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SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION

SEPTEMBER 2014 SESSION

SUBJECT CODE	:	**NMB11103**
SUBJECT TITLE	:	**ENGINEERING MECHANICS 1**
LEVEL	:	**BACHELOR**
TIME / DURATION	:	**9.00 AM – 12.00 PM (3 HOURS)**
DATE	:	**2 JANUARY 2015**

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 5 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) Three forces act on the bracket (Figure 1). Determine the magnitude and direction θ of F_1 so that the resultant force is directed along the positive *x*' axis and has a magnitude of 1 kN.

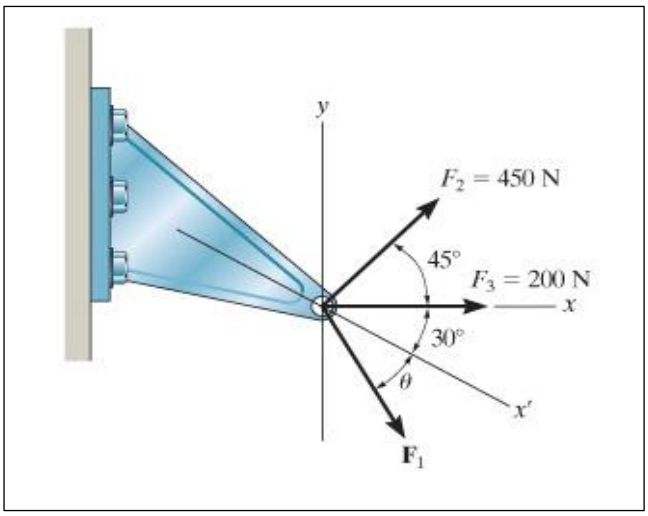


Figure 1

(12 marks)

(b) Express each force acting on the bracket in Figure 2 as a Cartesian vector. Determine the magnitude and coordinate direction angles of the resultant force acting on the bracket.

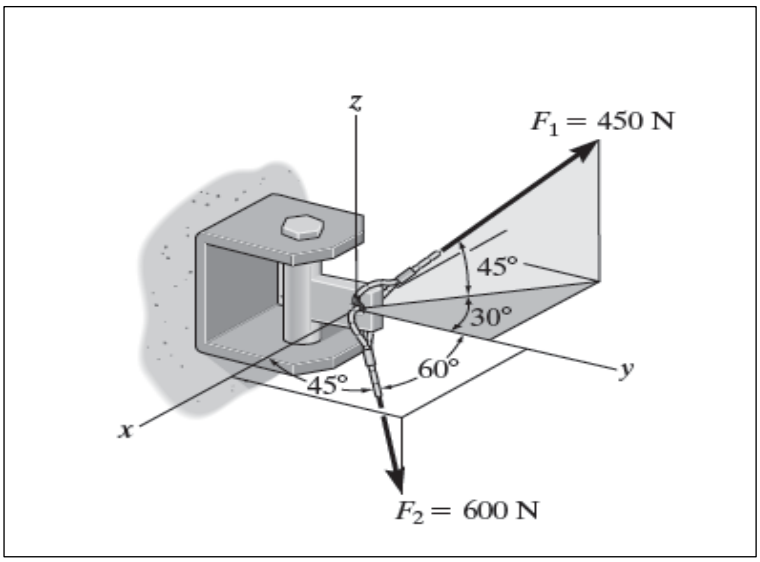


Figure 2

(13 marks)

QUESTION 2

A 450N load is suspended from the hook shown (Figure 3) below. If the load is supported by two cables and a spring having a stiffness k = 8 kN / m, determine the force in the cables and the stretch of the spring for equilibrium. Cable AD lies in the x-y plane and cable AC lies in the x-z plane. Sketch the free body diagram showing all forces.

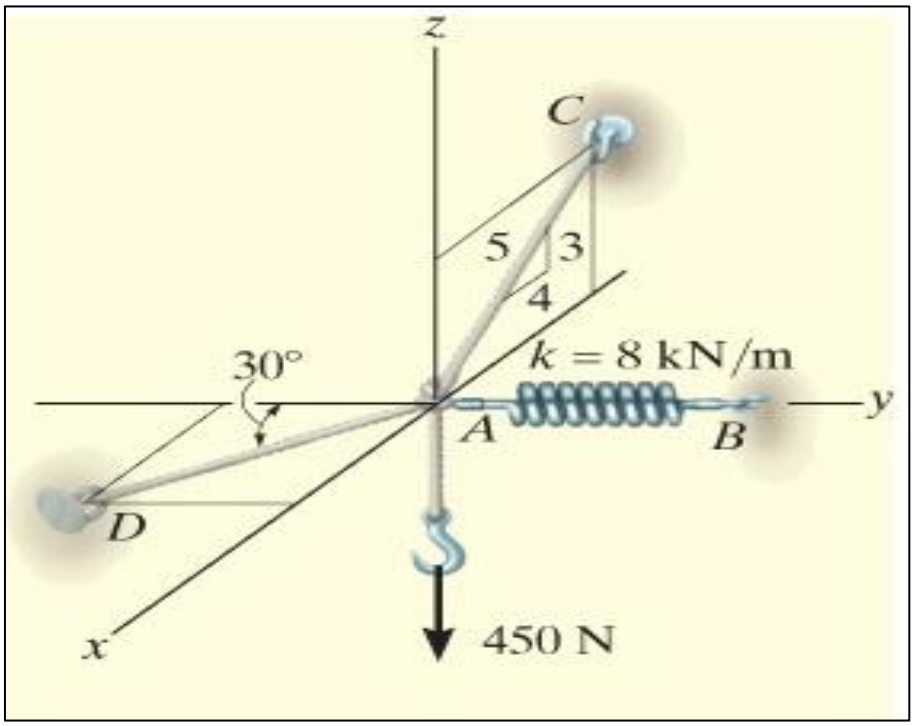


Figure 3

(25 marks)

QUESTION 3

(a) Replace the loading on the frame (figure 4) by a single resultant force. Specify where its line of action intersects member *AB*, measured from *A*.

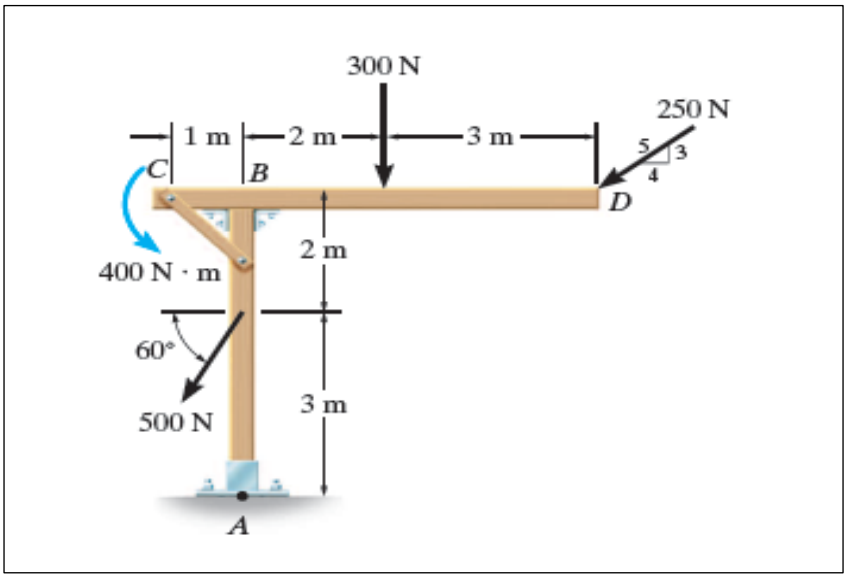


Figure 4

(13 marks)

(b) The semi cylinder of mass *m* and radius *r* lies on the rough inclined plane. If the inclination $\theta = 15^{\circ}$, determine the smallest coefficient of static friction which will prevent the semi cylinder from slipping

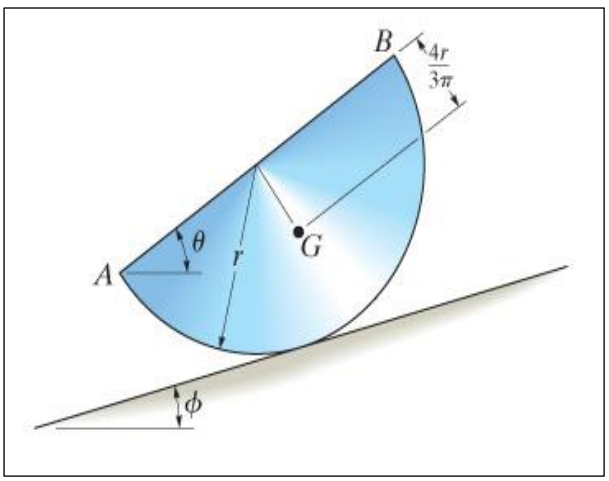


Figure 5

(12 marks)

Question 4

Determine the force in members EF, EP, LK, *CD* and *CM* of the *Baltimore bridge truss* (**Figure 6**) and state if the members are in tension or compression. Also, indicate all zero-force members.

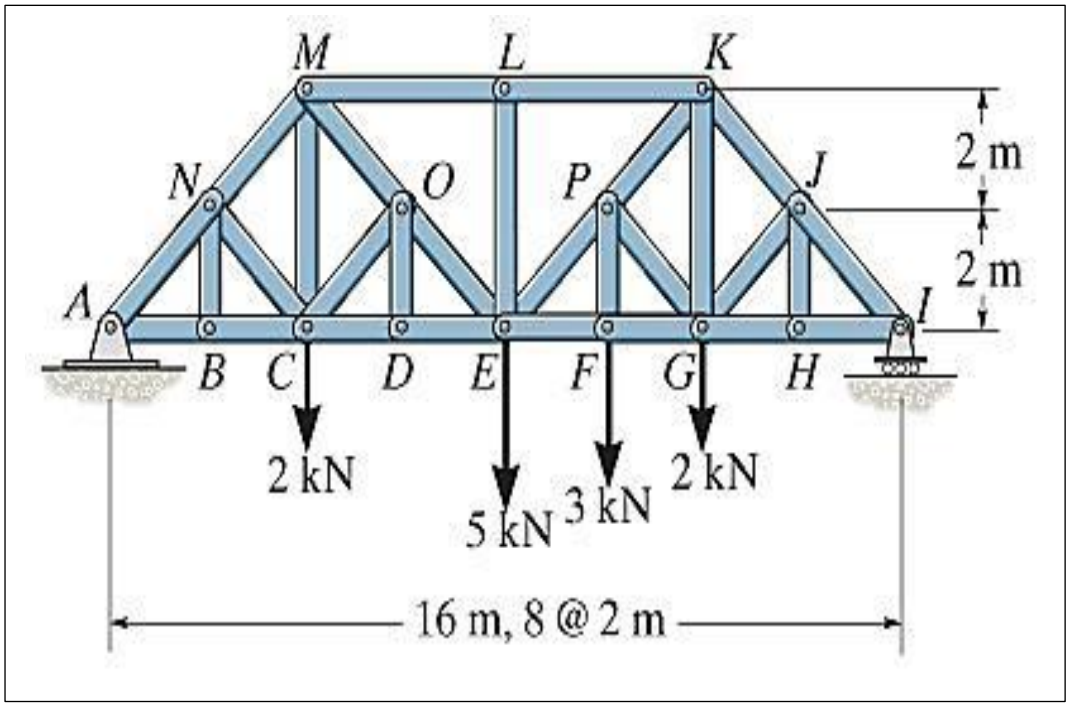


Figure 6

(25 marks)

Question 5

(a) Determine the mass moment of inertia of the overhung crank (**Figure 7)** about the x axis. The material is steel having a density of ρ = 7.85 Mg/m^3.

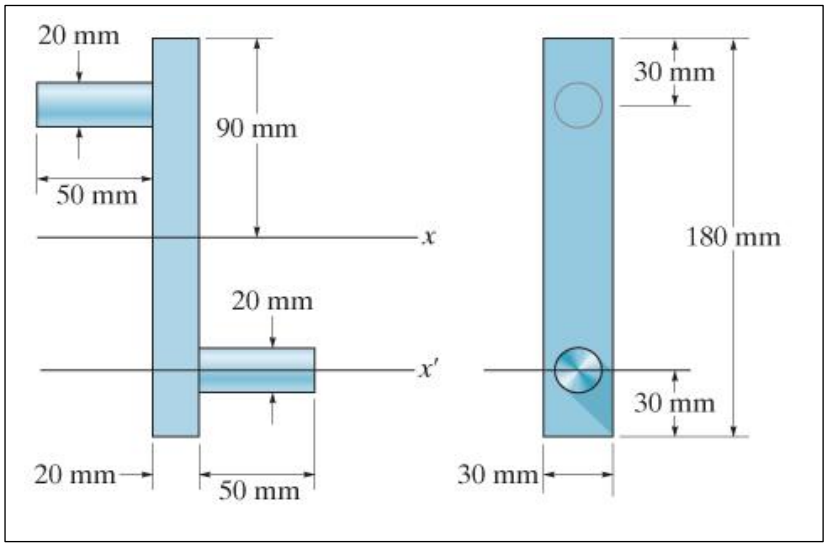


Figure 7

(13 marks)

(b) Locate the centre of gravity of the volume with a radius of 2 m as shown (**Figure 8).** The material is homogeneous. The volume can be describe by the curve $y^2 = 2z$.

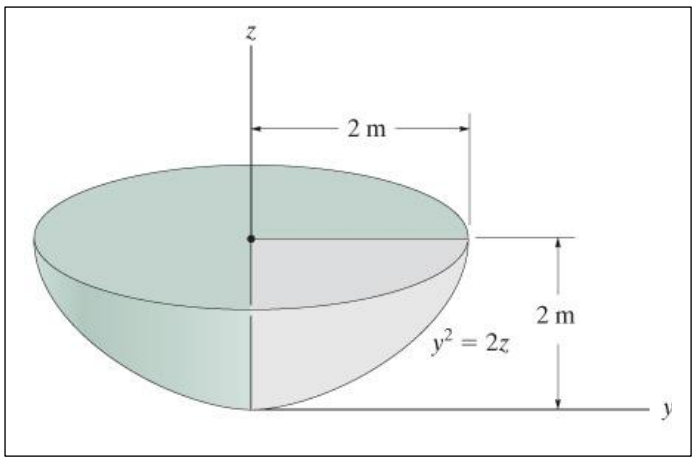


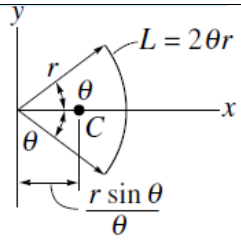
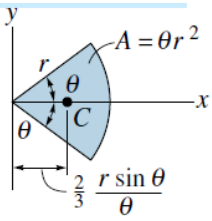
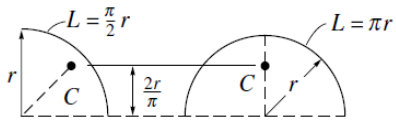
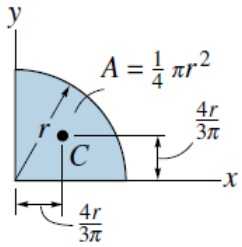
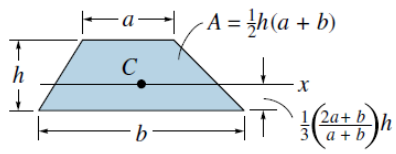
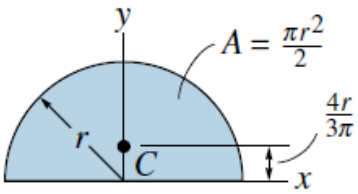
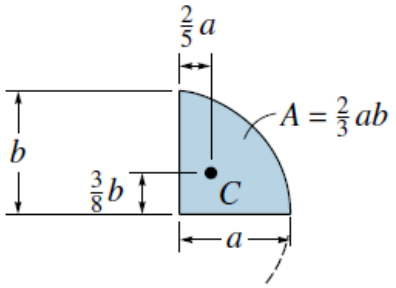
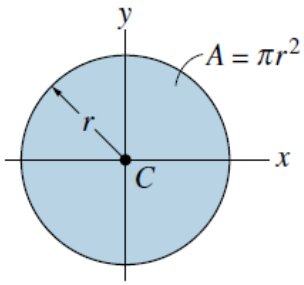
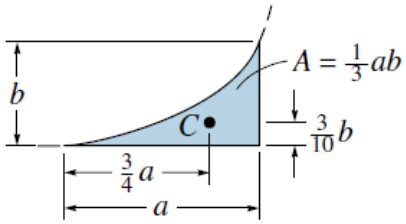
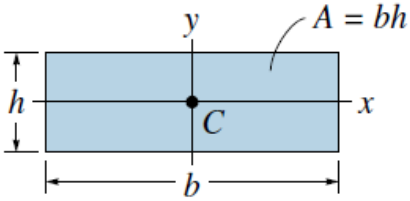
Figure 8

(12 marks)

END OF QUESTIONS

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

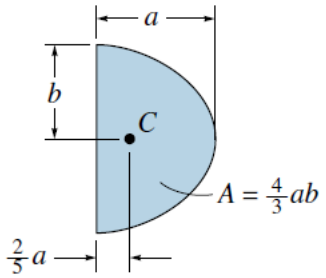
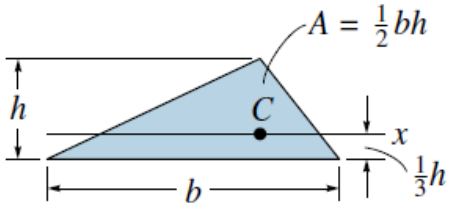
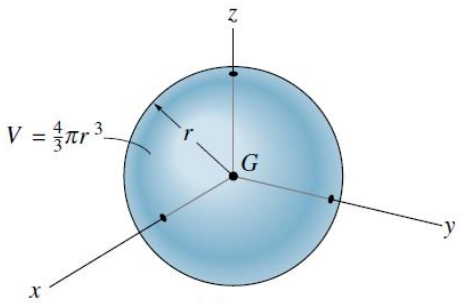
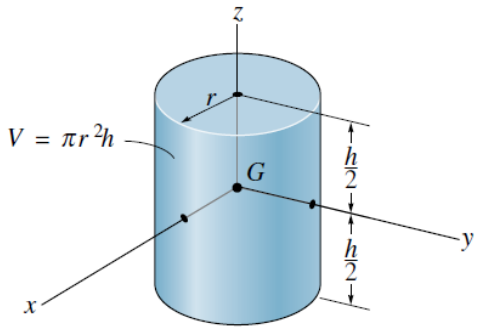
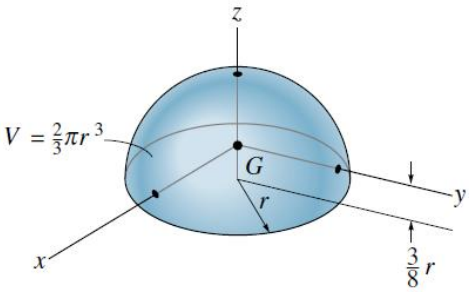
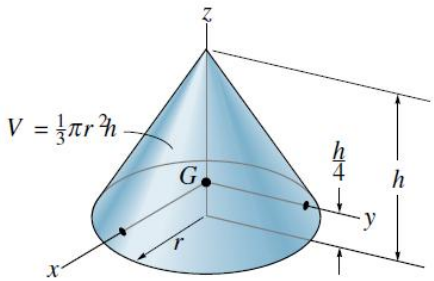
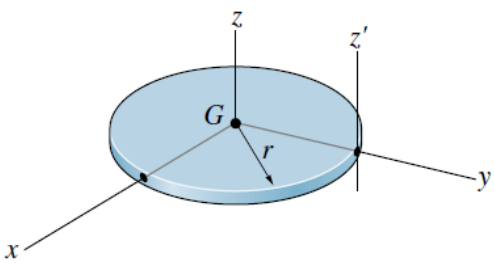
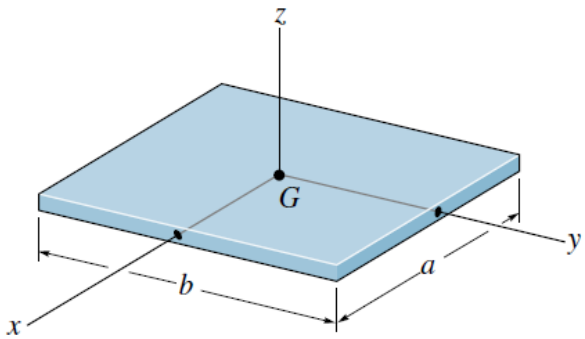
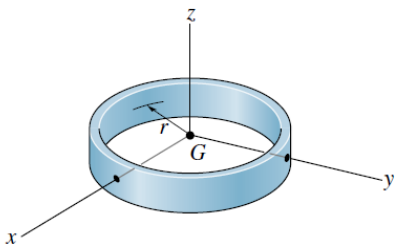
 Parabolic area	 $I_x = \frac{1}{36}bh^3$
Parabolic area	Triangular area

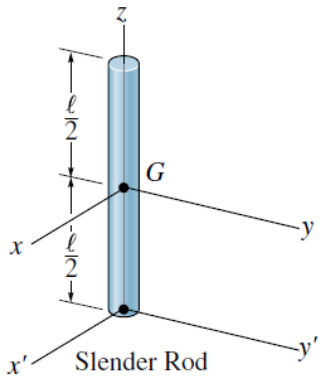
Table 2: Centre of Gravity and Mass Moment of Inertia of Homogenous Solids

 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

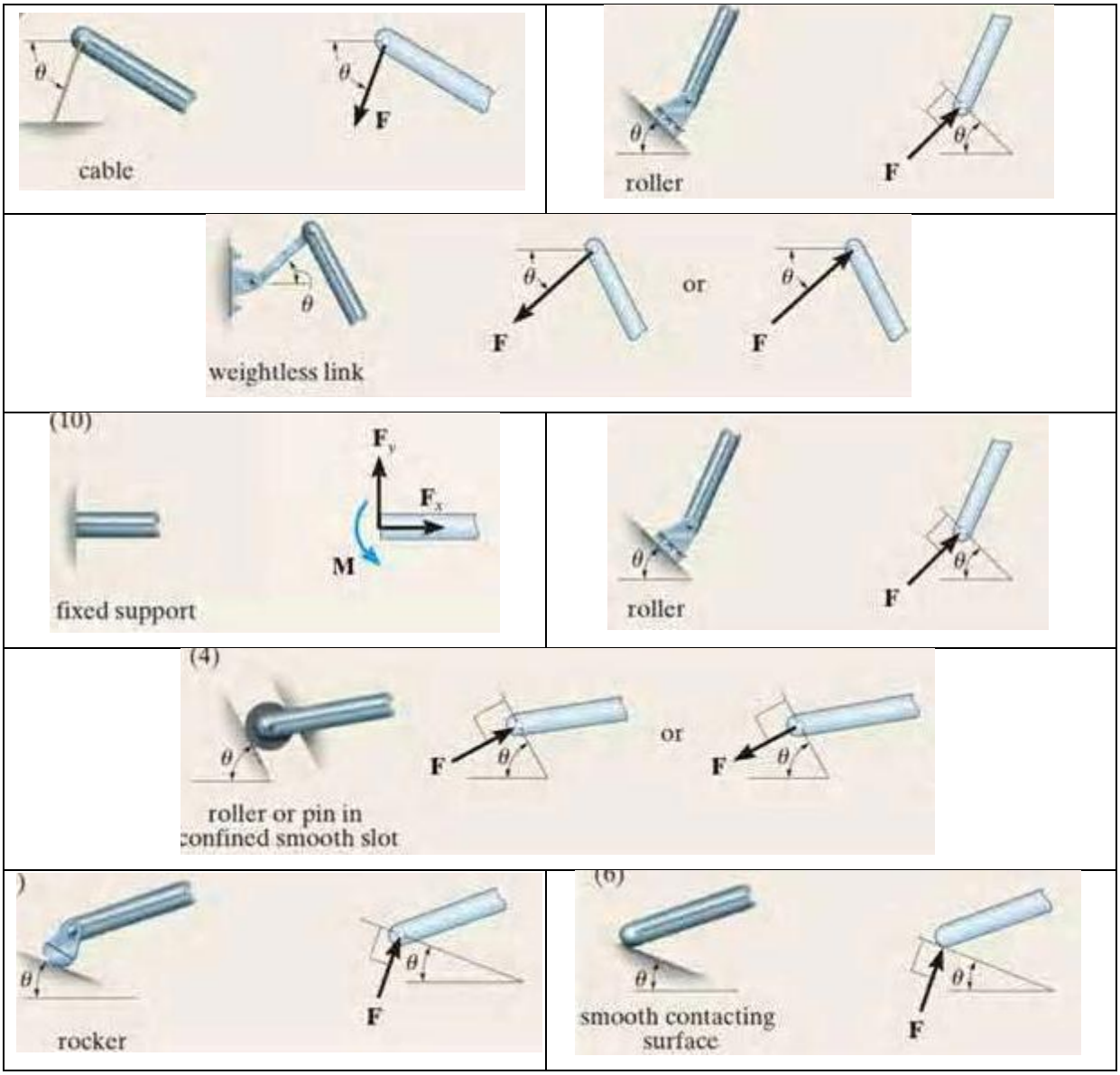
$I_{xx} = I_{yy} = \frac{1}{2}mr^2 \quad I_{zz} = mr^2$



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



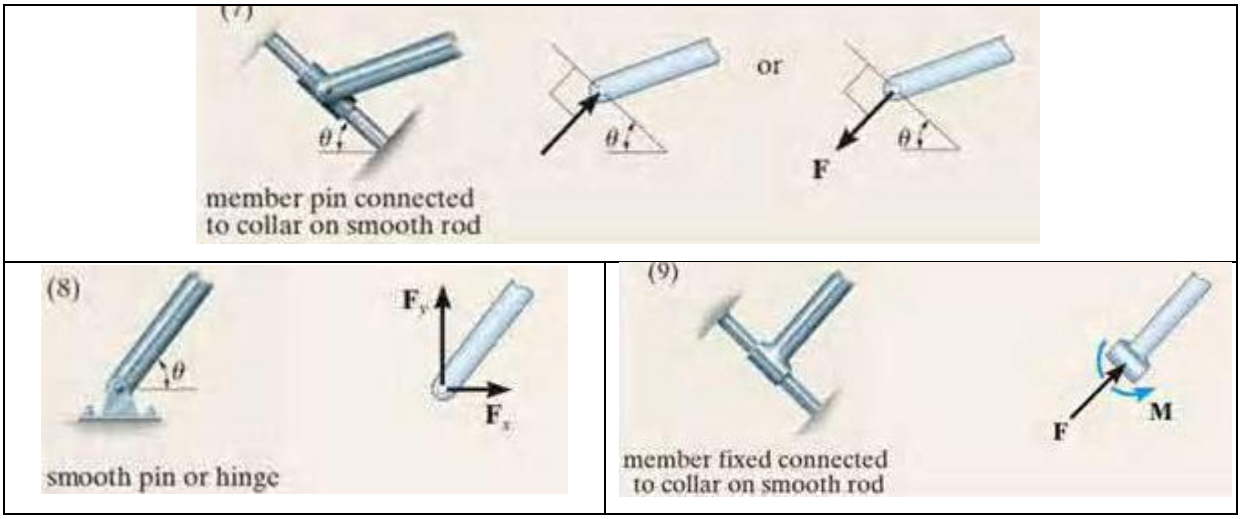
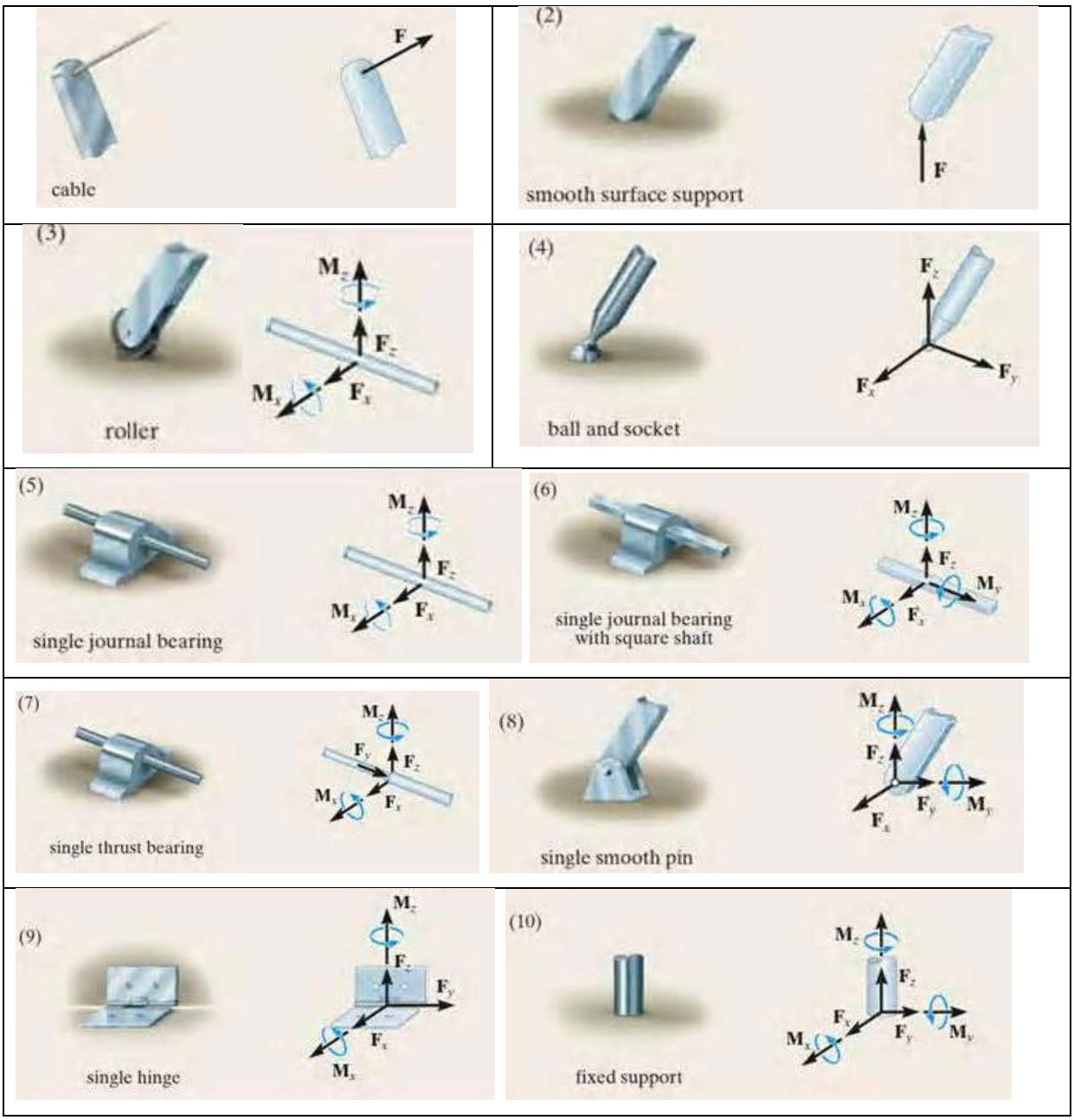


Table 4: Support for Rigid Bodies 3D



END OF APPENDIX