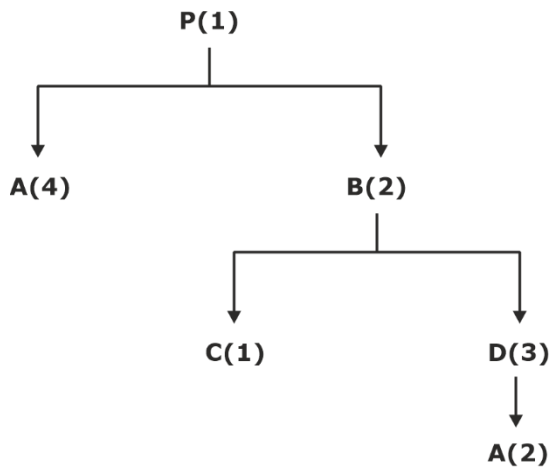# GATE 2022

Mechanical Engineering

Forenoon Shift

Questions & Answers (Memory Based)

(MEMORY BASED)

1. Given, A = 50 (In hand Inventory)
How many required of A units to make P of 10 (units)?

P(1)

A(4)　　　　　B(2)

C(1)　　　　　D(3)

A(2)

[NAT: 2 Marks]

Ans. 110 units

2. $\Psi = Kx^3y \ K = 1m^{-2}s^{-1} \ a(x, y) = (1, 1)$........

[NAT: 1 Mark]

Ans. $3\sqrt{2}$

3. Given, velocity $p \Rightarrow v = 2x\hat{i} + (y + 3t)\hat{j}$
temperature $T = 2x^2 + xy + 4t$
Find the rate of temperature with respect to time?
At x, y = 1, 1 and time 1 sec.

A. 10　　　　　　B. 16
C. 20　　　　　　D. 8

[MCQ: 2 Marks]

Ans. B

4. Consider steady, one-dimensional compressible flow of a gas in a pipe of diameter 1m. At one location in the pipe the density and velocity are 1 kg/m^3 and 100 m/s respectively. At a downstream location in the pipe, the velocity is 170 m/s. If the pressure
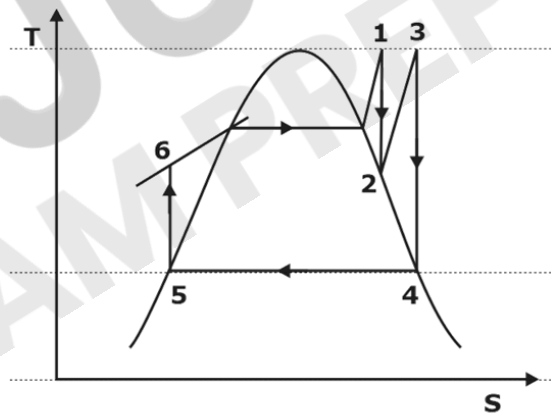
drop between the these two locations is 10 kPa, the force exerted by the gas on the pipe between these two location is.

A. 300 п　　　　　B. 100 п
C. 350 п　　　　　D. 750 п

[NAT: 2 Marks]

Ans. D

5. WT_1 = 400 kJ/kg
$W \ T_2$ = 850 kJ/kg
$W \ P_1$ = 15 kJ/kg
η_{cy} = 32%
Q_R = ?

[NAT: 2 Marks]

Ans. 2627.375 kJ/kg

6. Given swept volume = 250 cm^3
Clearance volume = 37.5 cm^3

Neat input is given $= 800\dfrac{kJ}{kg}$

Consider $C_v = 0.718\dfrac{kJ}{kgK}, \gamma = 1.4$

T_1= 25°C P_1 = 100 kPa
Find the maximum pressure (in kPa)

[NAT: 2 Marks]

Ans. 4829.03 kPa

2

7. Find polytropic work:

$P_1 = 110$ kPa,

$V_1 = 5m^3$,

$V_2 = 2.5$ m^3,

$n = 1.2$

[NAT: 1 Mark]

Ans. 408.92 kPa

8. Clausius inequality holds good for which
_____

[MCQ: 1 Mark]

A. Any process

B. Any cycle

C. Reversible process

D. Reversible cycle

Ans. B

9. Wall slab of thickness 0.1 m ..... Higher temp of left surface = 80°C .... thermal cond = 15 W/mk .... heat transfer through wall = 4500 W/m^2........ Find rate of entropy generation
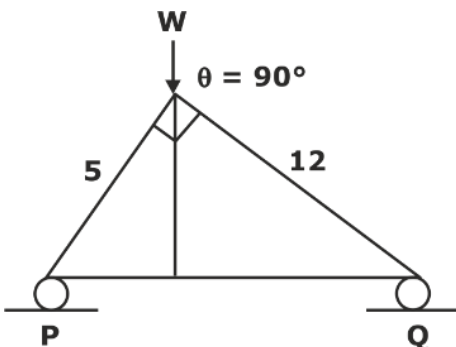
[NAT: 2 Marks]

Ans. 1.1884 w/m^2 K

10. Find the ratio of friction force at Q to P at θ = 90°. $\frac{\mu_Q}{\mu_P}$?

[NAT: 2 Marks]

Ans. 5.76

11. Rolling without slipping, ω = 5 rad/s, r = 0.15 m. Find V_{centre} ?

[NAT: 1 Mark]
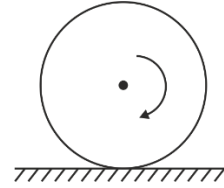
Ans. 0.75

12. The plane of the figure represents a horizontal plane. A thin rigid rod at rest is pivoted without friction about a fixed vertical axis passing through O. Its mass moment of inertia is = 0.1 kg cm^2 about O. A point mass of 0.001 kg hits it normally at 200 cm/s at the location shown, sticks to it immediately after the impact, the angular velocity of rod is _____ rad/s

[NAT: 1 Mark]
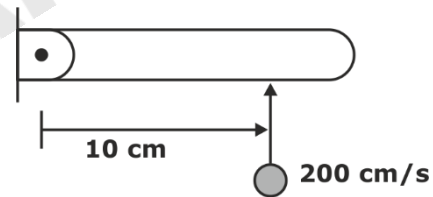
Ans. 20

13. In a unit square, rhombus formed by joining mid points of the square, and circle inscribed in the rhombus find diameter of the circle.

A. $\sqrt{2}$

B. $2\sqrt{2}$

C. $\frac{1}{\sqrt{2}}$

D. $\frac{2}{2\sqrt{2}}$

[MCQ: 2 Marks]

Ans. C

14. Area of equilateral triangle, square and circle is same. Find ratio of circumference

[MCQ: 2 Marks]

Ans. $\dfrac{6}{\sqrt{3}} : 4 : 2\sqrt{2}$

15. A distance of 80 km is covered in 6 hours some distance is covered @10 kmph & some distance is covered @18 kmph how much % of distance is covered @10 kmph.

A. 28.25

B. 43.75

C. 50

D. 37.75

[MCQ: 2 Marks]

Ans. B

16. The average of M, N, S is 4000 the average of N, S, P is 5000

P = 6000

M is _____% of P

A. 30%

B. 50%

C. 70%

D. 25%

[MCQ: 2 Marks]

Ans. B

17. If play tennis for _____ bowl, I am _____ used

[MCQ: 1 Mark]

Ans. two, too

18. Statement 1 : All teachers are professors

Statement 2 : No professor are males

Statement 3 : some males are engineer

Conclusion I : No engineer is a professor

Conclusion II : Some engineers are professors

Conclusion III : No male is a teacher

[MCQ: 1 Mark]

Ans. Only conclusion III is correct

19. 2-D momentum equation for natural convection;

$u\dfrac{\partial u}{\partial x} + v\dfrac{\partial u}{\partial y} = g\beta\,(T - T_\infty) + v\dfrac{\partial 2u}{\partial x2}$;

the from $g\,\beta\,(T - T_\infty)$ represent.

[MCQ: 1 Mark]

A. Ratio of inertia force to viscous force

B. Ratio of Buoyant force to viscous force

C. viscous force per unit mass

D. Buoyant force per unit mass

Ans. D

20. During an open heart surgery, a patient's blood is cooled down to 25°C from 37°C using a concentric tube counter-flow heat exchanger water enters the heat exchanger at 4°C & leaves at 18°C. Blood flow rate during surgery is 5 ltr.per min. using the following fluid properties
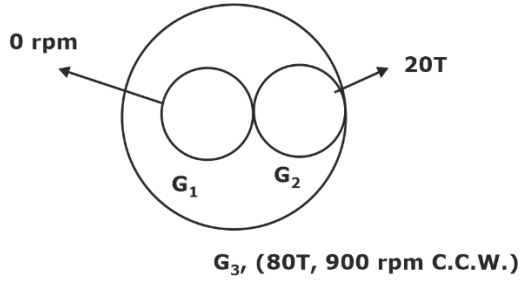
Calculate effectiveness of heat exchangers

Fluid	Density kg/m³	Specific Heat
Blood	1050	3740
Water	1000	4200

[NAT: 2 Marks]

Ans. 0.42

21. Find ω of arm

G_3, (80T, 900 rpm C.C.W.)

[NAT: 2 Marks]

Ans. −600

22. Find ω_n for given system ω_n
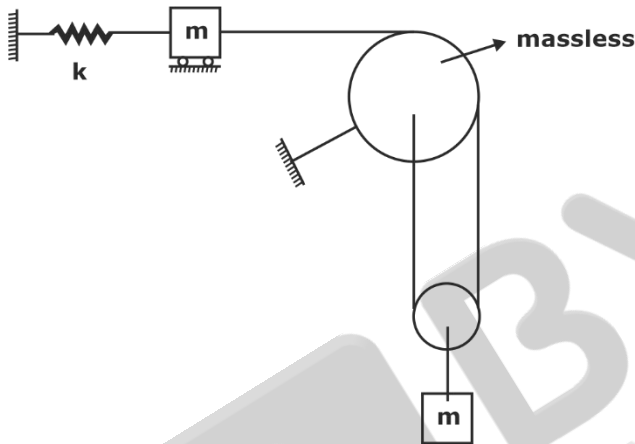
Ans. $\sqrt{\dfrac{k}{M+\dfrac{m}{4}}}$

23. A 4 mm thick Al sheet of width(he) = 100 mm is rolled in a two-roll mill of roll diameter 200 mm each. The N/P is lubricated with a mineral oil, which gives a μ = 0.1. The flow stress (σ) of the material in MPa is σ = 207 + 414 ∈ where ∈ is the true strain. Assembly rolling to be a plane strain deformation process, the roll separation force (F) for maximum permissible draft (thickness reduction) is - (kN)

Use :

$$F = 1.15\bar{\sigma}\left(1+\frac{\mu l}{2\bar{h}}\right)lb$$

Where $\bar{\sigma}$ is average flow stress and $\bar{h}$ is the average sheet thickness.

[NAT: 2 Marks]

Ans. 428.5 kN

24. A CNC work table is driven in a linear direction by a lead screw connected directly to a stepper motor. The pitch of the load screw is 5 mm. The stepper motor completes one full rotation upon running 600 pulses. If the work table speed is 5 m/min a there is no missed pulse, then the pulse rate being received the stepper motor is

[MCQ: 2 Marks]

A. 15 kHz
B. 20 kHz
C. 3 kHz
D. 10 kHz

Ans. D

25. The type of fit between a meeting shaft of diameter $25.00^{+0.010}_{-0.010}$ mm a hole of diameter $25.00^{+0.015}_{-0.015}$ mm is

[MCQ: 1 Mark]

A. Transition
B. Linear
C. Interference
D. Clearance

Ans. A

26. Which of the following additive manufacturing(s) can use a wire as a feel stock material?

[MSQ: 1 Mark]

A. Directed energy deposition processes
B. Stereolithography
C. Fused deposition modeling
D. Selective laser sintering.

Ans. A, C & D

27. Which of the following heat treatment processes is/are used for surface hardening of steels?

[MSQ: 1 Mark]

A. Annealing

B. Carburizing

C. Cyaniding

D. Carbonitriding

Ans. B, C & D

28. 1 mm thick cylinder tube, 100 mm diameter is orthogonally turned such that the entire wall thickness of the tube is cut in a single pass. The axial seed of the tools is 1 m/min. Cutting energy (μ) of the tube material is 6 J/mm^3, neglect contribution of feed force towards power. The power required is

[MAT: 2 Marks]

Ans. 31.48 kW

29. V = 20 V

I = 150 A

Welding Speed = 5 mm/sec

d = 3 mm

η_{ht} = 0.7

η_m = 0.6

feed rate = ??

Unit melt energy are required 10 J/mm^3 = u
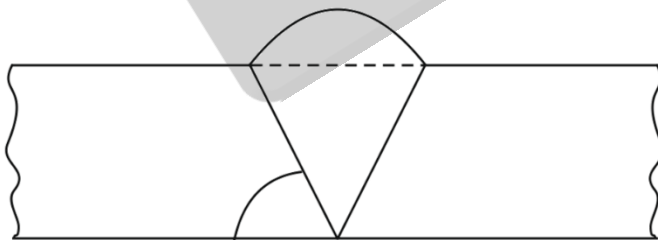
40% Plate
60% Electrode

[MCQ: 1 Mark]

Ans. 10.7

30. Let a random variable X follow Poisson distribution such that

Probability (X = 1) = Probability (X = 2)

The value of Probability (X = 3) is _____

(round of to 2 decimal place).

[NAT: 1 Mark]

Ans. 0.180

31. The Fourier series expansion of x^3 in the interval −1 ≤ x <1 with periodic continuation has

A. Only sine term

B. Both sine & cosine terms

C. Only cosine term

D. Only sine term and a non-zero constant

[MCQ: 1 Mark]

Ans. A

32. The Solution of linear equation

$$(x \quad y)\begin{bmatrix} 2 & 5-2a \\ a & 1 \end{bmatrix} = (0 \ 0)$$

has infinitely many non-trivial solutions for a special value of a. Which among the following options is/are non-trivial solutions of (x, y)?

A. x = −1   y = 4

B. x = 1   y = 1

C. x = 2   y = −2

D. x = 4   y = −2

[MSQ: 2 Marks]

Ans. A & C

33. $\begin{bmatrix} 10 & 2k+5 \\ 3K-3 & K+5 \end{bmatrix}$ is symmetric matrix then the value of K.

A. 8   B. 5

C. $\dfrac{1+\sqrt{5}}{12}$ D. 3

[MCQ: 1 Mark]

Ans. A

34. $P = \lim\limits_{x \to \pi} \left[\dfrac{x^3 + \alpha x + 2\pi^2}{x - \pi + 2\sin x} \right]$

Find α & P

A. π & π

B. −3π & π

C. −2π & 2π

D. 2π & 3π

[MCQ: 2 Marks]

Ans. B

35. Solution $\Delta^2 T = 0$ in a square domain (0 < x < 1 & 0 < y < 1) with boundary conditions:

T(x, 0) = x

T(0, y) = y

T(x, 1) = 1 + x

T(1, y) = 1 + y

T(x, y) =

A. x − xy + y   B. x + y

C. x + xy + y   D. −x + y

[MCQ: 1 Mark]

Ans. B

36. Given a function ψ = ½ $(x^2 + y^2 + z^2)$ in three dimensional cortisone space, the value of the surface in integral $\oiint \hat{n} \cdot \nabla \phi \, ds$ where S is the surface of sphere of unit radius $\hat{n}$ is the out word unit normal ratio on S, is

A. 4π/3   B. 4π

C. 0   D. 3π

[MCQ: 1 Mark]

Ans. B

37. The value of integral

$\oint \left(\dfrac{6z}{2z^4 - 3z^3 + 7z^2 - 3z + 5} \right) dz.$

Evaluated over counter-clockwise circular the pole z = i, where is the imaginary unit is,

A. (2 + i) π   B. (−1 + i) π

C. 2(1 − i) π   D. (1 + i) π
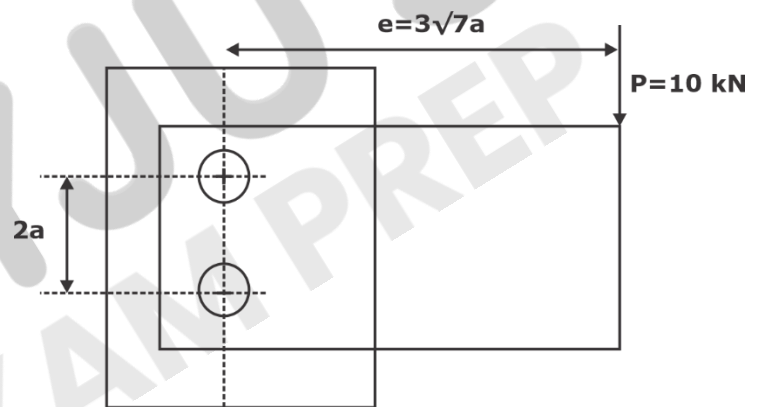
[MCQ: 2 Marks]

Ans. B

38. Given 2a = 100 mm

Permissible = 50 MPa

Find the area of rivet (in mm^2)

[MCQ: 2 Marks]

Ans. 800 mm^2

**39.** 10. A thin walled cylindrical Pr. Vessel had mean wall thickness of t and nominal radius of r. μ = 1/3 (wall material) when it was subjected to some internal Pr., its nominal perimeter in the cylindrical portion increased by 0.1% and the corresponding wall thickness become $\bar{t}$. The corresponding change in the wall thickness of the cylindrical portion.

i.e. 100 × ($\bar{t}$)/t is _____ %

[NAT: 2 Marks]

Ans. 0.06%

40. An L-shaped elastic member ABC with slender arm AB and BC of uniform cross-section is clamped at end a and connected to a pin at end C. The pin remain in continuous contact with and is constrained to move a smooth horizontal slot. The section modulus of the member is same in both the arms. The end C is subjected to a horizontal force P and all the deformations are in the plane of the fig. Given the length AB is 4a & BC is a, the magnitude & direction of the normal force on the pin from the slot are
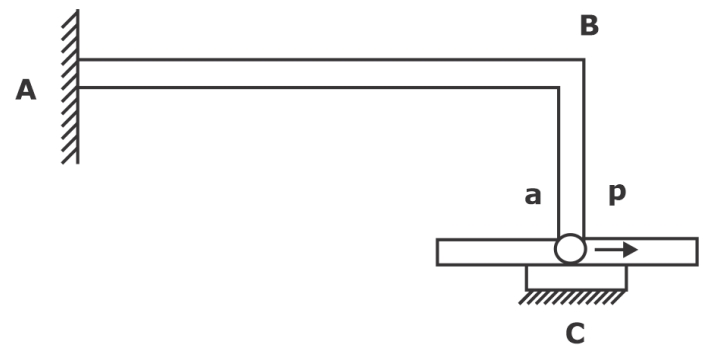
[MCQ: 2 Marks]

A. p/4 downward

B. 5p/8 upward

C. 3p/4 upward

D. 3p/8 downward

Ans. D

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