Compound Machines
Division C

School Name_____

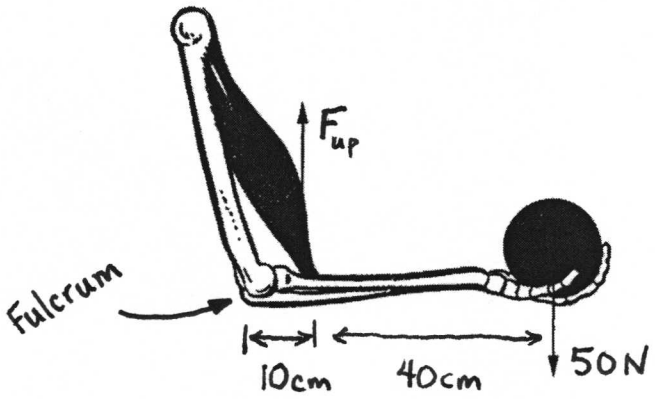
Team_____

Directions:

There are 13 multiple choice questions.

Write your answers (A, B, C, D or E) on the answer sheet provided.

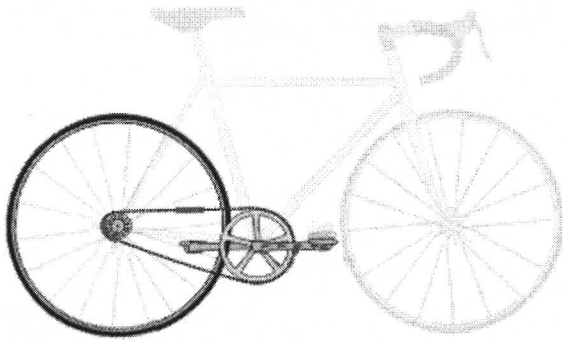
1. Human arm



What is the upward component of the force exerted by the bicep muscle, F_{up}? (Assume static equilibrium)

A) 10 N
B) 12.5 N
C) 50 N
D) 200 N
E) 250 N

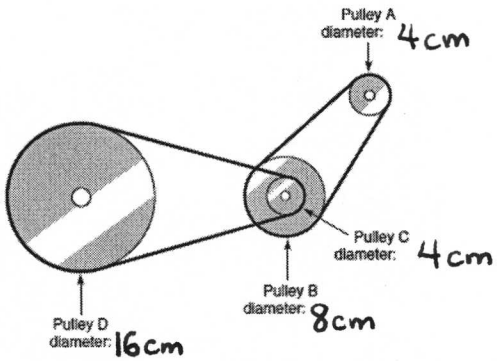
2. Bicycles



A bike is resting on the pavement. The radius of the front gear is 12 cm. The radius of the back gear is 6 cm. The radius of the back wheel is 40 cm. How far forward does the bike travel when the pedals are turned one full revolution? (~~Choice~~ Choose the closest answer)

A) 1.25 m
B) 2.5 m
C) 5.0 m
D) 7.5 m
E) 10 m

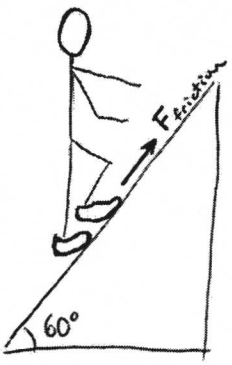
3. Belts and pulleys



The figure shows a belt and pulley system. Pulley B and pulley C are rigidly connected. Pulley D is turned one full revolution. How many revolutions does Pulley A turn?

A) 1
B) 2
C) 4
D) 8
E) 16

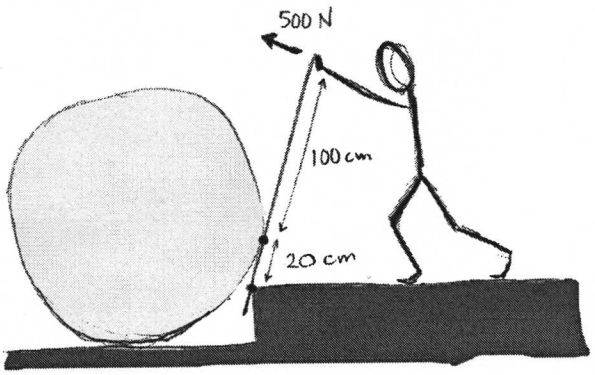
4. Rock climbing



The climber is ascending a rock face. The gravitational force on the rock climber is 600 N (straight down). The friction between the climbers shoes and the rock is large enough to stop the climber from slipping. What is the magnitude of the friction force, F_{friction}?

A) $600/\sqrt{3}$ N
B) $300/\sqrt{3}$ N
C) 600 N
D) $300\sqrt{3}$ N
E) $600\sqrt{3}$ N

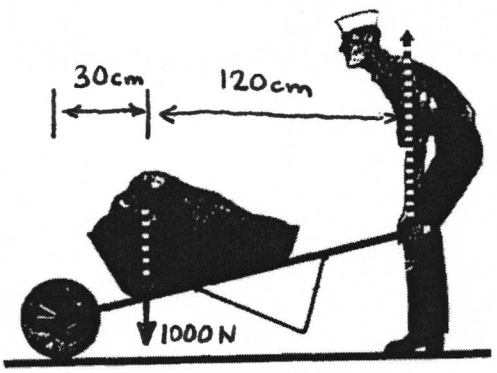
5. Rock in the street



The picture shows a man using a steel bar (total length 125 cm) to try and move a rock. The steel bar touches both the rock and the edge of the curb. The separation between contact points is 20 cm. The man applies 500 N of force to the top of the steel bar. The rock won't budge! How much force was applied to the rock?

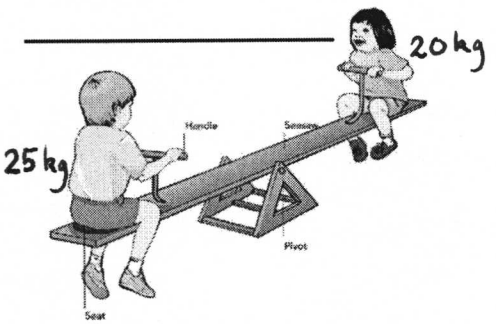
A) 100 N
B) 500 N
C) 2000 N
D) 2500 N
E) 3000 N

6. Wheelbarrow



What is the upward force exerted on the handle of the wheelbarrow by the man's hands?
A) 200 N
B) 250 N
C) 1000 N
D) 4000 N
E) 5000 N

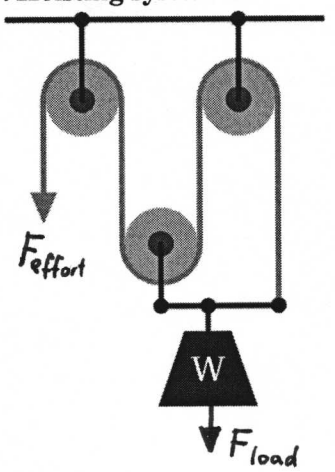
7. Seesaw



A 20 kg girl sitting on a seesaw invites a 25 kg boy to join her. The girl sits 1.25 m from the pivot point. How far does the boy sit from the pivot point so they are balanced in a horizontal position?

A) 1.00 m
B) 1.06 m
C) 1.25 m
D) 1.50 m
E) 1.56 m

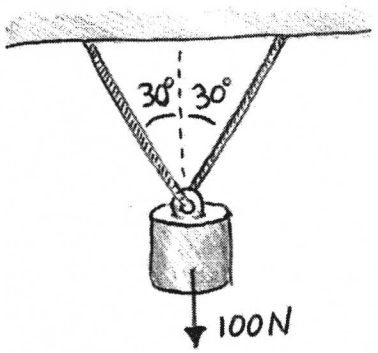
8. Hoisting system



Mechanical advantage is defined as the ratio F_{load}/F_{effort}. What is the mechanical advantage of the pulley system illustrated above?

A) 1
B) 2
C) 3
D) 4
E) 5

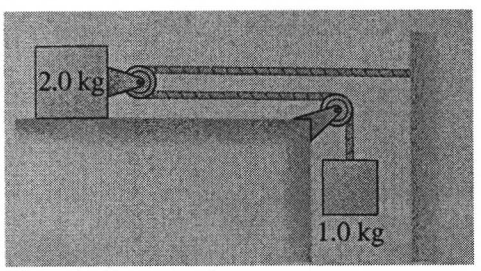
9. Tension



A weight is attached to the ceiling by threading a rope through the eyelet on the top of the weight. There is no friction between the rope and the eyelet. What is the tension in the rope?

A) $100/\sqrt{3}$ N
B) $100/\sqrt{2}$ N
C) $50/\sqrt{3}$ N
D) $50/\sqrt{2}$ N
E) $200/\sqrt{3}$ N

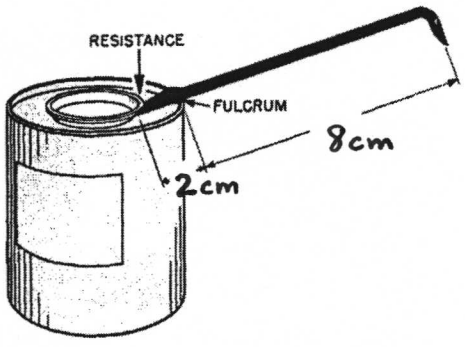
10. Sliding friction



The 2 kg block moves across the table at a constant velocity. What is the coefficient of sliding friction?

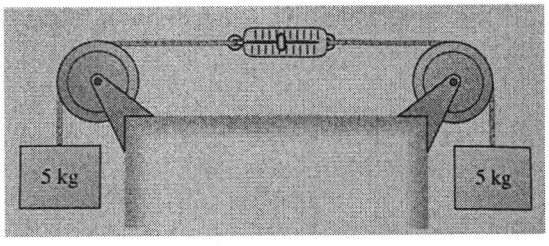
A) 1
B) 0.5
C) 2
D) 0
E) 4

11. Opening a can of paint



An upward force of 20 N must be applied to the paint can lid to get it open. What downward force is required at the right-hand end of the tool to open the lid?
A) 5 N
B) 80 N
C) 4 N
D) 200 N
E) 2 N

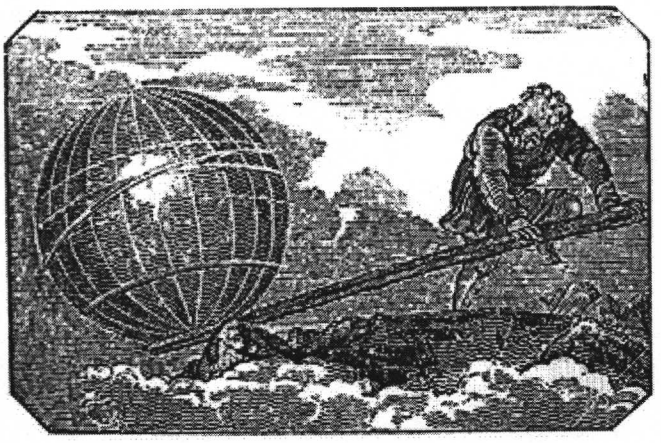
12. Balancing forces



The figure shows two masses at rest. The string is massless and pulley is frictionless. The spring scale reads in kg. What is the reading of the scale?

A) 0
B) 2.5 kg
C) 5 kg
D) 7.5 kg
E) 10 kg

13. History of Science



Who said "Give me a place to stand and I will move the earth"?

A) Archimedes
B) Galileo Galilei
C) Leonardo da Vinci
D) Heron of Alexandria
E) Archytas of Tarrentum