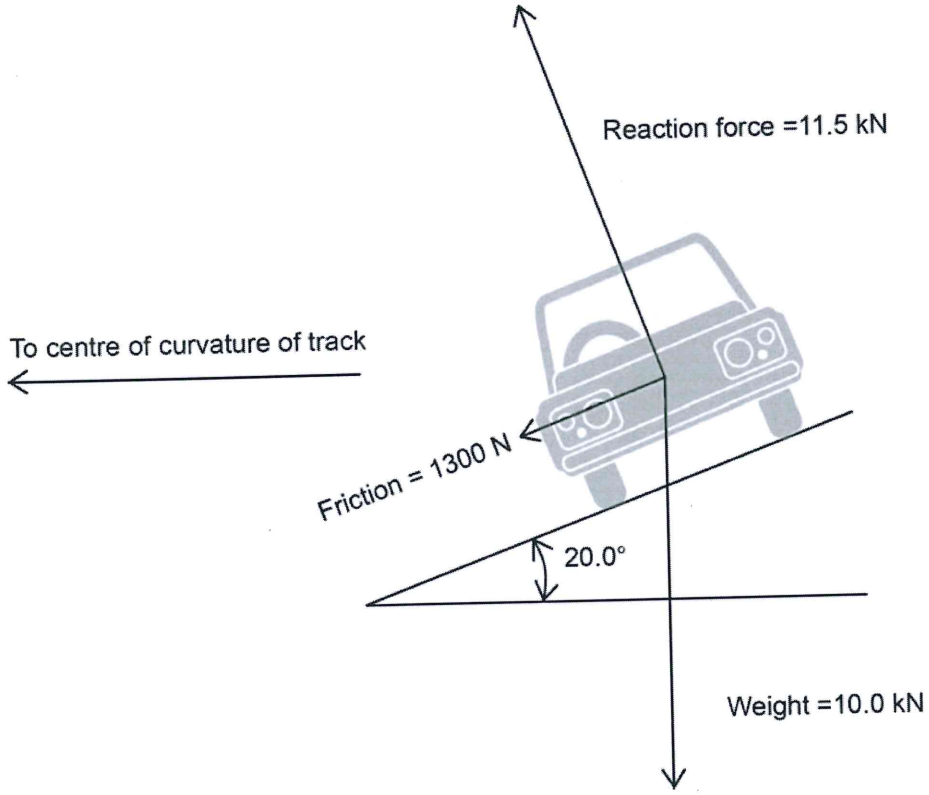
Exam Answers
Chapter 1.4 - Circular Motion
Answer 1 2011:1:12

(5 marks)

The diagram below shows the forces acting on a car following a curve on a banked track. The car is travelling at 17.0 m s^{-1} without slipping. Calculate the radius of the track.



Description	Marks
Centripetal force = (11.5 × 10^3 N × sin20°) + (1300N × cos20°) = 3933 N + 1222 N = 5155 N (1 mark each component)	1–2
Convert weight to mass m = W/g = 10000/9.8 = 1020 kg	1
Rearrange and substitute $r = \frac{mv^2}{F} = \frac{1020 \times 17^2}{5155}$	1
r = 57.2 m	1
	Total 5

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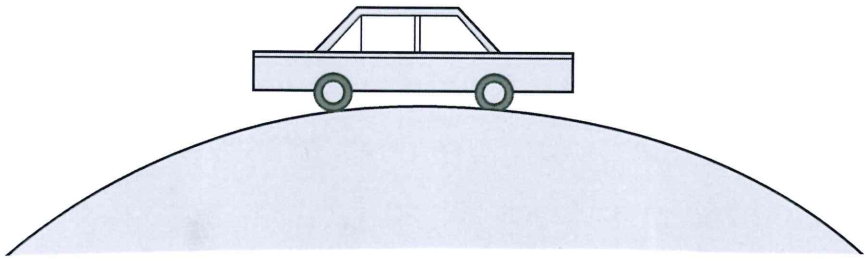
Chapter 1·4 - Circular Motion
Answer 2 2013:1:6

(3 marks)

A car is driving over a hill with a radius of 250 m at a speed of 30.0 m s^{-1}. Determine the magnitude of the net force experienced between a 65.0 kg passenger and their seat or seat belt.



A car is driving over a hill with a radius of 250 m at a speed of 30.0 m s^{-1}. Determine the magnitude of the net force experienced between a 65.0 kg passenger and their seat or seat belt.

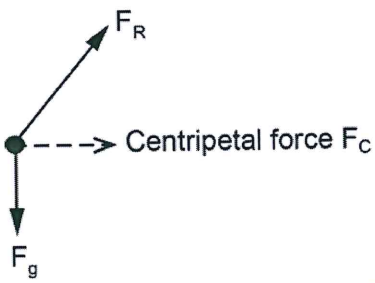
Description	Marks
$F_r=F_g-F_c$ So $F_r=mg-mv^2/r$	1
$F_r=65\times9.8-65\times30^2/250$	1
F_r= 403 N	1
Total	**3**

If stated 'net force = F_c' and calculates F_c correctly, then 2 only.

Answer 3 2013:1:9

(5 marks)

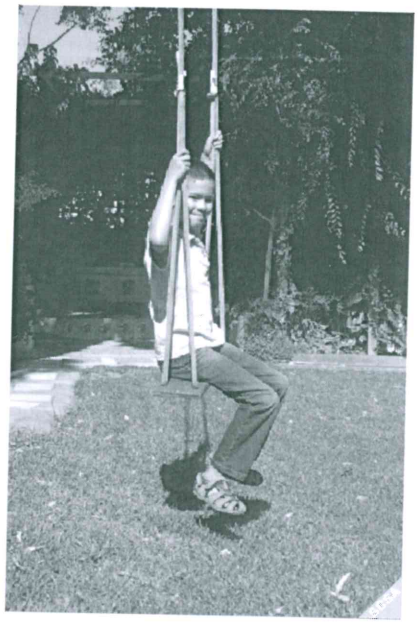
Use a labelled free body diagram to help explain why a runner or a cyclist needs to lean when making a turn.

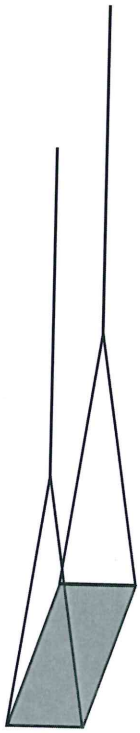
Description	Marks
Uses a diagram  Draws and labels two forces F_g and F_R (can include components of normal and frictional forces) Explains or draws a resultant F_c is produced	1–3
The unbalanced force is directed towards the centre of the circle	1
which provides the acceleration to move the object in a circle	1
Total	**5**

Exam Answers
Chapter 1·4 - Circular Motion
Answer 4 2014:1:11

(6 marks)

Shown are a photograph and diagram of a child's swing suspended 7.00 metres below the branch of a large tree. The wooden seat has a mass of 1.00 kg and is supported by ropes as shown in the diagram below. When the seat is horizontal, the ropes that **attach to the seat** each make an angle of 15.0° to the vertical.





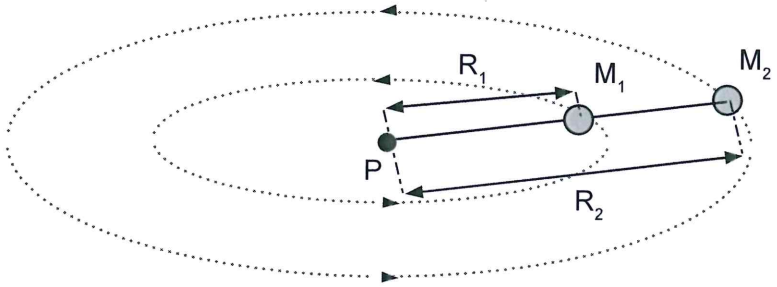
Calculate the maximum tension in each of the angled sections of the rope that attach to the seat when a 27.0 kg boy is sitting on the swing and moving with a tangential velocity of 4.00 m s^{-1}. Show **all** workings.

Description	Marks
Total mass in motion = 1 + 27 = 28.0 kg	1
$T = mg + mv^2 / r$ $T = 28 \times 9.8 + 28 \times 4^2 / 7$ $T = 274 + 64$ $T = 338$ N	1–2
Let t_r = tension in each section of rope: $t_r \times \cos 15° = 338 / 4$ $t_r \times 0.966 = 84.5$ N	1–2
$t_r = 87.6$ N (no mark for unit)	1
Total	**6**

Exam Answers
Chapter 1·4 - Circular Motion
Answer 5 2014:2:19

(10 marks)

A string linking two balls M_1 and M_2, (shown in the figure below) allows them to revolve in circular motion on the horizontal plane with radii R_1 and R_2. The periods of revolution of M_1 and M_2 are the same and equal to T. Ignore gravitational force and air resistance force.



(a) Draw a free body diagram for M_1. (3 marks)

Description	Marks
	
Force drawn towards the centre of the circle (left)	1
2 forces drawn in opposite direction	1
F_1 is larger than F_2	1
Total	**3**

(b) Complete the following for M_1 and M_2.

(i) Write an appropriate expression for the tangential velocity v_1 of M_1 in terms of R_1, R_2 and T. (2 marks)

Description	Marks
$v = s/t = (2\pi R / T)$	1
$v_1 = (2\pi R_1 / T)$	1
Total	**2**

(ii) Write an appropriate expression for the tension F_1 acting in the string between M_1 and M_2, in terms of the mass m_2, the radius R_2 and the period T. (2 marks)

Description	Marks
$F_1 = m_2 v_2^2 / R_2$	1
$= m_2(2\pi R_2/T)^2/R_2 = m_2 (4\pi^2 R_2) / T^2$	1
Total	**2**

(iii) Write an appropriate expression for the tension F_2 acting in the string between P and M_1, in terms of the masses m_1 and m_2, the radii R_1 and R_2 and the period T. (3 marks)

Description	Marks
$F_c = F_2 - F_1$	1
$F_2 = m_1 v_1^2 / R_1 + m_2 v_2^2 / R_2$	1
$= m_1(2\pi R_1/T)^2/R_1 + m_2(2\pi R_2/T)^2/R_2$ $= (m_1 R_1 + m_2 R_2)(4\pi^2 / T^2)$	1
Total	**3**