

Three forces keep a particle in equilibrium; one acts towards the East, another towards the North-west, and the third towards the South; if the magnitude of the first force be 3lbs., find the magnitudes of the other two.

3. Resolve a force of 7lbs. into two others, one making an angle of 30° with it, and the other an angle of 60° .

4. Find the magnitude and position of the resultant of two parallel forces acting in the same direction.

Parallel forces of 4lbs. and 9lbs. act in opposite directions at points A and B distant 15 inches apart. How far from the middle point of AB does their resultant cut AB produced?

5. State (without proof) the position of the centre of gravity of a triangle, and show that it coincides with that of three equal particles placed at the angular points of the triangle.

Having given the position of the centre of a body, and also that of a given point of it, show how to deduce the position of the centre of gravity of the remaining part.

6. If two forces acting on a lever keep it in equilibrium, prove that they are inversely proportional to the perpendiculars let fall upon them by the fulcrum.

The longer arm of a lever is 9 inches in length: if the lever be in equilibrium when weights of 3lbs. and 4lbs. are suspended from its arms, find the length of the other arm.

7. In the system of pulleys in which each pulley hangs on a separate string attached to the beam, find the relation between the power and the weight when the system is in equilibrium, neglecting the weights of the pulleys.

If there are three moveable pulleys, the lowest of which weighs 5lbs., the middle one 4lbs., and the highest 3lbs., and the weight is 7lbs., find the power.

8. Describe the Danish steelyard, and explain what is meant by graduating it.

AB is a Roman steelyard 12 feet long; its centre of gravity is 11 inches from A , and the fulcrum 8 inches from A . If the weight of steelyard be 4lbs. and that of the moveable weight 3lbs., find how many inches from B the graduation marked 15lbs. will be.

9. A particle of given weight W is in equilibrium upon an inclined plane whose inclination to the horizon is α , under the action of a horizontal force: find this force and also the pressure on the plane.

A particle weighing $8\sqrt{3}$ lbs. is in equilibrium upon an inclined plane under the action of a force of 12lbs. acting parallel to the plane: find the inclination of the plane and the pressure upon it.

RESULTS.

1. Yes. 2. $3\sqrt{2}$ lbs.; 3lbs. 3. $\frac{1}{2}\sqrt{3}$; $\frac{1}{2}$. 4. $19\frac{1}{2}$ inches. 6. $6\frac{1}{2}$ inches. 7. 4lbs. 8. 100. 9. 60° ; $4\sqrt{3}$ lbs.

TRIGONOMETRY.

1. Give the trigonometrical definition of an angle.

What angle does the minute hand of a clock describe between 12 o'clock and 20 minutes to four?

2. Define the sine of an angle, and trace the change in the value of the sine as the angle increases from 90° to 270° .

3. Express the cosine and the tangent of an angle in terms of the sine. The angle A is greater than 90° but less than 180° , and $\sin A = \frac{1}{2}$; find $\cos A$.

4. Find $\sin 60^\circ$ and $\tan 135^\circ$.

5. Prove geometrically $\sin(A - B) = \sin A \cos B - \cos A \sin B$, A and B being both positive angles less than 90° . Show that

$$(i) \tan(A+B) = \frac{\tan A + \tan B}{1 - \tan A \tan B};$$

$$(ii) \sin 2A = \frac{2 \tan A}{1 + \tan^2 A}.$$

6. Show that, if $A+B+C=180^\circ$,

$$\sin 2A + \sin 2B + \sin 2C = 4 \sin A \sin B \sin C.$$

7. Find an expression for all the values of θ for which $\cos \theta + \cos 2\theta = 0$.

8. Show that in a triangle the sides are proportional to the sines of the opposite angles. If in a triangle $a \cos A = b \cos B$, the triangle will be either isosceles or right-angled.

9. If two sides of a triangle be given, and the angle opposite to the shorter side; show how to find the other side and the other angles. Example. The sides are 1 foot and $\sqrt{3}$ respectively, and the angle opposite to the shorter side is 30° .

RESULTS.

1. -1320° . 3. $-\frac{1}{2}\sqrt{3}$. 7. $(2m+1)\frac{\pi}{2}$. 9. 1ft., 120° and 30° or 2ft., 60° and 90° .

Special Articles.

THE GOSPEL OF RELAXATION.

Many readers of the SCHOOL JOURNAL have some acquaintance with the works of the well-known English philosopher, Mr. Herbert Spencer. Those who are fortunate enough to have studied his educational theories will be pleased to have in a somewhat permanent form the following remarks, which are part of a speech delivered at a farewell entertainment given to him on the eve of his departure from New York. After some general remarks Mr. Spencer continued:—

And now that I have thanked you, sincerely though too briefly, I am going to find fault with you. Already, in some remarks drawn from me respecting American affairs and American character, I have passed criticisms, which have been accepted far more good-naturedly than I could reasonably have expected; and it seems strange that I should now again propose to transgress. However, the fault I have to comment upon is one which most will scarcely regard as a fault. It seems to me that in one respect Americans have diverged too widely from savages. I do not mean to say that they are in general unduly civilized. Throughout large parts of the population, even in long settled regions, there is no excess of those virtues needed for the maintenance of social harmony. Especially out in the West, men's dealings do not yet betray too much of the "sweetness and light" which we are told distinguish the cultured man from the barbarian. Nevertheless, there is a sense in which my assertion is true. You know that the primitive man lacks power of application. Spurred by hunger, by danger, by revenge, he can exert himself energetically for a time; but his energy is spasmodic. Monotonous daily toil is impossible to him. It is otherwise with the more developed man. The stern discipline of social life has gradually increased the aptitude for persistent industry, until among us, and still more among you, work has become with many a passion. This contrast of nature has another aspect. The savage thinks only of present satisfactions, and leaves future satisfactions uncared for. Contrariwise, the American, eagerly pursuing a future good, almost ignores what good the passing day offers him; and, when the future good is gained, he neglects that while striving for some still remoter good.

What I have seen and heard during my stay among you has forced on me the belief that this slow change from habitual inertness to persistent activity has reached an extreme from which there must begin a counter change—a reaction. Everywhere I have been struck with the number of faces which told in strong lines of the burdens that had to be borne. I have been struck, too with the large proportion of grey-haired men, and inquiries have brought out the fact that with you the hair commonly begins to turn some ten years earlier than with us. Moreover, in every circle I have met men who had themselves suffered from nervous collapse due to stress of business, or named friends who had either killed themselves by overwork, or had been permanently incapacitated, or had wasted long periods in endeavours to recover health. I do but echo the opinion of all observant persons I have spoken to, that immense injury is being done by this high-pressure life—the physique is being undermined. The subtle thinker and poet whom you have lately had to mourn, Emerson, says, in his essay on the gentleman, that the first requisite is that he shall be a good animal. The requisite is a general one—it extends to the man, to the father, to the citizen. We hear a great deal about "the vile body;" and many are encouraged by the phrase to transgress the laws of health. But nature quietly suppresses those who treat thus disrespectfully one of her highest products, and leaves the world to be peopled by the descendants of those who are not foolish.

Beyond these immediate mischiefs there are remoter mischiefs. Exclusive devotion to work has the result that amusements cease to please; and, when relaxation becomes imperative, life becomes dreary from lack of its sole interest—the interest in business. The remark current in England, that when the American travels, his aim is to do the greatest amount of sight-seeing in the shortest time, I find current here also. It is recognized that the satisfaction of getting on devours nearly all other satisfactions. When recently at Niagara, which gave us a whole week's pleasure, I learned from the landlord of the hotel that most Americans come one day and go away the next. Old Froissart, who said of the English of his day that "they take their pleasures sadly after their fashion," would doubtless, if he lived now, say of the Americans that they take their pleasures hurriedly after their fashion. In large measures with us, and still more with you, there is not that abandonment to the moment which is requisite for full enjoyment; and this abandonment is prevented by the ever-present sense of multitudinous responsibilities. So that, beyond the serious physical mischief caused by overwork, there is the further mischief that it destroys what there would otherwise be in the leisure part of life.

Nor do the evils end here. There is the injury to posterity. Damaged constitutions reappear in children, and entail on them far more of