GATE 2022 Examination* (Memory Based)

Mechanical Engineering (Forenoon Paper)

Test Date: 13-2-2022

Test Time: 9:00 a.m.

Stream Name: Mechanical Engineering (Forenoon Paper)

Q1. $\begin{bmatrix} 10 & 2k+5 \\ 3k-3 & k+5 \end{bmatrix}$ is symmetrical matrix. Find the value of k.

a) 5
b) -0.4
c) $\frac{1+\sqrt{1561}}{12}$
d) 8

Q2. A function $\Psi = \frac{1}{2}[x^2 + y^2 + z^2]$. In 3D cartisian space the value of surface integral $\oint\oint \hat{n}.\nabla\Psi \, ds$ where s is the surface of sphere with unit radius is:

a) 4π b) 3π c) 0 d) $4\pi / 3$

Q3. Polytropic process; work done?
Given:-

$$\begin{cases} P_1 = 110\text{kPa} \\ V_1 = 5\text{m}^3 \\ V_2 = 2.5\text{m}^3 \\ N = 12 \end{cases}$$

Q4. If $\Psi = kx^3y$ then $\left|\vec{a}\right|_{(1,1)} = ?$

Q5. $w = 5\,\frac{rad}{s}$
Find centre velocity whose disc starts rolling without slipping.

Q6. If there is a 12 hour clock...how man times hour, minutes, seconds of clock coincide from 3pm of day to 3am of next day
a) 144 b) 12 c) 11 d) 1

Q7. (x, y) $\begin{bmatrix} 2 & 5-2a \\ a & 1 \end{bmatrix}$ = (0, 0), for nontrivial solution the value of (xy).

a) x = –1, y = 4 b) x = 1, y = 1 c) x = 4, y = –2 d) x = 2, y = –2

Q8. In between 3pm to 3am, how many times all three hands of clock will coincide.

Q9. Clausius Inequality can be applied to
a) Reversible process b) Reversible cycle
c) Any process d) Any cycle

Q10. Four students P, Q, R, S
P learning French & Dutch
Q learning Chinese & Japanese
R learning Spanish & French
S learning Dutch & Japanese
→ French is easier than Dutch
→ Chinese is harder than Japanese
→ Dutch is easier than Japanese
→ Spanish is easier than French

Based on above data which girl is learning most difficult language?

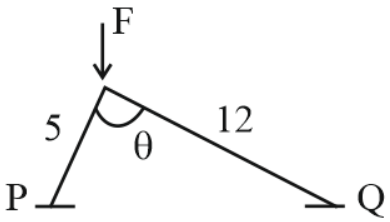
Q11. A/C to clausious inequality, which cycle is possible?

I. $\oint \frac{d\varphi}{T} < 0$

II. $\oint \frac{d\varphi}{T} = 0$

III. $\oint \frac{d\varphi}{T} > 0$

Q12.



For $\theta = 90^{o}$ and impending cond. Find $\frac{u_Q}{u_P}$

Q13. All teacher are professors
No professor is male
Some male are engineer
Conclusion
1) No engineer is professor
2) Some engineer are professor
3) No male is teacher

a) Only 3 follows
b) Only 1 follows
c) Both 1 & 2 follows
d) All 3 follows

Q14. The average of M, N, S is 4000
The average of NSP is 5000
P = 6000
M is _____ percentage of P?

Q15. A distance of 80 km is covered in 6 hrs. Some distance is covered at 10 kmph and some distance is covered at 18 kmph. How much percentage of distance is covered at 10 kmph.

Q16. In a unit square, rhombus is formed by joining mid points of the square and circle is inscribed in the rhombus. Find the diameter of circle?

a) $\sqrt{2}$
b) $2\sqrt{2}$
c) $\frac{1}{\sqrt{2}}$
d) $\frac{1}{2\sqrt{2}}$

Q17. Area of equilateral triangle, square and circle is same. Find ratio of circumference.

a) $\frac{6}{\sqrt{3}}:4:2\sqrt{5}$
b) $\frac{6}{\sqrt{2}}:4:\sqrt{\pi}$
c) $6:2:\sqrt{\pi}$
d) $4:3:\sqrt{\pi}$

Q18. $\int \lim_{x\to\pi}\left(\frac{x^2+ax+2\pi^2}{x-\pi+2\sin\pi}\right)$ has finite value, the value of a and limit f

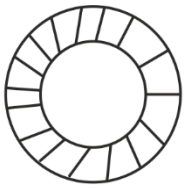
a) $-3\pi, \pi$
b) $2\pi, 3\pi$
c) $\pi, \pi-$
d) $-2\pi, 2\pi$

Q19. Wall slab of thickness 0.1 m ….. Higher temp of left surface = 80° …… thermal cond = 15 …… heat transfer through wall = 4500 W/m^2 …….. find rate of entropy generation.

Q20. Surface harden become of

a) Nitriding b) cyaniding c) Annealing d) Carburizing

Q21. 1 mm thickness cylindrical



t = 1mm
D = 100 mm

X - C/S area = Π Dt

fN = arial feed = $1^{mm}/_{mm} = \frac{1000}{60} = \frac{100}{6}$ mm

Power required = _____ ?

Q22. 2-D momentum equation for natural convection;

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

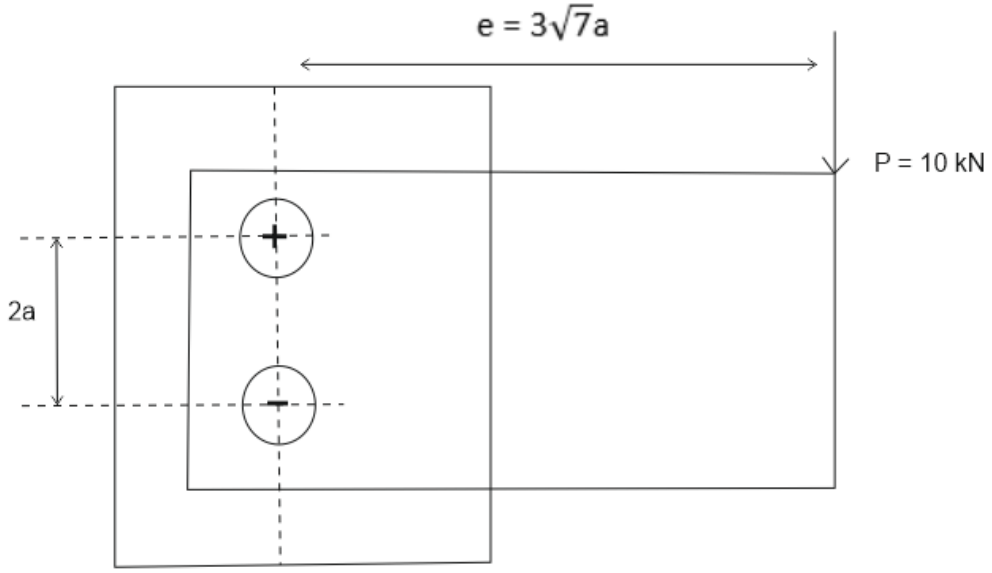
the from gβ (T–T) represent.

a) Ratio of inertia force to viscous force.
b) Ratio of Bouyant force to viscous force
c) viscous force per unit mass
d) Buoyant force per unit mass

Q23. For a poison distributed Random Variable x if P(x = 1) = P(x = 2), then what is the value of P(x = 3)?

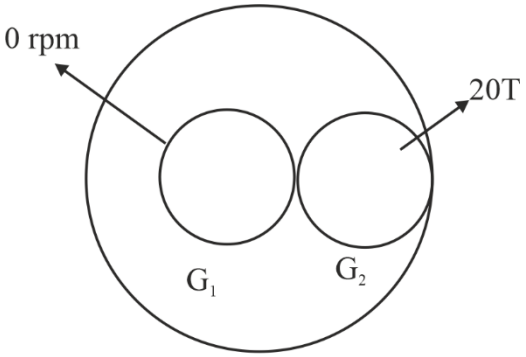
Q24. For an otto cycle following data will given
Displacement volume = $250cm^3$
Clearance volume = $35.7cm^3$
P_1 = 100 kPa
T_1 = 300k
Heat added = 800 kJ
C_V = 0.718 KJ/Kg – k
V = 1.4
Pmax = ?

Q25.



Given 2a = 100 mm
Permissible = 50 MPa
Find the area of rivet (in mm^2)

Q26.



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

Find ω of arm

Q27. A 4 mm thick A1 sheet of width(he) = 100 mm is rolled in a two-roll mill of roll diameter 200 mm each. The N/P lubsictal with a mineral oil, which gives a $\mu = 0.1$. The flow stres (σ) of the material in MPa is $\sigma = 207 + 414 \in$ where $\in$ 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:

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

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

Q28. A CNC worktable 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

a) 15 kHz b) 20 kHz c) 3 kHz d) 10 kHz

Q29. The type of fit between a meeting shaft of diameter
$25.00^{0.010}_{0.010}$
mm a hole of diameter
$25.00^{0.015}_{0.015}$

a) Transition b) Linear c) Interference d) Clearance

Q30. Which of the following additive manufacturing(s) can use a wire as a feel stock material?

a) Directed energy deposition processes

b) Stereolithography

c) Fused deposition modeling

d) Selective laser sintering.

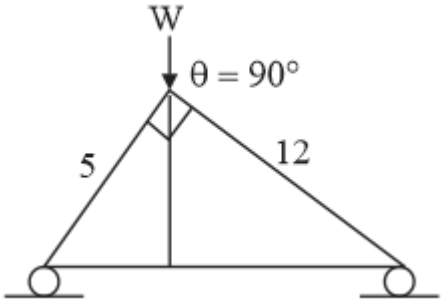
Q31. Which of the following heat treatment processes is/are used for surface hardening of steels?

a) Annealing b) Carburising c) Cyaniding d) Carbonitriding

Q32. 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

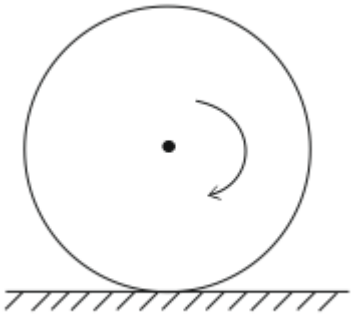
Q33. The Fourier series expansion of x^3 in the interval $-1 \leq x < 1$ with periodic continuation has
a) Only sine term
b) Both sine & cosine terms
c) Only cosine term
d) Only sine term and a non zero constant

Q34. Find the ratio of friction force at Q to P at $\theta = 90°$.



$\frac{\mu_Q}{\mu_P}$?

Q35.



Rolling without slipping, $\omega = 5$ rad/s, $r = 0.15$ m. Find V_{centre}.

Q36. Solution $\Delta^2 T = 0$ in a square domain $(0 < x < 1 \ \& \ 0 < y < 1)$ with boundary conditons:

$T(x, 0) = x$

$T(0, y) = y$

$T(x, 1) = 1 + x$

$T(1, y) = 1 + y$

$T(x, y) =$

a) $x - xy + y$

b) $x + y$

c) $x + xy + y$

d) $-x + y$

Q37. $P = \lim_{x \to \pi} \left[\frac{x^2 + \alpha x + 2\pi^2}{x - \pi + 2\sin x} \right]$

	a	P
a)	π	π
b)	-3π	π
c)	-2π	2π
d)	2π	3π