

2021

ENGINEERING MECHANICS

Full Marks: 60

Time: Two hours

The figures in the margin indicate full marks for the questions.

A. Multiple Choice Questions

1 x 20=20

1. According to Lami's Theorem, the three forces
 - a. Must be equal
 - b. must be at 120° to each other
 - c. must be both of above
 - d. may not be any of the two
2. If the sum of all the forces acting on a body is zero, then the body may be in equilibrium provided the forces are
 - a. concurrent
 - b. parallel
 - c. Like parallel
 - d. Unlike parallel
3. If the area of a section is in mm² and the distance of the centre of area from a line is in mm, then units of moment of inertia of the section about the line is expressed in
 - a. mm²
 - b. mm³
 - c. mm⁴
 - d. mm⁵
4. The rate of change of velocity is called
 - a. displacement
 - b. acceleration

- c. Angular velocity
 - d. Angular displacement
5. The moment of inertia of a circular body of diameter 1 mm is equal to
- a. 1 mm^4
 - b. 0.049 mm^4
 - c. 0.5 mm^4
 - d. none of the above
6. Newton's first law of motion gives the concept of
- a. work
 - b. force
 - c. inertia
 - d. energy
7. Resultant of two equal forces is equal to either of them. The angle between the forces is
- a. 0°
 - b. 60°
 - c. 90°
 - d. 120°
8. The three forces of 100 N, 200 N and 300 N have their lines of action parallel to each other but act in the opposite directions. These forces are known as
- a. Coplanar concurrent forces
 - b. Coplanar non-concurrent forces
 - c. Like parallel forces
 - d. Unlike parallel forces
9. Two like parallel forces are acting at a distance of 24 mm apart and their resultant is 20 N. If the line of action of the resultant is 6 mm from any given force, the two forces are
- a. 15 N and 5 N
 - b. 20 N and 5 N
 - c. 15 N and 15 N
 - d. None of these
10. The point, through which the whole weight of the body acts, irrespective of its

- position, is known as
- Moment of inertia
 - Centre of gravity
 - Centre of percussion
 - Centre of mass
11. The moment of inertia of a rectangular section 3 cm wide and 4 cm deep about X-X axis is
- 9 cm^4
 - 12 cm^4
 - 16 cm^4
 - 20 cm^4
12. The maximum frictional force, which comes into play, when a body just begins to slide over the surface of the other body, is known as
- Static friction
 - Dynamic friction
 - Limiting friction
 - Coefficient of friction
13. The friction experienced by a body, when in motion, is known as
- Limiting friction
 - Dynamics friction
 - Static friction
 - Coefficient of friction
14. The mechanical advantage of a lifting machine is the ratio of
- Distance moved by the effort to the distance moved by the load
 - Load lifted to the effort applied
 - Output to the input
 - All of the above
15. The efficiency of the lifting machine is the ratio of
- Output to the input
 - Work done by the machine to the work done on the machine
 - Mechanical advantage to the velocity ratio

- d. All of the above
- 16. A machine having an efficiency less than 50%, is known as
 - a. Reversible machine
 - b. Non-reversible machine
 - c. Neither reversible nor non-reversible machine
 - d. Ideal machine
- 17. For a self locking machine, the efficiency must be
 - a. Equal to 50%
 - b. Less than 50%
 - c. Greater than 50%
 - d. 100%
- 18. The velocity ratio for the first system of pulleys is
 - a. n (where n is the number of pulleys)
 - b. n^2
 - c. 2^n
 - d. $2^n - 1$
- 19. The slope on the road surface generally provided on the curves is known as
 - a. Angle of friction
 - b. Angle of repose
 - c. Angle of banking
 - d. None of these
- 20. Which of the following is a scalar quantity?
 - a. Force
 - b. Speed
 - c. Velocity
 - d. Acceleration

B. Very Short Question

2*6=12

1. What are the characteristics of a force?
2. What do you mean by system of forces? Give example
3. Differentiate between clockwise moment and anti-clockwise moment.

4. State Varignon's principle of moment.
5. Define co-efficient of friction and angle of friction.
6. Define the terms Mechanical advantage and velocity ratio of a simple machine.

C Short Question

4*7=28

1. Find the magnitude of two equal forces acting at a point with an angle of 60° between them, if the resultant is equal to $30\sqrt{3}$ N.
2. Two forces of equal magnitude P act at an angle θ to each other. What will be their resultant?
3. What is law of a machine ? Derive an equation for the same.
4. Derive the relation between mechanical advantage, velocity ratio and efficiency of a machine.
5. In a certain weight lifting machine, a weight of 1 kN is lifted by an effort of 25 N. While the weight moves up by 100 mm, the point of application of effort moves by 8 m. Find mechanical advantage, velocity ratio and efficiency of the machine.
6. A body of weight 300 N is lying on a rough horizontal plane having a coefficient of friction as 0.3. Find the magnitude of the force, which can move the body, while acting at an angle of 25° with the horizontal.
7. Find the centre of gravity of a T-section with flange $150 \text{ mm} \times 10 \text{ mm}$ and web also $150 \text{ mm} \times 10 \text{ mm}$.
