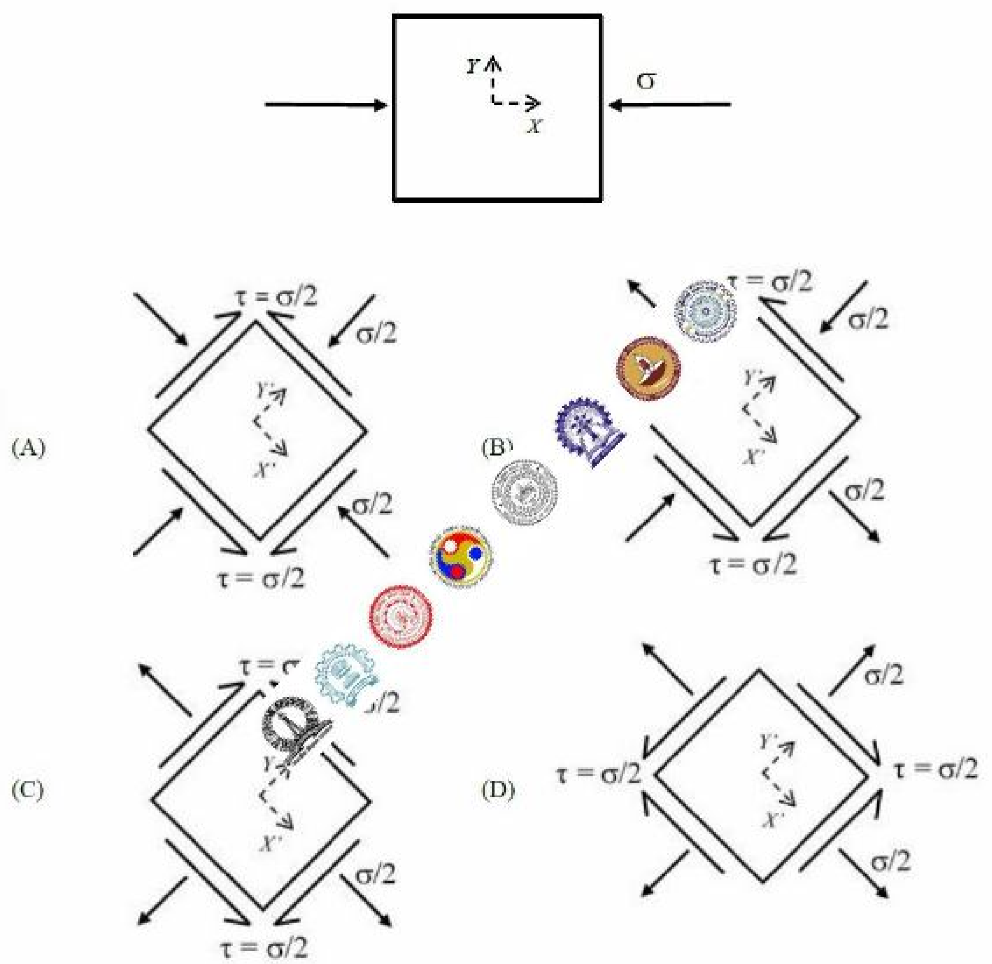
**GATE 2018- AEROSAPCE ENGINEERING & MECHANICAL ENGINEERING**

**Mock Test-1, SOM & Fluid Mechanics** **Duration 1hour 30 Minute**

**1.**

The state of stress at a point in a body is represented using components of stresses along $X$ and $Y$ directions as shown. Which one of the following represents the state of stress along $X'$ and $Y'$ axes? ($X'$ - axis is at $45^o$ clockwise with respect to $X$ - axis).

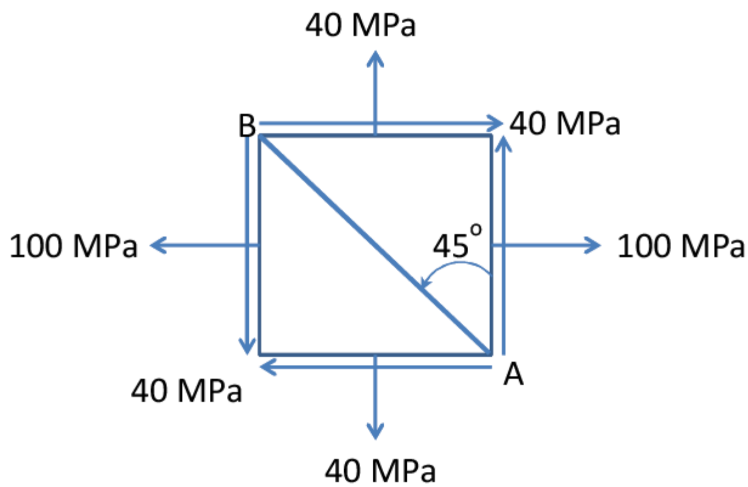



**2.**

The state of stress at a point is $\sigma_x = \sigma_y = \sigma_z = \tau_{xz} = \tau_{zx} = \tau_{yz} = \tau_{zy} = 0$ and $\tau_{xy} = \tau_{yx} = 50$ MPa.
The maximum normal stress (in MPa) at that point is__________

**3.**

At a point in an object subjected to plane stress conditions, the state of stress is as shown in the Figure.




Q.19 One of the principal stresses(in MPa) is

(A) 40 (B) 80 (C) 120 (D) 140

Q.20 The normal stress on the plane AB (in MPa) is

(A) 30 (B) 70 (C) 100 (D) 110

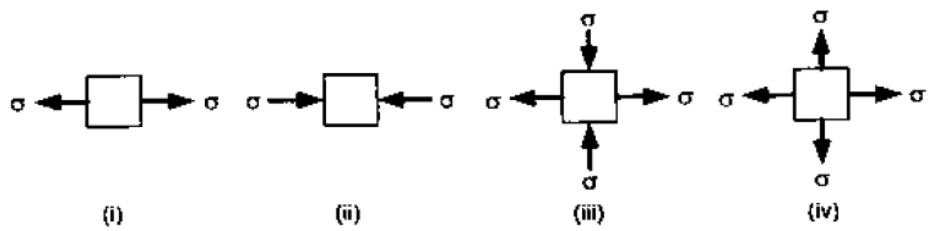
**4.**

For a biaxial state of stress defined by $\sigma_{xx} = 40$ MPa, $\sigma_{yy} = -20$ MPa, $\tau_{xy} = 30$ MPa, the Mohr's circle is centred at (in MPa)

(A) (0, 10) (B) (0, 30) (C) (10, 0) (D) (60, 0)

**5.**

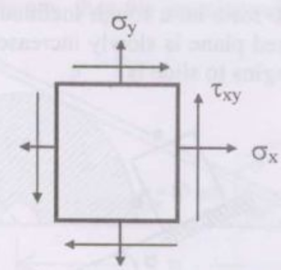
Which one of the following plane states of stress corresponds to Mohr's circle of radius zero?




(A) (i) (B) (ii) (C) (iii) (D) (iv)

**6.**

The state of stress at a point is as shown below. Both the normal and shear stresses on a plane, inclined at an angle of $45^o$ with horizontal are zero. If $\sigma_x = \sigma_y = 200$ MPa,




the shear stress $\tau_{xy}$ is

(A) 50 MPa (B) 70 MPa
(C) 100 MPa (D) 200 MPa

**7.**

State of stress at a point in a loaded body is given by $\sigma_x$=10 MPa, $\sigma_y$= 0, $\sigma_z$ = -5 MPa and $\tau_{xy}=\tau_{yz}=\tau_{zx}$= 0. Maximum shear stress at that point is

(A) 5 MPa (B) 2.5 MPa (C) 7.5 MPa (D) 0

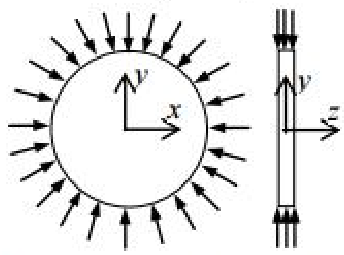
**8.**

State of stress at a point of a body in a plane stress problem is given by $\sigma_x$ = -6MPa, $\sigma_y$ = 2 MPa and $\tau_{xy}$ = MPa. Which of the following is true at that point?

(A) There exists at least one plane where normal stress is zero.
(B) There exists no plane where normal stress is zero.
(C) There exists no plane where shear stress is zero.
(D) In the plane of maximum shear, normal stress is zero.

**9.**

A thin plate of uniform thickness is subject to pressure as shown in the figure below

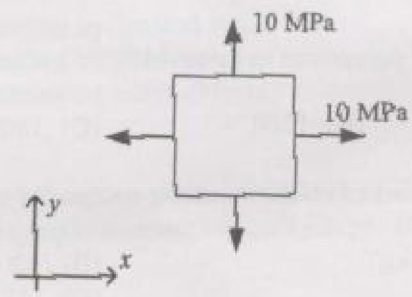



Under the assumption of plane stress, which one of the following is correct?

(A) Normal stress is zero in the $z$-direction
(B) Normal stress is tensile in the $z$-direction
(C) Normal stress is compressive in the $z$-direction
(D) Normal stress varies in the $z$-direction

**10.**

The two-dimensional state of stress at a point is given by




The corresponding Mohr's circle is

(A) a circle of radius 10 MPa with center at 10 MPa on the $\sigma$-axis
(B) a circle of radius 10 MPa with center at $-10$ MPa on the $\sigma$-axis
(C) a point on the positive $\sigma$-axis
(D) a point on the negative $\sigma$-axis

**11.**

A two dimensional fluid element rotates like a rigid body. At a point within the element, the pressure is 1 unit. Radius of the Mohr's circle, characterizing the state of stress at that point, is

(A) 0.5 unit (B) 0 unit (C) 1 unit (D) 2 units

**12.**

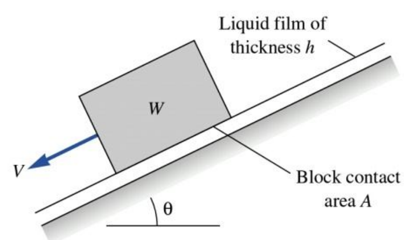
In a fluid the velocity measured at a distance of 75mm from the boundary is 1.125m/s. The fluid has absolute viscosity 0.048 Pa s and relative density 0.913. What is the velocity gradient and shear stress at the boundary assuming a linear velocity distribution? Determine its kinematic viscosity.

**13.**

A flat circular plate, 1.25 m diameter is immersed in sewage water (density 1200 kg/$m^3$) such that its greatest and least depths are 1.50 m and 0.60 m respectively. Determine the force exerted on one face by the water pressure,

**14.**

A block of weight $W$ slides down an inclined plane while lubricated by a thin film of oil, as in Fig. P1.45. The film contact area is $A$ and its thickness is $h$. Assuming a linear velocity distribution in the film, derive an expression for the "terminal" (zero-acceleration) velocity $V$ of the block. Find the terminal velocity of the block in Fig. P1.45 if the block mass is 6 kg, $A = 35\ \text{cm}^2$, $\theta = 15°$, and the film is 1-mm-thick SAE 30 oil at 20°C.




**15.**

The absolute viscosity $\mu$ of a fluid is primarily a function of
(*a*) Density, (*b*) Temperature, (*c*) Pressure, (*d*) Velocity,
(*e*) Surface tension

**16.**

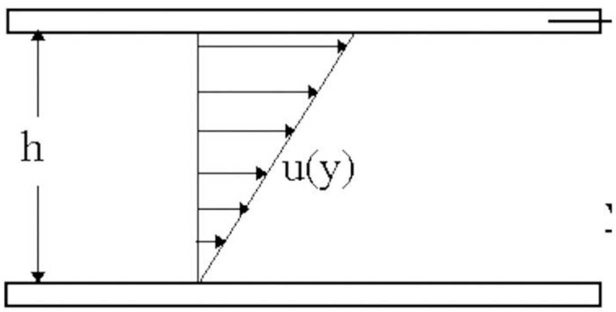
The velocity distribution for laminar flow between parallel plates is given by

$$\frac{u}{u_{max}} = 1 - \left(\frac{2y}{h}\right)^2$$

where $h$ is the distance separating the plates and the origin is placed midway between the plates. Consider flow of water at 15°C with maximum speed of 0.05 m/s and $h$ = 1 mm. Calculate the force on a 1$m^2$ section of the lower plate and give its direction.

**17.**

2. In the Fig., if the fluid is glycerin at 20°C and the width between plates is 6 mm, what shear stress (in Pa) is required to move the upper plate at V = 5.5 m/s? Note that glycerin viscosity = 1.5 N · s/m².




**18.**

In a two-dimensional flow field, the velocities in the $x$- and $y$- directions are $u$ and $v$, respectively. The shear stress for a Newtonian fluid having dynamic viscosity $\mu$ is given by

(A) $\mu\left(\frac{\partial v}{\partial x} - \frac{\partial u}{\partial y}\right)$ (B) $2\mu\frac{\partial v}{\partial y}$ (C) $2\mu\frac{\partial u}{\partial x}$ (D) $\mu\left(\frac{\partial v}{\partial x} + \frac{\partial u}{\partial y}\right)$

**19.**

A shaft with outside diameter of 18 mm turns at 20 revolutions per second inside a stationary journal bearing 60 mm long. A thin film of oil 0.2 mm thick fills the concentric annulus between the shaft and journal. The torque needed to turn the shaft is 0.0036 N · m. Estimate the viscosity of the oil that fills the gap.

**20.**

When a vehicle such as an automobile slams on its brakes (locking the wheels) on a very wet road it can "hydroplane." In these circumstances a film of water is created between the tires and the road. Theoretically, a vehicle could slide a very long way under these conditions though in practice the film is destroyed before such distances are achieved (indeed, tire treads are designed to prevent the persistence of such films). To analyze this situation, consider a vehicle of mass, M, sliding over a horizontal plane covered with a film of liquid of viscosity, $\mu$. Let the area of the film under all four tires be A and the film thickness (assumed uniform) be h.

a. If the velocity of the vehicle at some instant is V, find the force slowing the vehicle down in terms of A, V, h, and $\mu$.

b. Find the distance, L, that the vehicle would slide before coming to rest assuming that A and h remain constant (this is not, of course, very realistic).

c. What is this distance, L, for a 1000 kg vehicle if A = 0.1 m2 , h = 0.1 mm, V = 10 m/s, and the water viscosity is $\mu$ = 0.001 kg/(m·s)?

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| Question No | Answer |
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