1. What is the adverb for the given word below?
Misogynous
A. Misogynousness B. Misogynity
C. Misogynously D. Misogynous
Ans. C.
2. Ram and Ramesh appeared in an interview for two vacancies in the same department. The probability of Ram's selection is 1/6 and that of Ramesh is 1/8. What is the probability that only one of them will be selected?
A. $\frac{47}{48}$ B. $\frac{1}{4}$
C. $\frac{13}{48}$ D. $\frac{35}{48}$
Ans. B.
P Ram = 1/6; p Ramesh = 1/8
P(only at) = p(Ram) × p(not Ramesh) + p(Ramesh) × p(n_0 × R_{am}) = $\frac{1}{6}+\frac{7}{8}+\frac{1}{8}\times\frac{5}{6}$
$\Rightarrow \frac{12}{40}=\frac{1}{4}$
3. Choose the appropriate word/phrase, out of the four options given below, to complete the following sentence: Dhoni, as well as the other team members of Indian team, _____ present on the occasion.
A. were B. was
C. has D. have
Ans. B.
4. An electric bus has onboard instruments that report the total electricity consumed since the start of the trip as well as the total distance covered. During a single day of operation, the bus travels on stretches M, N, O and P, in that order. The cumulative distances travelled and the corresponding electricity consumption are shown in the table below

Stretch	Comulative distance(km)	Electricity used (kWh)
M	20	12
N	45	25
O	75	45
P	100	57

The stretch where the electricity consumption per km is minimum is
A. M B. N
C. O D. P
Ans. D.

Stretch	Comulative distance(km)	Electricity used (kWh)	Individual(km) Distance	Individual electricity(kWh)
M	20	12	20	12
N	45	25	25	13
O	75	45	30	20
P	100	57	25	12

For $M \Rightarrow 12/20 = 0.6$
$N \Rightarrow 13/25 = 0.555$
$O \Rightarrow 20/30 = 0.667$
$P \Rightarrow 12/25 = 0.48$
5. Choose the word most similar in meaning to the given word: Awkward
A. Inept B. Graceful
C. Suitable D. Dreadful
Ans. A.
6. In the following sentence certain parts are underlined and marked P, Q and R. One of the parts may contain certain error or may not be acceptable in standard written communication. Select the part containing an error. Choose D as your Answer: if there is no error
The student corrected
$\frac{\text{all the errors}}{P}$ that $\frac{\text{the instructor marked}}{Q}$ on the $\frac{\text{answer book}}{R}$
A. P B. Q
C. R D. No Error
Ans. B.
The is not required in „Q"
7. Given below are two statements followed by two conclusions. Assuming these statements to be true, decide which one logically follows.
Statement:
I. All film stars are playback singers.
II. All film directors are film stars.
Conclusions:
I. All film directors are playback singers.
II. Some film stars are film directors.
A. Only conclusion I follows
B. Only conclusion II follows
C. Neither conclusion I nor II follows
D. Both conclusions I and II follow
Ans. D.
8. Lamenting the gradual sidelining of the arts in school curricula, a group of prominent artists wrote to the Chief Minister last year, asking him to allocate more funds to support arts education in schools. However, no such increase has been announced in this year's Budget. The artists expressed their deep anguish at their request not being approved, but many of them remain optimistic about funding in the future.
Which of the statement(s) below is/are logically valid and can be inferred from the above statements?
i. The artists expected funding for the arts to increase this year.
ii. The Chief Minister was receptive to the idea of increasing funding for the arts.
iii. The Chief Minister is a prominent artist. iv. Schools are giving less importance to arts education nowadays.
A. iii and iv B. i and iv
C. i, ii and iv D. i and iii
Ans. B.
9. If $a^2 + b^2 + c^2 = 1$ then ab + bc + ac lies in the interval
A. $\left[1,\frac{2}{3}\right]$ B. $\left[\frac{-1}{2},1\right]$
C. $\left[-1,\frac{1}{2}\right]$ D. $[2,-4]$
Ans. B.
10. A tiger is 50 leaps of its own behind a deer. The tiger takes 5 leaps per minute to the deer's 4. If the tiger and the deer cover 8 metre and 5 metre per leap respectively, what distance in meters will the tiger have a run before it catches the deer?
A. 800 B. 600
C. 500 D. 450
Ans. A.

Tiger - 1leap ⇒ 8 meter
Speed = 5leap/hr = 40m/min
Deer → 1leap = 5meter
speed = 4hr = 20m/min
Let at time 't' the tiger catches the deer.
∴ Distance travelled by deer + initial distance between them
50 × 8 ⇒ 400m = distance covered by tiger.
⇒ 40 × t = 400 + 20t
⇒ t = $\frac{400}{200}$ = 20 min
⇒ total distance ⇒ 400 + 20 × t = 800ms

11. At least one eigenvalue of a singular matrix is

A. Positive B. zero

C. negative D. imaginary

Ans. B.

For singular matrix |A| = 0

According to properties of eigenvalue

Product of eigen values = |A| = 0

⇒ Atleast one of the eigen value is zero.

12. At x = 0, the function f(x) = |x| has

A. a minimum B. a maximum

C. a point of inflexion D. neither a maximum nor minimum

Ans. A.

For negative values of x, f(x) will be positive

∴ Minimum value of f(x) will occur at x = 0.

So, function of f(x) = |x| has a minimum value.

Hence option (A) is the correct answer.

13. Curl of vector V(x, y, z) = $2x^2$ i + $3z^2$j + y^2 k at x = y = z = 1 is

A. −3i B. 3i

C. 3i-4j D. 3i-6k

Ans. A.

Curl of vector = $\begin{vmatrix} i & j & k \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ 2x^2 & 3z^2 & y^3 \end{vmatrix}$

$= i\left[\frac{\partial}{\partial y}(y^3)\frac{\partial}{\partial z}(3z^2)\right] - i\left[\frac{\partial}{\partial x}(y^3)\frac{\partial}{\partial z}(2x^2)\right] + k\left[\frac{\partial}{\partial x}(3z^2)\frac{\partial}{\partial y}(2x^2)\right]$

= i[$3y^2$ − 6z] − j[0] + k[0 + 0]

At x = 1, y = 1 and z = 1

Curl = i(3 + 1^2 − 6 × 1) = -3i

14. The Laplace transform of e^{i5t} where $i = \sqrt{-1}$, is

A. $\frac{s-5i}{s^2-25}$ B. $\frac{s+5i}{s^2+25}$

C. $\frac{s+5i}{s^2-25}$ D. $\frac{s-5i}{s^2+25}$

Ans. B.

e^{i5t} = cos 5t + i sin 5t

$$L\left\{e^{(i5t)}\right\} = \frac{s}{s^2+25} + \frac{5i}{s^2+25}$$

$$= \frac{s+5i}{s^2+25}$$

15. Three vendors were asked to supply a very high precision component. The respective probabilities or their meetin2 the strict design specifications are 0.8, 0.7 and 0.5. Each vendor supplies one component the probability that out of total three components supplied by the vendors, at least one will meet the design specification is _____

A. 0.77 B. 0.87

C. 0.97 D. 0.79

Ans. C.

Probability of atleast one meet the specification

= 1 - $\left(\bar{A}\times\bar{B}\times\bar{C}\right)$

= 1 − (0.2 × 0.3 × 0.5)

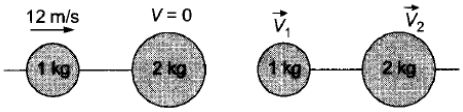
= 0.97.

16. A small ball of mass 1 kg moving with a velocity of 12 m/s undergoes a direct central impact with a stationary ball of mass 2 kg. The impact is perfectly elastic. The speed (in m/s) of 2 kg mass ball after the impact will be _____

A. 4 B. 8

C. 6 D. 2

Ans. B.



Conserving linear momentum

$1 \times 12 = 1 \times V_1 + 3 \times V_2$

$12 = V_1 + 2V_2$ . . . (i)

2. Velocity of approach = Velocity of separation

$12 - 0 = V_2 - V_1$

$V_2 - V_1 = 12$ . . . (ii)

From (i) and (ii)

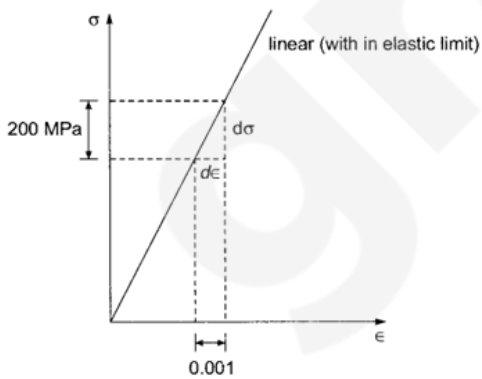
$V_2 = 8$ m/s

17. A rod is subjected to a uni-axial load within linear elastic limit. When the change in the stress is 200 MPa, the change in the strain is 0.001. If the Poisson's ratio of the rod is 0.3, the modulus of rigidity (in GPa) is _____

A. 76.9230 GPa B. 89.9230 GPa

C. 79.9230 GPa D. 87.9230 GPa

Ans. A.



With in linear elastic limit

$\sigma = E\epsilon$

$E \rightarrow$ slope of σvs ϵ curve

$$E = \frac{d\sigma}{s\in} = \frac{200}{0.001} = 200\text{GPa}$$

E = 2G[1 + u]

$$G = \frac{E}{2(1+u)} = \frac{200}{(2+1+0.3)} = \frac{100}{1.3}$$

T = 76.9230 GPa.

18. A gas is stored in a cylindrical tank of inner radius 7 in and wall thickness 50 mm. The gage pressure of the gas is 2 MPa. The maximum shear stress (in MPa) in the wall is

A. 35 B. 70

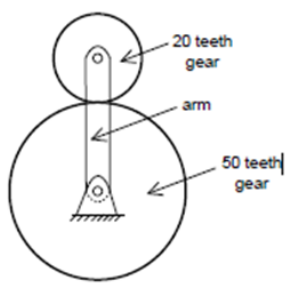
C. 140 D. 280

Ans. C.

Maximum shear stress in the wall

$$= \frac{\sigma_1}{2} = \frac{pd}{4t} = \frac{2\times14\times1000}{4\times50} = 140\,\text{MPa}$$

19. The number of degrees of freedom of the planetary gear train shown in the figure is



A. 0 B. 1

C. 2 D. 3

Ans. C.

Degree of freedom (F) = 3(l – 1) – 2j – h

= 3(4 – 1) – 2 × 3 – 1 = 2

20. In a spring-mass system, the mass is m and the spring constant is k. The critical damping coefficient of the system is 0.1 kg/s. In another spring-mass system, the mass is 2m and the spring constant is 8k. The critical damping coefficient (in kg/s) of this system is _____

A. 0.6 B. 0.3

C. 0.4 D. 0.8

Ans. C.

$$\xi = \frac{C}{2\sqrt{mk}}$$

$$C = 2\xi\sqrt{mk}$$

$$\frac{C_2}{C_1} = \frac{2\xi_2\sqrt{m_2k_2}}{2\xi_1\sqrt{m_1k_1}}$$

$$\frac{C_2}{0.1} = \frac{2\times1\sqrt{2m\times8k}}{2\times1\sqrt{m\times k}}$$

C_2 = 0.4 kg/s

21. The uniaxial yield stress of a material is 300 MPa According to von Mises criterion, the shear yield stress (in MPa) or the material is _____.

A. 173.1 MPa B. 184.2 MPa

C. 197.1 MPa D. 183.3 Mpa

Ans. A.

According to Von-Mises criterion,

$$\tau_y = \frac{\sigma_y}{\sqrt{3}}$$

$$= \frac{300}{\sqrt{3}} = 173.1 \text{ MPa}$$

22. If the fluid velocity for a potential flow is given by V(x,y) = u(x,y)i+ v(x,y)j with usual notations, then the slope of the potential line at (x. y) as

A. *v/u* B. *-u/v*

C. v^2/u^2 D. *u/v*

Ans. B.

$$d\phi = \frac{\partial\phi}{\partial x}dx + \frac{\partial\phi}{\partial y}dy$$

$$\therefore \frac{\partial\phi}{\partial x} = -u$$

$$\frac{\partial\phi}{\partial y} = -v$$

⇒ dφ = - u dx – v dy

⇒ ifφ = constant, dφ = 0

$$\Rightarrow \left(\frac{dy}{dx}\right)_\phi = -\frac{u}{v}$$

23. Which of the following statements regarding a Rankinecycle with reheating are TRUE?

(i) increase in average temperature of heat addition

(ii) reduction in thermal efficiency

(iii) drier steam at the turbine exit

A. only (i) and (ii) are correct

B. only (ii) and (iii) are correct

C. only (i) and (iii) are correct

D. (i), (ii) and (iii) are correct

Ans. C.

With reheat average temperature of heat addition increases.

Hence, efficiency of cycle also increases. Further, the quality of steam is higher at turbine exit.

Hence, statement (i) and (iii) are correct.

24. Within a boundary layer for a steady incompressible flow, the Bernoulli equation

A. holds because the flow is steady

B. holds because the flow is incompressible

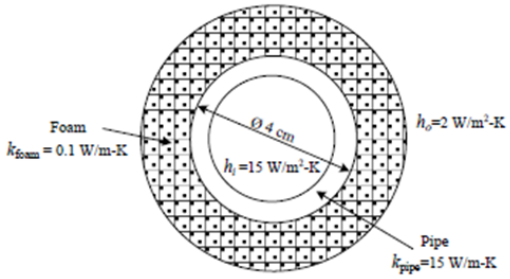
C. holds because the flow is transitional

D. does not hold because the flow is frictional

Ans. D.

Bernoulli equation does not hold because it is for non viscous flow. So, within boundary layer, Bernoulli equation is not valid because due to friction, flow is irrational.

25. If a foam insulation is added to a 4cm outer diameter pipe as shown in the figure, the critical radius of insulation (in cm) is _____



A. 5 cm B. 8 cm

C. 6 cm D. 9 cm

Ans. A.

$$r_{critical} = \frac{k_{ins}}{h} = \left(\frac{0.1}{2}\right) meter$$

= 0.05 m = 5 cm.

26. In the laminar flow of air (Pr = 0.7) over a heated plate. if ö and S denote, respectively, the hydrodynamic and thermal boundary layer thicknesses, then

A. $\delta = \delta_T$ B. $\delta > \delta_T$

C. $\delta < \delta_T$ D. $\delta = 0$ *but* $\delta_T \neq 0$

Ans. C.

$$Pr = \frac{\delta}{\delta \times}$$

As Pr = 0.7 < 1

$\Rightarrow \delta < \delta_t$

27. The COP of a Carnot heat pump operating between 6°C and 37°C is .....

A. 15 B. 10

C. 30 D. 20

Ans. B.

(COP) of Carnot Heat Pump

$$= \frac{T_H}{T_H - T_L}$$

$$= \frac{37 + 273}{31} = 10$$

28. The van der Wails equation of state is p ± (v-b = RT, where p is pressure, v is specific volume, T is temperature and R is characteristic gas constant The SI unit of a is

A. J/kg-K B. m^3/kg

C. m^5/kg-s^2 D. Pa/kg

Ans. C.

$$P = \frac{a}{v^2}$$

$$\frac{kg \times \frac{m}{s^2}}{m^2} = \frac{a}{\left(\frac{m^3}{kg}\right)^2}$$

$$\therefore a = \frac{m^5}{kg - s^2}$$

Option (C) is correct.

29. A rope-brake dynamometer attached to the crank shaft of an I.C. engine measures a brake power of 10 kW when the speed of rotation of the shaft is 400 rad/s. The shaft torque (in N-m) sensed by the dynamometer is _____

A. 25 B. 52

C. 35 D. 45

Ans. A.

Brake power = Brake torque × angular velocity

$$Torque = \frac{P}{W} = \frac{P}{\left(\frac{2\pi N}{60}\right)} = \frac{10,000}{\frac{2\pi \times N}{60}}$$

$$= \frac{10000}{400} = 25 N - m$$

30. The atomic packing factor for a material with body cantered cubic structure is

A. 0.68 B. 0.53

C. 0.89 D. 0.87

Ans. A.

Atomic packing factor =

$$\frac{\text{Volume occupied by } N_{average}}{\text{Volume of unit cell}}$$

$$= \frac{N_{average} \times \frac{4}{3}\pi r^3}{a^3}$$

For bcc structure, $a = \frac{4r}{\sqrt{3}}$ and $N_{average} = 2$

⇒ A.P.F = 0.68

31. The primary mechanism of material removal in electrochemical machining (ECM) is

A. chemical corrosion B. etching

C. ionic dissolution D. spark erosion

Ans. C.

Electrochemical Machining (ECM) is a non-traditional machining (NTM) processbelonging to Electrochemical category. ECM is opposite of electrochemical orgalvanic coating or deposition process. Thus ECM can be thought of a controlledanodic dissolution at atomic level of the work piece that is electrically conductive by ashaped tool due to flow of high current at relatively low potential difference throughan electrolyte which is quite often water based neutral salt solution. The primary mechanism of material removal in electrochemical machining (ECM) is ionic dissolution.

For electrochemical machining of steel, generally aneutral salt solution of sodium chloride (NaCl) is taken as the electrolyte. Theelectrolyte and water undergoes ionic dissociation as shown below as potentialdifference is applied

$NaCl \leftrightarrow Na^+ + Cl^-$

$H_2O \leftrightarrow H^+ + (OH)^-$

32. Which one of the following statements is **TRUE**?

A. The 'GO' gage controls the upper Limit of a hole

B. The 'NO GO' gage controls the lower limit of a shaft

C. The 'GO' gage controls the lower limit of a hole

D. The 'NO GO' gage controls the lower limit of a hole

Ans. C.

If a GO gage is used to verify the lower limit and a NOGO gage to verify the upper limit of ahole, inspection is precise, clean cut and extremely simple. Inspection with plug gages requiresno training or experience in the interpretation of numerical readouts or results which arenecessary if measuring instruments are used. By using plug gages an "inspector" has only todetermine whether a gage is entering or not entering a hole. 'GO' gauge controls the lower limit of a hole.

33. During the development of a product, an entirely new process plan is made based on design logic, examination of geometry and tolerance information. This type of process planning is known as

A. retrieval B. generative

C. variant D. group technology based

Ans. D.

This type of process planning is known as group technology based.

34. Annual demand of a product is 50000 units and the ordering cost is Rs. 7000 per order. Considering the basic economic order quantity model, the economic order quantity is 10000 units When the annual inventory cost is minimized, the annual inventory holding cost (in Rs.) is _____

A. 35,000 B. 43,330

C. 45,000 D. 65,000

Ans. A.

For minimum annual inventory cost, ordering cost = Holding cost

⇒ 7000 × number of order = holding cost

⇒ Holding cost = 7000 × $\frac{50000}{10000}$ = Rs. 35,000/-

35. Sales data of a product is given in the following table:

Month	January	February	March	April	May
Number of units sold	10	11	16	19	25

Regarding forecast for the month of June, which one of the following statements is TRTT?

A. Moving average will forecast a higher value compared to regression

B. Higher the value of order X the greater will be the forecast value by moving average.

C. Exponential smoothing will forecast a higher value compared to regression.
D. Regression will forecast a higher value compared to moving average
Ans. D.
As regression follow a pattern
$(\text{forcast})_{\text{june}}$ according to regression > 25
But according to moving average, $(T)_{\text{june}} < 25$

36. The chance of a student passing an exam is 20%. The chance of a student passing the exam and getting above 90% marks in it is 5%. GIVEN that a student passes the examination, the probability that the student gets above 90% marks is
A. 1/18 B. 1/4
C. 2/9 D. 5/18
Ans. B.
Given
p(passing the exam) = 0.2
p(passing the exam ∩ 90%) = 0.05
The desired probability = p(> 90 % passing the exam)

$$= \frac{p(\text{passing the exam} \cap > 90\%)}{p(\text{passing the exam})}$$

$$= \frac{0.05}{0.2} = \frac{1}{4}$$

37. The surface integral

$$\int\int_s \frac{1}{\pi}(9xi - 3yj).ndS$$

over the sphere given by $x^2 + y^2 + z^2 = 9$ is _____
A. 216 B. 315
C. 454 D. 258
Ans. A.
According to gauge divergence theorem

$$\int\int_s \frac{1}{\pi}(9xi - 3yj).ndS$$

$$= \frac{1}{\pi}\int \text{divergence}\,(9xi - 3yi),dv$$

$$= \frac{1}{\pi}[9-3] \times \frac{4}{3}\pi[r^3]$$

r = 3 [given]

$$= \frac{1}{\pi} \times 6 \times \frac{4}{3}\pi \times 27 = 216$$

38. Consider the following differential equation:

$\frac{dy}{dt}$ = -5y initial condition: y = 2 at t = 0.

The value of *y* at t = 3 is
A. $-5e^{-10}$ B. $2e^{-10}$
C. $2e^{-15}$ D. $-15e^{2}$
Ans. C.

$$\frac{dy}{dt} = -5y$$

$$\int \frac{dy}{y} = -\int 5dt$$

ln y = -5t + C
at t = 0
y = 2
ln 2 = C
So ln y = -5t + ln 2

$$\ln \frac{y}{2} = -5t$$

$$\frac{y}{2} = e^{-5t}$$

$y = 2e^{-5t}$
at t = 3
$y = 2e^{-15}$

39. The values of function $f(x)$ at 5 discrete poets are given below:

x	0	0.1	0.2	0.3	0.4
$f(x)$	0	10	40	90	160

Using Trapezoial rule with step size or 0.1, the value or

$$\int_0^{0.4} f(x)dx \text{ is } \_\_\_\_\_$$

A. 23 B. 22

C. 25 D. 28

Ans. B.

$$\int_0^{0.4} f(x)dx = \frac{h}{2}\left[y_0 + 2[y_1 + y_2 + y_3] + y_4\right]$$

$$= \frac{0.1}{2}\left[0 + 2[10 + 40 + 90] + 10\right] = 22.$$

40. The initial velocity of an object is 40 m/s. The acceleration *a* of the object is given by the following expression:

a= -0.1*v,*

where *v* is the instantaneous velocity of the object. The velocity of the object after 3 seconds will be ____

A. 29.6327 m/s B. 39.2523 m/s

C. 49.4562 m/s D. 27.5343 m/s

Ans. A.

u = 40 m/s

a = -0.1 V

V = ?

t = 3s

$$a = \frac{dv}{dt} = -0.1V$$

$$[\ln V]_{40}^{V} = -0.1[t]$$

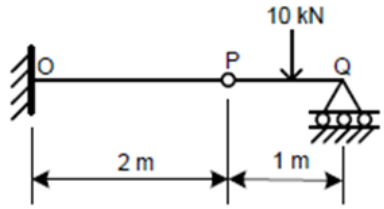
ln V – ln 40 = - 0.1 [3.0] = - 0.3

ln V = ln 40 – 0.3

ln V = 3.38887

V = 29.6327 m/s

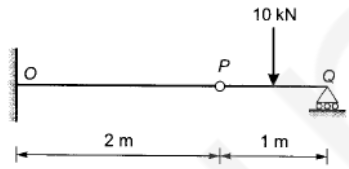
41. A cantilever beam OP is connected to another beam PQ with a pin joint as shown in the figure. A load of 10 kN is applied at the and-point of PQ. The magnitude of bending moment (in kN-m) at fixed end 0 is



A. 2.5 B. 5

C. 10 D. 25

Ans. C.



$\Sigma M_P = 0$

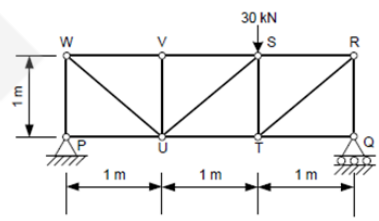
$\Rightarrow R_Q = 1 - 10 \times 0.5 = 0$

$\Rightarrow R_Q = 5kN$

$\Rightarrow M_O = 10 \times 2.5 - R_Q \times 3$

$= 25 - 15 = 10$ kN-m

42. For the truss shown in the figure, the magnitude of the force (in kN) in the member SR is



A. 10 B. 14.14

C. 20 D. 28.28

Ans. C.

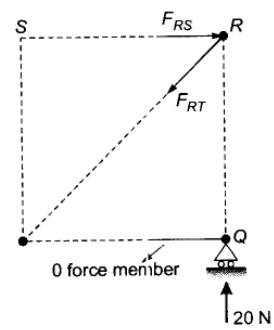
$\Sigma M_P = 0$

$30 \times 2 = R_Q \times 3$

$R_Q = 20$ N N

$R_P = 10$ N

Using method of section

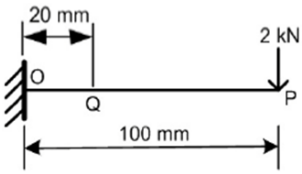


Considering moment about point T, which is zero

$R_Q \times 1 = F_{RS} \times 1$

$F_{RS} = R_Q = 20$ N compressive

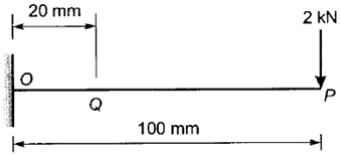
43. A cantilever beam with square cross-section of 6 mm side is subjected to a load of 2 kN normal to the top surface as shown in the figure. The Young's modulus of elasticity or the material of the beam is 210 GPa fl magnitude of slope (in radian) at Q (20 mm from the fixed end) is_____



A. 0.1872 B. 0.17823

C. 0.1587 D. 0.1823

Ans. C.



$S_Q - S_O = \frac{1}{EI}$ [area of bending moment diagram between O and Q]

Since, $S_O = 0$ [fixed end]

$S_Q =$

$$\frac{12}{210\times10^3\times(6)^4}\left[2\times80\times20+\frac{1}{2}\times2\times20\times20\right]\times10^3$$

$= 0.158$ radian

44. In a plane stress condition, the components of stress at a point are $\sigma_x = 20$ MPa, $\sigma_y = 80$ MPa and $\sigma_{xy} = 40$ MPa the maximum shear stress (in MPa) at the point is

A. 20 B. 25

C. 50 D. 100

Ans. C.

$$\sigma_{1.2} = \frac{1}{2}\left[(\sigma_x+\sigma_y)\pm\sqrt{(\sigma_x-\sigma_y)^2+4\tau_{xy}^2}\right]$$

$$= \frac{1}{2}\left[100\pm\sqrt{(60)^2+4\times40^2}\right]$$

$\Rightarrow \sigma_1 = 100$

$\sigma_2 = 0$

$$T_{max} = \frac{\sigma_1}{2} = 50 \text{ MPa.}$$

45. In a certain slides-crank mechanism, lengths of crank aid commenting rod are equal. If the crank rotates with a uniform angular speed of 14 rad/s and the crank length is 300 mm, the maximum acceleration of the slider (in m/s^2) is _____

A. 117.6 m/s^2 B. 217.6 m/s^2

C. 245.6 m/s^2 D. 347.6 m/s^2

Ans. A.

$$a = r\omega^2\left[\cos\theta+\frac{\cos2\theta}{n}\right]$$

$at\theta = 0$

$a \Rightarrow a_{max}$

$$a_{max} = r\omega^2\left[1+\frac{1}{n}\right]$$

$$= \frac{l}{r} = 1$$

$a_{max} = 2r\omega^2$

$= 2 \times 0.3 \times 14^2$

$a_{max} = 117.6$ m/s^2

46. A single-degree-freedom spring-mass system is subjected to a sinusoidal force of 10 N amplitude and frequency *w* along the axis of the spring. The stiffness of the spring is 150 N/m damping factor is 0.2 and the undamped natural frequency is 10*w.* At steady state, the amplitude of vibration (in m) is approximately

A. 0.05 B. 0.07

C. 0.70 (1) 0.90

Ans. B.

$$A = \frac{F_o / s}{\sqrt{\left[1-\left(\frac{\omega}{\omega_n}\right)^2\right]^2 - \left(2\xi\frac{\omega}{\omega_n}\right)^2}}$$

Data given

F = 10 N

S = 150 N/m

$$\frac{\omega}{\omega_0} = \frac{\omega}{10\omega} = 0.1$$

ε = 0.2

$$\Rightarrow A = \frac{10/150}{\sqrt{\left[1-(0.1)^2\right]^2 + \left[2\times0.2\times0.1\right]^2}}$$

= 0.07 m.

47. A hollow shaft of 1 m length is designed to transmit a power of 30 kW at 700 rpm. The maximum permissible angle of twist in the shaft is 1°. The inner diameter of the shaft is 0.7 times the outer diameter. The modulus of rigidity is 80 GPa. The outside diameter (in mm) of the shaft is _____

A. 44.5212 mm B. 54.5212 mm

C. 64.5212 mm D. 48.5212 mm

Ans. A.

Data given P = 30 kW

N = 700 rpm

$$\frac{2\pi NT}{60} = 30\times10^3 = P$$

⇒ T = 409.25 N-m

$$q = \frac{TL}{GJ}$$

$$\Rightarrow \frac{1\times\pi}{180} = \frac{409.25\times10^3\times10^3\times32}{\pi(d_0)^4(1-0.7^4)\times80\times10^3}$$

⇒ d_0 = 44.5212 mm.

48. A hollow shaft ($d_o = 2d_i$ where d_o and d_i are the outer and inner diameters respectively) needs to transmit 20 kW power at 3000 RPM. If the maximum permissible shear stress is 30 MPa, d_o is

A. 11.29 mm B. 22.58 mm

C. 33.87 mm D. 45.16 mm

Ans. B.

Date given $d_0 = 2d_i$

$$k = \frac{d_i}{d_O} = 0.5$$

P = 20 kW

N = 3000 RPM

$$\frac{2\pi NT}{60} = P$$

$$\Rightarrow T = \frac{60\times20\times10^3}{2\pi\times3000} = 63.6697\ N-m$$

$$\Rightarrow T_{max} = \frac{16T}{\pi d_0^3(1-k^4)}$$

$$\Rightarrow 30 = \frac{16\times3.66197\times10^3}{\pi\times d_0^3(1-0.5^4)}$$

⇒ d_0 (outer diameter) = 22.59 mm.

49. The total emissive power of a surface is 500 W/m² at a temperature T_1 and 1200 W/m² at a temperature T_2, where the temperatures are in Kelvin Assuming the emissivity of the surface to be constant, the ratio of the temperatures is

A. 0.308 B. 0.416

C. 0.803 D. 0.8741

Ans. C.

E (emmisive power) ∝ T^4 $(\because \in = \text{const.})$

$$\frac{E_1}{E_2} = \left(\frac{T_1}{T_2}\right)^4$$

$$\Rightarrow \frac{T_1}{T_2} = \left(\frac{500}{1200}\right)^{1/4} = 0.803$$

50. The head loss for a laminar incompressible flow through a horizontal circular pipe is h_1. Pipe length and fluid remaining the same, if the average flow velocity doubles and the pipe diameter reduces to half its previous value, the head loss is h_2.The ratio h_2/h_1 is

A. 1 B. 4

C. 8 D. 16

Ans. C.

$$H_f = \frac{32mUL}{wD^2}$$

$$h_f \propto \frac{V}{D^2}$$

$$\Rightarrow \frac{h_2}{h_1} = \left(\frac{V_2}{V_1}\right) \times \left(\frac{D_1}{D_2}\right)^2$$

$= 2 \times (2)^2 = 8$

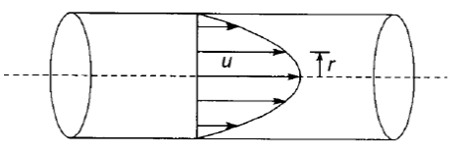
51. For a fully developed laminar flow of water (dynamic viscosity 0.001 Pa-s) through a pipe of radius 5 cm. the axial pressure gradient is —10 Pa/m. The magnitude or axial velocity (in m/s) at a radial location of 0.2 cm is

_____

A. 6.24 B. 8.34

C. 4.45 D. 7.43

Ans. A.



For incompressible laminar flows throughpipes velocity distribution

$$u = -\frac{1}{4}\left(\frac{\partial p}{\partial x}\right)\left(R^2 - r^2\right)$$

R = 5 cm

$$-\frac{\partial p}{\partial x} = 10 Pa/m$$

$$u = \frac{10}{4 \times 0.01}\left[\left(\frac{5}{100}\right)^2 - \left(\frac{0.2}{100}\right)^2\right]$$

= 6.24 m/sec.

52. A balanced counter flow heat exchanger has a surface area of 20 m^2 and overall heat transfer coefficient of 20 W/m^2-K. Air (Cp = 1000j/kg-K) entering at 0.4 kg/s and 280 K is to be preheated by the air leaving the system at 0.4 kg/s and 300 K The outlet temperature (in K) of the preheated air is

A. 290 B. 300

C. 320 D. 350

Ans. A.

Counter flow heat exchanged

Surface area A = 20 m^2

Mass flow rate = 0.4 kg/s

Temperature T_cI = 280K

T_{CO} = ?

$$u \frac{20W}{m^2K}$$

C_P of air = 1000 $\frac{J}{kgK}$

Since m is same for both flow = 0.4 kg/s

Assume C_P is same = 1000 J/kg K

Hence

$\Delta T_1 = T_i - T_{o0} = \Delta T_2 = T_{h0} - T_{ci}$

$\Delta T_1 = 300 - T_{co} = T_{h0} - 280$

$\Delta T_m = \Delta T_1 = \Delta T_2$

$$uA\Delta T_m = \dot{m} C_p \left(T_{co} - t_{ci}\right)$$

$20 \times 20 \times (300 - T_{co}) = 0.4 \times 1000(T_{co} - 280)$

$2T_{co} = 300 + 280$

$$T_{co} = \frac{580}{2} = 290 \text{ K}$$

53. A cylindrical uranium fuel rod of radius 5 mm in a nuclear reactor is generating heat at the rate of 4×10^7 W/m^3 the rod is cooled by a liquid (convective heat transfer coefficient 1000 W/m^2-K) at 25°C. At steady state, the surface temperature (in K) of the rod is

A. 308 B. 398

C. 418 D. 448

Ans. B.

For steady state of Rod,

The rate of heat generation in the rod = the rate of convection H.T. from Rod to fluid

$q \times \pi R^2 \times L = h \times (2\pi \times R \times L)\ (T_s - T_{fluid})$

$$T_s = T_{fluid} + \frac{qR}{2h}$$

$$= 25 + \frac{4\times10^7}{2\times1000}\times\frac{5}{1000}$$

$= 125°c = 398$ k.

54. Work is done on an adiabatic system due to which its velocity changes from 10 m/s to 20 m/ s. elevation increases by 20 m and temperature increases by 1 K. The mass of the system is 10 kg. Cv= 100 J/(kg K) and gravitational acceleration is 10 m/s^2. If there is no change in any other component of the energy of the system, the magnitude of total work done (in kJ) on the system is _____

A. 4.5 kJ B. 5.6 kJ

C. 6.5 kJ D. 7.4 kJ

Ans. A.

$\delta Q = dE + \delta W$

$O = \Delta U + \Delta K.E + \Delta P.E + \delta W$

$$O = mC_v dT + \frac{1}{2}m\left(C_2^2 - C_1^2\right) + mg\left(Z_2 - Z_1\right) + \delta W$$

$$O = 10 \times 0.1 \times 1 + \frac{1}{2}\times10(20)^2 - \left(10^2\right)\times10^{-3} +$$

$10 \times 10 \times 20 \times 10^{-3} + \delta W$

$\therefore \delta W = -4.5$ kJ $= 4.5$ kJ.

55. One kg of air (R = 287 j/kg-K) undergoes an irreversible process between equilibrium state 1 (20°C. 0.9 m^3) and equilibrium state 2 (20°C, 0.6 m^3). The change in entropy S2 - S1 (in j/kg-K) is

A. –117.433 J/kg – K B. –234.234 J/kg – K

C. –11.368 J/kg – K D. –323.343 J/kg – K

Ans. C.

$$s_2 - s_1 = C_v \ln\frac{T_2}{T_1} + R\ln\frac{V_2}{V_2}$$

$$= 287 \ln\frac{0.6}{0.9}$$

$= -116.368$ J/kg – K

56 For the same values of peak pressure, peak temperature and heat rejection, the correct order of efficiencies for Otto. Dual and Diesel cycles is

A. $\eta_{otto}>\eta_{Dual}>\eta_{Diesel}$ B. $\eta_{Diesel}>\eta_{Dual}>\eta_{otto}$

C. $\eta_{Dual}>\eta_{Diesel}>\eta_{otto}$ D. $\eta_{Diesel}>\eta_{otto}>\eta_{Dual}$

Ans. B.

For same values of peak pressure and temperature. Diesel cycle is most efficient and Otto cycle is least. Efficiency of dual cycle lies in between.

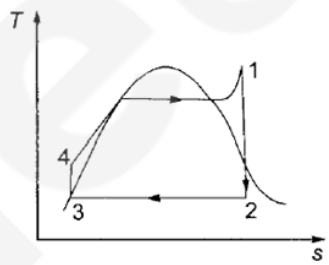
$\eta_{diesel} > \eta_{dual} > \eta_{otto}$

57. In a Rankine cycle, the enthalpies at turbine entry and outlet are 3159 kJ/kg and 2187 kJ/kg respectively. If the specific pump work is 2 kJ/ kg. The specific steam consumption (in kg/kW-h) of the cycle based on net output is _____

A. 3.711 B. 5.223

C. 5.244 D. 5.243

Ans. A.



$W_{turbine} = (h_1 - h_2) = (3159 - 2187)$ kJ/kg

$W_{net} = W_T - W_{pump} = 972 - 2 = 970$ kJ/kg

Specific steam consumption

$$= \frac{3600}{970} kg/KW-Hr$$

= 3.711 kg / KW-Hr

Specific steam consumption is amount of required to produce 1 kW-Hr (or) 300 kJ or work.

58. A cube and a sphere made or cast iron (each of volume 1000 cm^3) were cast under identical conditions. The time taken for solidifying the cube was 4 s. The solidification tune (in s) for the sphere is _____.

A. 6.57355 sec. B. 7.23455 sec.

C. 5.23455 sec. D. 2.52355 sec.

Ans. A.

Time of solidification (T)

$$= k\left[\frac{\text{volume}}{\text{surface area}}\right]^2$$

$$\left[\frac{T_{sphere}}{T_{cube}}\right] = \left[\frac{A_{cube}}{A_{sphere}}\right]^2 = \left[\frac{6a^2}{4/3\pi r^3}\right]^2 \quad \ldots \text{(i)}$$

$\because$ $[V_{sphere} = V_{cube}]$

$V_{cube} = a^3 = 1000\ cm^3$

$\Rightarrow a = 10$ cm

Similarly,

$$V_{sphere} = \frac{4}{3}\pi r^3 = 1000$$

$\Rightarrow r = 6.2035$ cm

Putting in (i), we get

$$\frac{T_{sphere}}{T_{cube}} = \left[\frac{6\times10^2}{4\pi\times(6.2035)^2}\right]^2$$

$T_{sphere} = 6.57355$ sec.

59. In a two-stage wire drawing operation, the fractional reduction (ratio of change in cross-sectional area to initial cross-sectional area) in the first stage is 04. The fractional reduction in the second stage is 03. The overall fractional reduction is

A. 0.24 B. 0.58

C. 0.60 D. 1.00

Ans. B.

Fractional reduction in first stage =

$$\frac{\text{change in area in first stage}}{\text{original area (A) before reduction}}$$

$$0.4 = \frac{\text{change in area in first stage}}{(A)}$$

Change in area in first stage = 0.4A

Area after first redirection = A – 0.4 A = 0.6A

Fraction reduction in second stage =

$$\frac{\text{change in area in second stage}}{\text{original area before second stage}}$$

$$0.3 = \frac{\text{change in area in second stage}}{0.6A}$$

Change in after 2nd stage = 0.18 A

Remaining area after 2nd reduction = 0.6 0.18 A = 0.42 A

Overall reduction in Area = A – 0.42 A = 0.58 A

Overall fractional reduction =

$$\frac{\text{overall reduction in area}}{\text{original area}} = \frac{0.58A}{A} = 0.58$$

60. The flow stress (in MPa) of a material is given by $\sigma = 500\ \varepsilon^{0.1}$. Where ε is true strain. The Young's modulus of elasticity of the mater 4l is 200GPa. A block or thickness 100 mm made of this material is compressed to 95 mm thickness and then the load is removed. The final dimension of the block (in mm) is _____

A. 95.1286 B. 94.1456

C. 97.1343 D. 91.1435

Ans. A.

Equating the stress to the equation up to elastic limit, we get

$\sigma = 500\ \epsilon^{0.1} = 200 \times 10^3 \times \epsilon$

$$\Rightarrow \epsilon^{0.9} = \frac{500}{200\times10^3}$$

$\Rightarrow \epsilon$ (true strain) $= 1.28476 \times 10^{-3}$

$\Rightarrow \epsilon_T = \ln(1 + \epsilon)$

$$\Rightarrow \epsilon(\text{engg. Strain})_{\text{upto elastic limit}} = 1.285586 \times 10^{-3} = \frac{\Delta L}{L}$$

$\Rightarrow (\Delta L)_{\text{upto elastic limit}} = 0.128558$ mm

$\Rightarrow$ Final dimension of block = 95 + elastic recover = 95.128558 mm.

61. During a TIG welding process, the arc current and arc voltage were 50 A and 60 V. respectively, when the welding speed was 150 mm/min. In another process, the TIG welding is carried out at a welding speed of 120 mm/min at the same arc voltage and heat input to the material so that weld quality remains the same the welding current (in A) for this process is

A. 40.00 B. 4472

C. 55.90 D. 62.25

Ans. A.

$$\frac{50\times0}{150} = \frac{I\times60}{120}$$

$$I = \frac{50\times12}{155} = 40 \text{ Ampere}$$

62. A single point cutting tool with 0^orake angle is used in an orthogonal machining process. At a cutting speed of 180 m/min. the thrust force is 490 N. If the coefficient of friction between the tool and the chip is 0.7, then the power consumption (in kW) for the machining operation is _____

A. 3.5 B. 2.1

C. 5.6 D. 7.1

Ans. B.

$$\frac{F}{N} = \frac{F_T}{F_C} = 0.7$$

$$\Rightarrow \frac{490}{F_C} = 0.7$$

F_C = 700 N

$$\text{Power } F_C \times V = \frac{700 \times 180}{60}$$

= 2.1 kW.

63. A resistance-capacitance relaxation circuit is used in an electrical discharge machining process. The discharge voltage is 100 V. At a spark cycle time of 25 μs, the average Power input required is 1 kW. The capacitance (in μF) in the circuit is

A. 2.5 B. 5.0

C. 75 D. 10.0

Ans. B.

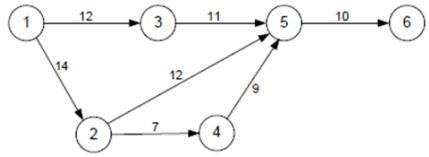
$$\text{Power} = \frac{\text{work}}{\text{time}}$$

$$P = \frac{1}{2}\frac{CV^2}{t}$$

$$C = \frac{P \times 2t}{V^2}$$

$$= \frac{1000 \times 2 \times 25 \times 10^{-6}}{(100)^2} = 5\mu F$$

64. A project consists of 7 activities. The network along with the time durations (in days) for various activities is shown in the figure



The minimum time (in days) for completion of the project is _____

A. 60 B. 40

C. 45 D. 65

Ans. B.

Time taken for 3 paths are follows

Path 1 = 12 + 11 + 10

Path 2 = 14 + 12 + 10

Path 3 = 14 + 7 + 9 + 10

∴ Path 3 is longest i.e., path 3 is critical path

∴ Project duration = 40 days.

65. A manufacturer has the following data regarding a product:

Fixed cost per month = Rs. 50000

Variable cost per unit = Rs. 200

Selling price Per unit = Rs. 300

Production capacity = 1500 units per month

If the production is carried out at 80% of the rated capacity, then the monthly profit (in Rs.) is_____

A. 60,000 B. 70,000

C. 57,000 D. 72,000

Ans. B.

Production = 0.8 × 1500 = 1200

Profit = S – V – F

= 1200 × 300 – 1200 × 200 – 50000

= Rs. 70,000

***