Kingdom of Saudi Arabia

Ministry of Education

Umm Al-Qura University

College of Applied Sciences

Physics Department

Semester: 1st semester 1439-1440
Exam: Final Exam
Program: Medical Physics
Course: Biomechanics.
Course Code: 403393-3
Exam Time: 2 Hrs
Exam Date: 11 / 4 /1440 A. H
Total Exam Marks: **50 Mark**

Student's Name: **Student ID:**   **Group No.:**

Please answer Five questions only: اجب عن **خمسة** أسئلة **فقط**

Question One   *[10 Marks]*

From the opposite figure a traction device used with an injury. The weight of the 2.2-kg object creates a tension in the rope that passes around the pulleys. Therefore, tension forces $\overrightarrow{T_1}$ and $\overrightarrow{T_2}$ are applied to the pulley on the foot. It may seem surprising that the rope applies a force to either side of the foot pulley. A similar effect occurs when you place a finger inside a rubber band and push downward. You can feel each side of the rubber band pulling upward on the finger. The foot pulley is kept in equilibrium because the foot also applies a force F to it. This force arises in reaction (Newton's third law) to the pulling effect of the forces $\overrightarrow{F_1}$ and $\overrightarrow{F_2}$ Ignoring the weight of the foot, Find the magnitude of $\overrightarrow{F}$?

(a)
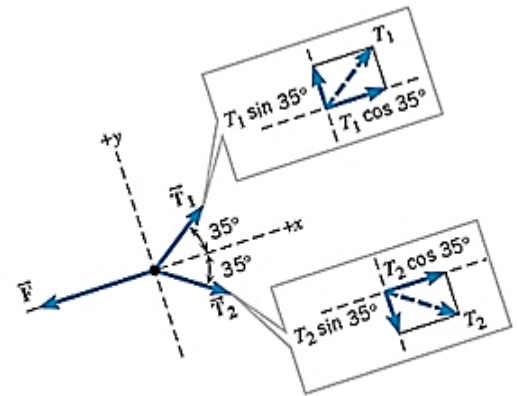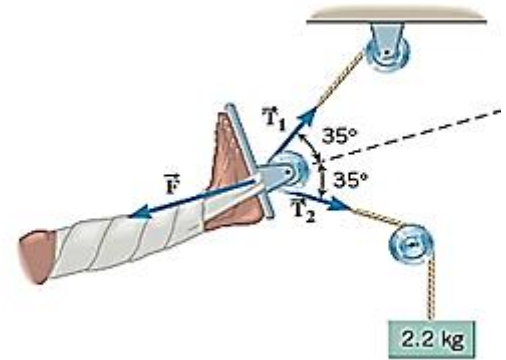
(b) Free-body diagram for the foot pulley

Question Two   *[10 Marks]*

Choose the correct answer for each sentence of the followings:

1) A body is said to be in a static equilibrium, if ....

      i.   ΣF=0 & ΣG=0   *ii. ΣF=0 & Στ=0*

      iii. Στ=0 & ΣK=0   *iv. ΣF=0 & ΣM=0.*

2) **In unstable equilibrium, the body is ...., the force of gravity accelerates it.**

  i.   Supported   ii. Attracted   iii. Unattached   iv. Unsupported.

3) **The ....the base on which the body rests, the more stable it is.**

  i.Shorter   ii. Wider   iii. Longer   iv. Bigger.

4) **The stability of the human body is due to static force because of the presence of the ………………….directly above the feet.**

  i. Reaction force   ii. density   iii. torso   iv. center of gravity.

5) **The work expended during the human leg step of a 70 kg person mass and the radius of the joint is about 3 cm with the coefficient of kinetic friction of 0.003 is ....**

  i. 700000 erg.   ii. 1481760 erg.

  iii. 823078 erg.   iv. 911000 erg.

6) **The normal force "F_n" on a person with 70 kg person mass erected on an incline with an angle of 31^0 is ....**

  i.   650 N   ii. 910N   iii. 800 N   iv. 588 N.

7) **The frictional force "F_f" of a person erected on an incline with an angle of 31^0 of leather shoes with 70 kg mass during erecting on an oak and the static coefficient of friction 0.6 is ....**

  i.   352.8 N   ii. 588N   iii. 560.4 N   iv. 219.7 N.

8) **The work done by a person with weight "W" and the joint radius of 3 cm during walking, whereas for lubricated joint, the kinetic coefficient of friction is 0.003, is equal to lifting the full weight of a person by a distance ....**

  i.   0.03 cm   ii. 0.027 cm   iii. 0.05cm   iv. 0.0216 cm.

9) **………...refers to the …………of a deformation, and refers to the ………of the deformation.**

  i. Stress, effect, strain, cause   ii. Strain, effect, stress, cause

  iii. Stress, cause, strain, effect   iv. Strain, cause, stress, effect

10) **The …………….is the maximum stress a body can experience without becoming permanently deformed.**

  i.Elastic limit   ii. Stiffness   iii. Ultimate strength   iv. No Correct answer.

Question Three   [10 Marks]

Put right sign (√) or wrong sign (x) for each sentence of the followings and re-correct the wrong one:

1)	The greater the strength of a substance, the higher its breaking stress.	( )
2)	The greater the stiffness of the material, the higher the strain produced.	( )
3)	The intermission of two surfaces produces a frictional reaction force.	( )
4)	In order to move the object along the surface, the applied force must be less than the frictional force.	( )
5)	The regular the surfaces, the greater is the frictional force.	( )
6)	The kinetic frictional force parallel to the motion of the object.	( )
7)	The magnitude of the frictional force depends on the size of the content area.	( )
8)	Rolling motion is encountered in a living system.	( )
9)	The lubricant synovial fluid between the joints of the human body increases the coefficient of friction by about a factor of 100 times.	( )
10)	The kinetic coefficient of friction "μ_k" for steel on ice is larger than the lubricated bone on joint of the human body.	( )

`Question Four   [10 Marks]

Define compliance of the blood vessels, compare between the compliance of artery and vein?

Question Five   [10 Marks]

Define each item of the followings *(Answer 5 items only):*

1) Elastic limit of ductile material.

2) Fluid Laminar flow.

3) Resilience energy of bone.

4) Blood Systolic pressure

5) Arteriosclerosis.

6) Power generated by the heart.

7) Bone as in homogeneous material.

Question Six   [10 Marks]

Calculate the equivalent pressure (in torr unit) of the kinetic energy of the blood for the followings:

- (i) At rest (blood flow rate is 5 liter/min and the effective blood flow velocity is 79.5 cm/Sec)
- (ii) At intensive activity (blood flow rate is 25 liter/min and the effective blood flow velocity is ≈ 398 cm/Sec)

   (Knowing that the blood density is 1.05 gm/cm^3).

Question Seven   [10 Marks]

When the rate of blood flow in the aorta is 5 liter/min, the velocity of the blood in the capillaries is about 0.33 mm/Sec. If the average diameter of a capillary is 0.008 mm, calculate the number of capillaries in the circulatory system?

Question Eight   [10 Marks]

Studies show that for strains less than 0.5 percent bones are elastic. We will calculate the elastic limit force for compression and stretch of a humerus 20 cm long and 3 cm^2 in cross sectional area. Using values $Y_{compression} = 9.4 \times 10^9$ N/m^2 & $Y_{stretch} = 16 \times 10^9$ N/m^2

Find:
- (1) The compression force 'Fc' of the bone?
- (2) The stretching force 'Fs' of the bone?

مع أطيب التمنيات بالنجاح و التفوق بأذن الله تعالى...