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SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION

JANUARY 2014 SESSION

SUBJECT CODE	:	**NMB11103**
SUBJECT TITLE	:	**ENGINEERING MECHANICS 1**
LEVEL	:	**BACHELOR**
TIME / DURATION	:	**3 HOURS**
DATE	:	

INSTRUCTIONS TO CANDIDATES

1. **Please read the instructions given in the question paper CAREFULLY.**
2. **This question paper is printed on both sides of the paper.**
3. **Please write your answers on the answer booklet provided.**
4. **Answers should be written in blue or black ink except for sketching, graphic and illustration.**
5. **This question paper consists of FIVE (5) questions. Answer FOUR (4) questions only.**
6. **Answer all questions in English.**
7. **Shapes and Geometric Tables is appended**

THERE ARE 6 PAGES OF QUESTIONS AND 4 PAGES OF APPENDIX, EXCLUDING THIS PAGE.

INSTRUCTION: Answer only FOUR questions.
Please use the answer booklet provided.

Question 1

(a) A small hot air balloon is tethered to the ground by three (3) cables AB, AC and AD as shown in the **Figure 1**. If the tension in cable AB is 800 N, evaluate the tensions in cable AC and AD and also up thrust force of the balloon assuming that the balloon is along the z-axis.

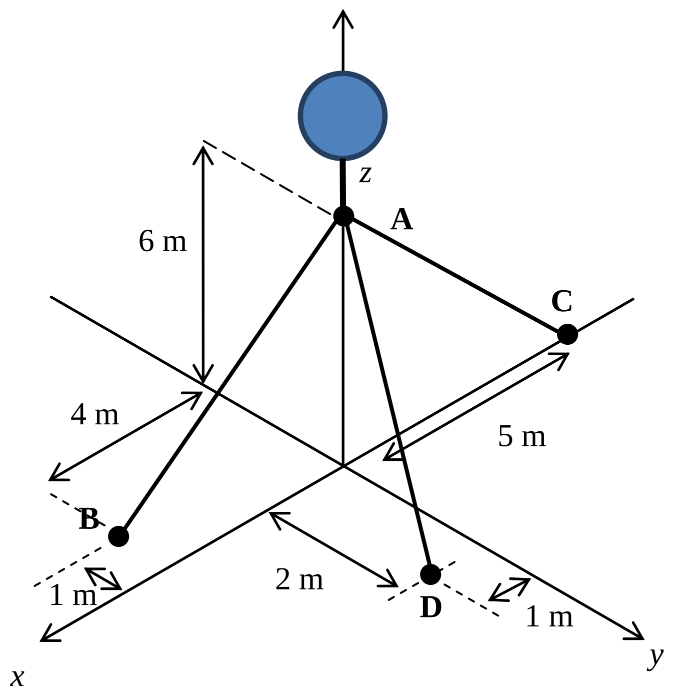


Figure 1

(14 marks)

(b) A position vector **P** starts from the origin to a point R of Cartesian coordinates (2, 7,-2) m. Calculates the angles α, β and γ which the vector made with respect to the positive x, y and z axes.

(6 marks)

(c) Calculate the magnitude of force F and the angle θ so that the particle in the **Figure 2** is in equilibrium.

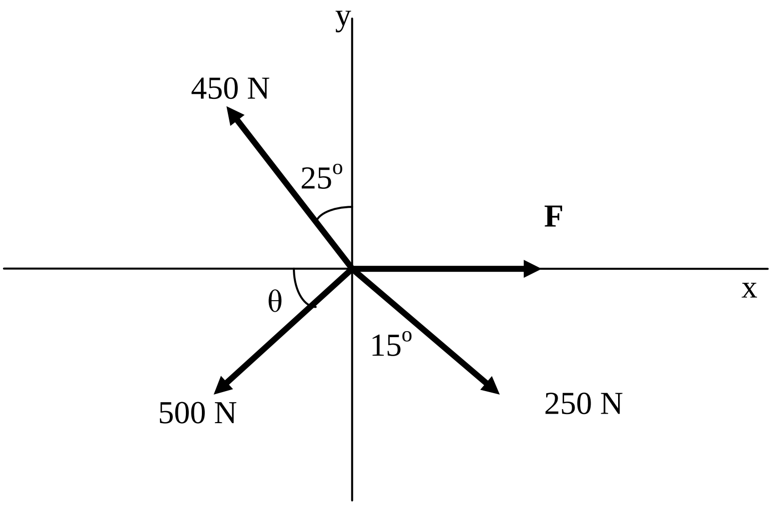


Figure 2

(5 marks)

Question 2

A 450 N force acted on the 7 m pole at position C as shown in the **Figure 3**. The pole was held at point A by a ball and socket joint and at B by cable BD and BE. Calculate the tension in each cable and the reaction forces at A.

(25 marks)

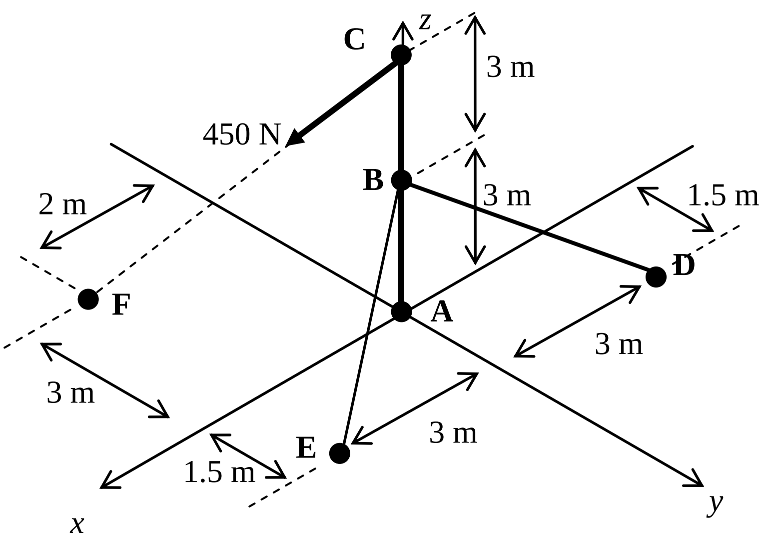


Figure 3

Question 3

Determine the force in each member of the truss in the bridge shown in the **Figure 4.** State if the members are in tension or compression. Identify the zero force members.

(25 marks)

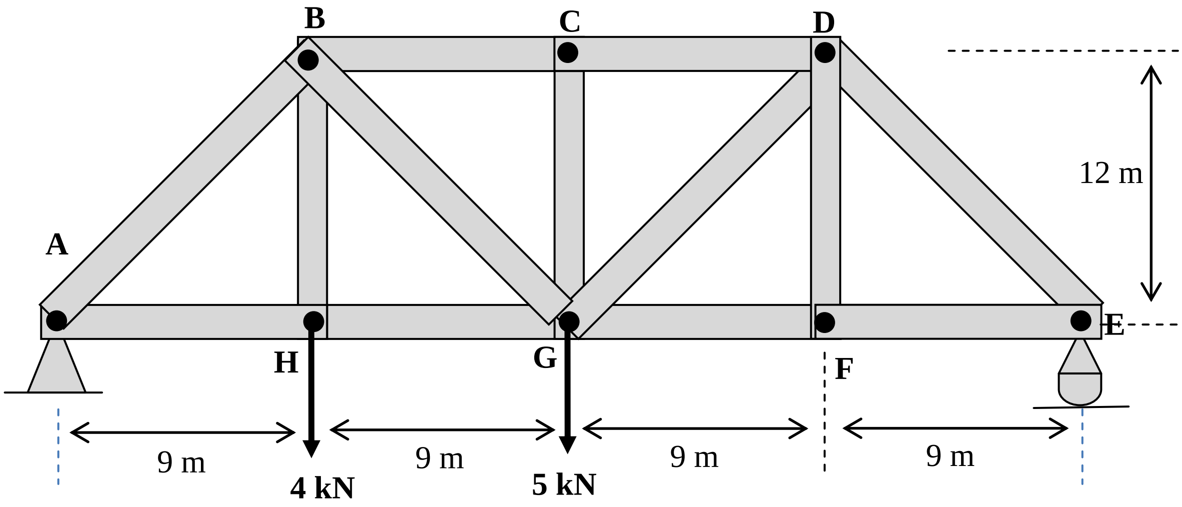


Figure 4

Question 4

The rail transport carriage shown in the **Figure 5** has a mass of 6000 kg and a centre of gravity at G. If the coefficient of static friction between the wheels and the tracks is $\mu_s = 0.4$ when the wheels are locked, find the normal force acting on the front wheels at A and the rear wheels at B when the brakes at both A and B are applied. Does the carriage move?

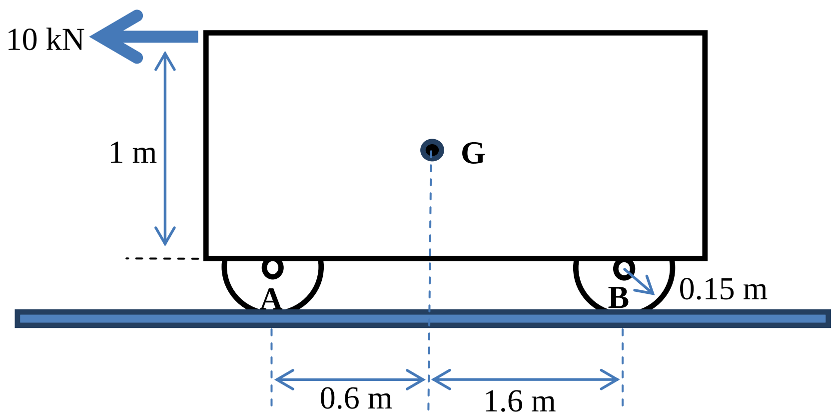


Figure 5

(25 marks)

Question 5

a. Locate the centroid x_c of the shaded area defined by the curve $\left(\frac{y}{2}\right)^2 = \frac{x}{4}$ as shown in the **Figure 6**. The length of a is 1 m, b is 3 m and c is 2 m.

(12 marks)

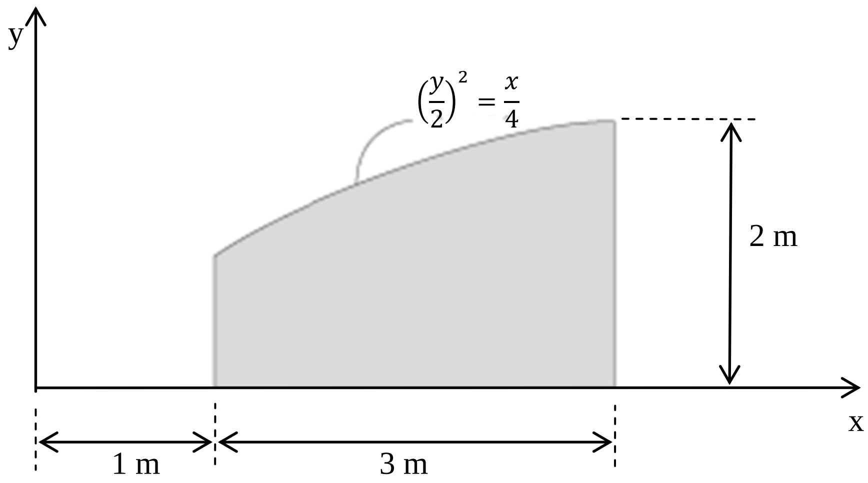


Figure 6

b. Determine the mass moment of inertia of the overhung crank as shown in the Figure 7 about the x axis. The material is steel having a density of ρ = 7.85 x 10^3 kg/m^3.

(13 marks)

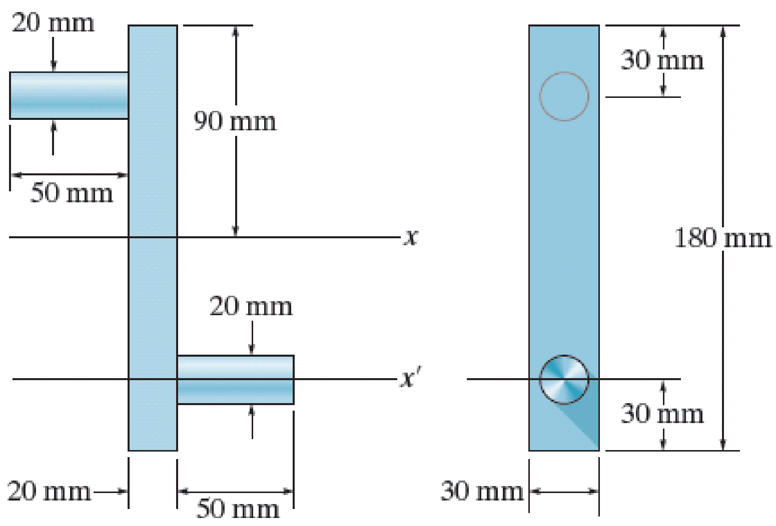
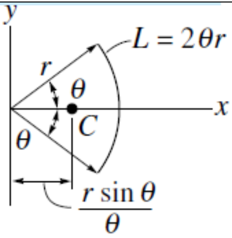
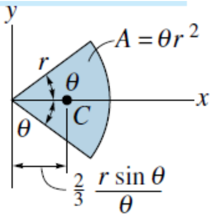
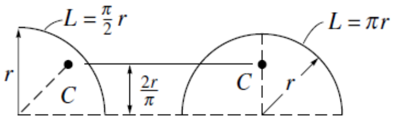
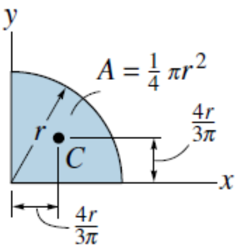
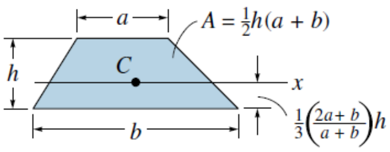
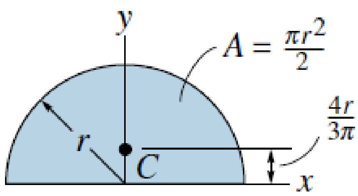
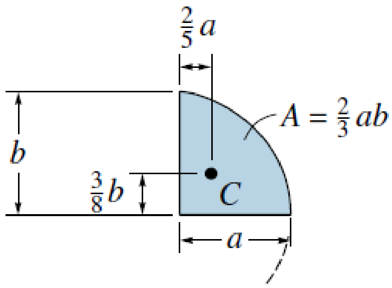
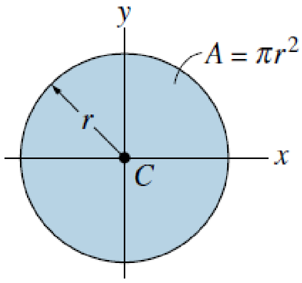
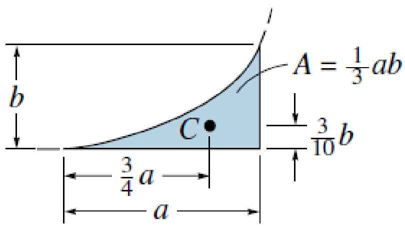
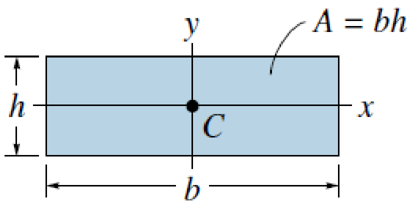


Figure 7

END OF QUESTION

APPENDIX

Table 1: Geometric Properties of Lines and Area Elements

Centroid Location	Centroid Location	Area Moment of Inertia
		$I_x = \frac{1}{4}r^4(\theta - \frac{1}{2}\sin 2\theta)$ $I_x = \frac{1}{4}r^4(\theta + \frac{1}{2}\sin 2\theta)$
Circular arc segment	Cicular sector area	
		$I_x = \frac{1}{16}\pi r^4$ $I_y = \frac{1}{16}\pi r^4$
Quarter & semicircle arcs	Quarter circle area	
		$I_x = \frac{1}{8}\pi r^4$ $I_y = \frac{1}{8}\pi r^4$
Trapezoidal area	Semicircular area	
		$I_x = \frac{1}{4}\pi r^4$ $I_y = \frac{1}{4}\pi r^4$
Semiparabolic area	Circular area	
		$I_x = \frac{1}{12}bh^3$ $I_y = \frac{1}{12}hb^3$
Exparabolic area	Rectangular area	

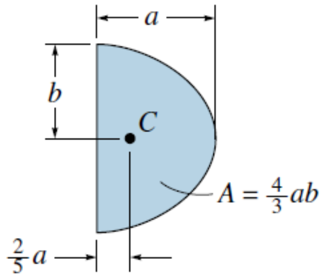
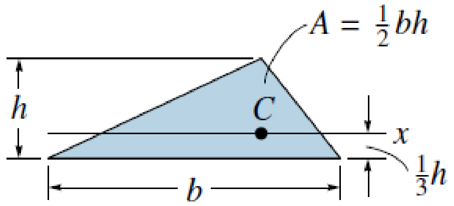
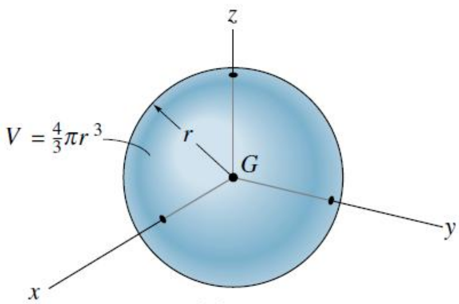
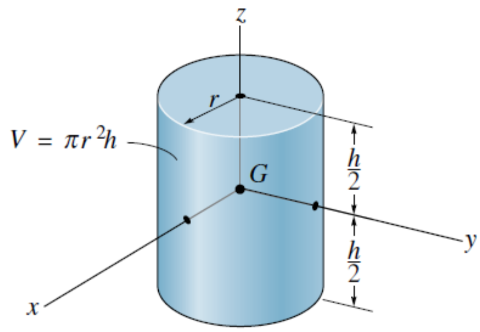
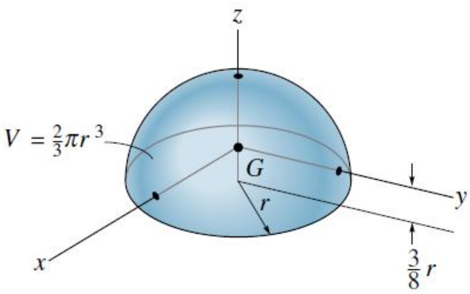
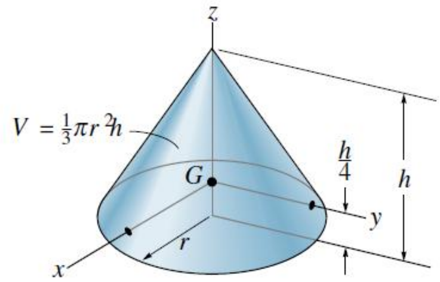
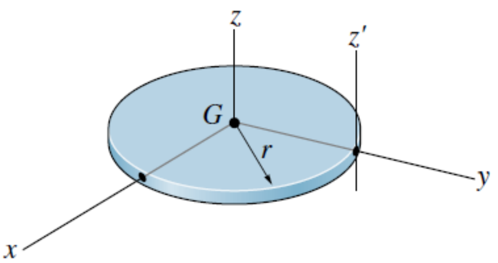
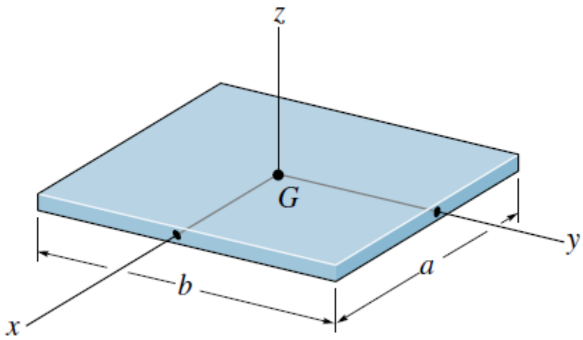
 Parabolic area	 $I_x = \frac{1}{36}bh^3$
Parabolic area	Triangular area

Table 2: Centre of Gravity and Mass Moment of Inertia of Homogenous Solids

 Sphere $I_{xx} = I_{yy} = I_{zz} = \frac{2}{5}mr^2$	 Cylinder $I_{xx} = I_{yy} = \frac{1}{12}m(3r^2 + h^2)$ $I_{zz} = \frac{1}{2}mr^2$
 Hemisphere $I_{xx} = I_{yy} = 0.259mr^2$ $I_{zz} = \frac{2}{5}mr^2$	 Cone $I_{xx} = I_{yy} = \frac{3}{80}m(4r^2 + h^2)$ $I_{zz} = \frac{3}{10}mr^2$
 Thin Circular disk $I_{xx} = I_{yy} = \frac{1}{4}mr^2$ $I_{zz} = \frac{1}{2}mr^2$ $I_{z'z'} = \frac{3}{2}mr^2$	 Thin plate $I_{xx} = \frac{1}{12}mb^2$ $I_{yy} = \frac{1}{12}ma^2$ $I_{zz} = \frac{1}{12}m(a^2 + b^2)$

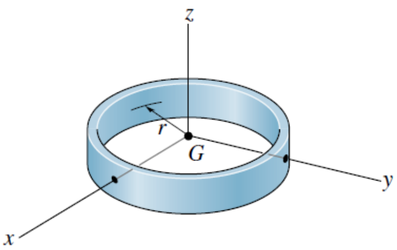
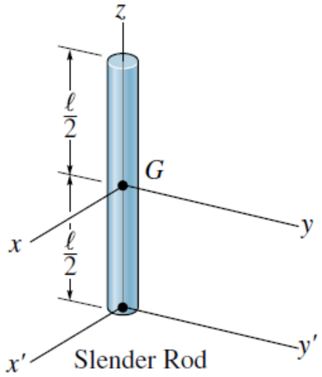
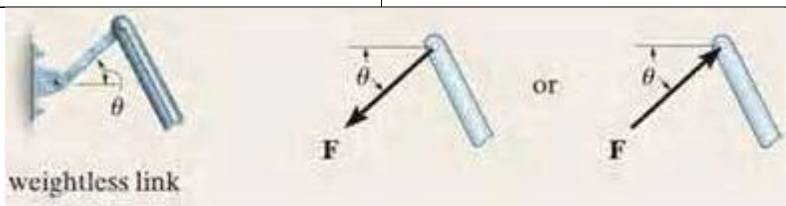
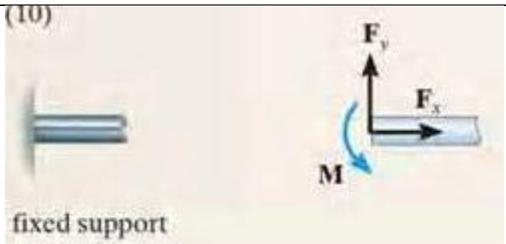
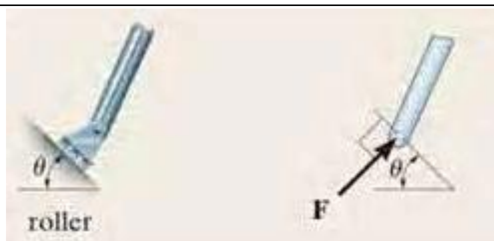
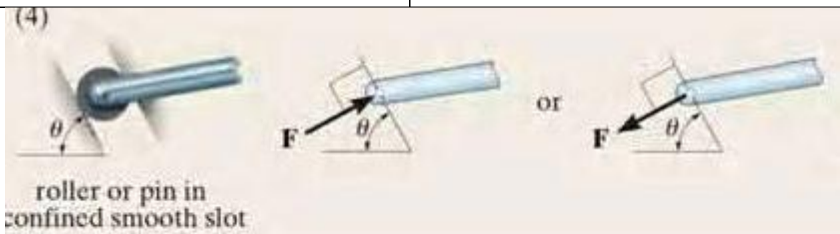
 Thin ring $I_{xx} = I_{yy} = \frac{1}{2}mr^2 \quad I_{zz} = mr^2$	 Slender Rod $I_{xx} = I_{yy} = \frac{1}{12}m\ell^2 \quad I_{x'x'} = I_{y'y'} = \frac{1}{3}m\ell^2 \quad I_{z'z'} = 0$

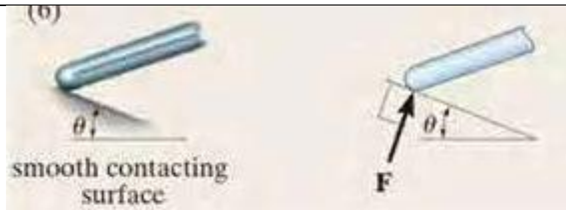
Table 3: Support for Rigid Bodies 2D

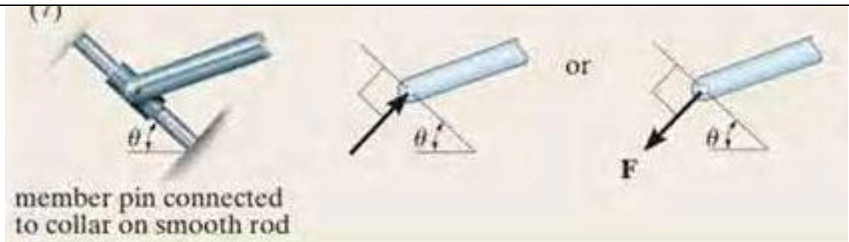












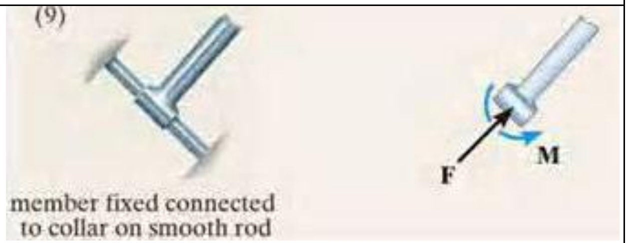
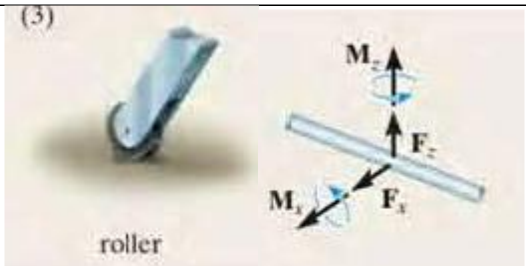
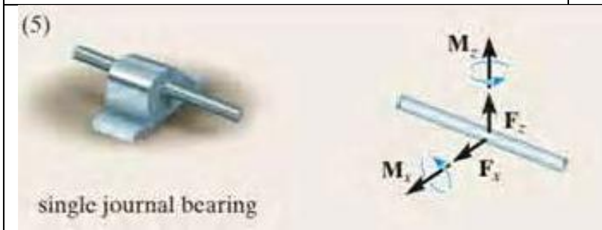
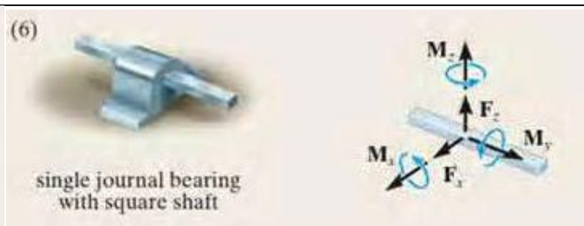
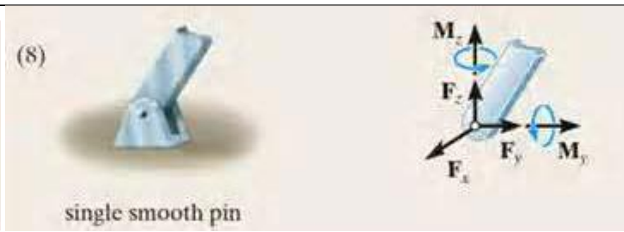


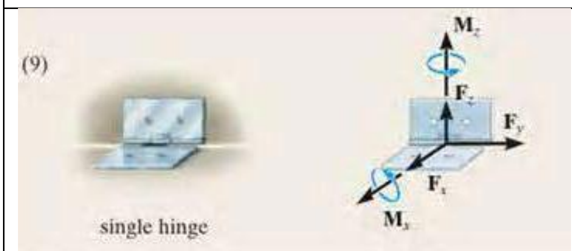
Table 4: Support for Rigid Bodies 3D

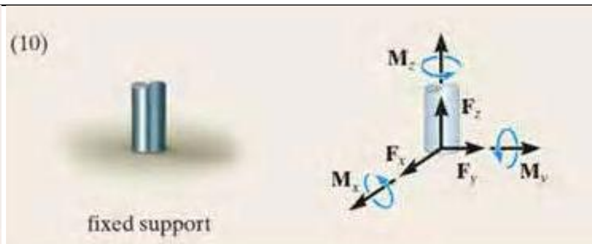












END OF APPENDIX