9.

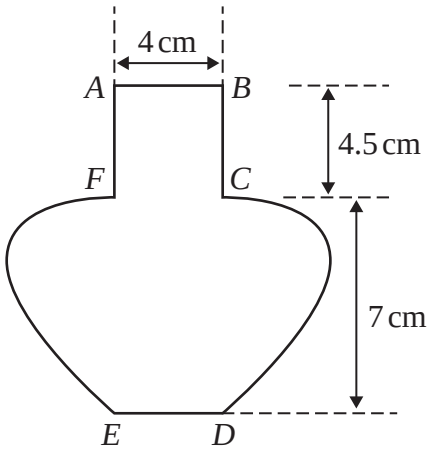

Figure 1

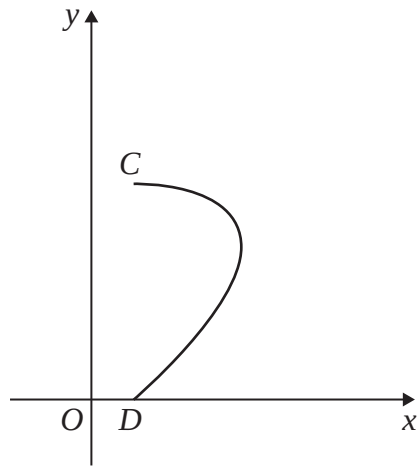

Figure 2

Figure 1 shows the central vertical cross-section *ABCDEFA* of a vase together with measurements that have been taken from the vase.

The horizontal cross-section between *AB* and *FC* is a circle with diameter 4 cm.

The base of the vase *ED* is horizontal and the point *E* is vertically below *F* and the point *D* is vertically below *C*.

Using these measurements, the curve *CD* is modelled by the parametric equations

$$x = a + 3\sin 2t \qquad y = b\cos t \qquad 0 \leqslant t \leqslant \frac{\pi}{2}$$

where *a* and *b* are constants and *O* is the fixed origin, as shown in Figure 2.

(a) Determine the value of *a* and the value of *b* according to the model.

(2)

(b) Using algebraic integration and showing all your working, determine, according to the model, the volume of the vase, giving your answer to the nearest cm^3

(7)

(c) State a limitation of the model.

(1)