**3.**

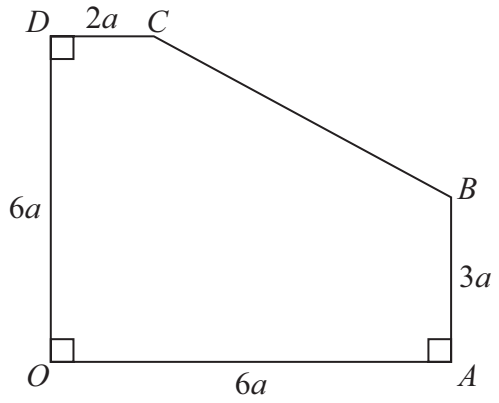



**Figure 1**

The uniform **lamina** $OABCD$ is shown in Figure 1, with $OA = 6a$, $AB = 3a$, $CD = 2a$ and $DO = 6a$ and with right angles at $O$, $A$ and $D$.

(a) Find the distance of the centre of mass of the lamina

(i) from $OD$,

(ii) from $OA$.

**(6)**

The lamina is suspended from $C$ and hangs freely in equilibrium with $CB$ inclined at an angle $\alpha$ to the vertical.

(b) Find, to the nearest degree, the size of the angle $\alpha$.

**(4)**

**(Total for Question 3 is 10 marks)**

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**4.** **In this question you must show all stages of your working.**
**Solutions relying on calculator technology are not acceptable.**

At time $t$ seconds ($t \geqslant 0$), a particle $P$ has position vector $\mathbf{r}$ metres with respect to a fixed origin $O$, where

$$\mathbf{r} = \left(t^3 - \frac{9}{2}t^2 - 24t\right)\mathbf{i} + \left(-t^3 + 3t^2 + 12t\right)\mathbf{j}$$

At time $T$ seconds, $P$ is moving in a direction parallel to the vector $-\mathbf{i} - \mathbf{j}$

Find

(a) the value of $T$,

**(5)**

(b) the magnitude of the acceleration of $P$ at the instant when $t = T$.

**(5)**

**(Total for Question 4 is 10 marks)**

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