ISRO IPRC 2016

Q1. A tensile load of 500 N is applied to a circular rod diameter of 5mm. The normal stress is approximately
(a) 100 N/mm^2
(b) 25 MPa
(c) 100 N/cm^2
(d) 25 Nmm

Q2. A reversible heat engine operates between 300K and 600K. If heat output is 200 kJ, the heat input is
(a) 100 kJ
(b) 300 kJ
(c) 600 kJ
(d) 400 kJ

Q3. Bernoulli's theorem applies to ____ flow.
(a) Incompressible
(b) Steady
(c) Non-viscous
(d) All of these combined

Q4. Tensile stress in thin spherical shell subjected to internal pressure is
(a) pd/4t
(b) pd/2t
(c) pd/8t
(d) pd/3t

Q5. Cavitation in a pump is associated with _____pressure.
(a) Atmospheric
(b) Critical
(c) vapor
(d) None of these

Q6. Petrol engine works on
(a) Carnot cycle
(b) Rankine cycle
(c) Otto cycle
(d) Joule cycle

Q7. Pressure at a depth of 15m under water surface in a dam is approximately
(a) 15 bar
(b) 1.5 MPa
(c) 150 kPa
(d) none of these

Q8. Ductility of material is indicated by
(a) Ultimate strength
(b) Endurance strength
(c) Yield strength
(d) Elongation

Q9. Unit of thermal conductivity is
(a) J/kgK
(b) W/m^{2}K
(c) W/MK
(d) None of these

Q10. Power transmitted by a shaft running at 700 rpm with torque of 6 kNm=
(a) 880 kW
(b) 440 kW
(c) 220 kW
(d) None of these

Q11. In a centrifugal pump, discharge Q is proportional to
(a) N^2
(b) N
(c) N^3
(d) $\sqrt{N}$

Q12. If flow rate of water in a pipeline is doubled, then pressure drop will be ____ the original value.
(a) same as
(b) 2 times
(c) 4 times
(d) one half of

Q13. The average cutting speed in machining mild steel by single point tool of HSS is
(a) 10 m/ minute
(b) 20 m/minute
(c) 20 m/minute
(d) 40 m/minute

Q14. The shear stress in throat area of weld joint of length L and weld leg h, subject to parallel load P is
(a) P/hl
(b) 0.707P/hl
(c) 1.414P/hl
(d) None of these

Q15. A nozzle has velocity head at outlet of 10m. If the jet is vertical, height reached by the steam is
(a) 100m
(b) $\sqrt{10}$m
(c) 10m
(d) $(1/\sqrt{10})$ m

Q16. Polar moment of inertia of a circular area is
(a) $\pi D^4/64$
(b) $\pi D^4/32$
(c) $\pi D^2/4$
(d) None of these

Q17. In centrifugal casting method, ____core is used.
(a) Sand
(b) No
(c) Ferrous
(d) Non-ferrous

Q18. If the tight and slack side tensions in a flat belt running at 1km/minute are 1500N and 100N, the power transmitted is
(a) 15.3 kW

(b) 10 kW
(c) 8.3 kW
(d) None of these

Q19. Which material has maximum thermal conductivity?
(a) Mild steel
(b) Aluminum
(c) Stainless steel
(d) Copper

Q20. Two forces 40N and 30N act at right angles to each other on a particle. The resultant force is
(a) 1200 N
(b) 50 N
(c) 50 kg
(d) 70 N

Q21. Heat transfer occurs due to _____-difference
(a) Thermal conductivity
(b) Temperature
(c) Specific heat
(d) Heat flux

Q22. Density of mild steel is ____ kg/m³.
(a) 10,200
(b) 7,860
(c) 9,010
(d) none of these

Q23. In a _____ die, both cutting and non-cutting operations are done in a press station in one stroke of ram.
(a) compound
(b) combination
(c) simple
(d) progressive

Q24. H7 F7 represents a _____fit.
(a) interference
(b) clearance
(c) transition

(d) very tight

Q25. Annealing does not _____
(a) soften the metal
(b) relieve stresses
(c) refine the grain structure
(d) increase the yield point

Q26. For a cantilever beam of length 2m, under load 1 kN/m, maximum bending moment is
(a) 1 kN/m
(b) 1 kNm
(c) 2 kNm
(d) none of these

Q27. A taper provided on pattern for its easy withdrawal from mould is called _____ allowance.
(a) shrinkage
(b) machining
(c) draft
(d) distortion

Q28. The output of a turbine is 300 kW and efficiency is 25%. The input power is
(a) 600 kW
(b) 1200 kW
(c) 900 kW
(d) 1500 kW

Q29. Thermal efficiency of Carnot cycle depends on _____temperature only.
(a) source
(b) sink
(c) source & sink
(d) none of these

Q30. For welding plates of <5mm thickness, the edges require _____ beveling.
(a) double V
(b) single V
(c) no
(d) single U

Q31. A 20 tooth pinion meshes with a 63-tooth gear. The gear ratio is
(a) 83.5
(b) 43.5
(c) 0.6
(d) 3.15

Q32. Thermal efficiency of a stroke engine is _____ with respect to a 4-stroke engine.
(a) more
(b) less
(c) same
(d) none of these

Q33. In Electro-Chemical machining, material removal is due to
(a) corrosion
(b) erosion
(c) fusion
(d) ion displacement

Q34. A rectangular bar with a circular hole is to be made of a material with actual maximum permissible stress of 150 MPa. If stress concentration factor for the configuration is 3.0, what is the nominal average stress for sizing the section?
(a) 450 MPa
(b) 50 MPa
(c) 147 MPa
(d) none of these

Q35. TIG welding is preferred for
(a) Aluminum
(b) Silver
(c) Mild steel
(d) All of these

Q36. _____ engine requires forward motion through air to produce thrust
(a) I.C.
(b) Rocket
(c) Steam

(d) Ramjet

Q37. Which of the following is essential for boiler operation?
(a) super heater
(b) economizer
(c) injector
(d) safety valve

Q38. A nozzle is said to be chocked when
(a) it discharges to atmosphere
(b) it is plugged
(c) it's flow is maximum
(d) exit pressure is zero

Q39. Human heart is a _____pump.
(a) reciprocating pump
(b) positive displacement pump
(c) centrifugal pump
(d) none of these

Q40. Choose the odd-one out
(a) Solar
(b) Wind
(c) Ocean thermal
(d) Coal

Q41. Large Reynold's number is an indication of
(a) Streamline flow
(b) Steady flow
(c) Laminar flow
(d) Highly Turbulent flow

Q42. As per Avogadro's law, volume of 1 kmol of any gas is ___m³ at N.T.P.
(a) 22.413
(b) 8.314
(c) 273.15
(d) none of these

Q43. Efficiency of induction motors can be about
(a) 50-90%

(b) 95-98%
(c) 99%
(d) 80-90%

Q44. A weight of 200N is to be pulled over a surface with coefficient of friction 0.2. What is the force needed to start motion?
(a) 1000N
(b) 40 N
(c) 200.2 N
(d) 199.2 N

Q45. When an orifice for flow measurement in a pipe is replaced by a venturimeter, the pressure drop for the same flow is expected to
(a) remain same
(b) increase
(c) decrease
(d) none of these

Q46. Operating Characteristic (OC) curve shows probability of acceptance Vs. Fraction ____-.
(a) acceptable
(b) rejection
(c) defective
(d) none of these

Q47. For maximum efficiency, the intermediate, P2, in stage reciprocating compressor should be
(a) (P1+P3)/2
(b) (P3-P1)/2
(c) $\sqrt{(P_1 \times P_3)}$

Q48. Break even analysis considers _____cost.
(a) fixed
(b) variable
(c) fixed and variable
(d) no

Q49. A 4-pole 50 Hz induction motor runs at 1455 rpm. What is the slip speed?
(a) 55 rpm
(b) 50 rpm
(c) 45 rpm
(d) none of these

Q50. Resistance of a material to fatigue is indicated by
(a) elastic limit
(b) limit of proportionality
(c) endurance limit
(d) none of these

Q51. Line balancing is imperative in _____production.
(a) batch
(b) mass
(c) job
(d) none of these

Q52. Fuel cell runs on
(a) methane
(b) nitrogen
(c) petrol
(d) hydrogen

Q53. 1HP = kW
(a) 0.554
(b) 0.653
(c) 0.735
(d) none of these

Q54. _____maintenance requires monitoring plant equipment health.
(a) Preventive
(b) Scheduled
(c) Predictive
(d) Break down

Q55. Which one is an attribute control chart?
(a) X
(b) P

(c) R
(d) None of these

Q56. A circle will appear in an drawing as _____
(a) circle
(b) hyperbola
(c) parabola
(d) ellipse

Q57. ABC analysis is a tool for _____management.
(a) inventory
(b) scheduling
(c) quality
(d) process

Q58. Thermal stress in a material is proportional to
(a) elastic modulus
(b) coefficient of expansion
(c) temperature difference
(d) all of these

Q59. The behavior of mild steel under creep is a result of _____
(a) strain hardening
(b) annealing
(c) both A & B
(d) none of these

Q60. An helical spring has coil diameter 50 mm and is subject to axial load W. Another spring has coil diameter 25 mm, but otherwise identical to the first. The deflection of second spring will be _____ of that of first spring.
(a) 1/2
(b) 1/4
(c) 1/8
(d) none of these

IPRC 2016 SOLUTION

Ans1.b
Solution:
F = 500N (tensile), Diameter of circular rod = 5mm
Therefore A = $\frac{\pi}{4}d^2 = \frac{\pi}{4}5^2 = \frac{25\pi}{4}$
Normal stress(σ) = $\frac{F}{A} = \frac{500}{25\pi/4}$ = 25.46MPa

Ans2.d
Solution:
T_L = 300K, T_H = 600K, Heat output = 200KJ
$1 - \frac{Heat\ output}{Heat\ input} = 1 - \frac{T_L}{T_H}$
$1 - \frac{200}{Heat\ input} = 1 - \frac{300}{600}$
$1 - \frac{200}{Heat\ input} = \frac{1}{2}$
Heat input = 400KJ

Ans3.d
Solution:

Ans4.a
Solution:

Ans5.c
Solution:

Ans6.c
Solution:

Ans7.c
Solution:
Height (h) = 15m and density of water (ρ) = 10^3kg/m^3
The pressure at a depth of 15m is:
P_a = ρgh = 150 kPa

Ans8.d
Solution:

Ans9.c
Solution:

Ans10.b
Solution:
Given D = 60mm, N = 180rpm, Permissible shear stress = 85 N/mm^2
Maximum torque T = $\tau_{max} \times Z_P$
= 85 × $\frac{\pi}{16} \times D^3$ = 85 × $\frac{\pi}{16} \times 60^3$ = 3604977.5Nmm = 3604.97Nm
P = $\frac{2\pi NT}{60}$ = 67.95 kW

Ans11.b
Solution:

Ans12.c
Solution:

Ans13.c
Solution:

Material	Range of Cutting Speed in m/min	Coolant used
Cast iron (soft)	24-40	Dry
Cast iron (hard)	16-27	Dry
Mild steel	**22-30**	Soluble oil
Medium carbon steel	12-23	Soluble oil
Brass & Bronze	30-45	Soluble oil
Aluminium	90 and up	Soluble oil

Ans14.c
Solution:

Ans15.c
Solution:
H = 10m
The velocity of the stream at the nozzle
H = $\frac{U^2}{2g}$

$U^2 = 20 \times g$
Equation of motion
$V^2 = U^2 - 2gh$
Putting the value of U^2 in the above equation, also the final velocity at height h will be 0
$20g = 2g \times h$
H = 10m
With no losses; Velocity head = the height reached by the stream

Ans16.b
Solution:

Ans17.b
Solution:

Ans18.c
Solution:
Using $P = v(T_1 - T_2)$
$P = (1500 - 1000) \times 16.68 = 8340 \, W = 8.3 \, kW$
$P = 8.3kW$

Ans19.d
Solution:

Ans20.b
Solution:
$R = \sqrt{F_1^2 + F_2^2}$
$R = \sqrt{40^2 + 30^2} = 50N$

Ans21.b
Solution:

Ans22.b
Solution:

Ans23.b
Solution:

Ans24.b
Solution: Here H specifies the hole basis assembly meaning the lower deviation of the hole is zero. F specifies the shafts whose upper deviation is below the zero line. The lower limit of the hole is above the upper limit of the shaft, hence Hole diameter is always bigger than the shaft diameter so the fit will be a clearance fit.

Ans25.d
Solution:

Ans26.c
Solution:
The maximum bending moment at a cantilever beam subjected to UDL is given by
$M = \dfrac{wL^2}{2}$
W = 1 kN/m, L = 2m
$M = \dfrac{1 \times (2)^2}{2} = 2kN\text{-}m$

Ans27.c
Solution:

Ans28.b
Solution:
The efficiency of the turbine is given by:
η_t = 25% = 0.25, Output Power = 300 kW
$0.25 = \dfrac{300}{Input\ Power}$
Input power = $\dfrac{300}{0.25}$ = 1200kW

Ans29.c
Solution:

Ans30.c
Solution:

Ans31.d
Solution:
Gear ratio is given by
$G = \dfrac{T}{t} = \dfrac{63}{20} = 3.15$

Ans32.b
Solution:

Ans33.d
Solution:

Ans34.b
Solution:
Stress concentration factor = 3, maximum permissible stress = 150 MPa
Stress developed at irregular section $\leq$ maximum permissible stress
$\therefore$ Normal average stress $\times$ stress concentration factor $\leq$ 150
Normal average stress $\times$ 3 = 150
$\therefore$ Normal average stress = 50

Ans35.a
Solution:

Ans36.d
Solution:

Ans37.d
Solution:

Ans38.c
Solution:

Ans39.b
Solution:

Ans40.d
Solution:

Ans41.d
Solution:

Ans42.a
Solution:

Ans43.d
Solution:

Ans44.b
Solution:

P = μ $\times$ R = 0.2 $\times$ 200 = 40N

Ans45.c
Solution:

Ans46.c
Solution:

Ans47.c
Solution:

Ans48.c
Solution:

Ans49.c
Solution:
Synchronous speed is given by
Where N number of poll = 4, frequency = 50 Hz
Ns = $\frac{120 \times f}{p} = \frac{120 \times 50}{4}$ = 1500rpm
Slip speed Ns - Nf = 1500 - 1455 = 45 rpm

Ans50.c
Solution:

Ans51.b
Solution:

Ans52.d
Solution:

Ans53.c
Solution:

Ans54.c
Solution:

Ans55.b
Solution:

Ans56.d
Solution:

Ans57.a
Solution:

Ans58.d
Solution:

Ans59.c
Solution:

Ans60.c
Solution:
For closed coil helical spring

Deflection under load $\delta = \dfrac{8WD^3n}{Gd^4}$

$D_1 = 50$, $D_2 = 25$

Since, $\delta \propto (D)^3$

$\dfrac{\delta_2}{\delta_1} = \left(\dfrac{D_2}{D_1}\right)^3 = \dfrac{1}{8}$