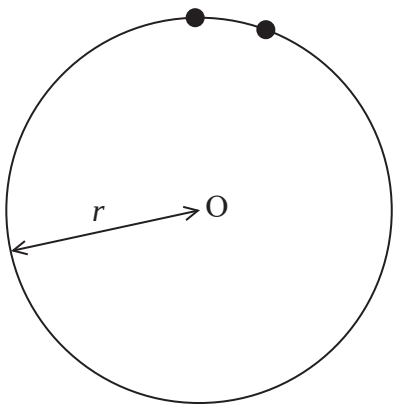
17 A centrifuge is a machine which rotates.

(a) A particle in a centrifuge moves in a circle of radius r, centre O, with a constant speed v.

The diagram represents two positions of the particle.



Derive the equation for centripetal acceleration $a = \frac{v^2}{r}$ by considering the velocity at these two positions.

Your answer should include a vector diagram.

(5)

(b) The United States' space agency, NASA, uses a centrifuge to test whether equipment will operate when experiencing large forces. The equipment to be tested is attached to the end of the frame of the centrifuge, which rotates around a vertical axis at its centre.

The centrifuge rotates at 50 revolutions per minute with a radius of 8.8 m.

(i) Show that the angular velocity of the centrifuge is about 5 rad s^{-1}.

(2)

(ii) Explain how the centrifuge applies large forces to the equipment under test.

(2)

(iii) The NASA website says the centrifuge can be used to test whether the equipment can withstand accelerations of up to about 25g.

Deduce whether this claim is correct.

(2)

(Total for Question 17 = 11 marks)