MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION

(Autonomous)

(ISO/IEC-270001 – 2005 certified)

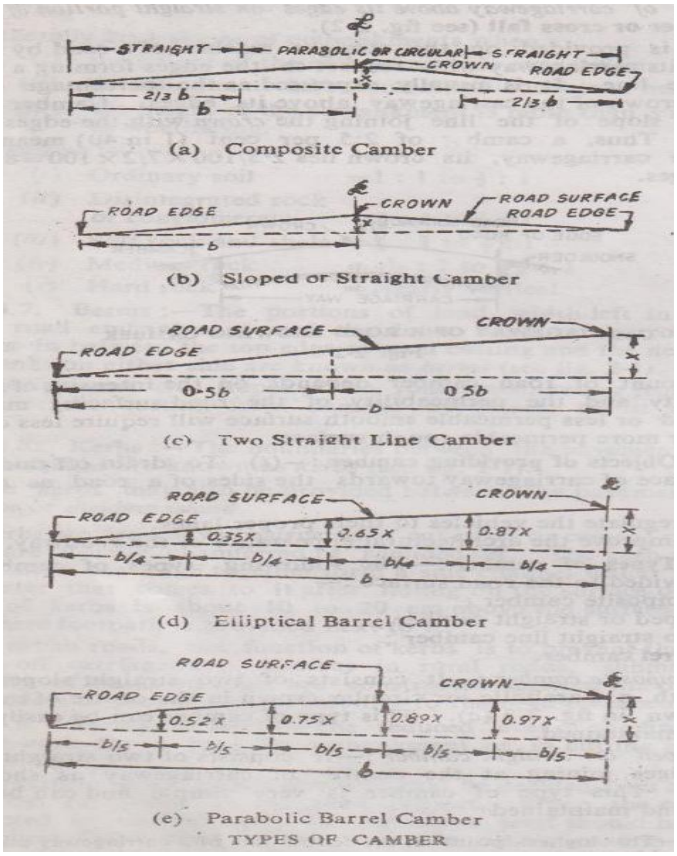
SUMMER -13 EXAMINATION

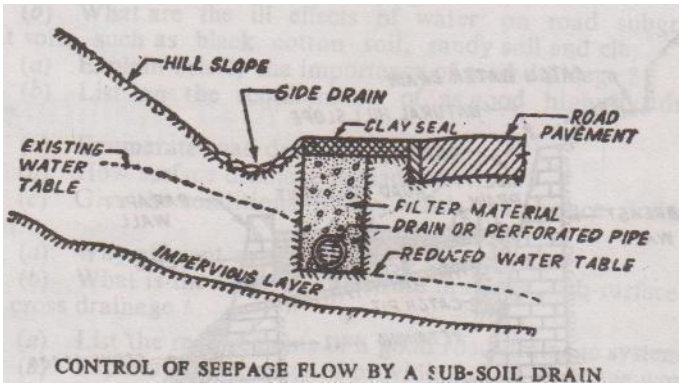
Subject code: 12139 **Model Answer** Page No: 01/13 Nos

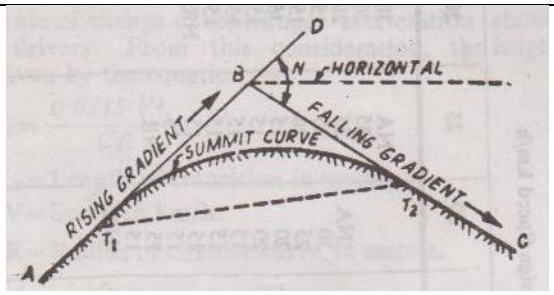
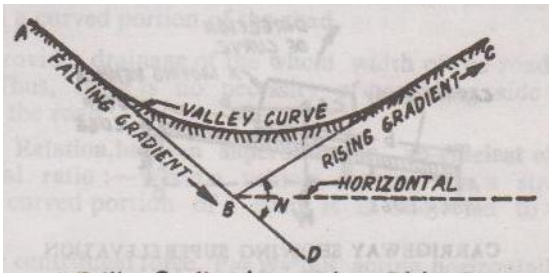
Important Instructions to examiners:

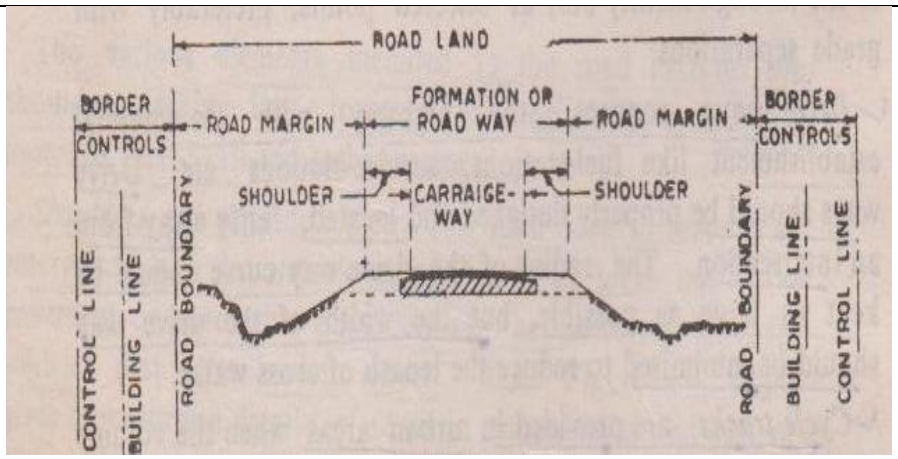
1) The answer should be examined by keywords and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language error such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and communication skill).
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figure drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In the some cases, the assumed constants values may vary and there may be some difference in the candidates answer and model answer.
6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidates understanding

Q.1)A)1)State the types of road surveys as per IRC for road project investigation.	4
Types of road surveys as per IRC:- a) Transport planning surveys i)Traffic surveys, ii)Highway inventories, iii)Pavement deterioration studies, iv)Accident studies	1
b) Alignment and route location survey:-i)Desk study, ii)Reconnaissance survey iii)Preliminary survey, iv)Final location survey or fixing of alignment of road.	1
c) Soil surveys:-i)Embankment and cut section survey, ii)High embankment investigations, iii)Bridge foundation investigations.	1
d) Pavement design investigations:-i)Soil properties and strength surveys, ii)Material location surveys	1

Q.1)A)2What do you mean by camber ? State types of cambers show sketch.	4
Camber:- the slope provided to the road surface in the transverse direction to drain of rain water from the road surface is known as camber.	1
Types of camber:-1) Composite camber, 2) Sloped or Straight camber, 3) Two Straight line camber 4)Elliptical barrel camber 5) Parabolic barrel camber	1
	2
Q.1)A)3)State function of soil and aggregate for road construction.	4
Function of soil:- 1) To provide adequate support to the road pavement. 2) To provide stability to the road pavement and good drainage.	2
Function of Aggregate:- 1) It is used for constructing sub-grade and sub base course. 2) It is used for constructing base course and wearing course	2
Q.1)A)4)State purpose of traffic studies.	4
Purposes of traffic studies:- 1) To decide the pavement thickness of the road. 2) To decide the geometrical design of the road.	1 1

3) To design the road system, bridges and culverts etc. 4) To design the road width, curves, traffic signals, intersections.	1 1
Q1) B)1)Classify roads according to modified third road development plan. Also state classification of urban roads.	6
Classification of roads according to modified third road development plan:- 1) Primary system:-Expressways and National highways 2) Secondary system:- State highways and Major district roads. 3) Tertiary system or rural roads:- Other district road and village roads **Classification of Urban roads:-** 1) Arterial roads, 2)sub- arterial roads, 3) Collector streets, 4) Local streets	3 3
Q1) B)2)How will you prevent a seepage flow observed in sub soil of road? Explain with sketch.	6
Control of seepage flow:- When the general ground as well as the impervious strata below are seepage flow is likely to exit. If the seepage zone is at depth less than 0.6 to0.9 m from the subgrade level, longitudinal pipe drain in trench filled with filter material and clay seal may be constructed to intercept the seepage flow.  CONTROL OF SEEPAGE FLOW BY A SUB-SOIL DRAIN	2 2 for fig. 2 for label
Q.2 a)What do you mean by i)Kerb ii)Right of way iii)Road margins iv)Seperators	4
i) Kerb:- Kerb indicates the boundary between the pavement and shoulder. **ii) Right of way:-** Right of way is the area of land acquired for the road along its alignment. **iii) Road margins:-** The various elements included in the road margins are shoulder, parking lane, frontage road, driveways, cycle track, footpaths, guard rail and embankment slope. **iv) Seperators:-** The main function of traffic separator is to prevent head on collision between vehicles moving in opposite directions on adjacent lanes.	1 1 1 1

Q.2)b)What do you mean by bitumen ? State any four properties of bitumen.	4
Bitumen:- Bitumen is hydrocarbon material of either natural or pyrogeneous origin, found in gaseous, liquid, semisolid or solid form and is completely soluble in carbon disulphate and in carbon tetra chloride. **Properties of bitumen:-** 1) It is mostly available in solid or semisolid state. 2) It is black or brownish in colour. 3) The bituminous material is highly temperature susceptible. 4) In presence of water the bitumen should not strip of from the aggregate.	2 ½ ½ ½ ½
Q.2)c)Draw a sketches of i)Summit curve ii)Valley curve with all labels.	4
 i)Summit curve  ii)Valley curve	1 for fig. 1 for label 1 for fig. 1 for label
Q.2) d)Draw a neat sketch of road in embankment.	4



Road in embankment.

2 for fig. 2 for label

Q2)e)Define design speed. State any four factors affecting design speed. 4

Design speed:-The maximum safe speed of vehicles assumed for geometrical design of highway is known as design speed. 2

Factors affecting design speed:- 1) Type and condition of road surface ½

2) structure of the road. ½

3) Nature, type and intensity of traffic. ½

4) Type of curve along the road. ½

Q2)f)Compare tar and bitumen (2 points only) 4

Tar	**Bitumen**	
1.It is produced by destructive distillation of wood or coal in the absence of air.	1.It is natural petroleum product. It is found in pure or nearly pure state.	1
2.It is black to brown colour.	2. It is also black to brown colour.	1
3.It has more quantity of free carbon.	3.It has less quantity of free carbon.	1
4.It has inferior weather resisting properties.	4. It has better weather resisting properties.	1

Q.3)a)What is the purpose of reconnaissance survey for roads. 4

Purpose of reconnaissance survey:- 1) To acquire general knowledge about topographical details of the area such as pond, lake, river, valley, ridge, hill, marshy land and permanent structures. 1

2) To collect geological information for foundation work of bridges and construction of road 1

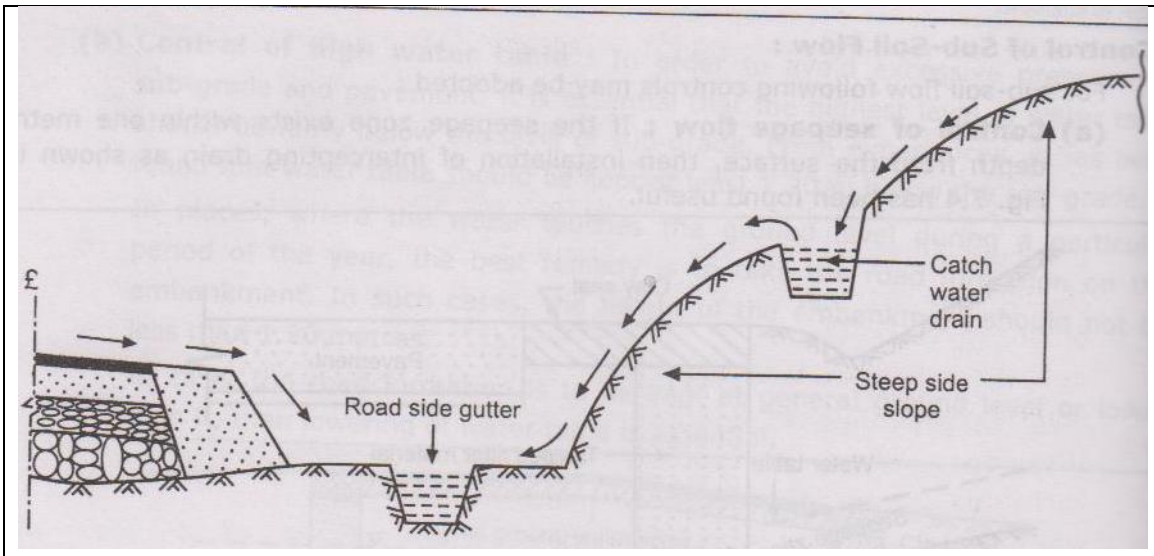
pavements. 3) To collect information regarding the availability of local construction materials and labours. 4) To locate the obligatory points along the alternative routes.	 1 1
Q.3)b)Define gradient .State purposes of providing gradient.	4
Gradient:- The rate of rise or fall provided to the formation of the road along its alignment is called gradient. **Purpose of gradient:-**1) To connect the terminal stations situated at different levels. 2) To make the earthwork of the road project economicalsince a perfectly level road involves more cutting and filling. 3) To provide effective drainage of rain water falling over the road surface. 4) To reduce the maintenance cost of the road surface.	2 ½ ½ ½ ½
Q.3)c)How Abrasion resistance of aggregate is tested in laboratory?	4
Abrasion test:-This test is perform to find the hardness, resistance to abrasion of the stone aggregate so that its suitability for the pavement construction work can be decided. This test can be carried out by Los Angeles abrasion test method, Devel abrasion test method or Dorry abrasion test method. Since Los Angeles abrasion test method has been established by ISI, therefore, being commonly adopted these days. **Los Angeles abrasion test method:-** In this method, the percentage abrasion value is determined . Which indicates a relative measure of the resistance of stone aggregate to abrasion than by comparing this value with the specified abrasion value for the different pavement construction work, the suitability of the road aggregate under construction can be evaluated.	2 2
Q3)d)Define i) Limiting gradient ii) Sight distance	4
Limiting gradient:- The gradient steeper than the ruling which may be used in restricted road lengths where the later is not feasible is called limiting gradient. **Sight distance:-** The distance along the centre line of a road at which the driver has visibility of an object, stationary or moving, at a specified height above the carriageway is known as sight distance.	2 2
Q3)e)Sate Functions of pavement.	
Functions of pavement:- 1) To carry heavy wheel loads of vehicular traffic.	1

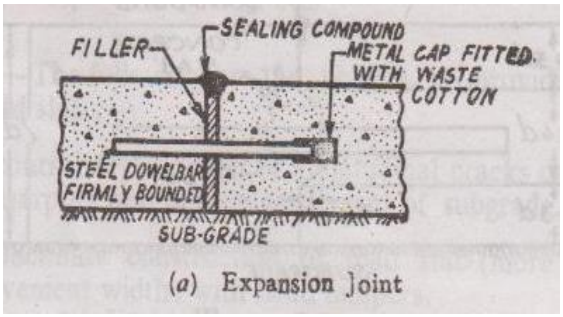
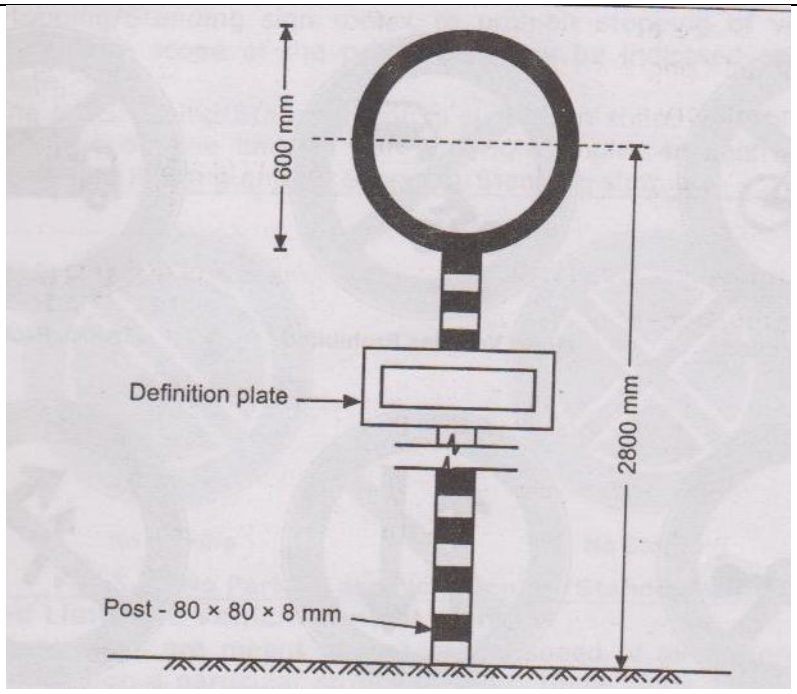
2) to distribute the heavy wheel loads of vehicular traffic over a large area of the underlying subgrade soil. 3) To prevent the subgrade soil from the bad effects of weathering agencies. 4) to provide a smooth riding surface.	1 1 1
Q3)f)State purposes of following tests on bitumen. I) Ductility test ii) Softening point test	4
i) Purpose of Ductility test:- This test is carried out to find out the adhesiveness and elasticity of the bitumen. **ii) purpose of Softening point test:-** This test is carried out to find out the temperature at which the bituminous attain a particular degree of softening for deciding its suitability for the construction of a road pavement.	2 2
Q4)A)i)State meanings of i) Borrow pit ii) Spoil bank iii) Lead iv) Lift related to the earthen road	4
i) Borrow pit:- Earthen road is generally constructed by using the soil available locally. This is obtained by digging the pits along one or both the sides of road and running parallel to the alignment of the road. These pits are known as borrow pits. **ii) Spoil bank:-** When the excavated materials cannot be used immediately it is stacked by the road side in the hips of regular shape for future use. These stack are known as spoil bank. **iii) Lead:-** Lead is the horizontal distance through which the material conveyed before it is disposed at specified and is used in the bank work or thrown as waste. **iv) Lift related to the earthen road:-** Lift is the vertical distance through which the earthen materials have to be raised before it is transported.	1 1 1 1
Q4)A)ii)What do you mean by Stabilization of soil. Explain any one method of Stabilization of soil.	4
Stabilization of soil:-The process of improving the bearing power of the ordinary soil by physical, chemical or physiochemical method is called stabilization of soil. Explanation of any one of the following methods. 1) Mechanical soil stabilization. 2) Soil-lime stabilization. 3) Soil-bitumen stabilization. 4) Complex stabilization with more than one stabilizer. 5) Stabilization by chemical.	2 2

6) Stabilization by heating. 7) Stabilization by grouting. 8) Stabilization by freezing.	
Q4)A)iii)How traffic volume study is carried out .	4
Traffic volume study:- The survey of the number of vehicle and pedestrian crossing a section of road per unit time during any selected period is called traffic volume study. This study can be carried out for vehicles and pedestrians separately or combined. It is done at number of selected points along the road. These selected points are known as count posts or traffic count stations. The location of the traffic count stations should be decided by dividing every road in to convenient sections, each carrying approximately similar traffic. This study may be carried out one or twice a year during session of peak traffic depending up on the importance of the road. In cities the peak traffic is at the starting and end of office timing.	4
Q4)A)iv)Explain terms i)Asphalt ii)Emulsion iii) Cutback iv) Tar	4
i)Asphalt:- A material or mechanical mixture in which bitumen is associated with inert material matter is known as asphalt. **ii)Emulsion:-** A liquid product obtain by vigorously stirring of a mixture of two unmixable liquid is known as emulsion. **iii) Cutback:-** The solution of bituminous material in a volatile solvent is known as cutback. **iv) Tar:-**The residual product obtained by destructive distillation of organic matter such as coal, oil, wood etc. is known as tar.	1 1 1 1
Q4)B)i)Design speed is 100 kmph for a horizontal curve 200 m radios calculate super elevation coeff. Of friction is 0.15.	6
We know , $e + f = \frac{v2}{127R}$ f=0.15, v=100 kmph, R=200 m Super elevation; $e=\frac{v^2}{127R}$- f $=\frac{100^2}{127\ x\ 200}$ - 0.15	2 1 1

e=0.243	2
Q4)B)ii)What do you mean by Landslides ? What are causes ? State any four methods to prevent Landslides.	6
Landslides:- The downward and outward movement of slope forming materials such as natural rock, soil, artificial fills etc. is known as land slides.	2
Causes of landslides:-1) Increase in water content	½
2) Hair cracking due to alternate swelling and shrinkage of soil mass.	½
3) Increase in load due to traffic.	½
4) Under mining caused by erosion.	½
Preventive measures of landslides:-1) By efficient surface and cross drainage.	½
2) By benching of soil slopes.	½
3) By reducing the angle of slopes.	½
4) By constructing buttress at toe of hill slopes.	½
Q.5)a)How road signs are classified as per IRC :67 :1977 ?	4
Classification of road signs:- 1) Mandatory or regulatory sign	1
2) Cautionary or warning sign	
3) Informatory sign.	
1) Mandatory or regulatory sign:- i) Giveway and stop sign	1
ii) Prohibitory sign	
iii) Speed limit and vehicle control sign	
iv) No parking and no stopping sign	
v) Restriction end sign	
vi) Compulsory direction control and other sign.	
2) Cautionary or warning sign:-i) Cross roads	1
ii) Narrow bridge.	
iii) School.	
iv) Narrow road ahead and so on.	
3) Informatory sign:- i) Direction and place identification sign	1
ii) Facility information sign	
iii) Other useful information sign	

iv) Parking sign	
Q5)b)State Purpose of providing retaining wall and parapet wall for hilly roads.	4
Purpose of providing retaining wall for hilly roads:-The wall constructed towards down slope side of the road to resist the pressure of earth filling and traffic load coming on the road. **Purpose of providing parapet wall for hilly roads:-** The purpose of parapet wall is to provide protection to the traffic against falling down the hill slope.	2 2
Q5)c)Why road signals are provided ?	4
Road signal:- 1) provide an orderly movement of traffic. 2) They help in reducing the frequency of accidents. 3) They intercept heavy traffic to allow the other traffic to cross the road safely. 4) they direct traffic on different routes without excessive congestion.	1 1 1 1
Q5)d)State Causes of road accidents ?	4
Causes of road accidents:- 1)Deficiency in roads. 2) Defective vehicles. 3) Violation of traffic rules. 4) Surprise happening such as changing timing of signal without any indication. 5) Bad weather and road condition. 6) Obstructed vision. 7) Advanced age of driver. 8) Disobeying the signals.	½ ½ ½ ½ ½ ½ ½ ½
Q5)e)What is Purpose of providing road drainage ?	4
Purpose of providing road drainage:- i) The entrance of the water in the soil subgrade of the pavement causes considerable decrease in its bearing strength and thus the pavement is likely to fail. ii) Excess of moisture content causes reduction in bearing strength of base course of bed material. iii) Due to poor drainage, waves and corrugation are formed. iv) At places where temperature reaches to freezing point, the frost action of water entering the pavement structure may cause damage to the road pavement.	1 1 1 1
Q5)f)Draw a sketch of a typical cross section of catch water drain, label the sketch**.**	4

 Catch water drain	2 for fig. 2 for label
Q.6)a)Enlist any eight important factors considered for road alignment.	4
Factors considered for road alignment:- 1)Purpose and class of the road:- it should be selected according to class of road. 2) Obligatory points:- It should pass through important town, groups of villages and places of commercial importance. 3) Need of traffic:- It should be suit the need of traffic such as fast moving and slow moving traffic. 4) Gradients:- The alignment should have gradient not steeper than ruling gradient. 5) curves:- The alignment should have flat curve. 6) sight distance:- The alignment should have good sight distance. 7) Obstructions:- The alignment should be free from obstruction 8) Railway and river crossing:- The alignment should cross river or railway line at right angle.	½ ½ ½ ½ ½ ½ ½ ½
Q6)b)Why Curves are provided on roads ?	4
Curves are provided on roads:-1) To provide easier gradient by diversions from the straight route. 2) To avoid excessive cutting and filling by changing the alignment. 3) To avoid costly land by diversions from the straight route. 4) To provide the track on stable and safe side of the hill by changing the alignment.	1 1 1 1

Q6)c)How will you provide Expansion joint for concrete road ?	4
Expansion joint for concrete road:-The transverse joint constructed to allow for the expansion of the road slab due increasing in temperature are known as expansion joint. The joints are provided at right angles to the Centre line of the road at 18 to 20 m intervals. These joints extend to the full width and the thickness of the road slab. **Figure:-**  (a) Expansion Joint	2 2 for fig. 2 for label
Q6)d)Draw a sketches of i) Typical prohibitory sign post ii)Right turn prohibited sign **.**	4
 Typical prohibitory sign post	1 for fig. 1 for label

	1 for fig. 1 for label
Q6)e)Why road maintenance is necessary ?	4
1) It is important to maintain road properly. Timely and correct maintenance of the road helps in preventing the accidents 2) If drains are not maintained, water may start flowing on the road, rendering the road slippery. The shoulders get eroded, decreasing the width of roads on curve. 3) Also maintenance increases the life of the pavement, making the cost of road economically viable in the longer run . 4) Various types of failures in the pavement ranging from minor and localize to major and general failure takes place on the road.	1 1 1 1
Q6)f)How will you repair a pothole on a bituminous road ?	4
Patching pot holes- For patching pot holes over 35 mm depth, these should be cut out square or rectangular in shape up to the affected depth .The holes are then cleaned of all loose aggregate ,dust ,foreign matter etc. The internal portion of the holes is then painted with tar or bitumen. After this usually premixed Patching mix is placed in the holes and surface is rammed or rolled according to the size of the patch. When the pot holes is more than 75 mm deep , the patch should be made in two or three layers and each layer is rammed before placing in next layer. The finish level of the patches is kept slightly above the original level to allow for further compaction under traffic.	4