ISP209 Fall 2003 **Homework 4** Name: _____
Due: Tues., Sept. 30, 10:20 am, in Rm 1410 BPS. ID:_____

1. Choose a magnitude and direction for two force vectors, $\mathbf{F}_1 = +F$, and $\mathbf{F}_2 = -F$, that can stretch a stationary spring.
2. What is the angle between the vectors $\mathbf{F}_1 = -F$ and $\mathbf{F}_2 = +F$? 180 degrees
3. Is there a value for C making vectors, $\mathbf{C} = -C$ and $\mathbf{T} = +T$, equal, Yes or NO?
   1) EQUAL FORCES MUST HAVE THE SAME DIRECTION
   2) MAGNITUDE MUST BE POSITIVE
4. A physics quantity can be either a vector or a scalar. Is the sum of 5 vectors a *scalar* or a *vector*? VECTOR
5. a) Given that $\mathbf{F} = -F$, and $\mathbf{T} = +T$, where $F = 2T$, What is $\mathbf{S} = \mathbf{F}+\mathbf{T} = = -T$.

   b) A vector sum, $\mathbf{F} + \mathbf{T} = 0$, and $\mathbf{F} = -F$. Which is correct? $\mathbf{T} = +F$
6. Acting on an object, can two force vectors cancel (have no effect at all)? NO (balanced forces will causedistortions)
7. Two forces satisfy three conditions if they are going to balance. How many objects can they act on? ONE. Are the two magnitudes equal or different? EQUAL. Are the two directions the same or opposite? OPPOSITE
8. Fixed to the ceiling, is a frictionless pulley wheel with a rope hanging over the wheel. The rope tension forces pulling on either side of the wheel must have equal magnitudes. True or False? TRUE.
9. Can two force vectors "balance" and be "equal" at the same time. NO The reason for this is balanced force have opposite directions, equal force have the same direction. Can two forces be balanced and be an action reaction pair?NO The reason for this is: balanced forces act on ONE object, action – reaction pair involveTWO objects.
10. Four force vectors act on an object: $\mathbf{F}_1 = +A$, $\mathbf{F}_2 = +3A$, $\mathbf{F}_3 = -2A$, and $\mathbf{F}_4$. If the forces balance, $\mathbf{F}_{\text{Net}} = 0$, including all four forces, what is $\mathbf{F}_4$? $\mathbf{F}_4 = -2A$

To balance means that the force vector sum is zero.

$\mathbf{F}_1 + \mathbf{F}_2 + \mathbf{F}_3 + \mathbf{F}_4 = 0 = (+A + 3A - 2A) + \mathbf{F}_4$

$+2A + \mathbf{F}_4 = 0$; therefore, $\mathbf{F}_4 = -2A$

Three identical springs are stretched and generate tension forces, T, that act on the left and right sides of a frame, as shown. The top and bottom of the frame (shaded) compress to balance the tension.

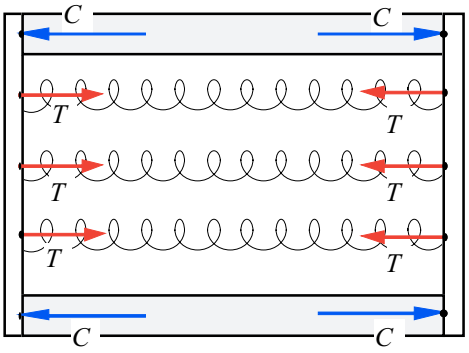

Figure for problems 11 and 12.

11. Compression force vectors, magnitude, C, are generated in the top and bottom. With a reasonable length and standard labels, draw both vectors on the figure.
12. What is the relationship between the magnitudes of the compression force vectors, C, and the tension in the springs? (LEFT SIDE)

$\mathbf{C} = -C$, $\mathbf{T} = +T$, $2\mathbf{C} + 3\mathbf{T} = 0$ (balance),

$2(-C)+3(T) = 0$, therefore, $C = \dfrac{3T}{2}$

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Four identical springs are stretched between two boards held apart by a bar (shaded) between them.

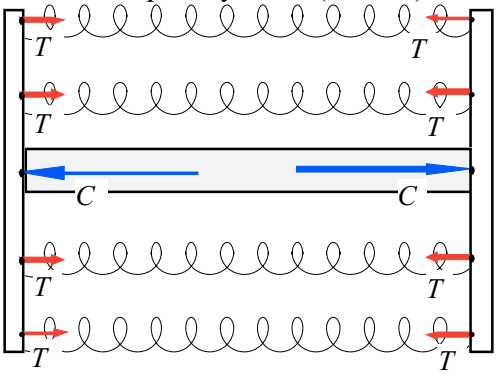

Figure for problems 13 and 14.

13. Forces with magnitude, T, are generated in the springs. With a reasonable length and standard labels, draw these vectors on the figure.

14. What is the relationship between the value of C, and the value of T, that is needed to balance the forces acting on the left or right board.

(left side) $\mathbf{C} = -C$, $\mathbf{T} = +T$, $\mathbf{C} + 4\mathbf{T} = 0$

$(-C) + (4T) = 0$, therefore, $T = \dfrac{C}{4}$

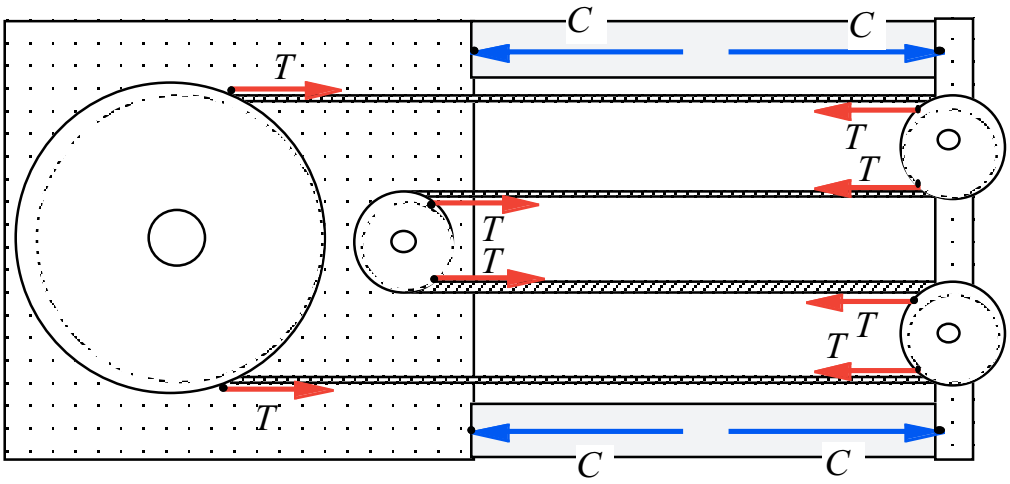

Figure for Problem 15 and 16

15. Three small pulleys and one large pulley are mounted on a frame. A belt with tension, T, runs over the pulleys causing compression forces, C , in the top and bottom of the frame as shown in the figure. With a reasonable length and standard labels, draw on the figure all tension force vectors acting at the ends of each section of belt.

16 From the balance condition on the right (or left) side of the frame, find the relationship between the tension T and the compression C .

To balance either side: $2C = 4T$, therefore $T = C/2$

17. Two objects pull on a spring with a force, F, one acting on each end of the spring.

What is the magnitude of the tension force the spring applies to those objects? $T=F$

What is the magnitude of the tension forces active at the center of the spring? $T=F$

18. Five springs, each with spring constant, 5 N/cm are connected. What is the spring constant if they are connected in parallel: $k' = 5k = 5(5\ \mathrm{N/cm}) = 25\ \mathrm{N/cm}$,

or in series $k' = \dfrac{k}{5} = \dfrac{(5\ \mathrm{N/cm})}{5} = 1\ \mathrm{N/cm}$