Kafr El-Sheikh University
Faculty of Engineering
Department of Civil Engineering
Year: 4th Civil Engineering
Name: Dr. Usama Heneash

Subject: Highway Engineering
Date: 26/1/2016
Time allowed: 3 Hours
Final Exam: 2 pages
Final Mark: 75 degree

Answer all questions, and assume any missing data.
(Highways tables are allowed)

Question 1 [15 Mark]

a) Why spiral curves are desirable as transition curves for horizontal alignment? **[3]**

b) What are the reasons for road widening? **[2]**

c) A driver is travelling along a right turn horizontal curve of 400 m radius and 115 m length. The HWY is 2-lane with 8 m width, superelevation rate is 6%, and shoulder width is 1.5 m and side slope of 8% to the outside. The cut slope is 3:1, and the longitudinal slope of the pavement is +3%. What is the max safe speed along this portion of the HWY knowing that the coefficient of longitudinal friction of the pavement is 0.29? **[5]**

- If the crown cross slope of the pavement is 1%, draw to a suitable scale the progress of the pavement edges from the distance between T.S. and S.C.? **[5]**

Question 2 [15 Mark]

a) What are the factors affecting the choice of a highway profile? **[3]**

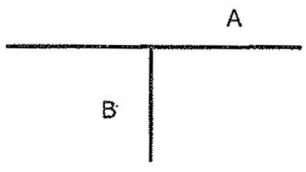
b) Mention the benefits of using shoulders? **[2]**

c) A -4.2 % grade intersects a 3 % grade at station 11+00 and elevation 20 m. These two grade lines are to be connected by a 260 m vertical parabolic curve.

- At what station is the cross-drainage pipes should be situated? **[5]**
- If the outside dimensions of the pipe is 95 cm, and the top of the pipe is 30 cm below the subgrade. Determine the bottom elevation of the pipe? **[5]**

Question 3 [15 Mark]

a) Design and draw the opposite T-intersection as fully channelized. The design speeds are 95 kph and 80 kph for road A and B respectively. The two roads are 2-lane Highway with 3.5m lane width, the turning speed is 20 kph, and the design vehicle is SU? **[7]**



b) Compute the conflict points for the above intersection, all movements are allowed? **[3]**

c) What are the advantages and disadvantages of At-Grade intersections? **[5]**

Question 4 [15 Mark]

a) How can the compaction in the field be checked? **[3]**

b) Determine the CBR value for the following soil? **[4]**

Penetration (in)	0.025	0.05	0.075	0.1	0.2	0.3	0.4	0.5
Load (Ib)	10	20	30	80	300	400	450	480

c) Classify the following soils and rate their behavior as subgrade for a highway pavement? Suggest the suitable type of rollers to compact each soil? **[8]**

Sieve size	# 4	#10	#40	# 200	L.L.	P.L.
Soil A (%passing)	92	75	55	8	------	NP
Soil B (%passing)	85	76	61	41	50	30

Question 5 [15 Mark]

a) The proposed pavement structure is comprised of 4" wearing surface, 6" granular base, and 4" subbase. Resilient modulus of these layers are 450 000, 25 000, and 12 000 psi respectively. The CBR of subgrade is 6 %, P_t = 2.5, P_i= 4.2, S_o = 0.45 and R = 90 %.

- Determine the expected total ESAL that the pavement can sustain? **[4]**
- If ESAL is 1.1×10^6, determine whether the proposed layer thicknesses are adequate? If not, suggest the required changes in the layer thicknesses? **[4]**

b) How can asphalt cement be liquefied? **[3]**

c) When highway engineers suggest soil stabilization? Describe four methods? **[4]**