then $\frac{24}{x}+\frac{34\frac{3}{4}}{60}=\frac{24}{y}+\frac{12}{x}-\frac{10\frac{1}{4}}{60}$;

and $\frac{24}{x}+\frac{34\frac{3}{4}}{60}+\frac{3}{x+y}=2\frac{10\frac{3}{8}}{60}$;

The first equation is obtained by equating the time which elapsed before the second train reached C; the second by equating the time before the collision. Reducing the equations we get $\frac{4}{x}-\frac{8}{y}+\frac{1}{4}=0$, and $\frac{8}{x}+\frac{1}{x+y}=\frac{17}{32}$

let $x=vy$; and we get $\frac{32}{17}\left(\frac{9v+8}{v^2+v}\right)=\frac{32v-16}{v}$; from which $v=1$; hence $x=y=16$. Hence the rates were each 16 miles per hour.

8. Let x and y be the commissions on \$100.00.

$$100-\frac{100-x}{1+\frac{y}{100}}=\frac{100\,(x+y)}{100+y}=\text{commission received for each}$$

\$100 received for the flour.

Similarly, $\frac{100(y+x)}{100+x}$ = com. on the second supposition, hence, we get the equations $\frac{100(x+y)}{100+y}=4\frac{46}{51}=\frac{250}{51}$.

$$\frac{100(y+x)}{100+x}=4\frac{88}{103}=\frac{500}{103}.$$

Dividing the first equation by the second, we get $\frac{100+x}{100+y}=\frac{103}{102}=\frac{100+3}{100+2}$; hence $x=3$, and $y=2$.

2. NATURAL PHILOSOPHY.

1. Book work.

2. [In the printing of this question, a word is omitted. Instead of EA, EC, ED, read EA, EB, EC, ED.—G. P. Y.]

Let E be the point on the square, ABCD; through E draw FG, HK parallel to the sides of the square; the point F being in AB, and H in AD. Then, the force EA, may be replaced by the forces EH and EF; the force $\frac{1}{2}$ EB, by the forces $\frac{1}{2}$ EF and $\frac{1}{2}$ EK; the force $\frac{1}{3}$ EC by $\frac{1}{3}$ EK and $\frac{1}{3}$ EG; and the force $\frac{1}{4}$ ED by $\frac{1}{4}$ EH and $\frac{1}{4}$ EG. Adding like terms, we get $\frac{5}{4}$ EH, $\frac{3}{2}$ EF, $\frac{5}{6}$ EK, and $\frac{7}{12}$ EG. Now, EH is two ft., therefore, EK is three; EF is $1\frac{2}{5}$, therefore, EG is $3\frac{3}{5}$, and $\frac{5}{4}\times2=2\frac{1}{2}$; $\frac{5}{6}\times3=2\frac{1}{2}$; $\frac{3}{2}\times\frac{7}{5}=2\frac{1}{10}$; $\frac{7}{12}\times\frac{18}{5}=2\frac{1}{10}$; hence we see the opposite forces exactly balance each other; the particle will therefore remain at rest.

3. Let friction at C be F; friction at A, S; reaction at C, P; reaction at A, R. Then, P and S are the only forces producing any result in a horizontal direction; and since the beam is in equilibrium, P is equal to S; take moments around A; and let AB, BC each equal a; then, $P\times a+F\times a=W\times\frac{1}{2}a$; or, $P+F=\frac{1}{2}$ W. But P=S ∴ S+F=$\frac{1}{2}$ W; and S and F are the frictions on the plane and wall respectively; and W is the weight; therefore, the sum of the two frictions is one-half the weight.

4. Resolving gravity parallel to the plane and at right angles to it, we get equal $\frac{W}{2}$ equal to the friction acting up the plane. Now to draw the body up the plane, we must overcome both friction, which now acts *down* the plane, and gravity resolved parallel to the plane, each of which has been shown to be $\frac{W}{2}$; hence, the force necessary to draw the body up must be equal to the weight.

5. Let g be the measure of gravity in feet per second; at the end of n seconds the velocity will be ng; and during the next n seconds this velocity will carry it through $ng\times n=n^2g$ ft; but during the same time, gravity will carry it through $\frac{1}{2}n^2g$; hence, the whole space is $\frac{3}{2}n^2g$, which is three times $\frac{1}{2}n^2g$, the space passed over by the second body in n seconds.

6. Since the forces denoted by the weights P and Q, are opposite to each other, the resultant is P—Q; this has to move a weight of P+Q; hence, the velocity generated in one second is $\frac{P-Q}{P+Q}g$, and the space passed over in n seconds is $\frac{1}{2}\left(\frac{P-Q}{P+Q}\right)gn^2$. Now, suppose the rope to be cut; P will continue to rise during $\frac{(P-Q)n}{P+Q}$ seconds, and will pass over a space of $\frac{1}{2}g\left\{\frac{(P-Q)\,n}{P+Q}\right\}^2$ feet. Therefore, as the space before the string is cut : the space after the string is cut : : $\frac{1}{2}\left(\frac{P-Q}{P+Q}\right)gn^2$: $\frac{1}{2}g\left\{\frac{(P-Q)\,n}{P+Q}\right\}^2$. Reducing this ratio, we get P+Q : P—Q.

7. Let t be the time before they meet; $\frac{1}{2}gt^2=$ space fallen by the particle from B; and $50t-\frac{1}{2}gt^2$ = space the particle from A rises. Then, $\frac{1}{2}gt^2+(50t-\frac{1}{2}gt^2)=100$; or, $t=2$ seconds. Hence, $\frac{1}{2}gt^2=64=$ distance of point of collision from B. Now, as the distance of the centre of gravity from B is to distance from A, so is the weight of A (16) to weight of B (9). This divides the whole space 100 ft., into 64 and 36, which is the same as we found in the previous case. Hence, the point of collision coincides with the centre of gravity of the particles.

8. The area of the surface pressed, together with the area of the surface of the liquid, is 5 sq. ft.; this multiplied by the height of the centre of gravity of the liquid, and again by the weight of a cub. ft. of the liquid, gives the pressure. Therefore, $5\times\frac{3}{8}\times1000=1875$ = pressure due to the water. The air will press the same as if no water was present. Hence, $144\times6\times15\times16\times\frac{1}{144}=1440$ = pressure due to the confined air; ∴ whole pressure = 1875+1440 = 3315 oz.

9. [In the printing of this question, insert the word "feet" after $3s-\frac{5}{6}$. Also, S is the same as s.—G. P. Y.]

Let x be the specific gravity of the lower cylinder; the point c, the centre of gravity of the whole cylinder; D, the surface of the water; DB the part submerged; and v the volume of each part of cylinder. Thus:

$vs+vx=$ weight of cylinder.
$2v=$ " of equal volume of water.

$\frac{v(s+x)}{2v}=$ fraction of cylinder submerged.

$\frac{v(s+x)}{2v}$ of 2 = ft. submerged $=s+x$.

Next, let y = distance of c from the lower end of the cylinder; and take moments around c. Then,

$$x\left(y-\tfrac{1}{2}\right)=s\left(\tfrac{3}{2}-y\right);\ \text{or, } y=\frac{x+3s}{2(s+x)}.$$

BD—BC = depth of centre of gravity below the surface of the water $=s+x-\frac{x+3s}{2(s+x)}$ and this $=3s-\frac{5}{6}$ by the question. Hence,

$$s+x-\frac{x+3s}{2(s+x)}=3s-\frac{5}{6}.$$

Solving this equation we get $x=2s$, which is the specific gravity of the lower cylinder.

[There is, of course, a second solution of the equation, but it would make x negative, and is, therefore, inadmissible.—G. P. Y.]

Note on Question 1, in the Nat. Philosophy Paper of July, 1873.

In this question, the side of the cube must be supposed to be given. In the solution, by Mr. Cockrane, which appeared in the Journal for October, 1873, the side was assumed to be 1 foot. Any other length might be taken, but then, the result would be different.—G. P. Y.

VI. Educational Intelligence.

OTTAWA COLLEGIATE INSTITUTE.——The ceremony of laying the corner stone of the new building for the Collegiate Institute, was performed Thursday, 4th ult., by His Excellency, the Governor-General, in the presence of a large concourse of people, as well as the pupils of the Institute and several other educational establishments in the city. The new building is situated in the corner of Cartier Park, near the Canal, and will be sufficiently retired for educational purposes. The following address was presented to Lord Dufferin by the Board of Trustees:

TO HIS EXCELLENCY EARL DUFFERIN.

May it please Your Excellency:

The Board of Trustees of the Collegiate Institute of the City of Ottawa, aware of the great interest that Your Excellency takes in all matters that tend to the welfare of Canada and especially of educational institutions, having respectfully prayed Your Excellency to lay the foundation stone of this building, which, when completed, will be devoted to the purpose of teaching the higher branches of a classical, scientific, and English education, and Your Excellency having graciously consented to