4. Let P move up AB from A to B, while W moves down BC from B to E; BE being equal to BA. Draw BD and EF perp. to AC; and let EG, parallel to CA, meet BD in G. Then, by the principle of virtual velocities,

$$P \times DB = W \times GB.$$

$$\therefore P : W = BG : BD = BE : BC = BA : BC.$$

But this is the relation which was found, in the previous question, to subsist between P and W.

5. (*a*). "The *magnitude* of forces is measured by their effects, and the effect of forces which we consider in Dynamics is *velocity*..... Accelerating Force is measured by the velocity which, in a given time, it would add to the motion of a body.....If the velocity added be equal in equal times, the force is said to be uniform or constant." [The above sentences, which I quoted once before from a work on Dynamics by Dr. Whewell, I quote again, because, though I have endeavoured, year after year, to get candidates for first-class certificates to apprehend the fundamentally important conceptions of acceleration and uniformly accelerating force, the recent examination shows that very general confusion of mind on the subject still prevails. One candidate says: "A uniformly accelerating force is one in which the acceleration is changed for every unit of time which the body moves." The writer would have been nearer the mark if he had said "is *not* changed." Another candidate says: "A uniformly accelerating force is a force that will move a particle through equal spaces in equal times." In this case I should say that there is no acceleration. Does the force of gravity at the earth's surface move a particle through equal spaces in equal times? Another candidate says: "A uniformly accelerating force is that which is acted on uniformly acted on (*sic*) by the force of gravity." Another: "A uniformly accelerating force is a force whose increment of increase is the same in equal times." A considerable number of other such answers have been given. Surely, teachers who desire to obtain first-class certificates may be reasonably expected to master a conception which is by no means abstruse, and without an accurate apprehension of which the whole science of Dynamics must be a mystery to them.—G. P. Y.]

5. (*b*) and (*c*). [These have not been satisfactorily answered by any of the candidates. I leave them as exercises for students. I believe that a student will derive benefit from a thorough examination of them. The only remark which I will make is, that the force to whose action, in conjunction with that of gravity acting vertically, the motion of the body along AB is due, is the reaction of the plane.—G. P. Y.]

6. As the uniformly accelerating force of gravity generates a velocity of 32 feet in the second, it will be 10 seconds before the velocity of 320 feet in the second is destroyed; and therefore when the particle shot upwards from A reaches its highest point, its elevation will be 1,600 feet. In 2 seconds more it has fallen 64 feet; hence, if D be the point where it is at the end of the 12th second, $AD = 1{,}536$ ft. But CD, the space down which the force of gravity has drawn the projectile from B in 12 seconds, is 16×144. Therefore,

$$AC = AD + DC = 1536 + 16 \times 144 = 3840 \text{ feet.}$$

$$\text{Also } AB^2 = BC^2 - AC^2 = (4800)^2 - (3840)^2 = 2880^2.$$

$$\therefore AB = 2880.$$

7. Let x be the height to which the liquid will rise in the vessel. Then the pressure, in lbs., of the confined air on the liquid below is $\frac{15 \times 144}{1-x}$. This is counterbalanced by $15 \times 144 + \frac{1152}{16}(1-x)$.

Therefore,

$$\frac{15 \times 144}{1-x} = 15 \times 144 + 72(1-x).$$

$$\therefore 30x = (1-x)_2$$

$$\therefore x = 16 - \sqrt{255}.$$

8. *Solution of Mr. John L. Davison.*—(DE is drawn parallel to AB.) Since $AB = 39$, and $BC = 26$ $\therefore AC = \sqrt{(2197)}$.

And, by sim. triangles,

$$\sqrt{2197} : 26 :: 26 : DC. \therefore DC = \sqrt{208}.$$

Again, by sim. triangles,

$$\sqrt{2197} : \sqrt{208} :: \sqrt{208} : CE. \therefore CE = 8.$$

[The value of CE is correctly found; but there is a mistake—a simple oversight, I presume—in the statement of the proportion. The second term should be 26 instead of $\sqrt{208}$.—G. P. Y.]

And $\therefore DM = 20$. [This is rather curt; though, of course, when DC and CE are known, ED is known; and, when EM and ED are known, MD is known.—G. P. Y.]

Now, the three forces that keep the body at rest are:

(1) The tension of string;
(2) The resistance of plane;
(3) The weight of the body acting vertically.

And since these forces keep the body at rest, the forces are each proportional to the sides of a triangle taken in order.

[This is not very well put. Mr. Davison should have said that the reaction of plane, the tension of string, and weight of body, are proportional to BD, DM, MB, the sides, taken in order, of the triangle BDM, whose sides are in the direction of the forces.—G. P. Y.] Now, since MB is parallel to the direction of gravity and is 34 feet in length, and since gravity [the weight of the body.—G. P. Y.] = 34, therefore each foot of the side corresponds to 1 lb. Therefore, since DM is 20 ft. in length, the tension of the string = 20 lbs.

9. *Solution of Mr. John L. Davison.*—(Mr. Davison draws AF and BG perpendicular to DC.)

Let R = force acting along DA.
R^1 = " " " BC.

[Mr. Davison resolves the forces vertically, and in a direction at right angles to the vertical; and then takes the moments about A. This gives him the following equations, x being the distance between the central point of the rod and the point of suspension of the weight.—G. P. Y.]

$$\frac{4R}{5} + \frac{12R^1}{13} = 112$$

$$\frac{3R}{5} = \frac{5R^1}{13}$$

$$56x + 784 = \frac{168R^1}{13}$$

[From these equations he obtains $x = 4$. Therefore, &c.—G. P. Y.]

II. Papers on Teachers' Institutes.

1. TEACHERS' INSTITUTES.

Elsewhere our readers will find a report of the proceedings of the Teachers' Institute held in the Central School during Friday and Saturday last. Those who had the good fortune to be present can testify to the practical and excellent character of the work accomplished, and they will probably conclude therefrom that something more must be done ere our educational system shall have attained its full growth and maturity. What that something is, must be, indeed, has been long, evident to all intelligent educators. The Normal School at Ottawa will probably be open for the reception of students in a year's time, and two additional ones will likely follow, one at Kingston and the other at some point in the west. Thus the whole Province will be amply supplied with Normal School privileges. As adjuncts to these Schools for the training of Teachers it is considered that Teachers' Institutes are necessary, and, judging from the success of that held here last week, we should be disposed to regard them as an essential part of the system. Their advantages have been recognized by the Legislatures of several of the neighbouring States. Appropriations for them have been made, and the result, so far, has been pronounced satisfactory. In the State of Michigan, $5,000 is annually allowed for Institute expenses; in Maine, $4,000; in California, $100 for each County Institute of from three to five days' length; in Pennsylvania the amount varies from $60 to $200 for each County Institute according to the attendance; in Iowa, $50 is allowed for each, and in Indiana the same amount.

In the School Act passed here early in the year 1850, an appropriation was made "for the encouragement of Teachers' Institutes," and in that year Messrs. Robertson and Hind, then masters of the Normal School, held Institutes in each County of the Province. Last year the Local Legislature made a similar appropriation, but the money has not yet been touched. Assuming, then, that sometime during 1874 we shall have two Normal Schools in operation, one in Toronto and one at Ottawa, with possibly the Kingston establishment in course of erection, and Institutes at different points as adjuncts to them, the question of efficient management and supervision immediately presents itself for consideration. At present the prisons of the Province and the Deaf and Dumb Institute at Belleville, and the Institution for the Blind in this town, are subjected to periodical inspection by a competent officer who is responsible to the Local Government. An officer with similar powers and suitable qualifications will, we may premise, be needed for the proposed Institutes and Normal Schools. For the proper dis