angle of 120° to each other which will, with these forces, produce equilibrium.

SOLUTION.—Since the given forces are represented by the sides of an equilateral triangle, *taken in order*, they must act at an angle of 120° to each other, and hence the forces required have simply to be equal to the given forces and to act in opposite directions at the same point.

4. In a system of four pulleys, each hanging by a separate string, the weight of each pulley being 1 lb., find the relation between the power and the weight.

SOLUTION.—Let W denote the weight, P the power; then since $\frac{1}{2}$ lb. of the power is required to support the first pulley, $\frac{1}{4}$ lb. for the second, $\frac{1}{8}$ lb. for the third, and $\frac{1}{16}$ lb. for the fourth, therefore the part of the power available for supporting W is $P-\frac{15}{16}$, and between them the usual relation holds; $\therefore W = 16P - 15$.

If a force of $2\frac{1}{2}$ lbs. just supports a weight of 45 lbs. in such a system, and the weight of the pulleys be equal, find the weight of each pulley.

SOLUTION.—If by "such a system" is meant a system of four pulleys, the problem does not admit of a solution; but if any greater number be allowed, then each number of pulleys will give a different solution.

5. If a substance be weighed in a balance having unequal arms, and in one side appear to weigh m lbs. and in the other $4n$ lbs., what is the true weight of the substance and what is the ratio between the lengths of the arms of the balance?

SOLUTION.—Let x be the true weight of the substance, and a, b, the lengths of the arms of the balance; then from one weighing we have

$$\frac{x}{m} = \frac{a}{b}$$

and from the other $\frac{4n}{x} = \frac{7}{b}$

$$\therefore x = 2\sqrt{mn}$$

and $\frac{a}{b} = \frac{x}{m} = 2\sqrt{\frac{n}{m}}$

6. What is the ratio of the power to the weight, in the case of the inclined plane, when the power acts (i) parallel to the plane, (ii) parallel to the base.

Show that the power is most effective when acting parallel to the plane.

7. Define specific gravity, and show how to find the specific gravity of a body lighter than water.

A piece of wood weighs 4 lbs. in air, and a piece of lead weighs 5 lbs. in water, the lead and the wood together weigh 4 lbs in water; determine sp. g. of the wood.

SOLUTION.—Since the lead weighs 4 lbs. when the wood is attached, therefore 1 lb. is needed to sink the wood, and since the wood itself weighs 4 lbs., therefore the wt. required to sink it is 5 lbs.; that is, it displaces 5 lbs. of water, and hence its sp. g. is $\frac{4}{5}$.

8. Describe, using diagram, the structure of the lifting pump. What determines the height to which water may be raised by means of it?

Describe the thermometer. At what temperature will the reading of the Fahrenheit thermometer be three times as great as that of the Centigrade? Give your answer in degrees Fahrenheit.

SOLUTION.—Let x be the number of degrees on the Fahrenheit thermometer, then $\frac{1}{3}x$ is the number on Cent.

$$\therefore x - 32 = \frac{9}{5} \text{ of } \frac{1}{3}x$$

$$\therefore x = 80.$$

9. A cubical block of wood, whose edge is 18 inches and whose sp. g. is .75, is placed in water, and pressed by a force into such a position that its upper surface, which is horizontal, is just one foot below the surface of the water; find the pressure on the whole outside of the cube, and the downward force acting upon it.

SOLUTION.—The average depth of the surface of the cube is $1\frac{1}{2}$ feet, its area $13\frac{1}{2}$ feet, $\therefore$ the pressure $= 13\frac{1}{2} \times 1\frac{1}{2} \times 1000$ oz. The volume of the block is $3\frac{3}{8}$ cub. ft., $\therefore$ it displaces $3\frac{3}{8}$ cub. ft. of water, but its weight is only equal to that of $\frac{3}{4}$ of $3\frac{3}{8}$ cub. ft. of water; $\therefore$ the force downwards must be equal to the wt. of $\frac{1}{4}$ of $3\frac{3}{8}$ cub. ft. of water.