
- (B) Iron-constantan
- (C) Platinum-platinum + rhodium
- (D) None of these

Answer: Option A

**137. Feed forward controller accounts for the \_\_\_\_\_ changes.**

- (A) Set point
- (B) Load
- (C) Both (A) & (B)
- (D) Neither (A) nor (B)

Answer: Option B

**138. Hot wire anemometer is used for the measurement of**

- (A) Flow rates of fluids
- (B) Flow rates of granular solids
- (C) Very high temperature
- (D) Thermal conductivity of gases

Answer: Option A

**139. Thermal wells are used in the temperature measurement to**

- (A) Guard against corrosive and oxidising action on thermocouple materials
- (B) Reduce measuring lag
- (C) Increase the fidelity
- (D) Increase the sensitivity

Answer: Option A

**140. Phase lag of the sinusoidal response of a first order system is**

- (A) 120°
- (B) 30°
- (C) 180°
- (D) 90°

Answer: Option D

**141. Liquid flow rate in a small channel is best measured by a/an**

- (A) Weir
- (B) Pitot tube
- (C) Vane meter
- (D) Venturimeter

Answer: Option B

**142. When the damping co-efficient ( $\xi$ ) is unity, the system is**

- (A) Overdamped
- (B) Critically damped
- (C) Underdamped
- (D) Highly fluctuating

Answer: Option B

**143. A first order system with a time constant of 1 min is subjected to frequency response analysis. At an input frequency of 1 radian/min, the phase shift is**

- (A)  $45^\circ$
- (B)  $-90^\circ$
- (C)  $-180^\circ$
- (D)  $-45^\circ$

Answer: Option D

**144. A system with transfer function  $[(2S/4S) + 1]$  is of \_\_\_\_\_ order.**

- (A) Zero
- (B) 1st
- (C) 2nd
- (D) 3rd

Answer: Option B

**145. Pick out the most suitable instrument for measuring temperature in the range of  $-40$  to  $425^\circ\text{C}$ .**

- (A) Mercury thermometer
- (B) Bimetallic thermometer
- (C) Radiation pyrometer
- (D) None of these

Answer: Option B

**146. Flow rate measurement of hostile acids and alkalis can be most suitably done by a/an**

- (A) Venturimeter
- (B) Orificemeter
- (C) Magnetic flow meter
- (D) Hot wire anemometer

Answer: Option C

**147. What is the normal percentage of rhodium in platinum + rhodium element used in the thermocouple?**

- (A) 0.1
- (B) 3
- (C) 13
- (D) 29

Answer: Option C

**148. Platinum resistance thermometer is the international standard for temperature measurement between**

- (A) Triple point of hydrogen and freezing point of antimony
- (B)  $13.81^\circ\text{K}$  to  $903.9^\circ\text{K}$
- (C) Both (A) and (B)
- (D) Neither (A) nor (B)

Answer: Option C

**149. Pick out the wrong statement.**

- (A) There is no transfer lag for a single first order system
- (B) Stirred tank with a water jacket exemplifies an interacting system
- (C) Transfer lag is a characteristic of all higher order systems (other than first order systems)
- (D) Transfer lag decreases as the number of stages decreases

Answer: Option D

**150. Which of the following thermocouple materials does not contain nickel?**

- (A) Alumel
- (B) Chromel
- (C) Constantan
- (D) None of these

Answer: Option D

**151. Cascade control means**

- (A) Feed forward control
- (B) More than one feed-back loop

- (C) On-off control
  - (D) One feed-back loop
- Answer: Option B

**152. To increase the speed of response of a pressure spring liquid or gas expansion thermometer, the clearance space between the thermometer bulb and the thermal well should not be filled with**

- (A) Air
- (B) A metal powder or graphite
- (C) Oil
- (D) Mercury

Answer: Option A

**153. In Bode plot,  $\phi$  vs.  $\omega$  is plotted on a/an \_\_\_\_\_ graph paper.**

- (A) log-log
- (B) Ordinary
- (C) Semi-log
- (D) Triangular

Answer: Option A

**154. Specific gravity of a liquid cannot be measured by a/an**

- (A) Anemometer
- (B) Specific gravity bottle
- (C) Pycnometer
- (D) Hydrometer

Answer: Option A

**155. Which of the following thermocouples has the widest temperature measurement range?**

- (A) Iron-constantan
- (B) Chromel-alumel
- (C) Copper-constantan
- (D) Platinum-platinum/rhodium

Answer: Option D

**156. Mass spectrometer is used for the composition analysis of**

- (A) Alloys
- (B) Solids
- (C) Isotopes
- (D) None of these

Answer: Option C

**157. The thermal emf-temperature relationship of most thermocouples is**

- (A) Linear
- (B) Parabolic
- (C) Exponential
- (D) Square root

Answer: Option B

**158. The \_\_\_\_\_ of a vapor pressure thermometer is a primary element.**

- (A) Pointer
- (B) Bourdon tube
- (C) Bulb
- (D) None of these

Answer: Option C

**159. \_\_\_\_\_ is an example of distributed parameter system**

- (A) Tubular reactor
- (B) CSTR
- (C) On-off controller
- (D) None of these

Answer: Option A

**160. Helium gas constant volume thermometer is suitable for the measurement of a temperature of \_\_\_\_\_ °C.**

- (A)  $< 100$

- (B) < 0
- (C) > 0
- (D) > 800

Answer: Option B

**161. Which of the following can measure temperatures in the range of - 20 to 300°C?**

- (A) Mercury in glass thermometer
- (B) Vapor pressure thermometer
- (C) Resistance thermometer
- (D) None of these

Answer: Option D

**162. Flow rate of a river is measured by a/an**

- (A) Pitot tube
- (B) Vane meter
- (C) Kennison nozzle
- (D) Open weir

Answer: Option B

**163. The level of a liquid under pressure can be determined using**

- (A) Bubbler system
- (B) Differential pressure manometer
- (C) Diaphragm box system
- (D) Air-trap system

Answer: Option B

**164. Thermal conductivity based continuous flue gas analyser makes use of varying thermal conductivity of the constituents of flue gases. Which of the following constituents of flue gases has the maximum thermal conductivity?**

- (A) CO<sub>2</sub>
- (B) N<sub>2</sub>
- (C) O<sub>2</sub>
- (D) CO

Answer: Option A

**165. In Bode plot, A.R. vs.  $w$  is plotted on a/an \_\_\_\_\_ graph paper.**

- (A) Log-lag
- (B) Triangular
- (C) Ordinary
- (D) Semi-log

Answer: Option A

**166. Which of the following thermometers is not suitable for distant reading upto 60 metres?**

- (A) Vapor pressure thermometer
- (B) Mercury in glass thermometer
- (C) Constant volume gas thermometer
- (D) Resistance thermometer

Answer: Option B

**167. Temperature control of an exothermic chemical reaction taking place in a CSTR is done with the help of cooling water flowing in a jacket around the reactor. The types of valve and controller action to be recommended are**

- (A) Air to open valve with the controller direct acting
- (B) Air to close valve with the controller indirect acting
- (C) Air to open valve with the controller indirect acting
- (D) Air to close valve with the controller direct acting

Answer: Option C

**168. The transfer function of a second order system is**

- (A)  $1/(T^2s^2 + 2\xi T_s + 1)$
- (B)  $1/(T^2s^2 + 2T_s + 1)$
- (C)  $1/(T^2s^2 + 2\xi T + 1)$
- (D) None of these

Answer: Option A

**169. Thermal well made of \_\_\_\_\_ gives the fastest speed of response, while measuring temperature by thermocouples.**

- (A) Steel
- (B) Vycor (a glass)
- (C) Nichrome
- (D) Inconel

Answer: Option B

**170. Range of hydrogen gas constant volume thermometer is \_\_\_\_\_ °C.**

- (A) -10 to 20
- (B) 0 to 100
- (C) 100 - 500
- (D) 400 - 1000

Answer: Option B

**171. With increase in temperature, the electrical conductivity of the platinum used in the resistance thermometer**

- (A) Increases
- (B) Decreases
- (C) Remain constant
- (D) Increases exponentially

Answer: Option B

**172. In an exothermic chemical reactor, the manipulated variable is the flow rate of**

- (A) Coolant
- (B) Reactants
- (C) Product
- (D) None of these

Answer: Option A

**173. For measuring the temperature of a red hot furnace, which is the most suitable instrument?**

- (A) Platinum resistance thermometer
- (B) Thermocouple
- (C) Optical pyrometer
- (D) Bimetallic thermometer

Answer: Option C

**174. The fluid used in hydraulic controller is**

- (A) Water
- (B) Steam
- (C) Air
- (D) Oil

Answer: Option D

**175. Bourdon tube is never made of**

- (A) Phosphor bronze
- (B) Monel metal
- (C) Stainless steel
- (D) Cast iron

Answer: Option D

**176. Which of the following thermocouples is the most suitable for measuring a temperature of about 1600°C in an oxidizing atmosphere?**

- (A) Platinum-platinum + rhodium
- (B) Iron-constantan
- (C) Copper-constantan
- (D) Chromel-alumel

Answer: Option A

**177. Minute depression of freezing point of a liquid solvent on addition of a solid solute can be best measured by a**

- (A) Beckman thermometer
- (B) Dilatometer
- (C) Mercury thermometer

(D) Bimetallic thermometer  
Answer: Option A

**178. Degree to which an instrument indicates the changes in measured variable without dynamic error is called its**

- (A) Speed of response
  - (B) Reproducibility
  - (C) Fidelity
  - (D) Static characteristics
- Answer: Option C

**179. The pressure sensing element of elastic type pressure gauge is never made in the form of a**

- (A) Bellow
  - (B) Diaphragm
  - (C) Strip
  - (D) Bourdon tube
- Answer: Option C

**180. Temperature measurement by optical pyrometer is done above \_\_\_\_\_ point, which is 1063°C.**

- (A) Antimony
  - (B) Gold
  - (C) Silver
  - (D) Nickel
- Answer: Option B

**181. Dome temperature of blast furnace stove is most accurately measured by a**

- (A) Radiation pyrometer
  - (B) platinum-platinum/rhodium thermocouple
  - (C) Iron-constantan thermocouple
  - (D) Platinum resistance thermometer
- Answer: Option B

**182. Resistance of a gas in a vessel is given by (where,  $P$  = pressure,  $V$  = volume of the vessel,  $n$  = no. of moles of the gas,  $R$  = gas constant)**

- (A)  $V/nRT$
  - (B)  $nRT/V$
  - (C)  $nRT/P$
  - (D)  $P/nRT$
- Answer: Option A

**183. The term analogous to voltage in a single tank system is the**

- (A) Heat content of the system
  - (B) Liquid volume in the tank
  - (C) Flow rate
  - (D) Level of liquid
- Answer: Option D

**184. Which of the following is not a differential pressure flow meter?**

- (A) Rotameter
  - (B) Flow nozzle
  - (C) Orificemeter
  - (D) Venturimeter
- Answer: Option A

**185. A negative gain margin expressed in decibels means a/an \_\_\_\_\_ system.**

- (A) Stable
  - (B) Unstable
  - (C) Critically damped
  - (D) None of these
- Answer: Option B

**186. \_\_\_\_\_ stability method uses open loop transfer function.**

- (A) Nyquist
- (B) Mikhailov

- (C) Ruth
  - (D) None of these
- Answer: Option A

**187. Humidity of air can be determined by a**

- (A) Chromatograph
- (B) Sling psychrometer
- (C) Mass spectrometer
- (D) Polarimeter

Answer: Option B

**188. The unit of 'time constant' of a system is the same as that of**

- (A) Velocity
- (B) Time
- (C) (Time)<sup>-1</sup>
- (D) None of these

Answer: Option B

**189. In a single tank system, the transfer function of level to inlet flow rate is**

- (A)  $R/TS$
- (B)  $R/(TS + 1)$
- (C)  $1/TS$
- (D) None of these

Answer: Option B

**190. An aneroid barometer measures the \_\_\_\_\_ pressure.**

- (A) Atmospheric
- (B) Absolute
- (C) Vacuum
- (D) Gage

Answer: Option B

**191. Pick out the wrong statement**

- (A) Proportional controller is normally used for level control in industrial applications
- (B) CSTR can be considered as a distributed parameter system
- (C) Distributed parameter approach gives partial differential equation
- (D) Non-linear behaviour is exemplified by an on-off controller

Answer: Option B

**192. What is the Laplace transform of impulse input having magnitude 'X'?**

- (A)  $X$
- (B)  $X^2$
- (C)  $1/X$
- (D) 1

Answer: Option D

**193. The closed loop pole of a stable second order system could be**

- (A) Both real and positive
- (B) Complex conjugate with positive real parts
- (C) Both real and negative
- (D) One real positive and the other real negative

Answer: Option A

**194. The offset introduced by proportional controller with gain  $K_c$  in response of first order system can be reduced by**

- (A) Reducing value of  $K_c$
- (B) Introducing integral control
- (C) Introducing derivative control
- (D) None of the above

Answer: Option B

**195. Which thermocouple can be used to measure a temperature of around 1400°C?**

- (A) Copper-constantan
- (B) Aluminium-Chromel
- (C) Platinum-platinum + rhodium

(D) None of these  
Answer: Option C

196. Which of the following is not a variable area flow meter?

- (A) Piston type meter
  - (B) Rotameter
  - (C) Magnetic flow meter
  - (D) Orifice and tapered plug meter
- Answer: Option C

197. Which of the following measurements can be made by the measurement of emf?

- (A) pH value
  - (B) Degree of hydrolysis
  - (C) Composition of complex ions
  - (D) All (A), (B) & (C)
- Answer: Option D

198. Configuration of Bourdon spring tube is never made of \_\_\_\_\_ shape.

- (A) Circular
  - (B) Semi-circular
  - (C) Helical
  - (D) Spiral
- Answer: Option A

199. Sub-zero temperature ( $< 0^{\circ}\text{C}$ ) can be measured by a constant volume gas thermometer employing

- (A) Helium
  - (B) Nitrogen
  - (C) Hydrogen
  - (D) None of these
- Answer: Option A

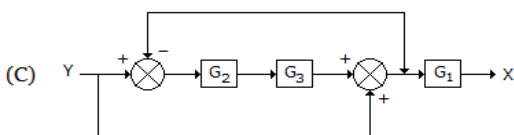
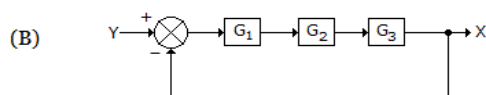
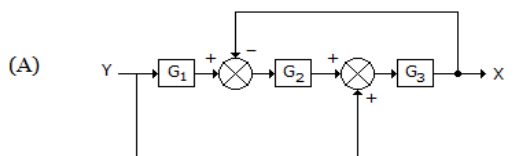
200. Nichol's chart deals with

- (A) A.R. vs. phase lag of first order
  - (B) A.R. vs. phase lag of second order
  - (C) Closed loop values vs. open loop values
  - (D) Frequency response values of controllers
- Answer: Option C

201. Specific conductance is defined as the reciprocal of resistance in ohms of 1c.c. of liquid at a specified temperature. Its value for distilled water is about \_\_\_\_\_ micro mho/cm<sup>3</sup>.

- (A) 50
  - (B) 100
  - (C) 10
  - (D) 1
- Answer: Option D

202. Transfer functions  $X/Y$  for which of the following block diagrams is  $(G_1 + G_1 \cdot G_2 \cdot G_3)/(1 + G_2 \cdot G_3)$



- (D) None of these



Answer: Option A

**203. Select the correct statement from the following.**

- (A) The frequency response of a pure capacity process is unbounded
- (B) The phase lag of a pure time delay system decreases with increasing frequency
- (C) The amplitude ratio of a pure capacity process is inversely proportional to frequency
- (D) The amplitude ratio of a pure time delay system increases with frequency

Answer: Option C

**204. The deflection in diaphragm (which is used as pressure sensor in pneumatic and electronic instruments) is dependent on the metal thickness, its diameter (D) and shape & number of corrugations. Its deflection is proportional to**

- (A)  $d$
- (B)  $d^2$
- (C)  $d^3$
- (D)  $d^4$

Answer: Option D

**205. An ideal PID controller has the transfer function  $[1 + (1/0.55) + 0.25]$ . The frequency at which the magnitude ratio of the controller is 1, is**

- (A) 0.5/0.2
- (B) 0.2/0.5
- (C)  $0.2 \times 0.5$
- (D)  $1/\sqrt{(0.2 \times 0.5)}$

Answer: Option D

**206. In a shell and tube heat exchanger, the flow rate of heating/cooling fluid is the \_\_\_\_\_ variable.**

- (A) Load
- (B) Controlled
- (C) Manipulated
- (D) None of these

Answer: Option C

**207. Phase lag of the frequency response of a second order system to a sinusoidal forcing function**

- (A) Is  $30^\circ$
- (B) Is  $90^\circ$  at the most
- (C) Approaches  $180^\circ$  asymptotically
- (D) Is  $120^\circ$

Answer: Option C

**208. Reset rate is the another term used for \_\_\_\_\_ time.**

- (A) Dead
- (B) Integral
- (C) Derivative
- (D) None of these

Answer: Option B

**209. Which of the following is an undesirable dynamic characteristic of an instrument?**

- (A) Reproducibility
- (B) Dead zone
- (C) Time lag
- (D) Static error

Answer: Option C

**210. The transfer function of a pure dead time system with dead time  $\tau_d$  is**

- (A)  $1/(\tau_d s + 1)$
- (B)  $\tau_d s + 1$
- (C)  $e^{-\tau_d s}$
- (D)  $e^{\tau_d s}$

Answer: Option C

**211. Positioning controllers are used for**

- (A) Low loads

- (B) Temperature changes
  - (C) High loads
  - (D) Flow rate changes
- Answer: Option C

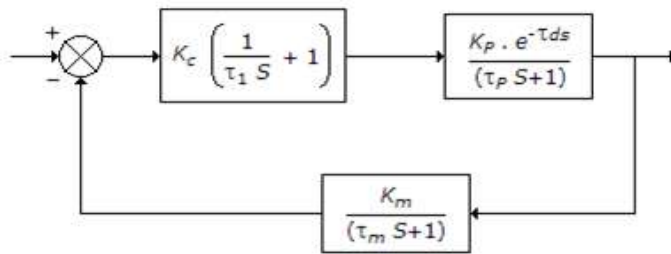
**212. Typical specifications for design stipulates the gain margin and phase margin to be respectively**

- (A)  $> 1.7$  and  $> 30^\circ$
  - (B)  $< 1.7$  and  $> 30^\circ$
  - (C)  $< 1.7$  and  $< 30^\circ$
  - (D)  $> 1.7$  and  $< 30^\circ$
- Answer: Option A

**213. Operating range of a temperature measuring instrument is 800 to 1600°C. It could be a/an \_\_\_\_\_ pyrometer.**

- (A) Radiation
  - (B) Optical
  - (C) Photoelectric
  - (D) None of these
- Answer: Option C

**214. For the block diagram shown below: The characteristic equation is**



- (A)  $\tau_i S (\tau_p S + 1) + K_c \cdot K_p (\tau_i S + 1) e^{-\tau_d S} = 0$
  - (B)  $(\tau_m S + 1) (\tau_p S + 1) + K_m \cdot K_p e^{-\tau_d S} = 0$
  - (C)  $\tau_i S (\tau_m S + 1) (\tau_p S + 1) + K_c \cdot K_p \cdot K_m (\tau_i S + 1) e^{-\tau_d S} = 0$
  - (D)  $(\tau_m S + 1) (\tau_p S + 1) + K_c \cdot K_p \cdot K_m \cdot e^{-\tau_d S} = 0$
- Answer: Option C

**215. Instrumentation in a plant offers the advantage of**

- (A) Greater safety of operation
  - (B) Better quality of product
  - (C) Greater operation economy
  - (D) All (A), (B) and (C)
- Answer: Option D

**216. A bimetallic thermometer as compared to industrial mercury in glass thermometer has almost the same**

- (A) Temperature measuring range (- 40°C to 450°C)
  - (B) Accuracy ( $\pm 1\%$  of span)
  - (C) Speed of response
  - (D) All a, b & c
- Answer: Option D

**217. Magnetic flowmeters are generally not used for the velocity/flow measurement of hydrocarbons due to their**

- (A) Low thermal conductivity
  - (B) Low electrical conductivity
  - (C) High viscosity index
  - (D) Low flash point
- Answer: Option B

**218. The maximum service temperature for fibre glass used as thermocouple wire insulation material is \_\_\_\_\_ °C.**

- (A) 250
- (B) 500
- (C) 750

(D) 1000  
Answer: Option B

**219. Routh stability method uses \_\_\_\_\_ loop transfer function.**

- (A) Open
  - (B) Closed
  - (C) Either (A) or (B)
  - (D) Neither (A) nor (B)
- Answer: Option B

**220. The temperature range for which copper resistance thermometer can be used is \_\_\_\_\_ °C.**

- (A) 0 to 150
  - (B) -200 to 150
  - (C) 350 to 750
  - (D) 500 to 900
- Answer: Option B

**221. The function of a transducer is to**

- (A) Modify the input signal
  - (B) Amplify the input signal
  - (C) Convert the primary signal into a more useful quantity, usually an electric impulse
  - (D) Codify/decode the input signal
- Answer: Option C

**222. Time constant is the**

- (A) Time taken by the controlled variable to reach 63.2% of its full change
  - (B) Same as transportation lag
  - (C) Same as dead time
  - (D) Time required by the measured variable to reach 63.2% of its ultimate change
- Answer: Option A

**223. \_\_\_\_\_ thermometer cannot measure sub-zero (< 0° C) temperature,**

- (A) Mercury in glass
  - (B) Bimetallic
  - (C) Vapor pressure
  - (D) Resistance
- Answer: Option B

**224. Continuous shell temperature measurement in a liquid-liquid heat exchanger is done by a**

- (A) Thermocouple
  - (B) Resistance thermometer
  - (C) Mercury in glass thermometer
  - (D) Vapor pressure thermometer
- Answer: Option A

**225. A mercury thermometer cannot be used to measure the temperature below the freezing point of mercury, which is \_\_\_\_\_ °C.**

- (A) -38.9
  - (B) -11.9
  - (C) -60.9
  - (D) -80.9
- Answer: Option A

**226. What is the ratio of output amplitude to input amplitude for a sinusoidal forcing function in a first order system?**

- (A) 1
  - (B) > 1
  - (C) < 1
  - (D) None of these
- Answer: Option C

**227. The second order system with the transfer function  $4/(s^2 + 2s + 4)$  has a damping ratio of**

- (A) 2.0
- (B) 0.5

- (C) 1.0
- (D) 4.0

Answer: Option B

**228. Flow rate through an orifice is \_\_\_\_\_ the pressure differential.**

- (A) Proportional to
- (B) Inversely proportional to the square root of
- (C) Proportional to the square root of
- (D) Inversely proportional to the square of

Answer: Option C

**229. The calibration data of a thermocouple with its cold junction at 0°C are given below. The hot junction of the thermocouple is placed in a bath at 80°C, while its cold junction is at 20°C. What is the emf of thermocouple?**

Hot junction temperature (°C)	0	20	40	60	80	100
Thermo emf (mv)	0.00	0.80	1.61	2.43	3.26	4.10

- (A) 3.26 mv
- (B) 0.80 mv
- (C) 2.46 mv
- (D) 2.43 mv

Answer: Option C

**230. Which of the following is not the triple point of water?**

- (A) 32°R
- (B) 273°K
- (C) 492°R
- (D) 32°F

Answer: Option A

**231. Presence of a small amount of water in the organic systems can be determined by the \_\_\_\_\_ method.**

- (A) Electrical conductivity
- (B) Polarimetry
- (C) Emission spectroscopy
- (D) Dielectric constant and loss factor

Answer: Option D

**232. Measurement of sub-zero Celsius temperature in industry is done most commonly by**

- (A) Thermocouples
- (B) Resistance thermometers
- (C) Gas thermometers
- (D) Bi-metallic thermometers

Answer: Option B

**233. Working principle of radiation pyrometer is based on the**

- (A) Wien's law
- (B) Kirchoff's law
- (C) Stefan Boltzmann law
- (D) Seebeck effect

Answer: Option C

**234. Characteristic equation is the denominator of \_\_\_\_\_ loop transfer function.**

- (A) Open
- (B) Closed
- (C) Both (A) and (B)
- (D) Neither (A) nor (B)

Answer: Option B

**235. Which of the following controllers has maximum offset?**

- (A) P-controller
- (B) P-I controller
- (C) P-D controller

(D) *P-I-D* controller  
Answer: Option A

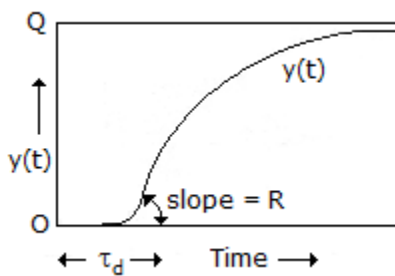
236. Smoke density of the flue gas going out of the chimney is measured by a

- (A) Polarograph
  - (B) Thermal conductivity meter
  - (C) Photo electric cell
  - (D) Chromatograph
- Answer: Option C

237. Which of the following flow-metering instruments is an areameter?

- (A) Venturimeter
  - (B) Rotameter
  - (C) Pitot tube
  - (D) Hot wire anemometer
- Answer: Option B

238. The experimental response of the controlled variable  $y(t)$  for a step change of magnitude 'P' in the manipulated variable  $x(t)$  is shown below: The appropriate transfer function of the process is



- (A)  $(Q/P) e^{-(Q/R)S} / (T_d S + 1)$
  - (B)  $(Q/R) e^{-T} d^S / (Q/P) (S + 1)$
  - (C)  $(Q/P) e^{-T} d^S / (Q/R) (S + 1)$
  - (D)  $(Q/R) e^{-(P/Q)S} / (T_d S + 1)$
- Answer: Option C

239. A magnetic flowmeter is

- (A) Based on the principle of Faraday's law
  - (B) Capable of measuring the flow rate of slurries and electrolytes
  - (C) Based on the linear relationship between the fluid flow rate and the induced voltage
  - (D) All (A), (B) and (C)
- Answer: Option D

240. Which is the most suitable instrument for measuring pressure below 3 microns?

- (A) Mcleod gauge
  - (B) Alphatron
  - (C) Ionisation gauge
  - (D) Bourdon gauge
- Answer: Option C

241. Paramagnetism method is not used for the composition determination of \_\_\_\_\_ in gases.

- (A) Oxygen
  - (B) Oxides of nitrogen
  - (C) Carbon dioxide
  - (D) Any of these
- Answer: Option C

242. \_\_\_\_\_ is undesirable in thermocouples used in industries,

- (A) Linear relation of emf to temperature
  - (B) Corrosion resistance
  - (C) Oxidation resistance
  - (D) Non-linear relation of emf to temperature
- Answer: Option D

243. Mercury manometer (U-tube type) exemplifies a \_\_\_\_\_ order system.

- (A) Zero
- (B) First
- (C) Second
- (D) Third

Answer: Option C

**244. Small furnace draught is accurately measured by an inclined tube manometer, in which the manometric liquid used most commonly is**

- (A) Water
- (B) Carbon tetrachloride
- (C) Paraffin
- (D) Ethylene glycol

Answer: Option C

**245. Liquid argon level in a pressurised storage tank (at  $3 \text{ kg/cm}^2$ ) is measured by a/an**

- (A) Gage glass
- (B) External float gage
- (C) Differential pressure gage
- (D) None of these

Answer: Option C

**246. Which of the following relates the absorption & evolution of heat at the junctions of a thermocouple to the current flow in the circuit?**

- (A) Seebeck effect
- (B) Peltier effect
- (C) Joule heating effect
- (D) Thomson effect

Answer: Option B

**247. E.m.f. generated by thermocouples is of the order of**

- (A) Milli volts
- (B) Micro volts
- (C) Volts
- (D) Kilo volts

Answer: Option A

**248. The term analogous to the electrical current in a thermal system is the**

- (A) Temperature difference
- (B) Heat flow rate
- (C) Heat content in the system
- (D) None of these

Answer: Option B

**249. Pick out the one which is a first order instrument.**

- (A) Mercury in glass thermometer (without any covering or air gap)
- (B) Bare metallic thermometer
- (C) Bare vapor pressure thermometer
- (D) All (A), (B) and (C)

Answer: Option D

**250. The open loop transfer function of a control system is  $KR/(1 + TS)$ . This represents**

- (A) A first order system
- (B) Dead time system
- (C) A first order time lag
- (D) A second order system

Answer: Option A

**251. The frequency response of a dynamic element shows a constant magnitude ratio at all frequencies. The element exhibits a negative phase shift at all frequencies. The absolute value of the phase shift increases linearly with frequency. The element has the transfer function**

- (A)  $e^{-\tau s}$
- (B)  $(T_1S + 1)/(T_2S + 1)$
- (C)  $(T_1S)/(T_2S + 1)$
- (D)  $(T_1S + 1)/(T_2S)$

Answer: Option A

**252. Dilute wine was used as a thermometric liquid initially to develop temperature scale. First empirical temperature scale developed was the \_\_\_\_\_ scale.**

- (A) Kelvin
- (B) Centigrade
- (C) Fahrenheit
- (D) Reaumer

Answer: Option C

**253. Suppose that the gain, time constant and dead time of a process with the following transfer function:  $G_c(s) = 10 \exp(-0.1s)/(0.5s + 1)$  are known with a possible error of  $\pm 20\%$  of their values. The largest permissible gain  $K_c$  of a proportional controller needs to be calculated below taking the values of process gain, time constant and dead time as**

- (A) 8, 0.6, 0.08
- (B) 12, 0.6, 0.12
- (C) 8, 0.6, 0.12
- (D) 12, 0.4, 0.08

Answer: Option B

**254. \_\_\_\_\_ are analysed using a Polarograph.**

- (A) Isotonic solutions
- (B) Solids
- (C) Liquids
- (D) Gases

Answer: Option B

**255. Transfer function of transportation lag is**

- (A)  $e^{Ts}$
- (B)  $e^{-Ts}$
- (C)  $1/(Ts + 1)$
- (D) None of these

Answer: Option B

**256. Polarisation of light forms the working principle of a**

- (A) Polarimeter
- (B) Polarograph
- (C) Chromatograph
- (D) Spectrometer

Answer: Option A

**257. An amplitude ratio of 0.1 corresponds to \_\_\_\_\_ decibels.**

- (A) 20
- (B) -20
- (C) 10
- (D) -10

Answer: Option B

**258. The transfer function for a PID controller is (where,  $\tau_i$  is the integral (reset) time and  $\tau_D$  is the derivative time.)**

- (A)  $K_c(1 + \tau_i s + \tau_D \cdot s)$
- (B)  $K_c[1 + (1/\tau_i s) + \tau_D \cdot s]$
- (C)  $K_c(1 + \tau_i s + (1/\tau_D \cdot s))$
- (D) None of these

Answer: Option B

**259. Emf developed by a thermocouple while measuring a temperature of 400°C is 22 mV. The type of thermocouple used is**

- (A) Chromel-alumel
- (B) Iron-constantan
- (C) Platinum-rhodium
- (D) Platinum-platinum + rhodium

Answer: Option B

**260. Stalagmometer is used for the measurement of**

- (A) Kinematic viscosity


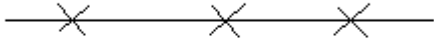
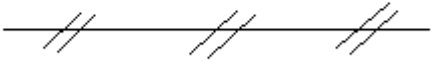

- (B) Surface tension
  - (C) Refractive index
  - (D) Optical activity
- Answer: Option B

**261. What is the dynamic error in a critically damped second order instrument for a ramp input (At)?**

- (A)  $0.5 AT$
- (B)  $2 AT$
- (C)  $\sqrt{AT}$
- (D)  $1.5 AT$

Answer: Option B

**262. The symbol for "capillary line" in instrumentation diagram is**

- (A) 
- (B) 
- (C) 
- (D) 

Answer: Option B

**263. Gas analysis is commonly done using the**

- (A) Thermal conductivity cell
- (B) X-ray diffraction
- (C) Mass spectrometer
- (D) Emission spectrometer

Answer: Option A

**264. Which of the systems having the following transfer function is stable?**

- (A)  $1/(S^2 + 2)$
- (B)  $1/(S^2 - 2S + 3)$
- (C)  $1/(S^2 + 2S + 2)$
- (D)  $\exp(-20 S)/(S^2 + 2S - 1)$

Answer: Option C

**265. Load cells are used for the measurement of**

- (A) Stress
- (B) Weight
- (C) Strain
- (D) Velocity

Answer: Option B

**266. Which of the following fluid flow measuring devices can measure the largest flow rate?**

- (A) V-notch
- (B) Rotameter
- (C) Orificemeter
- (D) Weir

Answer: Option D

**267. Turbine flow meters are suitable for**

- (A) Very limited flow ranges
- (B) Cryogenic flow measurements
- (C) Aerospace and in air borne applications
- (D) Both (B) and (C)

Answer: Option D

**268. The operation of a Rotameter is based on**

- (A) Variable flow area
- (B) Rotation of a turbine
- (C) Pressure drop across a nozzle
- (D) Pressure at a stagnation point



Answer: Option A

**269. Out of the following thermocouple wire insulating material, the highest temperature rating is for**

- (A) Teflon
- (B) Ceramic fibre
- (C) Asbestos
- (D) Fibre glass

Answer: Option B

**270. The unit step response of the transfer function  $1/(s^2 + 2s + 3)$**

- (A) Has a non-zero slope at the origin
- (B) Has a damped oscillatory characteristics
- (C) Is overdamped
- (D) Is unstable

Answer: Option B

**271. Which of the following controllers has the least maximum deviation?**

- (A) *P*-controller
- (B) *P-I* controller
- (C) *P-I-D* controller
- (D) *P-D* controller

Answer: Option D

**272. Bode stability method uses \_\_\_\_\_ loop transfer function.**

- (A) Open
- (B) Closed
- (C) Either (A) or (B)
- (D) Neither (A) nor (B)

Answer: Option A

**273. For increased speed of response of an expansion pressure spring thermometer, the thermometer bulb should have a**

- (A) Large area but small mass
- (B) High thermal conductivity
- (C) Small specific heat
- (D) All 'a', 'b' & 'c'

Answer: Option D

**274. For an input forcing function,  $X(t) = 2t^2$ , the Laplace transform of this function is**

- (A)  $2/s^2$
- (B)  $4/s^2$
- (C)  $2/s^3$
- (D)  $4/s^3$

Answer: Option D

**275. Liquid levels in autoclaves are measured by**

- (A) Simple float
- (B) Differential float type manometer
- (C) Glass gauge
- (D) None of these

Answer: Option B

**276. The deflection of the free end of the bimetallic strips in a bimetallic thermometer with temperature is nearly**

- (A) Linear
- (B) Non-linear
- (C) Parabolic
- (D) Hyperbolic

Answer: Option A

**277. Which of the following is the dynamic characteristics of an instrument?**

- (A) Reproducibility
- (B) Sensitivity
- (C) Dead zone

(D) Fidelity  
Answer: Option D

**278. Thermal conductivity cell is the primary element of a/an \_\_\_\_\_ analyser.**

- (A) Oxygen
  - (B) Carbon dioxide
  - (C) Carbon monoxide
  - (D) Sulphur dioxide
- Answer: Option B

**279. The amplitude ratio for the sinusoidal response of a \_\_\_\_\_ is 1.**

- (A) First order system
  - (B) Second order system
  - (C) Transportation lag
  - (D) None of these
- Answer: Option C

**280. The temperature of tempering oil baths maintained at 400°C during heat treatment of steel is measured by a/an \_\_\_\_\_ thermocouple.**

- (A) Chromel-alumel
  - (B) Iron-constantan
  - (C) Platinum-platinum/rhodium
  - (D) None of these
- Answer: Option B

**281. Which of following error integral is considered as the best criterion in controller settings?**

- (A)  $\int_0^{\infty} |e| dt$
  - (B)  $\int_0^{\infty} |e^2| dt$
  - (C)  $\int_0^{\infty} e^2 dt$
  - (D) None of these
- Answer: Option C

**282. Which of the following is not a mechanical pressure sensing element?**

- (A) Bellows
  - (B) Diaphragm
  - (C) Bourdon tube
  - (D) U-tube
- Answer: Option D

**283. Zirconia probe is used for the continuous measurement of \_\_\_\_\_ flue gases going out of the furnace.**

- (A) Oxygen in
  - (B) Carbon dioxide in
  - (C) Carbon monoxide in
  - (D) Temperature of
- Answer: Option A

**284. Working principle of bimetallic thermometers is difference in linear co-efficient of thermal expansion of two strips of different metals welded together. Which of the following has the maximum thermal co-efficient of linear expansion?**

- (A) Nickel
- (B) Brass
- (C) Chromel
- (D) Invar

Answer: Option B

**285. High temperature of around 2000°C of incandescent gas mantles is measured by a/an**

- (A) Specially designed thermocouple
- (B) Optical pyrometer
- (C) Radiation pyrometer
- (D) None of these

Answer: Option C

**286. Emf developed by a thermocouple, while measuring a temperature of 600°C is about 5.5 mV. The type of thermocouple used is**

- (A) Chromel-alumel
- (B) Iron-constantan
- (C) Platinum-platinum + rhodium
- (D) Either (A), (B) or (C)

Answer: Option C

**287. \_\_\_\_\_ is the static characteristics of an instrument.**

- (A) Response
- (B) Time lag
- (C) Drift
- (D) Dynamic error

Answer: Option C

**288. Pressure of 0.0001 absolute psi can be measured by \_\_\_\_\_ gauge.**

- (A) Mcleod
- (B) Pirani
- (C) Thermocouple
- (D) None of these

Answer: Option A

**289. Pick out the wrong statement.**

- (A) O<sub>2</sub>, NO and NO<sub>2</sub> exhibit paramagnetic properties as a result of unpaired electrons
- (B) CO<sub>2</sub> is the strongest paramagnetic gas
- (C) Paramagnetic susceptibility of gases decreases with temperature
- (D) Paramagnetic susceptibility of gases permits the measurement of their concentration

Answer: Option B

**290. Process degree of freedom indicates \_\_\_\_\_ number of controllers to be used.**

- (A) The maximum
- (B) The minimum
- (C) Both maximum and the minimum
- (D) Nothing about the

Answer: Option A

**291. The unit step response of the transfer function  $(2s - 1)/[(3s + 1)(4s + 1)]$  reaches its final steady state asymptotically after**

- (A) A monotonic increase
- (B) A monotonic decrease
- (C) Initially increasing and then decreasing
- (D) Increasing decreasing and then increasing

Answer: Option A

**292. Thermal conductivity measurement comprises the working principle of a**

- (A) CO<sub>2</sub> analyser
- (B) Polarimeter
- (C) Spectrometer
- (D) Chromatograph

Answer: Option A

**293. Thermal wells used in temperature measurements should have**

- (A) Very thick walls
- (B) Low emissivity
- (C) Polished surface
- (D) High transmissivity of radiation

Answer: Option D

**294. Which of the following is a 'contact' pyrometer?**

- (A) Resistance pyrometer
- (B) Optical pyrometer
- (C) Radiation pyrometer
- (D) Infra red pyrometer

Answer: Option A

**295. A proportional controller with a gain of  $K_c$  is used to control a first order process. The offset will increase, if**

- (A)  $K_c$  is reduced
- (B)  $K_c$  is increased
- (C) Integral control action is introduced
- (D) Derivative control action is introduced

Answer: Option B

**296. Which of the following is not a second order instrument?**

- (A) Mercury in glass thermometer with covering
- (B) Bare mercury in glass thermometer
- (C) Pressure gauge with one bellow, two tubes and a tank
- (D) None of these

Answer: Option B

**297. On-off controllers are normally used for**

- (A) Low loads
- (B) Temperature changes
- (C) Flow rate changes
- (D) None of these

Answer: Option A

**298. The \_\_\_\_\_ of a vapor pressure thermometer is a functioning element.**

- (A) Pointer
- (B) Bourdon tube
- (C) Bulb
- (D) None of these

Answer: Option A

**299. A pyrhelimeter is an instrument used for measuring the**

- (A) Bright sunshine period
- (B) Beam radiation
- (C) Diffuse radiation
- (D) None of these

Answer: Option B

**300. Pirani gauge is used for the measurement of**

- (A) Very high pressure
- (B) High vacuum
- (C) Liquid level under pressure
- (D) Liquid level at atmospheric pressure

Answer: Option B

**301. Which of the following temperature measuring instruments need not touch the object whose temperature is being measured?**

- (A) Radiation/infrared pyrometer
- (B) Filled system thermometer
- (C) Mercury in glass thermometer
- (D) Thermo electric pyrometer

Answer: Option A

**302. Zirconia probe is used for the measurement of**

- (A) Humidity of air
- (B) %  $\text{CO}_2$  in flue gas
- (C) %  $\text{O}_2$  in flue gas
- (D) Speed of a submarine

Answer: Option C

**303. A process is initially at steady state with its output  $y = 1$  for an input  $u = 1$ . The input is suddenly changed to 2 at time  $t = 0$ . The output response is  $y(t) = 1 + 2t$ . The transfer function of the process is**

- (A)  $2/s$
- (B)  $1 + (2/s^2)$
- (C)  $1 + (2/s)$
- (D)  $(1/s) [1 + (2/s)]$

Answer: Option D

**304. Volumetric expansion is the working principle of the \_\_\_\_\_ thermometers.**

- (A) Mercury in glass
- (B) Constant volume gas
- (C) Vapor pressure
- (D) Bimetallic

Answer: Option A

**305. In a shell and tube heat exchanger, the inlet temperature of heating/cooling fluid is the \_\_\_\_\_ variable.**

- (A) Load
- (B) Manipulated
- (C) Controlled
- (D) None of these

Answer: Option A

**306. The amplitude ratio for the sinusoidal response of \_\_\_\_\_ is  $< 1$ .**

- (A) Transportation lag
- (B) First order system
- (C) Second order system
- (D) None of these

Answer: Option B

**307. The \_\_\_\_\_ of a vapor pressure thermometer is a secondary element.**

- (A) Pointer
- (B) Bourdon tube
- (C) Bulb
- (D) None of these

Answer: Option B

**308. A simple pitot tube measures the**

- (A) Average velocity
- (B) Maximum velocity
- (C) Point velocity
- (D) Static pressure

Answer: Option D

**309. Thermistors are used in \_\_\_\_\_ devices.**

- (A) Voltage measuring
- (B) Temperature measuring
- (C) Temperature compensating
- (D) Both (B) & (C)

Answer: Option D

**310. Pressure of 0.01 psi (absolute) can be measured by \_\_\_\_\_ gauge.**

- (A) Ionisation
- (B) Pirani
- (C) McLeod
- (D) None of these

Answer: Option C

**311. Thermistor, which has high temperature co-efficient of resistivity, is used as the sensing element in resistance thermometer. It is a/an**

- (A) Insulator
- (B) Conductor
- (C) Solid semi-conductor
- (D) Liquid semi-conductor

Answer: Option C

**312. Flow rate of sludge is not measured by a/an**

- (A) Orificemeter
- (B) Open weir
- (C) Kennison nozzle
- (D) Both (B) & (C)

Answer: Option D

**313. The \_\_\_\_\_ of the fluid contained in the temperature sensing element (i.e., bulb) of filled system thermometers changes with change in temperature.**

- (A) Pressure
- (B) Volume
- (C) Viscosity
- (D) All (A), (B) and (C)

Answer: Option D

**314. Temperature measuring instruments are standardised mostly with \_\_\_\_\_ points of pure substances.**

- (A) Melting
- (B) Boiling
- (C) Both (A) & (B)
- (D) Neither (A) nor (B)

Answer: Option C

**315. For a feed back control system to be stable, the**

- (A) Roots of the characteristic equation should be real
- (B) Poles of the closed loop transfer function should lie in the left half of the complex plane
- (C) Bode plots of the corresponding open loop transfer function should monotonically decrease
- (D) Poles of the closed loop transfer function should lie in the right half of the complex plane

Answer: Option B

**316. Continuous measurement of moisture in paper is done by**

- (A) Sling psychrometer
- (B) Hair-hygrometer
- (C) Weighing
- (D) High resistance Wheatstone bridge circuit

Answer: Option D

**317. Which of the following thermocouples will give the highest output for the same value of hot and cold junction temperature?**

- (A) Platinum-platinum + rhodium
- (B) Iron-constantan
- (C) Chromel-constantan
- (D) All will give the same output

Answer: Option C

**318. Thermal conductivity measurement is used for the determination of**

- (A) O<sub>2</sub> percentage in the flue gas
- (B) Specific gravity of petrofuels
- (C) Composition of an alloy
- (D) CO<sub>2</sub> percentage in the flue gas

Answer: Option D

**319. Use of *I*-control along with *P*-control facilitates**

- (A) Elimination of offset
- (B) Reduction of offset
- (C) Reduction of stability time
- (D) None of these

Answer: Option A

**320. Flapper nozzle is used in a/an \_\_\_\_\_ controller.**

- (A) Electronic
- (B) Hydraulic
- (C) Pneumatic
- (D) None of these

Answer: Option C

**321. Polarograph is meant for the analysis of**

- (A) Gaseous mixture
- (B) Miscible liquids
- (C) Solids
- (D) Isotopes

Answer: Option C

**322. Which of the following judges the accuracy of an instrument?**

- (A) Dead zone
- (B) Drift
- (C) Static error
- (D) None of these

Answer: Option C

**323. Response of a system to a sinusoidal input is called \_\_\_\_\_ response.**

- (A) Impulse
- (B) Unit step
- (C) Frequency
- (D) None of these

Answer: Option C

**324. \_\_\_\_\_ controller has the maximum stabilising time.**

- (A) *P*
- (B) *PD*
- (C) *PI*
- (D) *PID*

Answer: Option C

**325. The characteristic equation for the control system with a closed loop transfer function  $G_1/1 + G_2$  is given by  $1 + G_2 = 0$ . The characteristic equation for the control system**

- (A) Depends only upon the open loop transfer function
- (B) Determines its stability
- (C) Is the same for set point or load changes
- (D) All 'a', 'b' & 'c'

Answer: Option D

**326. Compositional analysis of \_\_\_\_\_ is done using mass spectrometer.**

- (A) An isotope
- (B) Natural gas
- (C) A solid
- (D) An alloy

Answer: Option A

**327. A mercury barometer measures the \_\_\_\_\_ pressure.**

- (A) Atmospheric
- (B) Gauge
- (C) Vacuum
- (D) Absolute

Answer: Option A

**328. Which of the following relates the emf. generated in a single homogeneous wire to the temperature difference?**

- (A) Peltier effect
- (B) Thomson effect
- (C) Seebeck effect
- (D) None of these

Answer: Option B

**329. The root locus method, a pole of a transfer function  $G(s)$  is the value of  $s$  for which  $G(s)$  approaches**

- (A) -1
- (B) 0
- (C) 1
- (D)  $\infty$

Answer: Option D

**330. Liquid discharge from a tank or reservoir cannot be measured by**

- (A) Orificemeter
- (B) Weirs
- (C) Mouthpieces
- (D) Notches

Answer: Option A

**331. Strain gage pressure transducers are used to measure \_\_\_\_\_ pressures.**

- (A) Gage as well as vacuum
- (B) Absolute as well as differential
- (C) Both (A) and (B)
- (D) Neither (A) nor (B)

Answer: Option C

**332. Out of the following temperature measuring instruments, the measurement accuracy will be minimum for the**

- (A) Mercury in glass thermometer
- (B) Optical pyrometer
- (C) Iron-constantan thermocouple
- (D) Alcohol filled thermometer

Answer: Option B

**333. Starting temperature of optical radiation pyrometer is \_\_\_\_\_ °C.**

- (A) 800
- (B) 400
- (C) 1200
- (D) 1500

Answer: Option A

**334. Which of the following is a desirable characteristic of an instrument?**

- (A) High drift
- (B) High fidelity
- (C) High measuring lag
- (D) Poor reproducibility

Answer: Option B

**335. Emission spectroscopy is used for**

- (A) Solids and metal analysis
- (B) Determining water purity
- (C) Determination of CO<sub>2</sub> in gases
- (D) NO<sub>x</sub> determination

Answer: Option A

**336. The response of two tanks of same size and resistance in series is**

- (A) Under damped
- (B) Critically damped
- (C) Over damped
- (D) None of the above

Answer: Option B

**337. Pick out the first order system from among the following.**

- (A) Damped vibrator
- (B) Mercury in glass thermometer kept in boiling water
- (C) Interacting system of two tanks in series
- (D) Non-interacting system of two tanks in series

Answer: Option B

**338. Working principle of radiation pyrometer is based on the**

- (A) Wien's law
- (B) Kirchoff's law
- (C) Stefan-Boltzmann law
- (D) Seebeck effect

Answer: Option C

**339. Which of the systems having following transfer functions is stable?**

- (A)  $1/(s^2 + 2)$
- (B)  $1/(s^2 - 2s + 3)$
- (C)  $1/(s^2 + 2s + 2)$
- (D)  $\exp(-20s)/(s^2 + 2s - 1)$

Answer: Option C