# Circular Motion – Topic Test 1/2

AS Physics

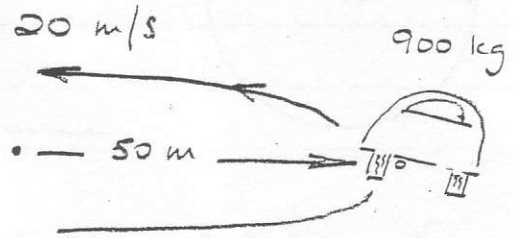
Take $g = 10$ N/kg

1. Define in words, and formulas, with units ...

a) Centripetal force (3)

b) Angular velocity (3)

2. A car drives around a circular horizontal track, at a steady speed.



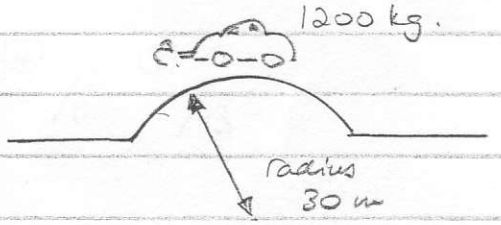

a) Draw a diagram to show the forces on the car. (3)

b) Why must there be a centripetal force, when the speed is constant? What provides it in this situation? (4)

c) Calculate the centripetal force on the car. (2)

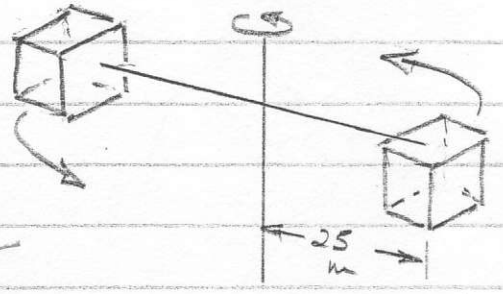
d) If the maximum centripetal force is 12 000 N, what is the maximum linear velocity the car can do on this track? (3)

3. A car drives over a circular bridge, that has a radius of 30 m.




The boy racer driver finds that a velocity of v m/s the car tyres just leave the road. Calculate the speed at which this occurs. (4)

4. Astronauts are trained to cope with big accelerations in this simulator ⇒




The simulator has a time period of 6.0 s.

a) What is it's frequency? (2)

b) What is the horizontal force on a 80 kg astronaut? (3)

c) What is the astronaut's linear speed? (2)

d) The simulator is speeded up until the astronaut experiences a horizontal force 5 times that due to normal gravity. Calculate the simulator's new time period for this to happen. (4)

TJH
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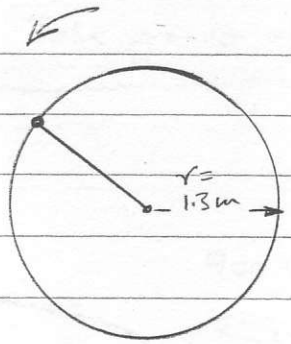
Q... [1] /6 [2] /12 [3] /4 [4] /11 Total /33.

# Circular Motion - Topic Test 2/2

A2 Physics

5. A stone is swung in a vertical circle with a time period of 0.6 s.




(a) Calculate the angular velocity (1)

(b) Calculate the string tension at the bottom of the circle. (3)

(c) The string can withstand a maximum tension of 500 N before it breaks. Calculate the Time period of the stone's circular motion for the string just to break. (3)

(d) What is the stone's linear speed and position in the circle when the string breaks? (3)

(e) Sketch a diagram showing the stone's path just after the string has broken. (2) (13)

So... Q (1) /6 (2) /12 (3) /4 (4) /11 (5) /13

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# Circular Motion – Test Answers

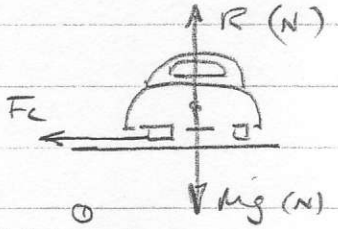
MN AS Physics

1 a) Force acting towards the centre that keeps an object moving in a circle ① ... $F_c = mv^2/r = m\omega^2 r$ ①

b) the angle through which the object moves in 1 second ①, $\omega = v/r$ ① rad/sec ①

2 (a) ⟹

(b) $F_c$ needed to keep car accelerating ① towards centre of circle ① because always changing direction ① ... provided by friction ①

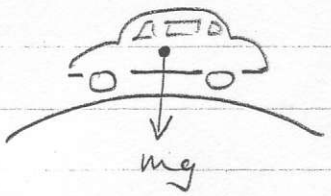



(c) $F_c = m\omega^2 r = mv^2/r$ ① $= 900 \times 20 \times 20 / 50 =$ 7200 N ①

d) $F_c$ max $= 12000 = mv^2_{max}/r$ ① ⇒ $v^2_{max} = 12\,000 \times r / m$ ① $= 667$ ①

So $v_{max} = \sqrt{667} =$ 25.8 ① m/s

3. When car tyres just leave the road the weight is just enough to keep the car in a circular path




$mg = F_c$ ① $= mv^2/r$ ①

So $1200 \times 10 = 1200 \times v^2/30$ ①

So $v^2 = 10 \times 30$ ⇒ $v = \sqrt{300} =$ 17.3 ① m/s

Total /46

4 a) $f = 1/T$ ① So $f = 1/6 =$ 0.167 ① Hz → $\omega =$ 1.05 rad/s

b) "horizontal force" $= F_c = m\omega^2 r$ ① $= m(2\pi f)^2 r$

$= 80 \times (2\pi \times 0.167)^2 \times 25$ ①

$=$ 220 ② /13

c) linear speed $v = \omega r = 2\pi f r = \frac{2\pi}{T} r =$ 26.2 ① m/s ① /11

d) normal gravity produces a force of $80 \times 10 =$ 800 N ① /4

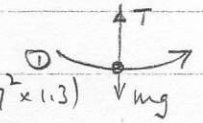
So $F_c = 5 \times 800 =$ 4000 ① (N) $= m\omega^2 r$ /3

So $\omega^2 = 4000 / 80 \times 25 = 2$ /2

So $\omega =$ 1.41 ① rad/s

but $T = 2\pi/\omega = 2\pi / 1.41 =$ 4.44 ① s. /1

5. (a) $\omega = 2\pi/T$ ① $=$ 10.47 ① rad s$^{-1}$. (b) at the bottom ... $T = mg + m\omega^2 r$ ①




$= (2.2 \times 10) + (2.2 \times 10.47^2 \times 1.3)$

$=$ 336 N ①

(c) $T_{max} = 500$ N $= F_c + mg$ ①

⇒ $F_c = 500 - 22 = 478 = m\omega^2_{max} r$ ①

So $\omega^2 = 478 / 2.2 \times 1.3 = 167$ ⇒ $\omega_{max} =$ 12.93 ① rad/s

$T = 2\pi/\omega = 0.486$ s.

(d) $v = \omega r$ 12.9 ① $\times 1.3 =$ 16.8 ① m/s at the bottom ①

(e)


TN 09.01 + 11.02