

Therefore $m(m^3 - 12m) = (m^2 - 8)^2$. Therefore, &c.

6. The first part of the question is book-work.

With regard to the second part, let the series be,

$$1, x, x^2, \&c.$$

Then $x^3 - 1 = 10x^4 - 10$. Therefore, &c.

[Among the real solutions of the equation $x^3 - 1 = 10x^4 - 10$, are $x=1$ and $x=-1$. Are these values, or is either of them, admissible?]

7. Let $10x$ be the number of men, and $5x$ the number of boys employed at first. The work done by these men and boys is equivalent to that of $12x$ men. The withdrawal of 10 men and 10 boys leaves an efficient force equivalent to that of $12x - 14$ men; but if, on the withdrawal of the 10 men and 10 boys, each of the remaining boys had done a man's work, there would have been left an efficient force equivalent to that of $15x - 20$ men. Now, by the question, the work which $12x$ men could perform in a certain time (say t days), is done by $12x - 14$ men in $t+7$ days, and by $15x - 20$ men in $t + \frac{1}{5}t$ days.

$$\text{Therefore } 12xt = (12x - 14)(t+7) = (15x - 20)(t + \frac{1}{5}t).$$

$$\text{Therefore } x=4; \text{ and } 10x=40; 5x=20.$$

8. Book-work.

NATURAL PHILOSOPHY.

1. In this question, by a clerical error, the force acting at B in the direction B D is made 10lbs. instead of 20, which was the number intended to be written by the examiner who prepared the paper. Assuming the force acting in the direction B D to be 20lbs, the solution is as follows:—Taking the resolved parts of the forces, first in a vertical, and then in a horizontal direction, we obtain the equations,

$$m=20+20+5=45.$$

$$n=5\sqrt{3}.$$

These values provide that no motion of the rod can take place either in a vertical or in a horizontal direction. Take now the moments round A, and we have (denoting C B by $2c$) as their algebraical sum,

$$20 \times 3c - m \times 4c + 20 \times 6c;$$

which (since $m=45$) is zero. Therefore no rotation can take place, and the beam is absolutely at rest. (Candidates were not allowed to suffer by the error above referred to.)

2. Most of the candidates, who solve this question, proceed by resolving the forces vertically and horizontally. This easily leads to the desired result. One gentleman supplies an elegant variation in the proof. He observes that the force which acts in a direction parallel to the plane, being equal to that whose direction is parallel to the base of the plane, the resultant of these two must bisect the angle between their directions; and must, therefore, make equal angles with the direction of the weight, and with the direction of the force of reaction; Therefore (he concludes) the reaction is equal to the weight.

3. The solution of this question by Mr. Fletcher is rather elegant. Representing the weight of the square by x , he says: "Since the C. G. of the square is at its centre, x must act at that point, which is in the diagonal A C. The question then simply amounts to finding the C. G. of three weights, x , q , and $x+3q$; for the direction of the string must pass through that point." Mr. Fletcher has no difficulty in showing that the centre of gravity of the three weights in question is at the middle point of the line drawn from A to the centre of the square.

4. Let the particles come into collision in t seconds after the first has left A. Then,

$$384 - 32t = 32(t - 2)$$

$$\therefore t=7.$$

$$\text{But A B} = 16(t-2)^2 + 384t - 16t^2$$

$$\therefore \text{A B} = 2304.$$

5. If h be the perpendicular let fall from C on A B. Then,

$$\text{Time of falling down C B from rest} = z\sqrt{\left(\frac{2}{gh}\right)}$$

$$\text{Time of falling down C D from rest} = \sqrt{\left(\frac{2yz}{gh}\right)}$$

$$\therefore \text{Time of falling down C A from rest} = z\sqrt{\left(\frac{2}{gh}\right)} - \sqrt{\left(\frac{2yz}{gh}\right)}$$

$$\text{But time of falling down C A from rest} = x\sqrt{\left(\frac{2}{gh}\right)}$$

$$\therefore z-x=\sqrt{\quad} \quad \therefore (z-x)^2=yz.$$

[The above is Mr. Fletcher's proof, with some details omitted.]

6. Let t be the time during which the particle projected from A was in motion. Then

$$160(t-4) - 16(t-4)^2 = 160t - 16t^2$$

$$\therefore t=7.$$

$$\therefore \text{vertical height of C above A B} = 160 \times 7 - 16 \times 49 = 336 \text{ feet.}$$

7. Let c cubic feet be the content of the body. Then,

$$1000c = \text{weight (in ounces) of water displaced by the body.}$$

$$1000c+1 = \text{weight of first liquid displaced.}$$

$$1000c-1 = \text{weight of second liquid displaced.}$$

$$\therefore \frac{1000c+1}{1000c-1} = \frac{1000t+1}{1000t-1}$$

$$\therefore t=c.$$

8. This question was not correctly solved by any of the candidates. It is left as an exercise for students.

G. P. Y.

The proposition to connect Scotland and Ireland by a tunnel 12 miles long, at an expense of \$23,000,000, is again before English engineers.

Professor Phin has devised a substitute for spongy platinum in the experiments with hydrogen gas that is well worth the attention of chemical teachers. Make a cylinder of pumice stone $\frac{3}{4}$ of an inch in diameter. With a fine saw cut it into discs about one twentieth of an inch thick. Soak these for some time in a strong solution of bichloride of platinum in alcohol, and then as long in an alcoholic solution of sal-ammoniac. After being once thoroughly ignited, these discs will inflame a jet of hydrogen, and be found much more useful, and far more convenient and economical than the brittle form commonly purchased of apparatus dealers.

III. Papers on Practical Education.

1. SIGNALING CLASSES.

Much diversity of custom prevails among teachers with respect to means and methods of signaling the movements of classes. Many teachers use the bell, giving a stroke for attention, one for rising, and another for moving in a certain order. Some teachers signal by successive snaps of the finger, or by raising in succession one, two, and three fingers; one advantage of this means is that it is always at hand. This is perhaps its chief, if not its only, recommendation. Again, some teachers move their classes by the simple tap of a pencil upon the desk, others by counting one, two, three, etc., or by giving the orders *attention*, *rise*, *pass*.

If a bell is used, it should be with the least sound audible. Anything like a loud stroke or jingling of the bell should be avoided. Nothing is more inspiring of disorder, confusion, and noise in a school than a loud and careless use of the bell. On the other hand no inarticulate sound is more conducive of quietness and good order than the almost inaudible tap of the teacher's pencil. On general principles, however, where signals are given by the teacher, we prefer vocal ones to those given by any other means. The teacher's voice is the natural medium of communication with his pupils, and is no less available as a means of indicating the order of their movements than of directing the course of their general conduct. Its sound is the only proper sovereign one of the place.

Whatever means of signaling a teacher may employ, the system of signals should be as simple as possible consistent with a proper degree of order in the movements of pupils. Some teachers give too many signals, having one for attention, another for taking up books, another for turning toward the aisles, another for rising, another for dressing the line, another for moving to recitation seats, and another for sitting. To thus grind up the aggregate of the movements of a class, and then shake a tea-bell at each one of the microscopic particles, is not order, but rather a most ridiculous affectation of it.

Without almost constant care on the part of the teacher, the pupils become careless in observing the separate signals. At the signal for rising some will be gathering up their books; others, again, will be moving to the recitation. This evil, like all others, can be corrected only by attending to it—by having but few signals and requiring prompt and exact observance of each. Again, teachers are liable to fall into the habit of giving the different signals too rapidly. This invariably causes the pupils to anticipate the signals, to make the movement before the particular signal for it has been given. The teacher is often thus led to hurry up the signals in order to get them all in, if possible, before the pupils