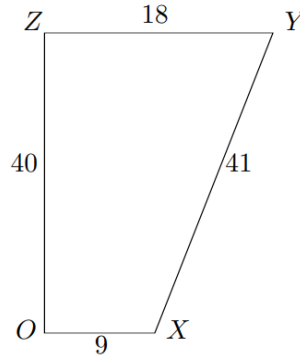
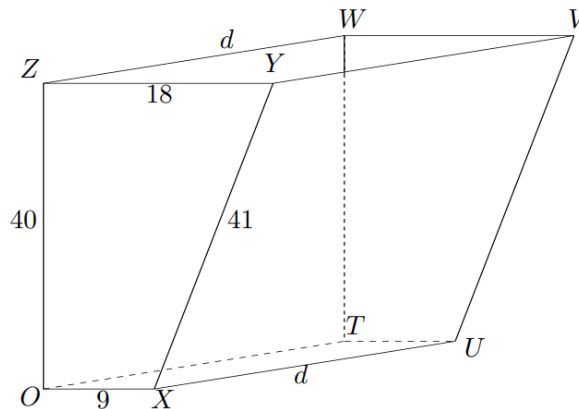


## STEP II, 2009, Q9

- 9 (i) A uniform lamina  $OXYZ$  is in the shape of the trapezium shown in the diagram. It is right-angled at  $O$  and  $Z$ , and  $OX$  is parallel to  $YZ$ . The lengths of the sides are given by  $OX = 9$  cm,  $XY = 41$  cm,  $YZ = 18$  cm and  $ZO = 40$  cm. Show that its centre of mass is a distance 7 cm from the edge  $OZ$ .



- (ii) The diagram shows a tank with no lid made of thin sheet metal. The base  $OXUT$ , the back  $OTWZ$  and the front  $XUVY$  are rectangular, and each end is a trapezium as in part (i). The width of the tank is  $d$  cm.



Show that the centre of mass of the tank, when empty, is a distance

$$\frac{3(140 + 11d)}{5(12 + d)} \text{ cm}$$

from the back of the tank.

The tank is then filled with a liquid. The mass per unit volume of this liquid is  $k$  times the mass per unit area of the sheet metal. In the case  $d = 20$ , find an expression for the distance of the centre of mass of the filled tank from the back of the tank.



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