move in the next unit of time if the velocity were to remain uniformly the same as it was at that instant.

$$v^2 = V^2 - 2fs,$$
$$\therefore 8^2 = V^2 - 64 \times 63,$$
$$\therefore V^2 = 64 \times 62.$$
$$\therefore V = 62{\cdot}9 \; Ans.$$

[NOTE.—In transposing, in the last line but one, Mr. Somerville, by a manifest inadvertence, neglected to change the sign of one of the terms. Had it not been for this oversight, he would have got $V_2 = 64 \times 64$, which gives $V = 64$, the correct answer. G. P. Y.]

5th.
$$S = Vt + \tfrac{1}{2} ft^2$$
$$\therefore S_1 = 44\,t + 16\,t^2$$
$$S_2 = 20\,t + 16\,t^2$$

Since each particle was moving the same length of time, "t" is the same in each equation.

Let $x = S_1$
then $480 - x = S_2$
then $16t^2 + 44t = x$
and $16t^2 + 20t = 480 - x$

(adding) $32t^2 + 64t = 480$
$\therefore t^2 + 2t = 15$
$\therefore t = 3$ sec.
Now $S_1 = 44t + 16t^2$
$= 132 + 144$
$= 276 \,ft$
And $S_2 = 20t + 16t^2$
$= 60 + 144$
$= 204 ft$

$\therefore$ One moves $276 ft$ and the other $204 ft$ $\Big\}$ *Ans.*

6th. Since "C" is the fulcrum, and the lever is in equilibrium, the resultant of P and W is P + W acting at the point C.

And, the moment of the resultant of any two forces about a point in their plane, is equal to the sum of the moments of the forces about the same point $\therefore$ taking the moments about the point "D" we have

$$P \times AD + W \times BD = (P + W) \times DC.$$

Q. E. D.

7th. Mr. Somerville draws F E G at right angles to A B through the point E, and then proceeds as follows :—

Resolve along A B and along F G. $10\sqrt{5}$ resolved along A B will be $10\sqrt{5} \times \dfrac{1}{\sqrt{5}} = 10$ lbs, acting in the direction of E B.

And, resolved along F G it would be $10\sqrt{5} \times \dfrac{2}{\sqrt{5}} = 20$ lbs, because the Cos. of the angle C E F is $\dfrac{2}{\sqrt{5}}$.

Again, $5\sqrt{5}$ resolved along A B is $5\sqrt{5} \times \dfrac{1}{\sqrt{5}} = 5$ lbs in the direction of E A, and there is also another force of 5 lbs acting along E A $\therefore$ the whole force acting in the direction E A is 10 lbs; but there is 10 lbs acting along E B $\therefore$ these neutralize each other, and the R is along F G at right angles to A B. And the result is

$$10\sqrt{5} \times \frac{2}{\sqrt{5}} + 5\sqrt{5} \times \frac{2}{\sqrt{5}} = 20 + 10 = 30 \text{ lbs.}$$

[NOTE.—This is substantially correct; but the cosine of the angle C E F is not $\sqrt{\dfrac{2}{5}}$, but $\dfrac{2}{\sqrt{5}}$, which makes the resolved portion in the direction F G 20 lbs, as Mr. Somerville finds. G. P. Y.]

8th. Since the C. G. of a cone is $\frac{2}{3}$ of its $\perp r$ height from the apex, it follows, that if the cone were laid with its axis horizontal, the radius of the base would need to be $\frac{2}{3}$ of the $\perp r$ height. But, if laid on its side, it would not need to be so long since the C. G. is lowered.

As the time is up, I have no more time to investigate it.

G. A. S.

[NOTE.—Mr. Somerville unfortunately mistook the problem, by substituting the word *cone* for *cylinder*. Had it not been for this oversight it seems evident that he would have solved the question proposed, as he shows, by what he has written, that he understands the principle involved. G. P. Y.]

9th. Taking the moments around the point A we have

$192 \times 2\frac{1}{2} = T \times 12$
$\therefore 24\,T = 960$
and $T = 40$ lbs = tension on B C.

Now, taking moments around L we have

$192 \times 2\frac{1}{2} = F \times 12$
$\therefore F = 40$ lbs = friction at A.

Again, taking moments around B we have

$R \times 5 = 192 \times 2\frac{1}{2} + F \times 12$
$= 480 + 480$
$= 960$
$\therefore R = 192$ lbs = re-action on beam at A.

$\therefore$ Re-action on beam at A = 192 lbs; Tension on string C B = 40 " $\Big\}$ *Ans.*

[NOTE.—Why does not Mr. Somerville apply his principles more boldly? Is it not obvious that the re-action must be equal to the weight of the beam, as the re-action and the weight are the only vertical forces (which must, therefore, counter-balance one another), all the other forces being in a horizontal direction? G. P. Y.]

SOLUTIONS OF THE QUESTIONS IN ALGEBRA.

1. The H. C. M., found by the ordinary rule, is $x^2 - x - 1$.

2. The three values of the cube root of unity are the roots of the equation, $x^3 - 1 = 0$. But,
$$x^3 - 1 = (x - 1)(x^2 + x + 1) = 0.$$
Therefore, the required roots are found by the solution of the equations, $x - 1 = 0$, and $x^2 + x + 1 = 0$.

3. Let the reciprocals of the required numbers be
$$x,\ x+y,\ x+2y,\ x+3y.$$
Then, by the second condition of the question—
$$2x + 3y = 7;$$
And, by the first condition—
$$15x^2 = 4\,(x+y)\,(x+3y).$$
The elimination of y from these equations gives us
$$x^2 = 4 \;\therefore\; x = 2 \;\therefore\; y = 1;$$
Hence, the required numbers are $\frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \frac{1}{5}$.

Another solution, by Miss Anna Living, is as follows :—

Let x = the first number.
y = the common difference of the reciprocals.

then $\dfrac{1}{x}$ = first reciprocal,

$\dfrac{1+xy}{x}$ = second "

$\dfrac{1+2xy}{x}$ = third "

$\dfrac{1+3xy}{x}$ = fourth "

$$15\left(\frac{x}{1+xy} + \frac{x}{1+3xy}\right) = 8x + 16x^2y$$
$$15 = 4 + 16xy + 12x^2y^2$$
$$x^2y^2 + \frac{4}{3}xy = \frac{11}{12} \;\therefore\; xy = \frac{1}{2}$$
$$\text{And } \frac{1}{x} + \frac{1+xy}{x} + \frac{1+2xy}{x} + \frac{1+3xy}{x} = 14$$
$$2 + 3xy = 7x \text{ and } xy = \frac{1}{2}$$
$$\therefore 2 + \frac{3}{2} = 7x \;\therefore\; \frac{1}{2} = x, \text{ and } 1 = y.$$

$\therefore$ the four numbers are $\frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \frac{1}{5}$.

5. The following solution of this question is by Mr. James Ferrie:—As the minute and the hour hands are together four times in the course of 12 hours, between 4 and 5 o'clock, the time will be $\frac{4}{11}$ of an hour past 4 o'clock, *i.e.* 4 h. 21 m. $49\frac{1}{11}$ sec. by the watch going too fast. And, as the watch losing time shows 59 minutes 59 seconds, when the other shows 60 minutes 1 second, we find the time on the watch going too slow by the proportions

60 m. 1 sec. : 59 m. 59 sec. : : 4 h. 21 m. $49\frac{1}{11}$ sec.,

which gives for answer 4 h. 21 m. 40 $\frac{14500}{39611}$ sec.

6. When $p + q\sqrt{-1}$ is substituted in the given equation, the result is of the form—
$$A + B\sqrt{-1} = 0,$$
A and B being rational. But, in order that this equation may subsist, A and B must each be zero. Now, if $p - q\sqrt{-1}$ be substituted in the given equation, the result is
$$A - B\sqrt{-1} = 0.$$
But, A and B each being zero, the equation $A - B\sqrt{-1} = 0$ subsists. Therefore, the given equation is satisfied by the value of x, $p - q\sqrt{-1}$.

The roots of the equation, $x^2 - \dfrac{52x}{7} + m = 0$, remain real, so long as $\left(\dfrac{26}{7}\right)^2 - m$ is positive. When this expression is zero, the roots are equal; and for every value of m greater than $\left(\dfrac{26}{7}\right)^2$, the roots are imaginary.