SCHOOL WORK.

MATHEMATICS.

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First Class Teachers—Grade C.

ELEMENTARY MECHANICS.

Examiner—J. C. Glashan.

1. Define velocity, constant velocity, variable velocity, and uniformly accelerated velocity. Explain how the mean velocity during a given time and the velocity at a given moment are determined and expressed.

State the law of composition of rectilinear motions and the law of composition of velocities.

A boy throws a stone at a railway train travelling at the rate of 30 miles per hour. If the stone be thrown at right angles to the railway track, and if the horizontal component of its velocity relative to the ground be 66 ft. per second, what will be its horizontal component relative to the train? (Draw a figure to illustrate your solution, marking on it the direction of the motions.)

1. Vel. of train=44 ft. per sec.; vel. of stone=66.

$\therefore$ rel. horizon. vel. $=\sqrt{22^2+66^2}=22\sqrt{13}$

2. How are forces generally measured in statics and how in dynamics? Define any statical unit of force, and also any dynamical unit of force, and compare their magnitudes.

State the law of composition of concurrent forces.

A, *B*, *C*, *D*, are the angular points taken in order of a square with two-inch sides. A force of 8 lbs. acts from *A* towards *B*, one of 1 lb. from *A* towards *D*, one of 8 lbs. from *C* towards *B*, and one of 20 lbs. from *C* towards *D*. Determine the resultant of these four forces. (Draw the figure, representing the forces on a scale of 8 lbs. to the inch.)

2. Rt. of 8 and 20 is 12, and acts at a pt. in BC produced $\frac{1}{3}$ in fr. C.

Rt. of 1 and 8 is 7, and acts at a pt. in DC produced $\frac{1}{7}$ in fr. C.

Rt. of 12 and 7 at right angles

$$=\sqrt{(12)^2+(7)^2}=\sqrt{193}.$$

3. Define moment of a force, couple, arm of a couple and moment of a couple.

State the principle of moments, the law of the composition of parallel forces and the laws of the composition of couples.

A uniform rod 6 ft. long and weighing 6 lbs. has weights of 2 lbs., 3 lbs., 4 lbs. and 5 lbs. suspended on it, in order, at distances 2 ft. apart. Determine the point about which it will balance, and the pressure on the point.

Had the 2 lbs., the 3 lbs. and the 5 lbs. all been upward pressures instead of weights, what would have been the resultant?

3. Wt. acts at middle pt. Ler x be distance of fulcrum from middle pt. Denote it by F, taking moments about F.

$$6x+3(1+x)+2(3+x)=4(1-x)+5(3-x)$$
$$6x+3+3x+6+2x=4-4x+15-5x$$
$$11x+9=19-9x$$
$$20x=10$$
$$x=\tfrac{1}{2}.$$

$\therefore$ fulcrum is at dist. of 6 inches from m. pt and towards 5 lb. weight, and pressure is sum of weights and rod 20 lbs.

Taking moments about the middle point we have as resultant a force of two pounds tending to turn the rod about its middle point.

4. Distinguish between mass and weight, force and acceleration, force and working-power (rate of doing work), momentum and energy.

A mass of 6 moving from rest under the action of a constant force acquires in 5 seconds a momentum of 150. Determine the force and the acceleration, also the velocity, the kinetic energy and the working-power at the end of the 5 seconds.

4. $Pt=mv$. $\therefore$ $Pt=150$, *i.e.*, $5P=150$