# GATE 2011 Sample Question Paper with video Explanation

## Mechanical Engineering

**ME-1.** A solid circular shaft is subjected to a maximum shearing stress of 140 MPa. The magnitude of the maximum normal stress developed in the shaft is:
(a) 140 MPa
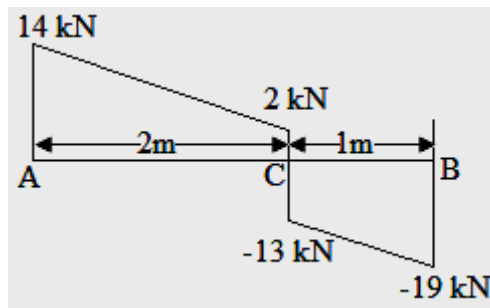(b) 80 MPa
(c) 70 MPa
(d) 60 MPa

**ME-1. Ans. (a)**
Exp.

$$\tau_{max} = \frac{\sigma_1 - \sigma_2}{2}$$ maximum normal stress will developed if

$$\sigma_1 = -\sigma_2 = \sigma.$$

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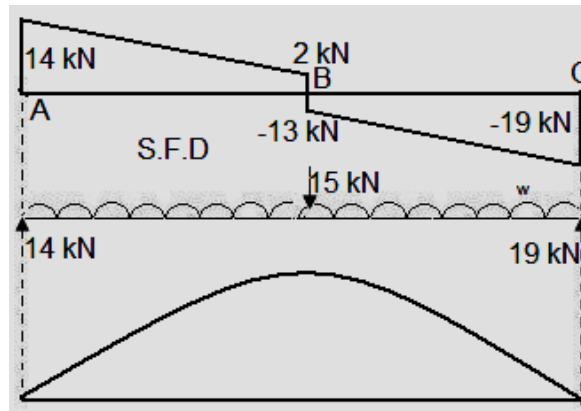**ME-2.** The shear force diagram of a loaded beam is shown in the following figure:
The maximum Bending Moment of the beam is
(a) 16 kN-m
(b) 11 kN-m
(c) 28 kN-m
(d) 8 kN-m



**ME-2. Ans. (a)**
Exp.

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**ME-3.** **Fluids that require a gradually increasing shear stress to maintain a constant strain rate are known as:**
   (a) Rheopectic fluids
   (b) Thixotropic fluids
   (c) Pseudoplastic fluids
   (d) Newtonian fluids

**ME-3. Ans. (a)**
   **Exp.**

$$\tau = \mu \left( \frac{du}{dy} \right)^{n} + f(t) \text{ where f(t) is increasing.}$$

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**ME-4.** **What is the vertical component of pressure force on submerged curved surface equal to?**
   (a) Its horizontal component
   (b) The force on a vertical projection of the curved surface

(c) The product of the pressure at centroid and surface area

(d) The gravity force of liquid vertically above the curved surface up to the free surface

**ME-4. Ans. (d)**

**Exp.**

The vertical component of the hydrostatic force on a submerged curved surface is the weight of the liquid vertically above it.

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**ME-5.** For a stream function to exist, which of the following conditions should hold?

1. The flow should always be irrotational.

2. Equation of continuity should be satisfied.

3. The fluid should be incompressible.

4. Equation of continuity and momentum should be satisfied.

Select the correct answer using the codes given below:

**Codes:**

(a) 1, 2, 3 and 4

(b) 1, 3 and 4

(c) 2 and 3

(d) 2 alone

**ME-5. Ans. (d)**

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**ME-6.** In a cyclic heat engine operating between a source temperature of 600°C and a sink temperature of 20°C, the least rate of heat rejection per kW net output of the engine is:

(a) 0.460 kW

(b) 0.505 kW

      (c) 0.588 kW

      (d) 0.650 kW

**ME-6. Ans. (b)**

Exp.

Reversible engine has maximum efficiency where

$$\frac{Q_1}{T_1} = \frac{Q_2}{T_2} = \frac{Q_1 - Q_2}{T_1 - T_2} = \frac{W}{T_1 - T_2}.$$

Therefore least heat rejection per kW net output,

$$Q_2 = \frac{W}{T_1 - T_2} \times T_2 = \frac{1}{873 - 293} \times 293 = 0.505\,\text{kW}$$

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**ME-7.** **What will be the loss of available energy associated with the transfer of 1000 kJ of heat from constant temperature system at 600 K to another at 400 K when the environment temperature is 300 K?**

      (a) 150 kJ

      (b) 250 kJ

      (c) 500 kJ

      (d) 700 kJ

**ME-7. Ans. (b)**

Exp.

Loss of available energy

$$= T_o \times (\Delta S)_{univ.} = 300 \left\{ \frac{1000}{400} - \frac{1000}{600} \right\} kJ = 250\,kJ$$

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**ME-8.** **For a manual operation to study the total processing standard time using a chronometer, following observations were made:**

| Processing time | : | 16 minutes |
|---|---|---|
| Rating of the worker | : | 120% |
| Personal allowance | : | 0.6 minutes |
| Basic fatigue allowance | : | 1.92 minutes |
| Unavoidable delay allowance | : | 1.08 minutes |

What is the standard operating time for the operation?

(a) 16 minutes        (b) 17.92 minutes

(c) 21.52 minutes      (d) None of the above

**ME-8. Ans. (d)**

Exp.

Standard time = Normal time + PDF allowance

= Observed time × Performance rating + PDF allowance

= 16 × 1.2 + (0.6 + 1.92 + 1.08) min = 22.8 min.

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**ME-9.** **Brittle materials such as grey cast iron can be extruded by which one of the following extrusion process?**

(a) Cold Extrusion

(b) Hot Extrusion

(c) Backward extrusion

(d) Hydrostatic extrusion.

**ME-9. Ans. (d)**

Exp.

Hydrostatic extrusion suppresses crack formation by pressure induced ductility. Relative brittle materials can be plastically deformed without fracture. And materials with limited ductility become highly plastic.

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**ME-10.** **Match List-I (Chemical formula of refrigerant) with List-II (Numerical Designation) and select the correct answer using the codes given below the lists:**

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| List-I | | List-II | |
|---|---|---|---|
| **A.** | $NH_3$ | **1.** | 12 |
| **B.** | $CCl_2F_2$ | **2.** | 22 |
| **C.** | $CHClF_2$ | **3.** | 40 |
| **D.** | $CCl_2\, FCCl\, F_2$ | **4.** | 113 |
| | | **5.** | 717 |

| Codes: | A | B | C | D |
|---|---|---|---|---|
| (a) | 4 | 1 | 5 | 2 |
| (b) | 5 | 3 | 2 | 4 |
| (c) | 4 | 3 | 5 | 2 |
| (d) | 5 | 1 | 2 | 4 |

**ME-10. Ans. (d)**

    **Exp.**

    $R(C - 1)$ $(H + 1)$ $F$ and $Cl$ by balance.

    And for inorganic refrigerant $R$ (700 + Molecular weight).

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