

1 (a) Define the radian.

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 [1]

(b) The rear wheel and the pedals of a bicycle are connected by a chain that passes around two cogs (toothed wheels), as shown in Fig. 1.1.

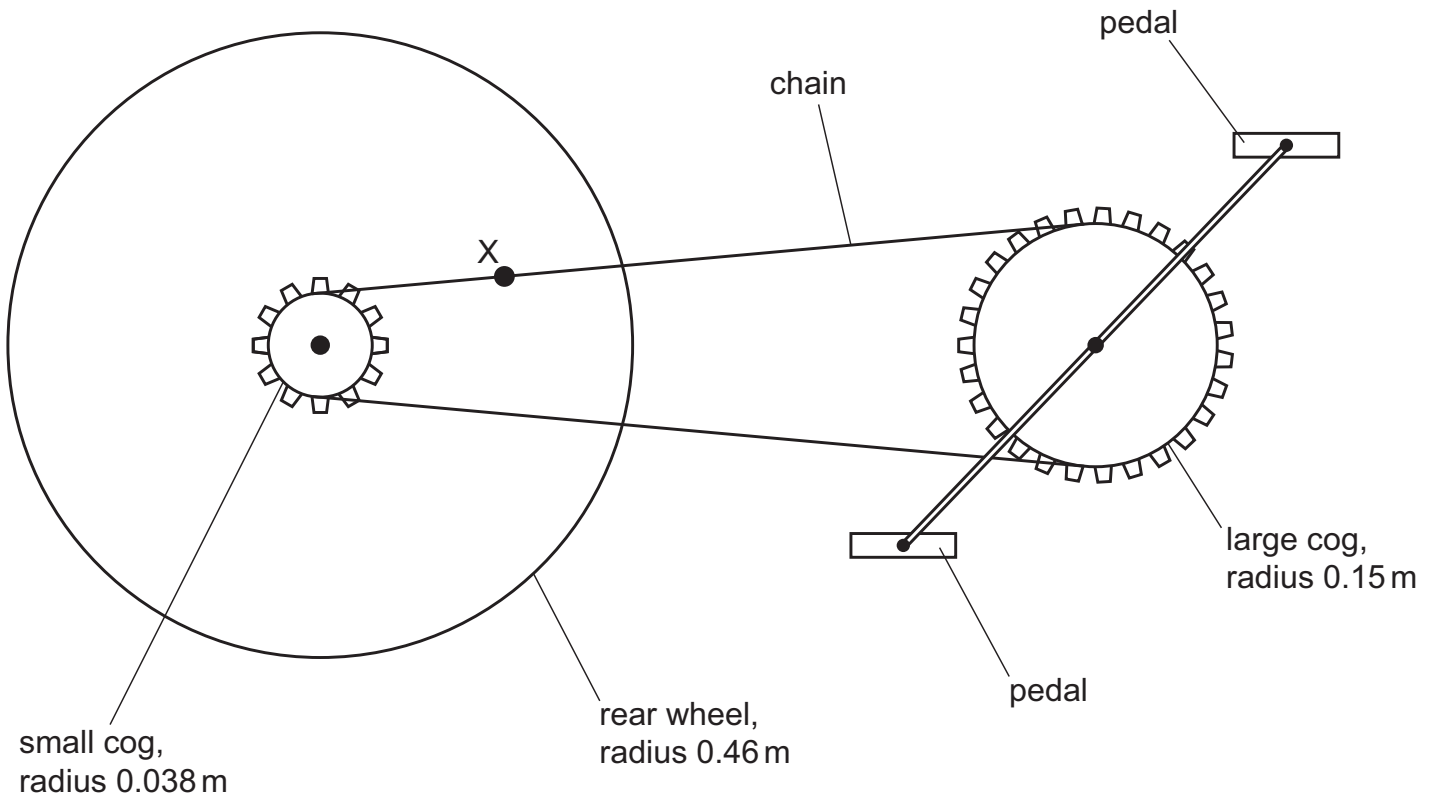


Fig. 1.1 (not to scale)

The small cog has a radius of 0.038 m and is fixed to the rear wheel so that it rotates with it. The large cog has a radius of 0.15 m and is fixed to the pedals so that it rotates with them. The rear wheel has a radius of 0.46 m.

The bicycle is being pedalled so that it moves in a straight line at a constant speed of 17 m s^{-1} .

(i) Calculate the angular speed of the rear wheel.

angular speed = rad s^{-1} [2]

(ii) Calculate the period of rotation of the small cog.

period = s [2]

(iii) Show that the distance moved by point X on the chain during one full rotation of the small cog is 0.24 m.

[1]

(iv) Use the information in (b)(iii) to determine the angle through which the large cog rotates during one full rotation of the small cog.

angle = rad [2]

(c) The chain of the bicycle in (b) is moved onto a smaller cog fixed to the rear wheel. The speed of the bicycle does not change.

Explain, without calculation, the effect of this change on the angular speed of the pedals.

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 [2]