a straight line be brought under the action of two forces which exactly balance each other, what will be the result with regard to the motion of the body?

3. Explain how a force may be completely represented by a straight line.

Draw a diagram to represent the frame and the forces acting thereon in the following:—A square frame $ABCD$, whose sides are each 3 ft. long, is under the action of four forces; 1st, a force of 3 lbs. acting at A, and from A towards C; 2nd, a force of 3 lbs. acting at B, in the direction from D to B; 3rd, a force of 6 lbs. acting at C, and from C towards D; 4th, a force of 5 lbs. acting at D, in a line parallel to CA, and in the direction from C to A.

4. State the parallelogram of forces.

Two forces of 10 units each act in lines which meet in a point, and the angle between their directions is 120°. Show that they may be balanced by two forces of 5 units each, and determine the directions in which these must act.

Ans. In the same direction and opposite to that of the Resultant of former two.

5. State the principle of the lever.

Two boys playing at see-saw find they balance each other standing on the ends of a uniform plank laid across a log, when the arms of their see-saw are 7 ft. and 8ft. respectively. Find the weight of the plank, the weights of the boys being 75 lbs. and 90 lbs. respectively. *Ans.* 60 lbs.

6. What is meant by the specific gravity of a body?

A cubic foot of anthracite coal which weighs 100 lbs. in the air is found to weigh only 45 lbs. 2 oz. in a certain specimen of petroleum. Find the specific gravity of the petroleum, assuming that a cubic foot of water weighs 1,000 oz. *Ans.* .878.

7. Describe the common mercury barometer and state the principles of its action.

Find the greatest height to which water will rise in a common suction pump when the mercury in the barometer stands at 30 inches, the specific gravity of mercury being 13.6.

Ans. 34 ft.

UNIVERSITY OF TORONTO.

ANNUAL EXAMINATIONS, 1883

Junior Matriculation: Arts.

ALGEBRA—HONORS.

Examiner—W. Fitzgerald, M.A.

1. Find the product of $(a+b)$, (a^2+ab+b^2), $(a-b)$, and (a^2-ab+b^2).

2. If a and b are positive integers, show that $x^a \times x^b = x^{a+b}$.

3. Prove the rule for finding the Greatest Common Measure of two quantities.

Find the Greatest Common Measure of
$6x^3+15x^4y-4x^2z^2-10x^2yz^2$, and
$9x^2y-27x^2yz-6xyz^2+18yz^2$.

4. State the rule for extracting the square root of a compound quantity.

Extract the square root of x^2+y.

5. Solve the following equations:

$$(a)\quad \begin{aligned} 3x+z&=11.\\ 2y+3z&=16.\\ 5x+4y&=35.\end{aligned}$$

$$(b)\quad \frac{x+a}{x-a}-\frac{x+b}{x-b}=c.$$

$$(c)\quad \frac{x}{a}+\frac{a}{x}=2+\frac{c}{x}.$$

6. When are quantities said to be in geometrical progression, when in harmonical progression, and when in arithmetical progression?

(*a*) Find two harmonical means between a and b.

(*b*) The first term of a geometric series is $\frac{1}{3}$, the ratio $\frac{1}{2}$, and the number of terms is 6; find the sum of the series.

7. Show that the number of combinations of n things taken r together is

$$\frac{n(n-1)(n-2)\ldots\ldots(n-r+1)}{1\cdot 2\cdot 3\ldots\ldots r}$$

How many words of four letters can be formed out of the first 13 letters of the alphabet, having one vowel in each word?

8. Expand to five terms $(a+b)^{-\frac{1}{2}}$.