INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR

Class Test 1-Autumn Semester 2019-20

Date of Examination : 05/09/2019 Duration: 1 hrs Full Marks: 20
Subject No. : *ME10001* Subject : *Mechanics* Department/Center/School : All 1st Year UG
Special Instructions:

[1] **ANSWER ALL PARTS OF QUESTION AT THE DESIGNATED PLACE ONLY.**
[2] **RETURN THIS QUESTION PAPER CUM ANSWER-SCRIPT BOOKLET AT THE END OF EXAMINATION**
[3] **FILL YOUR NAME, ROLL No. AND SECTION AT THE PLACE PROVIDED BELOW THIS HEADER**
[4] **ALL FREE BODY DIAGRAMS MUST BE DRAWN USING PENCIL ONLY.**

NAME:	ROLL No.:	SECTION:

Questions 1 to 6 Carry 1 Mark each (No Part Marks in this Section)

1. Different situations regarding the moment produced by two non-zero forces about an axis are described in the 1st column of the table below. In the second column, fill **YES** is the moment is zero and **NO**, otherwise (moment is non-zero).

Situation	Is moment about the axis zero?
Line of action of one of the forces intersects the axis and that of the other is parallel to the axis	
Lines of action of both the forces intersect the axis	
Lines of action of both the forces are parallel to the axis	
The forces produce a couple moment and the direction of that couple moment is parallel to the axis	

2. A rigid body acted upon by four non-zero and co-planar forces is in static equilibrium. Which of the following statements are valid for this problem?

(a) If two forces produce a couple moment then the remaining two forces must produce a couple moment.

(b) If lines of action two of the forces intersect at a point then that of the remaining two forces must intersect at the same point.

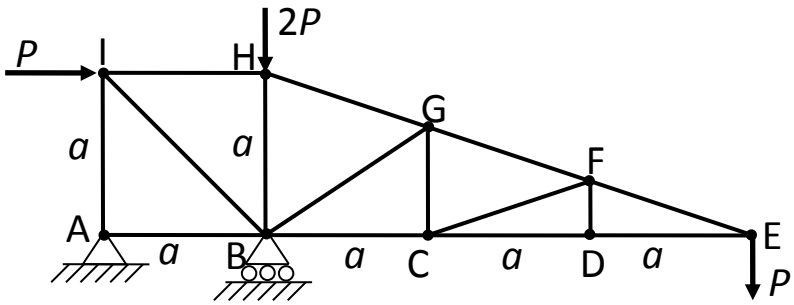
(c) If two of the forces are parallel but do not form a couple then the remaining two forces should not form a couple.

(d) If the lines of action of three of the forces intersect at a common point then the line of action of the remaining one force must pass through that common intersection point.

Tick all the correct options: (a) (b) (c) (d)

Place for Rough Work

3. Put bold cross marks at the centre of each zero-force member of the truss shown in the figure.



4. In the truss given in Question No. 4, the magnitude of reactions at points A and B are _____ *P* and _____ *P*, respectively.

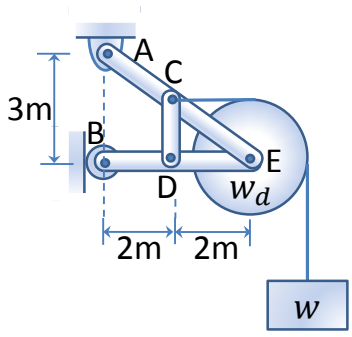
Place for Solution:

5. In the truss given in Question No. 4, the force in member AI is _____ and in member BI is _____ (Fill compressive or tensile, as appropriate, in the blank space without values).

6. From visual and mental analysis, the *non-zero force members* of the truss given in Question No. 4, that can be replaced by strings are _____(List all **five members**).

Questions 7 to 10 Carry 2 Mark each (No Fractional Part Marks, Minimum Part Mark is 1 Mark)

7. A frame shown in the figure where the frictionless pulley has weight $w_d = 50$ N and a weight $w = 100$ N hangs from the rope connected to pin C on member AE.



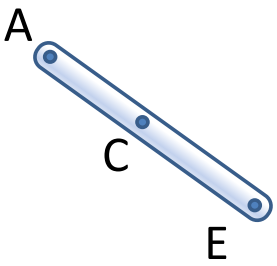
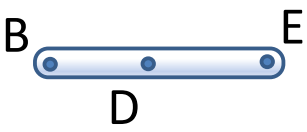
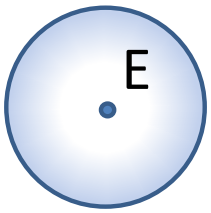
The two-force member(s) in the frame is/are _____.

The magnitude of reaction at roller support A is _____ N.

Place for Solution:

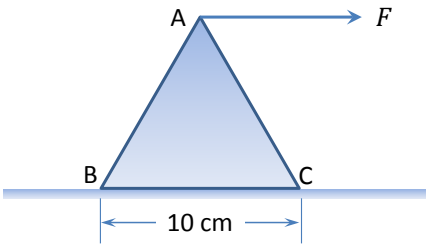
Place for Rough Work

8. For the same frame as in Question No. 7, complete the free body diagrams (FBDs) of members AE, BE and the pulley over the outline of the bodies presented below.

FBD of AE	FBD of BE	FBD of Pulley
		

9. For the same frame as in Question No. 7, the reaction force at pin D is _____ N as computed from FBD of member _____ by taking moment about point _____.

10. An equilateral prism of 10 N weight and 10 cm each side, is kept on a flat rough surface as shown in the figure. A horizontal force is applied at the top edge and there is sufficient friction to prevent the prism from sliding over the surface. If the prism is just about to topple at one of edge C then



The magnitude of the horizontal force is _____ N.

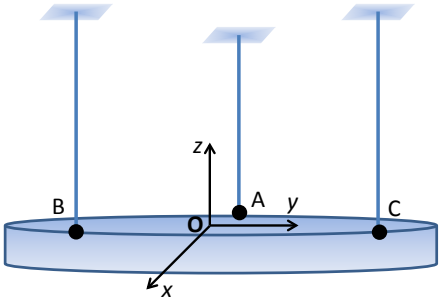
The resultant ground reaction force at C acts along line _____ .

Place for Solution:

Place for Rough Work

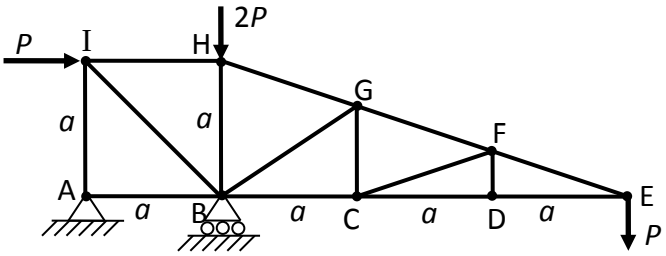
Questions 11 and 12 Carry 3 Mark each (No Fractional Part Marks, Minimum Part Mark is 1 Mark

11. A 6.4 kN disc is hung in a horizontally by three strings as shown in the figure. The line of action of self-weight of the disc is passes through origin of the coordinate system. The positions of points A, B and C, respectively, in x-y plane are (–1, 0) m, (0.6, 0.8) m and (0.6, –0.8) m. The tensions in the cable at A is _____ kN, at B is _____ kN and at C is _____ kN.



Place for Solution:

12. Consider the truss shown in the figure. Draw the FBD section of the truss so that the force in member HI can be computed from that section by *using just one moment balance equation* and *without calculating any of the support reactions*.



Place for FBD of the Section and Solution:

Moment about point _____ needs to be taken to determine force in member HI and the force in member HI is _____ *P* Tensile /Compressive (Strike of the incorrect part).