also the figures FKGA, DGHB, EHKC. Also that each of the triangles ABE, &c. is $\frac{1}{3}$ ABC. Denote ea. of the tri. ADG by a, and each of the figures FKGA by b. Then bec. BCD eq. 2 ABE $\therefore a+2b+GHK=4a+2b \therefore GHK=3a$.

Also since ADG, AEB are sim. triangs., DG : GA as EB : BA $\therefore$ DG is $\frac{1}{3}$ AG. Through H draw HL parallel to AB meeting GK in L, then ADG, HLG are sim. $\therefore$ GL is $\frac{1}{3}$ GH eq. $\frac{1}{3}$ GK. $\therefore$ LGH is $\frac{1}{3}$ GHK. $\therefore$ LGH eq. DGA $\therefore$ AG eq. GH $\therefore$ GHB eq. GAB; but GAB eq, 3GAD $\therefore$ GDBH eq. 5ADG $\therefore$ ABC eq. 21 ADG eq. 7GHK.

2. The sides of a triangle ABC are 25, 30, 35 feet, on these sides external squares ACED, ABHK, BCFG are described: find the aggregate area of the squares described on the lines GH, KD, EF.

Produce EC to P draw FP perp. to EP, also draw BL perp. to AC. Then bec. ang. LCP eq. BCF, each being a rt. ang., from ea. take BCP $\therefore$, BCL eq, PCF and angs. at P, L are rt. angs. and BC eq. FC hence CP eq. CL.

Since $EF^2=EC^2+CF^2+2EC\cdot CP$

$$=AC^2+CB^2+2AC\cdot CL$$

But $2AC\cdot CL=AC^2+CB^2-AB^2$

$$\therefore EF^2=2AC^2+2CB^2-AB^2$$

Sim. $DK^2=2BA^2+2AC^2-BC^2$

and $HG^2=2CB^2+2BA^2-CA^2$

$$\therefore EF^2+DK^2+HG^2=3(AB^2+BC^2+CA^2)$$

$$=3(35^2+30^2+25^2)$$

$$=8250.$$

3. Find the contents of frustum of a cone, diameter of larger end being $2\frac{1}{2}$ inches, of smaller 1 inch, and depth 5 inches.

Complete the cone and let x be the height of the smaller cone, then $x+5$ is the whole ht. and $2\frac{1}{2}:1$ as $x+5:x \therefore x=3\frac{1}{3}$.

Then vol. of frustum = vol. of large cone — vol. of smaller

$$=(2\tfrac{1}{2})^2\times\cdot7854\times\tfrac{1}{3}\times8\tfrac{1}{3}-1\times\cdot7854\times\tfrac{1}{3}\times3\tfrac{1}{3}$$
$$=12\cdot7627.$$

4. Find the centre of gravity of a right-angled isosceles triangle and the squares described on the two equal sides.

Let CA, CB be the two eq. sides, draw CD perp. to AB, then the cen. gr. is evidently in the line CD. Then c. g. of the triangle is distant $\frac{1}{3}$ DC from line AB, and c. g. of each sq. is distant DC from AB. Let x = dist. of c. g. required from AB and let W be the wt. of ABC. Then taking moments above the line AB we have (each sq. being = 2ABC)

$$W\times\tfrac{1}{3}DC+2W\times DC+2W\times DC=5W\times x$$
$$\therefore x=\tfrac{13}{15}DC,$$

5. A sphere weighing 200 lbs. rests between two planes inclined to the horizon at angles 30° and 60°; find the pressure on the planes, (by moments.)

Draw a line ECD horizontal, also draw CB CA making angles 30° and 60° respectively with ED. Let the sphere touch the planes at A, B, let O be its centre. Join OA, OB, and draw OX cutting ED at rt. ang. Then the sphere is kept at rest by three forces, the reaction (P) of the plane at A in dir. AO reaction (Q) at at B in dir. BO. and its weight in dir. OX. Now, since these three forces produce equilibrium the sum of their moments about any point is zero. Take a point G in OB and draw GF perp. to OX; taking moments about G we have

$$P\times OG-200GF=O.$$

But $OG=2GF \therefore P=100$

Similarly Q can be shown $=100\sqrt{3}$

6. A carriage wheel whose weight is W and radius R rests upon a level road; show that the power F necessary to draw the wheel over an obstacle of height H is

$$W\frac{\sqrt{2RH-H^2}}{R-H}$$

Let A be the point where the wheel touches the road, B where it touches the obstacle, C its centre, join CA, CB and draw BD perp. to AC. Then CB=R, CD=R—H and hence

$$BD=\sqrt{\{R^2-(R-H)^2\}}=\sqrt{(2RH-H^2)}$$

Therefore taking moments about B we have

$$F\times(R-H)=W\times\sqrt{2RH-H^2}$$
$$\therefore F=W\frac{\sqrt{2RH-H^2}}{R-H}$$

7. A rigid rod, the weight of which is 10 lbs., acting at its middle point, moves at one end