

Homework 5

Answer all the questions

ME297

SJSU Eradat

Due Tuesday Nov. 1

5.1) Rules of thumb

- Decisions are made by efficiently applying “rules of thumb” to make quick approximations. Throughout your career, you should make sure to collect these and know how and when to use them (Jim Burge). As part of your homework assignments, **you should review the relevant notes and find at least 6 useful rules of thumb from the last week’s lecture notes LN11 – LN13**. Report them in the following format.

Name for Rule	Small Angle Approximation
The Rule of Thumb	$\sin \theta \cong \theta$ (in radians)
When is this used?	This is used for small angles (< 0.2 radians or 11.5°) Application of this approximation greatly simplifies analysis and calculation
Limitations	The percent error in the approximation is roughly $\theta^2/6 \times 100\%$ so the approximation is valid to $< 1\%$ for angles < 0.24 radians (14°) and is valid to 0.01% (100ppm) for angles < 1.4 . (you find this by calculating $(\sin \theta - \theta) * 100$ for a range of angles and arguing when if you use it is a situation what kind of error you are signing up for)

5.2) Free Body diagrams

Correct the free body diagrams for 4 of the 5 cases.

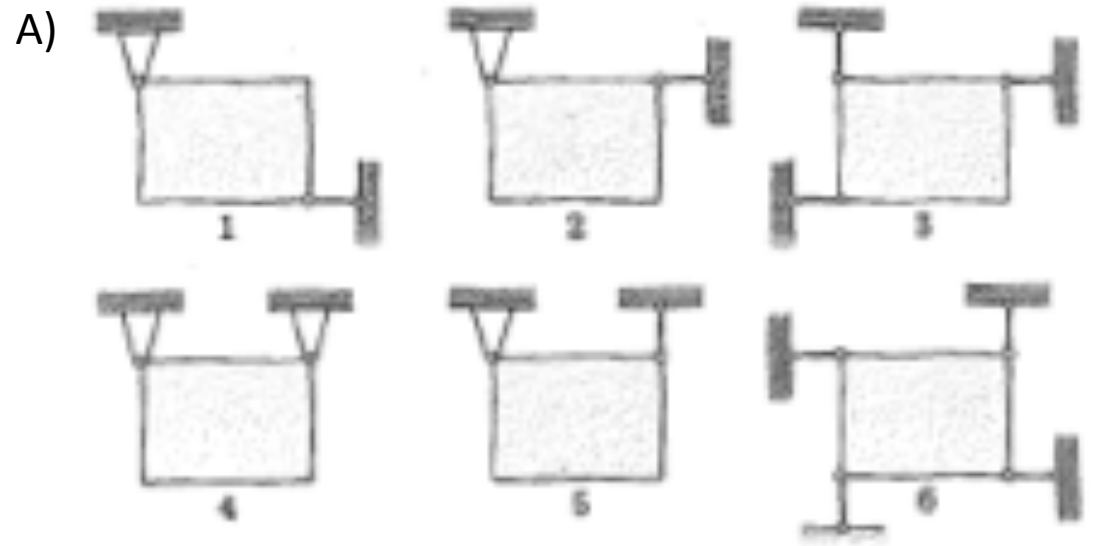
	Body	Wrong or Incomplete <i>FBD</i>
1. Lawn roller of mass m being pushed up incline θ .		
2. Prybar lifting body A having smooth horizontal surface. Bar rests on horizontal rough surface.		
3. Uniform pole of mass m being hoisted into position by winch. Horizontal supporting surface notched to prevent slipping of pole.		
4. Supporting angle bracket for frame; Pin joints.		
5. Bent rod welded to support at A and subjected to two forces and couple.		

5.3 Static determinacy

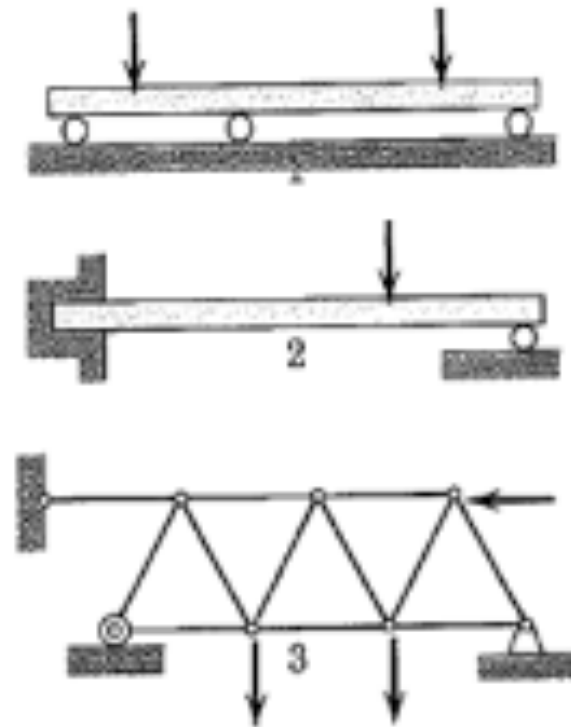
Of the following cases which ones have

1. Static determinacy
2. Overconstraint
3. Underconstraint
4. Simultaneous overconstraint and underconstraint.

Suggest proper modifications to correct them.



B)

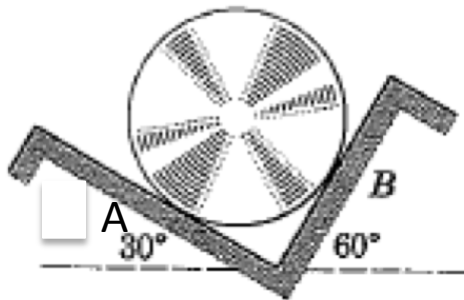


5.4

The homogeneous cylinder has a mass of 40 kg and rests on the surfaces which are inclined at 30 and 60 degrees respectively from the horizontal.

Determine the contact forces

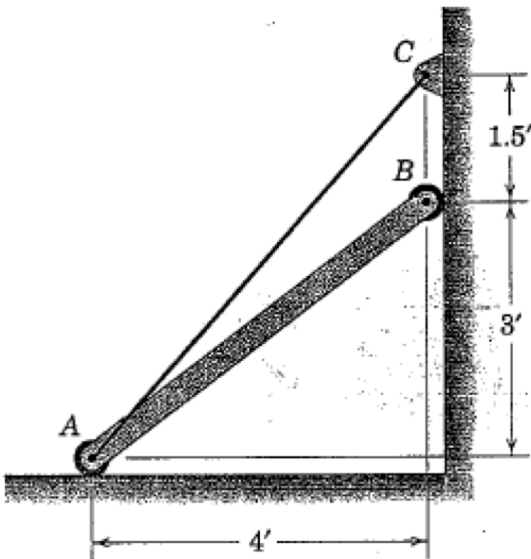
- For smooth surface without friction
- For rough surfaces with coefficient of friction 0.4



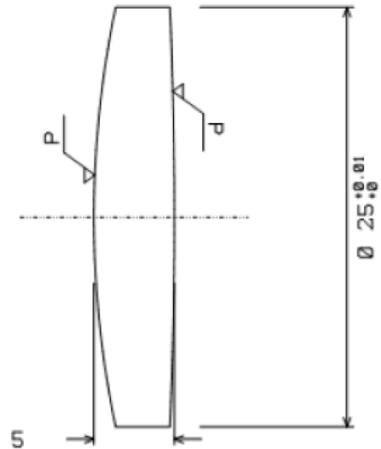
5.5

The uniform bar AB is 30 kg including the end rollers. It is supported by the horizontal and vertical surfaces and by the wire AC .

- Calculate the tension T in the wire and the reaction against the rollers at A and B on the earth.
- Repeat the calculations for the structure on the Mars.



5.6) ISO 10110 Drawings: For the lens below, define each of the quantities indicated



DIMENSIONS IN MILLIMETERS

LEFT SURFACE	MATERIAL	RIGHT SURFACE
R 58.6 \pm _{0.15} ^{0.15} CX Ø _E 22.5 \pm ₀ ^{0.1} @ 0.9 FOR 450 < L < 750 3/ 0.25(.2/.125) 4/ .3' 5/ 5X0.05;L1X0.001;E0.5 6/ 0.5;1053;3 POLISHED: RQ 0.01 1/3	GLASS: N-SK15 N _d = 1.622960 \pm _{1E-005} ^{1E-005} V _d = 58.02 Ø/ 5 1/ 1X.1 2/ 2;3	R 277 \pm _{0.8} ^{0.8} CX Ø _E 22.5 @ 0.9 FOR 450 < L < 750 3/ 0.25(.2/0.125) 4/ 0.3' 5/ 5X.05;L1X.001;E0.5 6/ 0.5;1053;3 POLISHED: RQ 0.01 1/3

ISO ELEMENT DRAWING INDICATIONS ACCORDING TO ISO 10110

6.1 Mirror mount

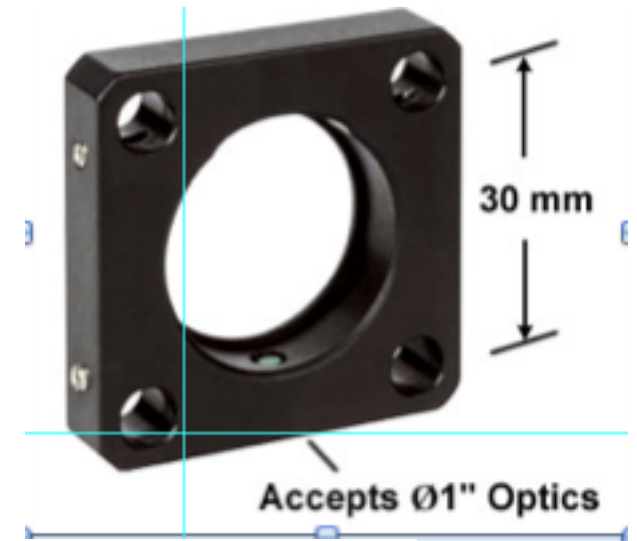
This part is not due on Nov. 1st. It is to get started with cad design.

Understand the definition of a datum on a drawing. Make a CAD drawing for the 1" flat mirror mount that use ANSI Y14.5 conventions for dimensioning and tolerancing.

Correctly show dimensions for linear size, diameter, and radii. Make up the numbers and tolerances based on the following most important issues:

- Diameter of the optics is 1"
- center-to-center of the holes is 30mm
- Specs of the mirror to be mounted is given in the table. We want to preserve the mirror's functionality and specs.

Use feature control frames to specify tolerances for straightness, flatness, roundness, profile, perpendicularity, parallelism, concentricity, position, and runout. Define datum references as necessary.



Backside Polished Mirrors			
Item #	BB1-E02P	BB1-E03P	PF10-03-P01P
Diameter	Ø1"		
Diameter Tolerance	+0.00 mm / -0.10 mm		
Thickness	6 mm		
Thickness Tolerance	±0.2 mm		
Substrate	Standard Grade Fused Silica		
Wedge	<5 arcmin		
Front Surface			
Coating	Broadband Dielectric 400-750 nm	Broadband Dielectric 750-1100 nm	Protected Silver
Flatness	λ/10		
Surface Quality	10-5 (Scratch-Dig)		
Clear Aperture	>90% of Diameter		
Reflectivity	>99% for S and P Polarization for Angles of Incidence from 0° to 45°		R _{avg} >96% from 400 nm - 700 nm R _{avg} >97.5% from 700 nm - 2000 nm
Damage Threshold	0.25 J/cm ² (532 nm, 10 ns, 10 Hz, Ø0.803 mm)	1 J/cm ² (810 nm, 10 ns, 10 Hz, Ø0.133 mm) 0.5 J/cm ² (1064 nm, 10 ns, 10 Hz, Ø0.433 mm)	3 J/cm ² (1064 nm, 10 ns, 10 Hz, Ø1.000 mm)
Back Surface			
Flatness	λ/4		
Surface Quality	20-10 (Scratch-Dig)		