**3** **(a)** Explain why a body moving with uniform speed in a circle must experience a force towards the centre of the circle.

……

……

……

……

……[3]

**(b)** Astronauts in space adopt a way to simulate gravity through the rotation of the spacecraft as shown in Fig. 3.1. A person, standing on the interior circumference of a spacecraft with radius $r$ (in metres), experiences artificial gravity when the spacecraft rotates at a rate of $f$ revolutions per minute.

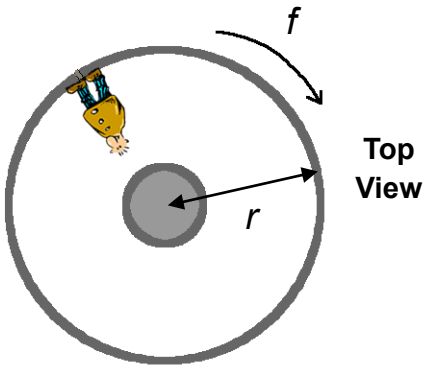


**Fig. 3.1**

**(i)** State the force that provides the centripetal force.

……[1]

**(ii)** Express the artificial gravitational acceleration $k$ (in S.I. units) experienced by the person in terms of $r$ and $f$.

$k$ = ……m $s^{-2}$ [3]

**(iii)** Studies have shown that humans develop debilitating motion sickness when the rate of rotation exceeds 2.0 revolutions per minute. Determine the minimum radius, $r$, of the spacecraft that will be able to create *artificial gravity* equivalent to the one found near the surface of the Earth at a rate of rotation humans can tolerate.

$r$ = …… m [3]

[Total: 10]