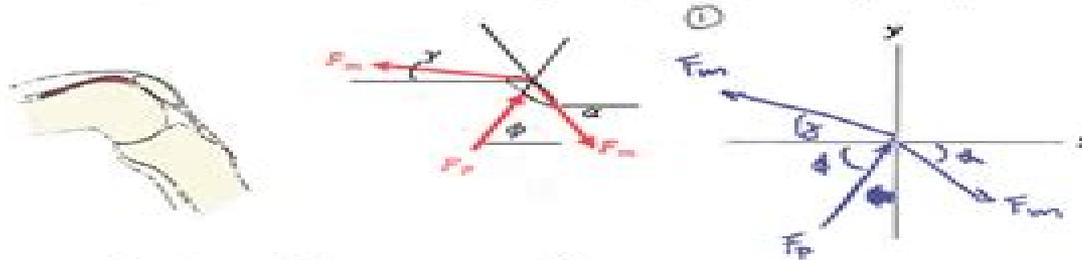


**Problem 1:**

As discussed in class, the patella helps to provide an additional moment arm to the quadriceps muscle to reduce the force necessary to extend the knee. Noting that the patella acts like a pulley, we can see that the muscle tension helps push the patella against the distal condyle of the femur. Using the knee diagrams below, complete the following:

1. Draw a FBD on the  $xy$ -axes assuming that the patellar compressive and muscle forces all intersect at the origin.
2. Write a set of force and moment balance equations describing the joint
3. Find expressions for the patellar contact angle,  $\phi$ , and the patellar force  $F_p$ , as functions of muscle force magnitude and direction ( $F_m, \gamma, \alpha$ ).
4. How do you expect the patellar force to be different during a deep squat (high knee flexion angle) compared to standing? Justify your answer using the equations developed in (3).



$$\textcircled{2} \sum F_x = 0: -F_m \cos \gamma + F_p \cos \phi + F_m \cos \alpha = 0$$

$$F_p = \frac{F_m (\cos \gamma - \cos \alpha)}{\cos \phi}$$

$$\uparrow \sum F_y = 0: F_m \sin \gamma + F_p \sin \phi - F_m \sin \alpha = 0$$

$$\sum M = 0$$

$$\textcircled{3} \text{ From } \sum F_y \rightarrow$$

$$\sin \phi = \frac{F_m (\sin \alpha - \sin \gamma)}{F_p} = \frac{\cos \phi (\sin \alpha - \sin \gamma)}{\cos \gamma - \cos \alpha}$$

$$\text{TAN} \phi = \frac{\sin \alpha - \sin \gamma}{\cos \gamma - \cos \alpha}$$

$$\phi = \text{TAN}^{-1} \left[ \frac{\sin \alpha - \sin \gamma}{\cos \gamma - \cos \alpha} \right]$$

$\textcircled{4}$  AT HIGH FLEXION:  $\alpha$  INCREASES }  $F_p \approx \frac{1 - \cos \alpha}{\cos \phi} \rightarrow F_p \dots$   
 $\gamma \approx \text{CONST, SMALL}$  }  $F_m \cos \phi$  } INCREASES  
 $\rightarrow \alpha \rightarrow 90^\circ \dots \rightarrow 45^\circ$  }  $F_m$  } DECREASES

# Biomechanics Sample Problems And Solutions

**Rachel Sandford**



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*Kinesiology* David Paul Greene, Susan L. Roberts, 2005-01-01 Approaching the subject of kinesiology from the perspective of occupational therapy this unique text written by occupational therapists examines the everyday activities of people using the principles of biomechanics to adapt to changes in their functional abilities This new edition stresses applicability to clinical practice with the inclusion of case examples In depth coverage of wrist and hand pathokinesiology as well as normal kinesiology function of the wrist and fingers Key terms chapter outlines and applications that enhance studying and learning 12 appendices and a glossary with metric conversions review of mathematics a diagram of body segment parameters and laboratory activities New material providing explanations of the pathokinesiology of shoulder subluxation rotator cuff tear adhesive capsulitis fractures tendon injuries and shoulder problems secondary to CVA More case studies and less emphasis on heavy calculations to ensure the concepts are more easily grasped Perforated lab manual filled with activities tied directly to the chapters Enhanced illustrations for easier visualization of the concepts demonstrated

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Waldron,1997-10-20 This book covers the state of the art in both biological and artificial legged locomotion systems The seven chapters focus on topics ranging from very detailed modelling of the musculo skeletal system through mathematical modelling and simulation to theories applicable to locomotion mechanics and control The final two chapters deal with the mechanics control and design of artificial legged locomotion systems **Physics, Uspekhi** ,2002 *ASME Technical Papers* ,1974 *Fundamentals of Biomechanics* Nihat Özkaya,Dawn Leger,David Goldsheyder,Margareta Nordin,2016-12-24 This textbook integrates the classic fields of mechanics statics dynamics and strength of materials using examples from biology and medicine The book is excellent for teaching either undergraduates in biomedical engineering programs or health care professionals studying biomechanics at the graduate level Extensively revised from a successful third edition *Fundamentals of Biomechanics* features a wealth of clear illustrations numerous worked examples and many problem sets The book provides the quantitative perspective missing from more descriptive texts without requiring an advanced background in mathematics It will be welcomed for use in courses such as biomechanics and orthopedics rehabilitation and industrial engineering and occupational or sports medicine This book Introduces the fundamental concepts principles and methods that must be understood to begin the study of biomechanics Reinforces basic principles of biomechanics with repetitive exercises in class and homework assignments given throughout the textbook Includes over 100 new problem sets with solutions and illustrations *Dissertation Abstracts International* ,2006 *New Scientist* ,1979 A Collection of Technical Papers: Structural dynamics ,1986 Medicine and Sport Ernst Jokl,1971

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1. Understanding the eBook Biomechanics Sample Problems And Solutions
  - The Rise of Digital Reading Biomechanics Sample Problems And Solutions
  - Advantages of eBooks Over Traditional Books
2. Identifying Biomechanics Sample Problems And Solutions
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in an Biomechanics Sample Problems And Solutions
  - User-Friendly Interface
4. Exploring eBook Recommendations from Biomechanics Sample Problems And Solutions
  - Personalized Recommendations
  - Biomechanics Sample Problems And Solutions User Reviews and Ratings
  - Biomechanics Sample Problems And Solutions and Bestseller Lists
5. Accessing Biomechanics Sample Problems And Solutions Free and Paid eBooks

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  - Biomechanics Sample Problems And Solutions eBook Subscription Services
  - Biomechanics Sample Problems And Solutions Budget-Friendly Options
6. Navigating Biomechanics Sample Problems And Solutions eBook Formats
    - ePub, PDF, MOBI, and More
    - Biomechanics Sample Problems And Solutions Compatibility with Devices
    - Biomechanics Sample Problems And Solutions Enhanced eBook Features
  7. Enhancing Your Reading Experience
    - Adjustable Fonts and Text Sizes of Biomechanics Sample Problems And Solutions
    - Highlighting and Note-Taking Biomechanics Sample Problems And Solutions
    - Interactive Elements Biomechanics Sample Problems And Solutions
  8. Staying Engaged with Biomechanics Sample Problems And Solutions
    - Joining Online Reading Communities
    - Participating in Virtual Book Clubs
    - Following Authors and Publishers Biomechanics Sample Problems And Solutions
  9. Balancing eBooks and Physical Books Biomechanics Sample Problems And Solutions
    - Benefits of a Digital Library
    - Creating a Diverse Reading Collection Biomechanics Sample Problems And Solutions
  10. Overcoming Reading Challenges
    - Dealing with Digital Eye Strain
    - Minimizing Distractions
    - Managing Screen Time
  11. Cultivating a Reading Routine Biomechanics Sample Problems And Solutions
    - Setting Reading Goals Biomechanics Sample Problems And Solutions
    - Carving Out Dedicated Reading Time
  12. Sourcing Reliable Information of Biomechanics Sample Problems And Solutions
    - Fact-Checking eBook Content of Biomechanics Sample Problems And Solutions
    - Distinguishing Credible Sources
  13. Promoting Lifelong Learning
    - Utilizing eBooks for Skill Development

- Exploring Educational eBooks
14. Embracing eBook Trends
- Integration of Multimedia Elements
  - Interactive and Gamified eBooks

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