

$a + b$ = specific gravity of 2nd bullet,

k = " " tube,

$\frac{4}{3}\pi r^3$ = volume of each bullet,

$(2\pi r^3 + 2\pi r \times 14r) = \dots$ tube.

Find C. G. of bullets.

Let x = distance of C. G. from outside extremity of the heaviest bullet, taking moments about this point.

$$\frac{4}{3}\pi r^3 \{a + \overline{a+b} + \dots + \overline{a+6b}\} x =$$

$$\frac{4}{3}\pi r^3 \{a + 13r + \overline{a+b} + 11r + \overline{a+2b} + 9r + \dots + \overline{a+6b}\}$$

$$x = \frac{7a + 13b}{a + 3b} \cdot r.$$

The C. G. of tube will be at its middle point, at a distance $7r$ from the same end as above.

Let y = distance of C. G. of whole system from the same end, taking moments about this end.

$$\left\{ \frac{4}{3}\pi r^3 \{a + \overline{a+b} + \dots + \overline{a+6b}\} \right\} \div$$

$$30\pi r^3 \cdot k \cdot y$$

$$= 30\pi r^3 \cdot k \cdot 7r + \frac{4}{3}\pi r^3$$

$$\{a + \overline{a+b} + \dots + \overline{a+6b}\} \times \frac{7a + 13b}{a + 3b} r.$$

$$y = \frac{210kr + \frac{28}{3} \cdot (a + 3b) \times \frac{7a + 13b}{a + 3b} r^2}{\frac{28}{3} (a + 3b)r + 30k}$$

$$= \frac{315kr + 14(7a + 13b)r^2}{14(a + 3b)r + 45k}$$

$$= 7r \frac{45k + 14ar + 26br}{45k + 14ar + 42br}.$$

7. The forces acting are:

1st. Weight of sphere vertically down through its centre.

2nd. Reaction of peg passing through the centre.

3rd. Tension of string passing also through the centre.

Let A be the peg from which the sphere hangs, B be the peg the sphere rests against, C be the centre of sphere. The triangle ABC will have its sides parallel to the directions of the forces,

$$\therefore T : W :: AC : AB :: 2r : b$$

$$T = \frac{2r}{b} W.$$

$$R : W :: BC : AB :: r : b$$

$$R = \frac{r}{b} W = 47$$

ARITHMETICAL PROBLEMS.

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1. Distinguish between *Notation and Numeration*; *Simple Rules and Compound Rules*; *Prime Numbers and Composite Numbers*; *Vulgar Fractions and Decimal Fractions*.

2. Simplify

$$107 \div \left\{ 2 + 3 \div [4 + 5 \div (2 + \frac{1}{4})] \right\} +$$

$$\left(\frac{1}{3} + \frac{1}{4} \text{ of } \frac{1}{3} - \frac{1}{10} \right) \times \left(\frac{1}{2} \text{ of } \frac{1}{3} - \frac{1}{10} \text{ of } \frac{1}{10} \right).$$

Ans. 43.

3. (a) Prove $.53\bar{21} = \frac{5268}{9900}$.

(b) From what kind of *Vulgar Fractions* do we obtain *Circulating Decimals*?

4. The remainder is $\frac{2}{3}$ of the divisor, the divisor is $\frac{2}{3}$ of the quotient, and the sum of the divisor and remainder is 4 less than the quotient. Find the dividend. Ans. 381.

5. Find the least number which, when divided by 200, 175, 150, will leave in each case a remainder of 10; and find the largest number which will divide the same three numbers, leaving as remainders 20, 25, 0, respectively. Ans. 4210; 30.

6. Find the least sum of money with which a farmer can purchase sheep at \$5 $\frac{1}{4}$, pigs at \$4 $\frac{1}{2}$, calves at \$8 $\frac{1}{10}$, and cows at \$24.

Ans. \$792.

7. A person walks in 6 days 315 miles, going each successive day 5 miles less than the previous day. How far did he go on the fourth day? Ans. 50 miles.

8. The school rate in a section is 4 $\frac{1}{2}$ mills on the \$, the amount of taxable property being \$180,000, and the expenses in connection with the school being eight times the collector's fees less \$90. Find what part of the whole tax is spent in collecting.

Ans. $\frac{1}{11}$.