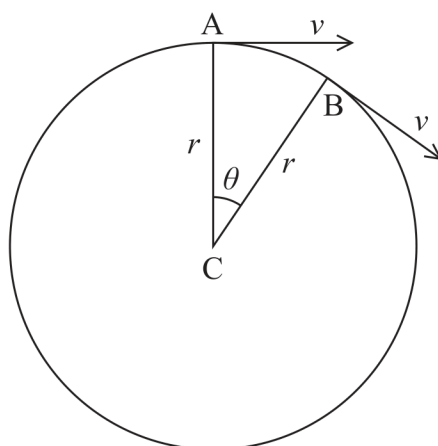16 (a) An object travels with speed v around a circular path or radius r. The diagram shows two positions, A and B on the path.

The acceleration of the object is a.

Derive the expression $a = \dfrac{v^2}{R}$

You should include a vector diagram.

(4)

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(b) The photograph shows a toy with small aeroplanes suspended from a canopy by wires.

As the platform rotates, the aeroplanes rise and follow a circular path.

At a particular speed, the aeroplanes follow a circular path of diameter 10.8 cm and the wires make an angle of 19° to the vertical.

(i) Complete a free body force diagram for one of the aeroplanes at this speed.

(1)

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(ii) Show that, at this speed, the time for an aeroplane to make 4 complete rotations is about 3 s.

mass of aeroplane = 5.2 g

(4)

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(iii) Student A suggests that if the radius of the canopy was increased and rotated at the same angular velocity as before, the wires supporting the aeroplanes could be vertical.

Student B suggests that the wires would be at an angle of greater than 19° to the vertical.

Explain whether either of the students is correct.

(5)

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(Total for Question 16 = 14 marks)