UNIVERSITY WORK.

MATHEMATICS.

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MATRICULATION, JANUARY, 1882.

NATURAL PHILOSOPHY.

1. State Newton's Second Law of Motion.

Two bodies whose masses are 31 ozs. and 33 ozs. respectively, suspended at the two ends of a thin string passing over a smooth pulley, are allowed to move freely for three seconds. What will be the velocity acquired, and what will be the space traversed, by each body?

SECOND LAW.—Change of motion is proportional to the moving force, and takes place in the straight line in which that force acts.

The moving force is 2 ozs. and the mass moved is 64 ozs.;

$\therefore$ acceleration $f = \frac{2}{64} \times g = \frac{g}{32} = 1 \quad (g = 32)$.

Vel. acq. $= f \times t = \frac{g}{32} \times 3 = 3$ ft. per second.

$S = \frac{1}{2}$ ft. $^2 = \frac{1}{2} \times 1 \times 9 = 4\frac{1}{2}$ ft.

2. A half-ton shot is discharged from an eighty-one ton gun with a velocity of 1620 feet per second. What will be the velocity with which the gun will recoil, if the mass of the powder be neglected?

Will the gun or the shot be able to do more work before coming to rest, and in what proportion?

Since the powder produces the same momentum in the gun as in the shot, &

$\therefore \left(\frac{\frac{1}{2} \text{ ton}}{g}\right) \times 1620 = \left(\frac{81 \text{ ton}}{g}\right) \times$ velocity

$\therefore$ velocity $= 10$ feet per second.

Work done by shot equals product of its weight into space it would have to fall to acquire its velocity; and similarly for the gun.

$$\therefore \frac{\text{work done by shot}}{\text{work done by gun}} = \frac{\frac{1}{2} \times \frac{(1620)^2}{2g}}{81 \times \frac{(10)^2}{2g}} = \frac{162}{1}$$

$\therefore$ shot will do more work.

3. A number of forces act at a point in different directions. Explain how to determine their resultant in magnitude and direction.

Forces P, $2P$, $3P$ and $4P$ act along the sides of a square $ABCD$, taken in order. Find the magnitude, direction, and line of action of the resultant.

Resolve each of the forces along two perpendicular directions: find the algebraic sum in each direction. Suppose X and Y, then the resultant $= \sqrt{X^2 + Y^2}$, and its direction make an angle with $X = \tan^{-1} \frac{Y}{X}$.

Let $ABCD$ be the square. Resolve the forces along AD and AB.

$2P - 4P = -2P$ along AD.

$P - 3P = -2P$ " AB.

$\therefore R = 2P\sqrt{2}$ in the direction of CA produced, and making an angle of 45° with AB produced.

4. What is the centre of gravity of a body? How would you determine experimentally the position of the centre of gravity of a thin plate?

Weights of 1 lb., 2 lbs., 3 lbs. and 4 lbs. are suspended from a uniform lever 5 ft. long at distances of 1 ft., 2 ft., 3 ft. and 4 ft. respectively from one end. If the mass of the lever is 4 lbs., find the position of the point about which it will balance.

The centre of gravity of a body is a point on which the body will balance in all posi-