InkPhysics

QUESTION WORKBOOK

Circular motion

Periodic motion · Year 13

AQA 3.6.1.1 · CIE 12.1.1, 12.1.2, 12.1.3, 12.2.1, 12.2.2, 12.2.3, 12.2.4
OCR A 5.2.1(a), 5.2.1(b), 5.2.1(c), 5.2.2(a), 5.2.2(b), 5.2.2(c), 5.2.2(d)(i)

19 questions · 52 marks

NAVY SCREEN EDITION

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SECTION A · Warm-up

A1 Explain why an object moving at constant speed in a circle is nevertheless accelerating. [2]

A2 An object rotates at a frequency of 5.0 Hz. Calculate its angular speed. [2]

A3 An object moves in a circle of radius 2.0 m at a speed of 10 m s^{-1}. Calculate its angular speed. [2]

A4 A car travels 24 m along a bend that is an arc of radius 60 m. Calculate the angle, in radians, through which the car turns. [1]

A5 A drill bit rotates at 3000 revolutions per minute. Calculate its angular speed. [2]

A6 State what provides the centripetal force on (a) the Moon in its orbit round the Earth and (b) a car travelling round a flat roundabout. [2]

SECTION B · Standard

B1 A 0.50 kg object moves in a circle of radius 4.0 m at 8.0 m s^{-1}. Calculate (a) its centripetal acceleration and (b) the centripetal force on it. [3]

B2 A car of mass 1000 kg goes round a bend of radius 50 m at 15 m s^{-1}. Calculate the centripetal force required. [2]

B3 A point on the rim of a spinning wheel moves in a circle of radius 0.30 m at a frequency of 2.0 Hz. Calculate (a) its angular speed, (b) its linear speed and (c) its centripetal acceleration. [4]

B4 A 0.20 kg ball is whirled in a horizontal circle of radius 0.80 m at 4.0 m s^{-1}. Calculate the tension in the string providing the centripetal force. [2]

B5 A student swings a bucket of water in a vertical circle of radius 0.90 m ($g = 9.81$ m s^{-2}). Calculate the minimum speed at the top of the circle for the water to stay in the bucket. [3]

B6 A coin of mass 12 g rests 0.15 m from the centre of a turntable rotating at 45 revolutions per minute. The maximum frictional force the surface can exert on the coin is 0.045 N. Deduce whether the coin stays in place or slides off. [4]

B7 A cyclist rides at constant speed round a circular track of radius 25 m, completing one lap in 18 s. Calculate the cyclist's speed and centripetal acceleration. [3]

SECTION C · Stretch

C1 A 0.10 kg object moves in a horizontal circle of radius 0.50 m with a period of 0.40 s. Calculate (a) its angular speed, (b) its centripetal acceleration and (c) the centripetal force on it. [4]

C2 A 0.25 kg mass is whirled in a horizontal circle of radius 1.0 m on a string that breaks when the tension exceeds 50 N. Calculate the maximum speed at which it can be whirled. [3]

C3 State the direction of the centripetal force on an object in circular motion, and describe what happens to the object if that force is suddenly removed. [3]

C4 A pendulum bob of mass 0.40 kg swings on a string of length 1.8 m. At the lowest point of the swing its speed is 3.2 m s^{-1} (g = 9.81 m s^{-2}). Calculate the tension in the string at the lowest point. [4]

C5 A laboratory centrifuge spins samples at 100 revolutions per second in a circle of radius 8.0 cm ($g = 9.81\ \text{m s}^{-2}$). Show that the centripetal acceleration of a sample is about 3200 times g. [3]

C6 Explain why the centripetal force on an object moving in a circle at constant speed does no work on the object. [3]