For, denote DE by c, then

$$a^2 + (2b)^2 = BC^2 = (a + 2c)^2$$
$$\therefore 4b^2 = 4ac + 4c^2$$
$$b^2 = ac + c^2$$
$$= (a + c)\, c$$
$$= BE \,.\, EC$$

7. To find a point within a triangle from which, if straight lines be drawn to the angles, they will divide the triangle into three equal parts.

Let ABC be the triangle. Draw a straight line parallel to BC, cutting the perpendicular from A on BC at a point one-third of its length from BC. Then if B, C be joined to any point in this line, a triangle will be formed whose area is one-third of the triangle ABC. If then a line be similarly drawn with regard to one of the other sides of the triangle, the point where these lines intersect will be the point required.

8. Given any triangle, to make a similar one of double the area.

Let AB be a side of the given triangle; through B draw BC at right angles to AB, making BC eq. AB; join CA; on CA construct a triangle similar to the given triangle; this shall be the triangle required. For similar triangles are to one another as the squares on their homologous sides, and the square on AC eq. twice the square on AB.

10. If the perpendiculars Am, Bn, Cd be drawn from the angular points of a triangle ABC upon the sides, shew that they will bisect the angles of the triangle mnd.

Because AmB, AnB are right angles, a circle may be described, passing through the four points A, n, m, B, therefore the angle Bnm is eq. to BAm. Again, a circle may be described, passing through the four points B, d, n, C, therefore the angle dnB is eq. to dCB; but the angle dCB is eq. to BAm, for a circle may be described, passing through A, d, m, C, therefore the angle Bnd eq. Bnm, and similarly for the other angles.

SECOND-CLASS NATURAL PHILOSOPHY—WITH SOLUTIONS.

1. What conditions are necessary so that three forces acting on a body may maintain equilibrium?

Shew how the following forces may be arranged so as to produce equilibrium: (i) 4 lbs., 5 lbs. and 7 lbs. (ii) $(\sqrt{7}+\sqrt{5})$ lbs., $(\sqrt{7}-\sqrt{5})$ lbs., and $2\sqrt{7}$ lbs. (iii) 1 lb,, 4 lbs. and $\sqrt{17}$ lbs.

SOLUTION.—Draw a straight line AB; through B draw BC at right angles to AB; from centre A, with a radius equal to 5 times AB, describe a circle cutting BC in C; produce AB to D, making AD 4 times AB; through D draw DE parallel to AC, and through C draw CE parallel to AD. Forces represented by AC, AD and EA will produce equilibrium.

(ii) If the first two forces act at a point and in the same direction, and the third act at that point in the opposite direction, equilibrium will be produced.

(iii) Draw AB, AC at right angles, making AB 4 times AC; complete the rectangle ABDC. Forces represented by AB, AC and DA will produce equilibrium.

2. Examine the truth of the following statement: "If three forces acting on a body are parallel to the sides of a triangle, they will keep it at rest."

A rod AC, (supposed without weight) hinged at C, has a weight of 200 lbs. hung at A, and is kept in position by a horizontal tie-rod AB. The angle BAC is 30°; find the tension of the tie-rod and the thrust along AC.

SOLUTION.—Let AD be the line in which the weight acts; draw CD perp. to AD, and CB perp to AB, then taking moments about C we have tension in AB $\times$ CB $=200 \times$ CD, and if we suppose the length of AC to be 2, we shall have BC$=1$, DC$=\sqrt{3}$, $\therefore$ tension in AB $= 200\sqrt{3}$. Again, the magnitude of the thrust along AC is equal to that of the resultant of the other two forces acting at rt. ang., and therefore $= 400$.

3. If two sides of an equilateral triangle taken in order, 8 ft. long, represent in direction and magnitude two forces acting at a point, find two equal forces acting at an