ISRO IPRC 2018

Q1. A 10 tonne refrigeration system consumes 10kW of electrical energy. It's Coefficient of Performance will be_____
(a) 10
(b) 3.5
(c) 0.35
(d) 35

Q2. A metal flat, 40mm wide 10mm thick section and 2m length, is under axial compressive load of 40 kN. If contraction in length is 1mm and increase in width is 0.006mm, What is the value of Poisson's ratio ?
(a) 0.06
(b) 0.3
(c) 0.1
(d) 0.4

Q3. For the same cross sectional area (or weight),_____shafts have higher strength and rigidity than_____
(a) solid, hollow
(b) hollow, solid
(c) Both are equal
(d) None of these

Q4. With reference to object size, choose the odd one among the following 2D transformations:
(a) Translation
(b) Reflection
(c) Rotation
(d) Scaling

Q5. 1 m³ of a gas at 5 bar pressure is compressed at constant temperature to 0.5 m³. What is the final pressure?
(a) 2.5 bar
(b) 0.1 bar

(c) 10 bar
(d) None of these

Q6.In a wind turbine,_____measures the wind direction and guides the yaw drive to position the rotor to face the wind.
(a) Speedometer
(b) Wind vane
(c) Anemometer
(d) None of these

Q7. A thermometer reads 73.5°C and the correction from calibration curve is -0.35 °C in the measurement range of 70°C to 90°C. What is the true value of the temperature?
(a) 73.85°C
(b) 73.15°C
(c) 70.35°C
(d) 90.85 °C

Q8. A cylindrical tank of internal diameter 10m is fabricated from 10mm thick steel plate. What is the maximum tangential stress due to internal pressure of 4kPa?
(a) 1MPa
(b) 4 MPa
(c) 2 MPa
(d) 0.5 MPa

Q9. _____is the tool for organizing the workplace in a clean, efficient and safe manner to enhance productivity and enable standardized working.
(a) 5S
(b) 3D
(c) 6σ
(d) None of these

Q10. Industrial RTDs for precise measurements are usually made from
(a) Silver
(b) Platinum

(c) Aluminium
(d) Steel

Q11. For same compression ratio & heat supplied, which thermodynamic air cycle has maximum thermal efficiency?
(a) Otto cycle
(b) Diesel cycle
(c) Dual cycle
(d) All of these

Q12. _____are casting defects caused by improper shrinkage / hindered contraction.
(a) Hot tears
(b) Swell
(c) Shifts
(d) Fins

Q13. In Q7 tools for process improvement, the one that graphs pairs of numerical data to look for a relationship is
(a) Fishbone chart
(b) Check sheet
(c) Scatter diagram
(d) Histogram

Q14. The refrigerant used in reversed Brayton or Bell-Coleman cycle is
(a) air
(b) Freon
(c) ammonia
(d) water

Q15. In a closed loop process control system with PID controller, ____response depends only on the difference between set point and the process variable.
(a) proportional
(b) integral
(c) differential
(d) All of these

Q16. Which is not a part of PDCA cycle (Deming wheel)?

(a) Do
(b) Check
(c) Plan
(d) Approve

Q17. Increasing carbon content in steel,_____ ultimate strength and_____ ductility of steel.
(a) increases, decreases
(b) decreases, decreases
(c) increases, increases
(d) decreases, increases

Q18. A mass of wet steam contains 15% liquid water. Dryness fraction of steam is__
(a) 0.15
(b) 1.15
(c) 0.85
(d) None of these

Q19. R charts are control charts for_____.
(a) variables
(b) reliability
(c) attributes
(d) maintainability

Q20. A key of 14mm width, 9mm height and 100 mm length is mounted on a shaft of 50mm diameter. If allowable shear stress for the key material is 50 MPa, what is the maximum torque that can be transmitted?
(a) 3500Nm
(b) 4500Nm
(c) 2250Nm
(d) 1750Nm

Q21. The by-pass factor of a cooling coil is 0.2. If the surface temperature is 5°C and air enters at 40°C, the exit temperature of air will be_____
(a) 5°C
(b) 12°C
(c) 20°C
(d) 40°C

Q22. _____is used for measuring vacuum.
(a) LVDT
(b) Rota meter
(c) Pirani gauge
(d) Anemometer

Q23. An I. C. Engine develops indicated power of 150 kW. If the mechanical efficiency of the engine is 80%, then brake power delivered is
(a) 187.5 kW
(b) 120 kW
(c) 200 kW
(d) 180 kW

Q24. A job-design to be time-studied has fatigue and delay allowance of 10 minutes & 25 minutes per 8-hour shift. In addition 25 minutes personal time is permitted in a shift. Then, the total allowance factor necessary to calculate Standard Time for this activity will be___
(a) 1.143
(b) 0.8
(c) 12.0%
(d) None of these

Q25. The ability of an acceptance sampling Plan to distinguish between good and bad lots of products is known from it's
(a) Trend graph
(b) Quality history
(c) OC curve
(d) None of these

Q26. Penetration in case of gas metal arc welding is about,
(a) 3.5
(b) 5
(c) 1.25
(d) 15

Q27. Tachometers are used to measure
(a) displacement
(b) strain
(c) vibration
(d) angular velocity

Q28. Absolute temperature of 77K =____, approximately.
(a) -196°C
(b) 350°C
(c) 77°F
(d) None of these

Q29. A firm wants to install automatic machines to produce 250,000 castings per annum. The operation takes 1.5 minute of machine time and about 2% products are defective. Each machine is available for 2,000 hours of capacity per year. How many machines are required ?
(a) 6
(b) 5
(c) 4
(d) None of these

Q30. For a repairable product, the ratio of the time it is working satisfactorily to _____called availability
(a) the total down time
(b) the test interval
(c) the total up time
(d) failure rate

Q31. A simple method of detecting surface flaws in welds is
(a) Dye penetrant test
(b) X-ray inspection
(c) Impact test
(d) Bend test

Q32. A toy manufacturing factory has annual capacity of 12,000 toys. If the fixed costs are rupees 1 lakh /year, variable cost rupees 20 per unit and the selling price rupees 40 per unit, the quantity to break-even is

(a) 5000
(b) 300
(c) 2500
(d) None of these

Q33. Ship building is an example of_____ layout.
(a) Job shop
(b) Fixed point
(c) Line processing
(d) Continuous flow

Q34. Operation of hydraulic press is on the basis of___
(a) Joule's law
(b) Pascal's law
(c) Newton's law
(d) Dalton's law

Q35. Select the correct statements: The Pelton wheel, can be installed either horizontally or vertically
1 can be installed either horizontally or vertically
2 gives optimum efficiency at runaway speed
3 remains submerged in water
4 operates by converting the available energy fully into kinetic energy before entering the rotor
(a) a and b
(b) a and c
(c) b and d
(d) a and d

Q36. Abrupt change of cross section in a member subject to load can result in__.
(a) thermal stresses
(b) creep
(c) stress concentration
(d) fatigue

Q37. An investment of Rs 60,000 in a new equipment is expected to have salvage

value of Rs 8,000 after 5 years. What is the straight line depreciation ?
(a) Rs 13,600
(b) Rs 10,400
(c) Rs 12,000
(d) None of these

Q38. Condition monitoring is the basis for_____
(a) preventive
(b) shutdown
(c) breakdown
(d) predictive

Q39. For a liquid being pumped, Pressure head at pump inlet + velocity head in suction pipe - vapor pressure head =_____
(a) Stagnation head
(b) Net Positive Suction Head
(c) Total energy head
(d) Hydraulic head

Q40. A vacuum gauge connected to a chamber reads 40 kPa Atmospheric pressure at the location is 100 kPa. Then, the absolute pressure in the chamber is
(a) 40 kPa
(b) 160 kPa
(c) 60 kPa
(d) None of these

Q41. In ABC classification system of inventory management,
(a) A
(b) B
(c) C
(d) Any of these

Q42. _____is a close running fit used in small electric motor and pump shafts.
(a) H11 C11
(b) H7 F7
(c) H9 H9

(d) H8 M7

Q43. _____ is a manufacturing philosophy that emphasizes careful scheduling of work, on-time delivery of zero-
(a) PERT
(b) MRP
(c) EOQ
(d) JIT

Q44. Water from a large pipe at 4 bar(g) flows out as vertical jet through a small nozzle. The maximum height that the water jet may achieve is _____approximately
(a) 45 m
(b) 4 m
(c) 35 m
(d) 40 m

Q45. In the context of factors utilized in FMEA, choose the odd one out.
(a) Occurrence
(b) Severity
(c) Serviceabilityy
(d) Detection

Q46. An electric motor running at 900 rpm drives a pump at 1500 rpm. If the pulley on the driving shaft is 750mm in diameter, what is the required size of pulley on the driven shaft?
(a) 1250 mm
(b) 450 mm
(c) 900 mm
(d) None of these

Q47. "ISO 9001 standard measures and recognizes the quality of a company's products". This statement is:
(a) False
(b) May be
(c) True
(d) None of these

Q48. Cutting operations like blanking and piercing can be performed simultaneously in
(a) combination die
(b) simple die
(c) compound die
(d) progressive die

Q49. _____is useful instrument for finding velocity profile in the boundary layer.
(a) Hot-wire anemometer
(b) Rota meter
(c) Bourdon gauge
(d) Turbine meter

Q50. Young's modulus of elasticity of mild steel is ___approximately.
(a) 200 MPa
(b) 310 MPa
(c) 210 GPa
(d) 300 GPa

Q51. Equivalent evaporation of a boiler is defined with respect to generation of steam from & at_____
(a) 20°C
(b) 100°C
(c) 150°C
(d) Any of these

Q52. _____regulations relate to industrial safety.
(a) FEMA
(b) OSHA
(c) COFEPOSA
(d) NASA

Q53. Lower calorific value of Diesel is about
(a) 45,000kJ/kg
(b) 55,000kJ/kg
(c) 35,000kJ/kg
(d) None of these

Q54. SI Unit of specific heat capacity is
(a) J/mk
(b) J/kg K
(c) J/kg
(d) J/K

Q55. _____engines can work in vacuum.
(a) Turbojet
(b) Rocket
(c) Turboprop
(d) Ramjet

Q56. Angle of ISO metric screw thread is
(a) 45°
(b) 55°
(c) 60°
(d) 47.5°

Q57. Aditya L1 is a_____.
(a) Long-range missile
(b) Spacecraft project
(c) Rocket to moon
(d) Light combat aircraft

Q58. A beam, of 80mm x 120mm section and 4m long, is simply supported at ends. If it carries a load of 20kN at mid-span, what are the maximum shear force and bending moment acting on it?
(a) 20kN, 20kNm
(b) 20kN, 10kNm
(c) 10kN, 10 kNm
(d) 10kN, 20 kNm

Q59. Reynolds number is directly proportional to
(a) Pipe diameter
(b) Average flow velocity
(c) Both A & B
(d) Neither A nor B

Q60. Endurance limit of steel is associated with _____number of cycles in fatigue loading.
(a) low
(b) infinite
(c) limited
(d) 1000

IPRC 2018 SOLUTION

Ans1. b
Solution:
A 10-tonne refrigeration system
1 tonne = 3.5 kW hence, 10 tonne = 35 kW
Q_1 = 35 kW
Refrigeration system consumes 10 kW of electrical energy.
W_R = 10 kW
COP = $\frac{Q_1}{W_R} = \frac{35}{10}$ = 3.5

Ans2. b
Solution:
P = 40 kN, ΔL = 1mm, L = 2000mm, Δw = 0.006mm, w = 40m, t = 10mm
Lateral strain $\in_d = \frac{\Delta w}{w} = \frac{0.006}{40}$ = 0.00015
Longitudinal strain $\in_L = \frac{\Delta L}{L} = \frac{1}{2000}$ = 0.0005
Poisson ratio (μ) = $\frac{\text{Lateral strain}}{\text{Longitudinal strain}}$
M = $\frac{0.00015}{0.0005}$ = 0.3

Ans3. b
Solution:

Ans4. d
Solution:

Ans5. c
Solution:
V_1 = 1 m³, P_1 = 5 bar, V_2 = 0.5 m³
For the isothermal process
$P_1 V_1 = P_2 V_2$
5 × 1 = P_2 × 0.5
P_2 = 10 bar

Ans6. b
Solution:

Ans7. b
Solution:

Reading Temperature (l) = 73.5°C, correction factor = l - 0.35°C.
True Value of temperature = I - 0.35°C.
True Value of temperature = 73.5°C - 0.35°C = 73.15°C.

Ans8. c
Solution:
P = 4 kPa, d = 10 m = 10 × 10³ mm, t = 10 mm.
Tangential or hoop stress:
$\Sigma_h = \frac{pd}{2t} = \frac{4 \times 10 \times 10^3}{2 \times 10} = 2 \times 10^3$ KPa = 2MPa

Ans9. a
Solution: 5S is a Japanese methodology for workplace organization. It is a methodology of Total Productive Maintenance (TPM). It stands for Sort, Set, Shine, Standardization and Sustain. 5S is a simple tool for organizing your workplace in a clean, efficient and safe manner to enhance your productivity, visual management and to ensure the introduction of standardized working.

Ans10. b
Solution:

Ans11. a
Solution:

Ans12. a
Solution:

Ans13. c
Solution: The 7 basic quality tools i.e. Q7 tools are as follows:
Flow Chart
Histogram
Cause-and-Effect Diagram
Check Sheet
Scatter Diagram

Control Charts
Pareto Charts

Ans14. a
Solution: Reversed Brayton cycle used in the air refrigeration cycle which uses air as the refrigerant.

Ans15. d
Solution:
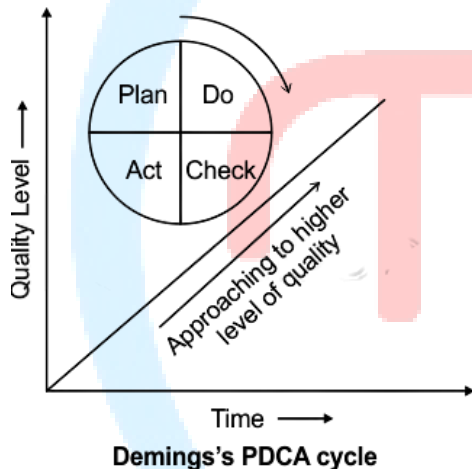Close loop transfer function depends on all type of controller.
$E(s) \propto st_d$ (Derivative controller)
$E(s) \propto K$ (Proportional controller)
$E(s) \propto K_I/s$ (Integral controller)

Ans16. d
Solution:

Demings's PDCA cycle

Ans17. a
Solution:

Ans18. c
Solution:
$M_l = 15$, $m_v = 85$.
Dryness fraction $(x) = \frac{85}{15 + 85} = 0.85$
$X = 0.85$

Ans19. a
Solution:

Ans20. d
Solution:
B = 14mm, l = 100mm, d = 50mm = 0.05m,
Allowable stress of key = 50 MPa
For rectangular key shear stress is
$T = \frac{F}{A} = \frac{F}{B \times l}$
$\frac{F}{B \times l} \leq 50$ MPa
$F \leq 50 \times b \times l$
F = 50 × 14 × 100 = 70000 N = 70 kN
The torque transmitted by the shaft
T = F × d/2
T = 70000 × 0.025 = 1750 Nm
Hence max torque that can be transmitted is 1750

Ans21. b
Solution:
The bypass fator of a cooling coil is given by:
$BPF = \frac{T_{outlet} - T_{coil}}{T_{inlet} - T_{coil}}$
BPF = 0.2, T_{inlet} = 40°C, and T_{coil} = 5°C
$0.2 = \frac{T_{outlet} - 5}{40 - 5}$
Therefore T_{outlet} = 12°C

Ans22. c
Solution:

Ans23. b
Solution:
Indicated power = 150 kW, Mechanical efficiency = 80%
$\eta_m = \frac{Brake\ power}{Indicated\ power}$
$0.8 = \frac{Brake\ power}{150} = 120$ kW

Ans24. a
Solution:
Personal allowance = 25 minutes,
Fatigue allowance = 10 minutes,
Unavoidable delay allowance = 25 minutes,
Standard time = 8 hour (shift)

Total allowance = Personal allowance + Fatigue allowance + Unavoidable delay allowance

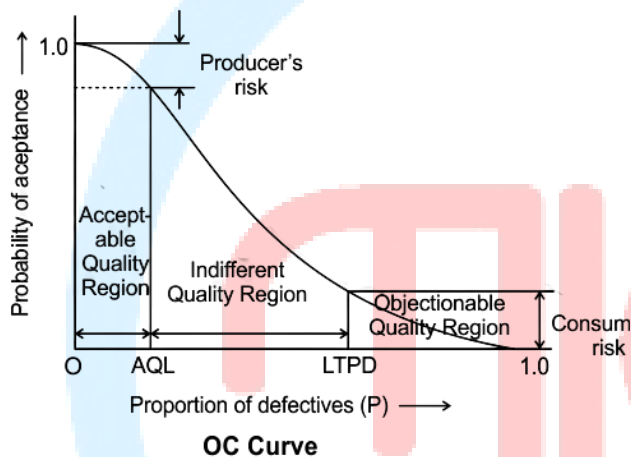Total allowance = 25 + 10 + 25 = 60 minutes = 1 hour

Standard Time = Normal Time   Total Allowance

∴ Normal time = Standard time - Total allowance = 8 - 1 = 7 hour

Allowance factor = $\frac{Standard\ time}{Normal\ time} = \frac{8}{7} = 1.143$

Ans25. c
Solution:

OC Curve

Ans26. c
Solution:

Ans27. d
Solution:

Ans28. a
Solution:
T = 77 K
T (K) = t (°C) + 273.15. 7
77 K = t (°C) + 273.15.
T = - 196°C.

Ans29. c
Solution:
Total castings per year = 250000, machine time = 1.5 minute, Each Machine available for 2000 hours per year, 2% products are defective

Therefore

Total number of castings required to produce = $\frac{250000}{0.98}$ = 255102

Number of castings produced by each machine = $\frac{2000 \times 60\ minutes}{1.5\ minutes}$ = 80000

Therefore Number of machines required = $\frac{Total\ number\ of\ products}{Capacity\ of\ machine} = \frac{255102}{80000}$ = 3.188

As number of machines can not be in decimal or fraction therefore considering it to be 4.

Ans30. b
Solution:

Ans31. a
Solution:

Ans32. a
Solution:

Break even point = $\frac{Total\ fixed\ cost\ (TFC)}{Price\ per\ unit\ (P) - Variable\ cost\ (V.C.)}$

Total fixed cost (TFC) = 100000, P = 40, VC = 20.

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Total fixed cost (TFC) = 100000, P = 40, VC = 20. .

Break even point = $\frac{100000}{40-20}$ = 5000

Hence, the quantity of break-even is 5000 units.

Ans33. b
Solution: In a fixed-position layout, the product remains at one location & manufacturing equipment is moved to the product rather than vice-versa. Very high weight and bulky product which can not be moved from one place to another place

conveniently like Ships, Rockets, Submarine are made with this layout.

Ans34. b
Solution: Pascal's Law is the principle of transmission of fluid-pressure. It says that "a pressure exerted anywhere in a point of the confined fluid is transmitted equally in all directions throughout the fluid".

Ans35. b
Solution:

Ans36. c
Solution:

Ans37. b
Solution:
Annual Depreciation (D) in straight line method

$$D = \frac{C(Cost\ price\ of\ equipment) - V(Salvage\ value)}{n(estimated\ life\ of\ machine\ in\ years)}$$

$$= \frac{60000 - 8000}{5} = 10400$$

= Rs10400

Ans38. d
Solution:

Ans39. b
Solution:

Ans40. c
Solution:
We know, Absolute Pressure = Vacuum Pressure - Atmospheric pressure
Vacuum pressure = 40 kPa, Atmospheric pressure = 100 kPa Absolute pressure = 100 - 40 = 60 kPa

Ans41. a
Solution:

Ans42. b
Solution:

ISO Symbol		Description
Hole Basis	Shaft Basis	
H11/c11	C11/h11	Loose running fit for wide commercial tolerances or allowances on external members.
H9/d9	D9/h9	Free running fit not for use where accuracy is essential, but good for large temperature variations, high running speeds, or heavy journal pressures.
H8/f7	F8/h7	**Close running fit** for running on accurate machines and for accurate location at moderate speeds and journal pressures. *(Clearance Fits)*
H7/g6	G7/h6	Sliding fit not intended to run freely, but to move and turn freely and locate accurately.
H7/h6	H7/h6	Locational clearance fit provides a snug fit for locating stationary parts but can be freely assembled and disassembled.
H7/k6	P7/h6	Locational transition fit for accurate location, a compromise between clearance and interference. *(Transition Fits)*
H7/n6	N7/h6	Locational transition fit for a more accurate location where greater interference is permissible.
H7/p6	P7/h6	Locational interference fit for parts requiring rigidity and alignment with prime accuracy of location but without special bore pressure requirements.
H7/s6	S7/h6	Medium drive fit for ordinary steel parts or shrink fits on light sections, the tightest fit usable with cast iron. *(Interference Fits)*
H7/u6	U7/h6	Force fit suitable for parts that can be highly stressed or for shrink fits where the heavy pressing forces required are impractical.

Ans43. d
Solution:

Ans44. d
Solution:
P = 4 bar = 4 × 10⁵ Pa
Now, Pressure of water p = ρgh,
4 × 10⁵ = 1000 × 10 × h
H = 40 m

Ans45. c
Solution:

Ans46. b
Solution:
The ratio of speed and diameter of the driver and driven pulley is given as

$$\frac{N_2}{N_1} = \frac{d_1 + t}{d_2 + t}$$

N_2 = 1500 rpm, N_1 = 900 rpm, d_1 = 750 mm,
Now, by the formula we have,
As thickness is not given so neglecting it, we get

$$\frac{1500}{900} = \frac{750}{d_2}$$

D_2 = 450 mm

Ans47. a
Solution:

Ans48. c
Solution:

Ans49. a
Solution: A hot-wire anemometer measures local instantaneous velocity profile in the boundary layer theory based on principles of heat transfer. However, it requires that the fluid itself be at a uniform temperature. It can be used to measure three components of velocity and velocity fluctuations arising in a turbulent flow. It is used in gas flows, while a hot-film is used for liquid flow.

Ans50. c
Solution:

Ans51. b
Solution:

Ans52. b
Solution:

Ans53. a
Solution:

Ans54. b
Solution:

Ans55. b
Solution: In the case of travelling through a vacuum, there is no fluid medium. In any propulsion system, a working fluid is accelerated by the system and the reaction to this acceleration produces a force on the system.

Ans56. c
Solution:

Ans57. b

Solution: Aditya-L1 is the first Indian space mission to observe the Sun and the solar corona. ISRO is planning to launch the Aditya-L1 mission, the first Indian space mission to observe the Sun by June/july 2023.

Ans58. d
Solution:
L = 4 m, P = 20 kN.
Maximum shear force (F)
F = 0.5 × P
F = 0.5 × 20
F = 10 kN.
Maximum bending moment (M_M)
$M_M = \dfrac{P \times L}{4}$
$M_M = \dfrac{20 \times 4}{4}$
M_M = 20 kNm.

Ans59. c
Solution:

Ans60. b
Solution:
It is defined as the maximum value of completely reversed bending stress which a polished standard specimen can withstand without failure, for an infinite number of cycles (usually 106 cycles). Hence for steel in fatigue loading the endurance limit is the maximum reversed bending stress it can withstand without failure for an infinite number of cycle.