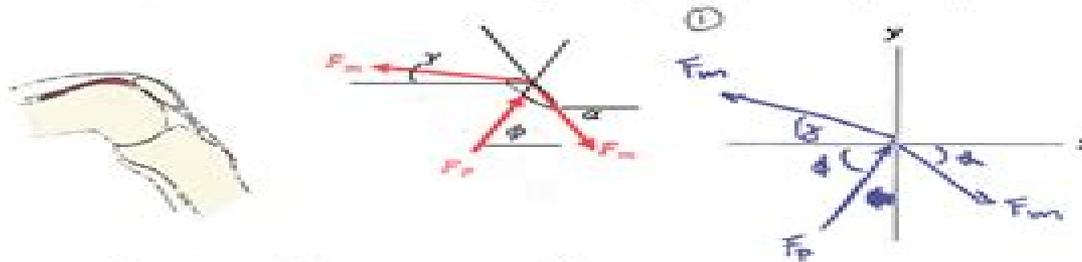


Problem 1:

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, ϕ , and the patellar force F_p , as functions of muscle force magnitude and direction (F_m, γ, α).
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: α 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

Huangqi Zhang



Biomechanics Sample Problems And Solutions:

Kinesiology of the Musculoskeletal System - E-Book Donald A. Neumann,2016-11-03 With its focus on the normal and abnormal mechanical interactions between the muscles and joints of the body Kinesiology of the Musculoskeletal System Foundations for Rehabilitation 3rd Edition provides a foundation for the practice of physical rehabilitation This comprehensive research based core text presents kinesiology as it relates to physical rehabilitation in a clinically relevant and accessible manner It provides students and clinicians with the language of human movement and acts as a bridge between basic science and clinical management Full color anatomic and kinesiological illustrations clearly demonstrate the anatomy functional movement and biomechanical principles underlying movement and dynamic new video clips help you interpret new concepts with visual demonstration More than 900 high quality illustrations provide you with the visual accompaniments you need to comprehend the material Clinical Connections boxes at the end of each chapter in Sections II through IV highlight or expand upon a particular clinical concept associated with the kinesiology covered in the chapter Special Focus boxes interspersed throughout the text provide numerous clinical examples that demonstrate why kinesiological information is needed Critical thinking questions challenge you to review or reinforce the main concepts contained within each chapter Evidence based approach emphasizes the importance of research in physical therapy decision making Evolve site for students comes with video clips answers to study questions and references linked to Medline Evolve site for instructors includes an image collection from the text teaching tips and lab activities NEW Kinesiology of Running chapter covers the biomechanics of running NEW Video clips help you interpret new concepts with visual demonstration NEW All new content on the pelvic floor NEW Thoroughly updated references emphasize the evidence based presentation of information in the text NEW QR codes linked to videos for easy viewing on mobile devices NEW Pageburst enhanced edition allows you to access multimedia content from the eBook without going to another website [Applied Mechanics Reviews](#),1974

EIT Industrial Review Donovan Young,2003-09-18 This guide is written for the afternoon FE EIT Industrial Exam and reviews each topic with numerous example problems and complete step by step solutions End of chapter problems with solutions and a complete sample exam with solutions are provided Topics covered Production Planning and Scheduling Engineering Economics Engineering Statistics Statistical Quality Control Manufacturing Processes Mathematical Optimization and Modeling Simulation Facility Design and Location Work Performance and Methods Manufacturing Systems Design Industrial Ergonomics Industrial Cost Analysis Material Handling System Design Total Quality Management Computer Computations and Modeling Queuing Theory and Modeling Design of Industrial Experiments Industrial Management Information System Design Productivity Measurement and Management 101 problems with complete solutions SI Units [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

An Introduction to Biomechanics Jay D. Humphrey, Sherry L. O'Rourke, 2016-10-18 This book covers the fundamentals of biomechanics Topics include bio solids biofluids stress balance and equilibrium Students are encouraged to contextualize principles and exercises within a big picture of biomechanics This is an ideal book for undergraduate students with interests in biomedical engineering **Engineering Mechanics** R. C. Hibbeler, 2010 Text and illustrations on lining papers

Biomaterials Science Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen, Jack E. Lemons, 2012-12-31 The revised edition of this renowned and bestselling title is the most comprehensive single text on all aspects of biomaterials science It provides a balanced insightful approach to both the learning of the science and technology of biomaterials and acts as the key reference for practitioners who are involved in the applications of materials in medicine Over 29 000 copies sold this is the most comprehensive coverage of principles and applications of all classes of biomaterials the only such text that currently covers this area comprehensively *Materials Today* Edited by four of the best known figures in the biomaterials field today fully endorsed and supported by the Society for Biomaterials Fully revised and expanded key new topics include of tissue engineering drug delivery systems and new clinical applications with new teaching and learning material throughout case studies and a downloadable image bank Engineering Mechanics , Statics J. L. Meriam, L. G. Kraige, 2001-08-28

Orthopaedic Surgery Mark Baratz, Anthony D. Watson, Joseph E. Imbriglia, 1999 Offering a complete fully integrated approach to the entire field of orthopaedic surgery this reference covers basic science anatomy surgical approaches evaluation treatment and anticipated outcome Highlights include full discussions of musculoskeletal soft tissues joint pathology imaging techniques trauma oncology adult and pediatric orthopaedics medical malpractice and evolving telemedicine technology The book s detailed yet easy to read format aids in implementing the practical tips and guidelines highlighted throughout With its complete approach this book also provides the core curriculum for orthopaedic residents including state of the art sections on gene therapy outpatient orthopaedics new surgical procedures and resource management Journal of Biomechanical Engineering , 1981 Scientific Bases of Human Movement Barbara A. Gowitzke, Morris Milner, 1988 *Human and Machine Locomotion* A. Morecki, K.J. 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

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Proceedings of the ASME Pressure Vessels and Piping Conference--2006: Fluid-structure interaction ,2007 ASME Technical Papers ,1974 A Collection of Technical Papers: Structural dynamics ,1986 **Journal of Applied Mechanics** ,1989 **International Workshop on Nondestructive Testing and Computer Simulations in Science and Engineering** ,2001 **New Scientist** ,1979

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