**Name of the Student**:_____
**Max. Marks : 20 Marks** **Time : 20 Minutes**

Mark Schemes

**Q1.**

| Question Number | Answer | | Mark |
|---|---|---|---|
| **(a)** | Velocity/direction changing **Or** (object is) accelerating<br>Force towards centre of circle | **(1)**<br>**(1)** | **2** |
| **(b)** | High(er) speed means large(r) force<br>**Or** small(er) radius means large(r) force<br><br>(For sharp bends) centripetal/resultant/required force would need to be greater than maximum frictional force<br>**Or** (for sharp bends) friction cannot provide the (required) centripetal/resultant force | **(1)**<br><br>**(1)** | **2** |
| **(c)(i)** | Resolving forces vertically $N \sin \theta = mg$<br>Resolving forces horizontally $N \cos \theta = mv^2/r$<br>Division of vertical equation by horizontal equation to get correct answer | **(1)**<br>**(1)**<br>**(1)** | **3** |
| **(c)(ii)** | Use of $\tan \theta = gr/v^2$<br>$\theta = 57°$<br><br>Example of calculation<br>$\tan \theta = (9.81 \text{ m s}^{-2} \times 18.7 \text{ m}) / (11.0 \text{ m s}^{-1})^2$<br>$\theta = 56.6°$ | **(1)**<br>**(1)** | **2** |
| | **Total for question** | | **10** |

**Q2.**

| Question Number | Answer | Mark |
|---|---|---|
| (a) | Evidence of frictional force = $(0.35 \times mg)$ (1)<br>Use of $F = mr\omega^2$ **Or** $F = mv^2/r$ (1)<br>Use of $\omega = 2\pi/T$ **Or** $v = 2\pi r/T$ (1)<br>$t = 3.0$ s (1)<br><br>Example of calculation<br>frictional force = $0.35 \times 20$ kg $\times 9.81$ m s$^{-2}$ = 68.7 N<br>$F = mr\omega^2$<br>$\omega = \sqrt{}$ (68.7 N / (20 kg $\times$ 0.80 m)<br>$\omega$ = 2.1 rad s$^{-1}$<br>$t = 2\pi/2.1$ rad s$^{-1}$<br>$t = 3.0$ s | 4 |
| (b) | There would be no difference (1)<br><br>Both expressions for force depend on mass<br>**Or** algebraic equation for $\omega$ or $T$ derived (could be in the working for (a)) showing $\omega$ or $T$ independent of $m$<br>**Or** statement that masses cancel if supported by evidence in (a) (1) | 2 |
| | **Total for question** | 6 |

**Q3.**

| Question Number | Acceptable Answer | Additional Guidance | Mark |
|---|---|---|---|
| | • top of bridge identified as point at which car has greatest chance of losing contact. (1)<br>• at the point which car loses contact with bridge push from bridge onto car becomes zero **Or** resultant force on car = weight of car (1)<br>• Newton's 2nd law applied with $a = \frac{v^2}{r}$ (1)<br>• $v_{max}$ = 9.9 m s$^{-1}$ (1)<br>• 25 mph = 11.3 m s$^{-1}$, so speed limit is not suitable (1) | Example of calculation:<br>$mg = \frac{mv^2}{r}$<br>$v = \sqrt{rg} = \sqrt{10\,\text{m} \times 9.8\,\text{ms}^{-2}} = 9.9\,\text{ms}^{-1}$<br>25 mph = $\left(\frac{25}{10}\right) \times 0.45\,\text{ms}^{-1} = 11.25\,\text{ms}^{-1}$ | (5) |