Question 7.1

Compute the minimum length of vertical crest curve to provide a passing sight distance of 190 metres at the intersection of a +2.6% grade and a –2.4% grade. The driver eye height is set at 1.07 metres and the object height at 0.25 metres.

Compute the distance if the object height reduces to zero

Solution 7.1

S=190
p=2.6
q=-2.4
h1=1.07
h2-0.25
A=5
e=1.18
therefore L>S
L= 383m
If h2=0
L=843m

Question 7.2

A design speed of 85 km/hr was selected for a stretch of highway. The results from a speed survey taken along the route in question are given in Table Q7.2:

Speed Range (km/hr)	Observed cars
Less than 60	10
60 – 64	12
65 – 69	54
70 – 74	140
75 – 79	176
80 – 84	120
85 – 89	60
90 – 94	15
95 – 99	6
Greater than 100	1

Table Q7.2

Determine the 50^{th}, 85^{th} and 99^{th} percentile speed range and compare it with the selected design speed

Solution 7.2

Speed Range (km/hr)	Observed cars with speed within or below this range	Percentile speed	
Less than 60	10	2rd	
60 – 64	22	4th	
65 – 69	76	13th	
70 – 74	216	36th	
75 – 79	392	66th	50th
80 – 84	512	86th	85th
85 – 89	572	96th	
90 – 94	587	99th	99th
95 – 99	593	100th	
Greater than 100	594	100th	

Question 7.3
A highway with a design speed of 85 km/hr (desired sight stopping distance = 160 metres) is designed with a sag curve connecting a descending gradient of 6% with an ascending gradient of 6%.

If comfort is the primary design criterion, assuming a vertical radial acceleration of 0.3 m/s2, calculate the required length of the sag curve.

Solution 7.3

The design speed of 85 km/hr gives a desired sight stopping distance of 160 metres

$$e = -(q - p)\frac{L}{8} = -(-0.06 - 0.06) \times 160 \div 8$$

=2.4 metres, which is greater than the driver's eye height of 2 metres.

Since e < H_1, S < L as the sight distance lies outside the curve length.

Thus,

$$L_m = \frac{AS^2}{8\left[l - (H_1 + H_2)/2\right]} = \frac{0.12 \times 160^2}{8\left[5.7 - (2.0 + 0.26)/2\right]} = 84 \text{ metres}$$