

**WINTER – 2015 EXAMINATION**

**Subject: Transportation Engineering**

**Subject Code: 17418**

**Important Instructions to examiners:**

- 1) The answers should be examined by key words 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 errors such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and Communication Skills.)
- 4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by the candidate and those in the 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 some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and the model answer.
- 6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidate's understanding.
- 7) For programming language papers, credit may be given to any other program based on equivalent concept.

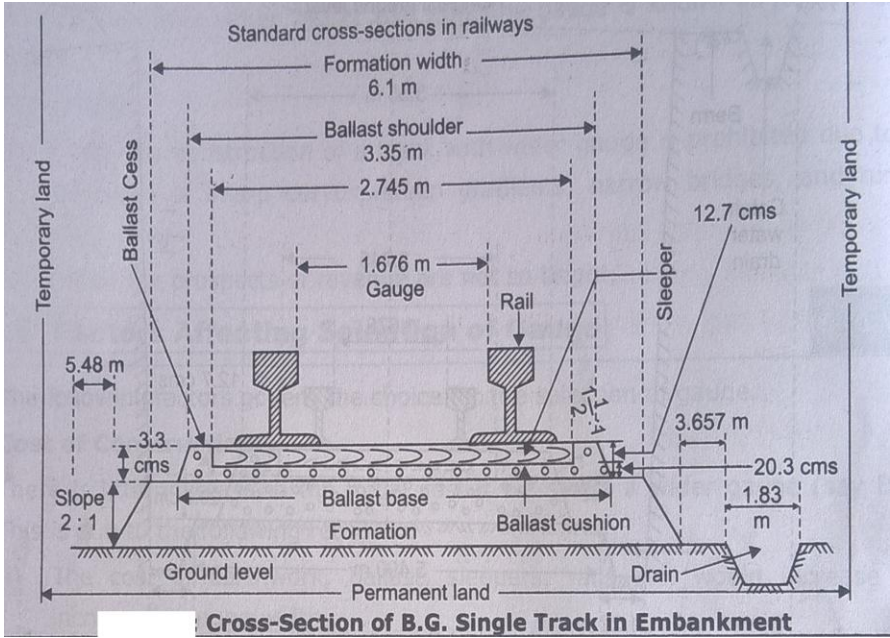
## Model Answer

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
<b>Q.1</b>	<b>a)</b>	<b>Attempt any <u>SIX</u> of the following:</b>		<b>12</b>
		<b>i. Enlist any four modes of transportation.</b> <b>Ans.</b> 1. Roadways 2. Railways 3. Airways 4. Waterways	$\frac{1}{2}$ <b>mark each</b>	<b>2</b>
		<b>ii. Define gauge of railway track.</b> <b>Ans.</b> The clear horizontal distance between the inner faces of the two rails forming a track is known as gauge. The distance between the inner face of a pair of wheels is called the wheel gauge.	<b>2 marks</b>	<b>2</b>
		<b>iii. List the types of bridges as per alignment.</b> <b>Ans.</b> Classification of bridge as per alignment are as follows; 1. Square Alignment 2. Skew Alignment	<b>1 mark each</b>	<b>2</b>
		<b>iv. Define Tunnel.</b> <b>Ans.</b> The underground passages which are constructed without disturbing or removing the ground surface are known as tunnels. They may be constructed by cutting the hills or mountains, below ground, streams etc. for various purposes.	<b>2 marks</b>	<b>2</b>



Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
		<p><b>v. List any four types of sleepers.</b></p> <p><b>Ans.</b> There are various types of sleepers which are used on Indian Railways. They are classified as follows:</p> <ol style="list-style-type: none"><li>1. Wooden Sleepers</li><li>2. Metal Sleepers<ol style="list-style-type: none"><li>(a) Steel Sleepers</li><li>(b) Cast Iron Sleepers</li></ol></li><li>3. Concrete Sleepers<ol style="list-style-type: none"><li>(a) Reinforced Concrete Sleepers</li><li>(b) Prestressed Concrete Sleepers</li></ol></li></ol>	<p><math>\frac{1}{2}</math> mark (Any four)</p>	2
		<p><b>vi. Define HFL and freeboard related to bridge.</b></p> <p><b>Ans. Highest Flood Level (HFL):</b> the level of the highest flood ever recorded or calculated level for the highest possible flood discharge in a stream or river is called Highest flood level.</p> <p><b>Freeboard:</b> the difference between the highest flood level after allowing the afflux, if any and the lowest point on the underside of the bridge superstructure is called freeboard.</p> <p style="text-align: center;">OR</p> <p>It is the difference between the HFL and the level of the crown of the road at its lowest point.</p>	<p>1 mark</p> <p>1 mark</p>	2
		<p><b>vii. State any four types of tunnels as per shapes.</b></p> <p><b>Ans.</b> Following are the usual cross-section or shapes of tunnel which are commonly adopted;</p> <ol style="list-style-type: none"><li>1. Rectangular ( or Box Shape) Tunnel</li><li>2. Segmental Shape Tunnel</li><li>3. Circular Shape Tunnel</li><li>4. Horse-Shoe Shape tunnel</li><li>5. Egg Shape Tunnel</li><li>6. Elliptical Shape Tunnel</li></ol>	<p><math>\frac{1}{2}</math> mark each (Any four)</p>	2
		<p><b>viii. Define Tunnel surveying.</b></p> <p><b>Ans.</b> The process of setting out the alignment of the tunnel on the ground and then transferring the same to inside of the tunnel through shafts is called tunnel surveying.</p>	2 marks	2



Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.1	b)	<p><b>Attempt any <u>TWO</u> of the following:</b></p> <p><b>i. Draw a neat labeled cross section of single line B. G. railway track in embankment.</b></p> <p><b>Ans.</b></p>  <p><b>ii. What are the informations required to be collected for design data of bridges.</b></p> <p><b>Ans.</b> For proper execution of the bridge project, various data required for design of the bridge.</p> <p>1. General Data:</p> <p>i. This data includes maps, plans and topographical features of the proposed bridge site. Various drawing are required at the time of investigation like under map, contour survey plan, site plan, cross sections, longitudinal sections, catchment area map.</p> <p>2. Geological Data: This data includes following information.</p> <p>i. Nature &amp; properties of existing soil in bed, banks and approaches.</p> <p>ii. Safe intensity of pressure of the foundation soil.</p> <p>iii. Liability of the site to earthquake disturbances and its magnitude.</p> <p>3. Hydraulic Data:</p> <p>This data included following information.</p> <p>i. Intensity and frequency of rainfall in the catchment area.</p> <p>ii. Hydrograph for one or more years.</p> <p>iii. Size and shape, surface characteristic of catchment area including percolation and interception.</p> <p>iv. Observed maximum depth of scour.</p>	4	8
			1 mark each (Any four)	4

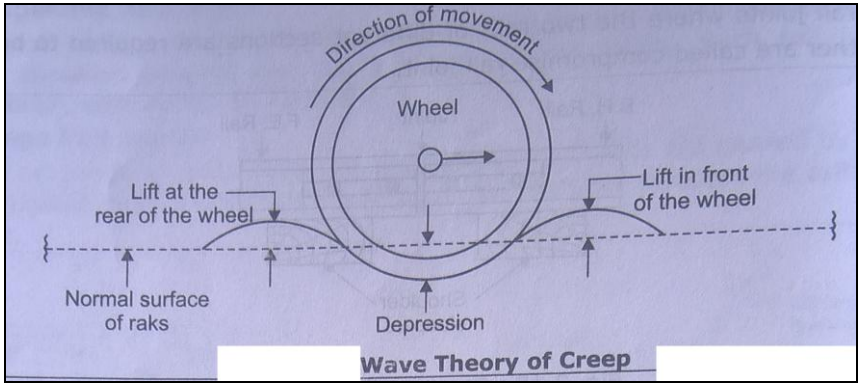
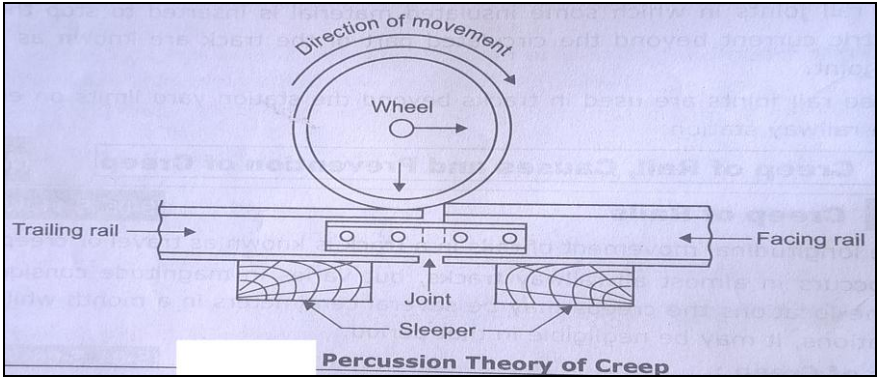


Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
<b>Q.1</b>	<b>b)</b>	<p>4. Climate Data: This data includes information regarding annual temperature range, cyclones, wind velocity, rainfall, characteristics, and relative humidity.</p> <p>5. Loading and other data:</p> <ol style="list-style-type: none"><li>Live load for which the bridge is to be designed as per IRC Code of practice.</li><li>Type of Stream.</li><li>LWL, HFL, ordinary flood level.</li><li>Type and nature of stream.</li><li>Velocity of stream.</li><li>Seismic conditions of area.</li></ol> <p><b>iii. Enlist any four purposes of tunnel.</b></p> <p><b>Ans.</b> Tunnels are constructed for various purposes as follows:</p> <ol style="list-style-type: none"><li>To provide passage for railway track.</li><li>To provide passage for roads.</li><li>To provide access to mines.</li><li>To lay conduits for water etc.</li><li>They connect the terminal stations by the shortest route and thus results in less transportation cost.</li><li>They help on avoiding holding-up of traffic for long periods due to traffic congestion and provide rapid transportation.</li><li>They help in avoiding acquisition of costly and valuable land property for transportation projects.</li></ol>	<b>1 mark (Any four)</b>	<b>4</b>



Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.2		<b>Attempt any <u>FOUR</u> of the following:</b>		<b>16</b>
	a)	<b>State any four characteristics of road transportation.</b> <b>Ans.</b> The characteristics of road transportation are as follows: 1. Road transportation is the most suitable type for short haul passenger and good transport. 2. A number of smaller units like scooter, rickshaws, cars etc. are available for personalized transport. 3. It is ideal for non-bulk cargo especially passenger and freight. 4. It is economical from common man's point of view. 5. They provide door-to-door service. 6. In hilly or mountainous regions, roads are the only means of conveyance. 7. They act as feeders for airways, waterways and railways. 8. Starting and destination points need not be necessarily defined unlike in other modes of transport. 10. Help in providing medical aid to remote places.	<b>1 mark each (Any four)</b>	<b>4</b>
	b)	<b>Mention the ideal requirements of rail joints.</b> <b>Ans.</b> The ideal requirements of a standard rail joint are as follows: 1. A perfect rail joint should be as strong and stiff as the rail section itself. 2. Both the adjoining rail ends at the joints should remain true in line laterally as well as vertically when the train passes over the joint. 3. It should provide enough expansion gaps in between the two adjoining ends of rails for the expansion of rails due to variation in temperature. 4. It should be elastic both laterally and vertically. 5. It should not allow the rail ends to get battered in any case. 6. It should facilitate easy removal and replacement of rails without disturbing the whole track. 7. It should be economical in its cost of construction as well as maintenance.	<b>1 mark each (Any four)</b>	<b>4</b>
	c)	<b>What are the causes of creep of rail?</b> <b>Ans.</b> The following are the principle causes of creep:  <u>1. Wave action or Wave Theory:</u> Wave motion is set-up in a resilient track by the moving wheel loads. The train wheels causes depression under themselves forming lifts or crests. With movement of wheels, the lifts on front of the moving wheels are carried forward whereas the lifts at the rear of the moving wheels get back to their normal position. Thus, the rails are pushed forward which causes creep in the forward direction.		



Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
		<div></div> <p><u>2. Percussion Theory:</u> The rail creep is due to impact of wheels at the end of facing rail at each fish plate joint as shown in figure. When the wheel pass over such a rail joint the trailing rail depresses down and the wheel give impact to the end of facing rail, which results creep in forward direction.</p> <div></div> <p><u>3. Accelerating or Starting of a train:</u> At the time of accelerating or starting of a train, the engine wheels give a backward thrust which tends to push the rails backwards, causing creep in the backward direction.</p> <p><u>4. De-accelerating or Stopping the train:</u> When the train is de-accelerated or stopped, the braking effect tends to push the rail forward. Thus, causing the creep in the forward direction.</p> <p><u>5. Expansion and contraction of rails due to variation in temperature:</u> Creep may also be caused due to unequal expansion, contraction of rails due to variation in temperature.</p> <p><u>6. Intensities of Traffic:</u> In a single line track, the creep will be resulted in the direction of heavy intensity of traffic. In a double line track, the creep occurs in both the tracks in the direction of movement of trains.</p> <p><u>7. Alignment of the track:</u> Creep is greater on curved portion than on straight portion of the track.</p> <p><u>8. Gradient of the track:</u> Creep is more on a track with steep gradient, particularly, if the trains move downwards with heavy loads.</p>	1 mark each (Any four)	4



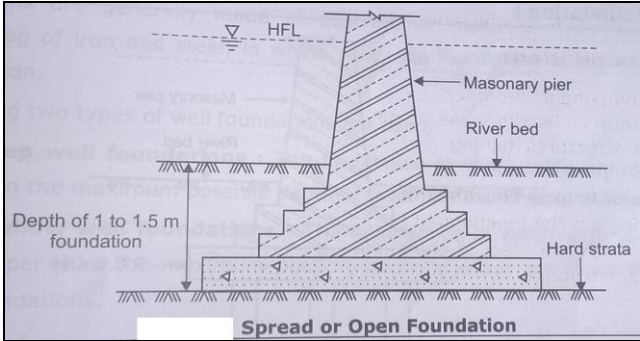
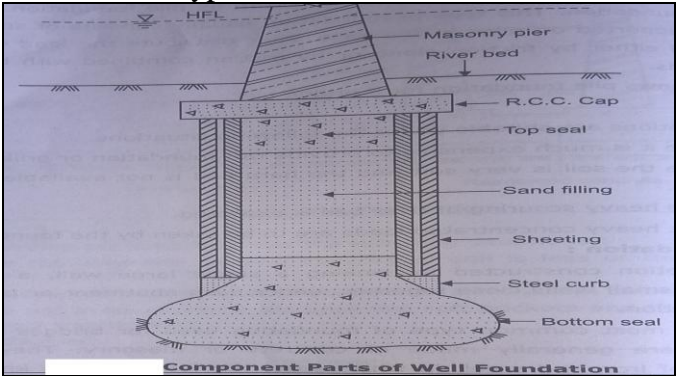
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.2	d)	<p><b>Sketch any two types of steel truss bridges and give their suitability.</b></p> <p><b>Ans.</b> The various types of steel bridges are;</p> <ol style="list-style-type: none"><li>1. Steel trough plate bridge</li><li>2. Steel girder bridge</li><li>3. Steel arch bridge</li><li>4. Steel truss bridge</li><li>5. Bow string girder bridge</li><li>6. Continuous steel bridge</li><li>7. Steel rigid frame bridge</li><li>8. Steel suspension bridges</li><li>9. Steel cantilever bridges</li><li>10. Steel movable bridges</li></ol> <p><b>Steel truss bridge:</b> The bridge having its superstructure consisting of steel trusses which carry the bridge floor is called as steel truss bridge. They are commonly used for carrying heavy loads on long spans for roads and railways. Span is greater than 30 m.</p> <div></div> <p><b>Steel suspension bridge:</b> The bridge having its superstructure consisting of two or more set of cables which carry the bridge floor by means of suspenders is known as steel suspension bridge. Cables are usually made of chain or steel wire ropes.</p> <div></div> <p><b>Simple suspension bridge</b></p> <p><i>Note: Sketch and explanation of any above mentioned types should be considered.</i></p>	1 1 1 4	4



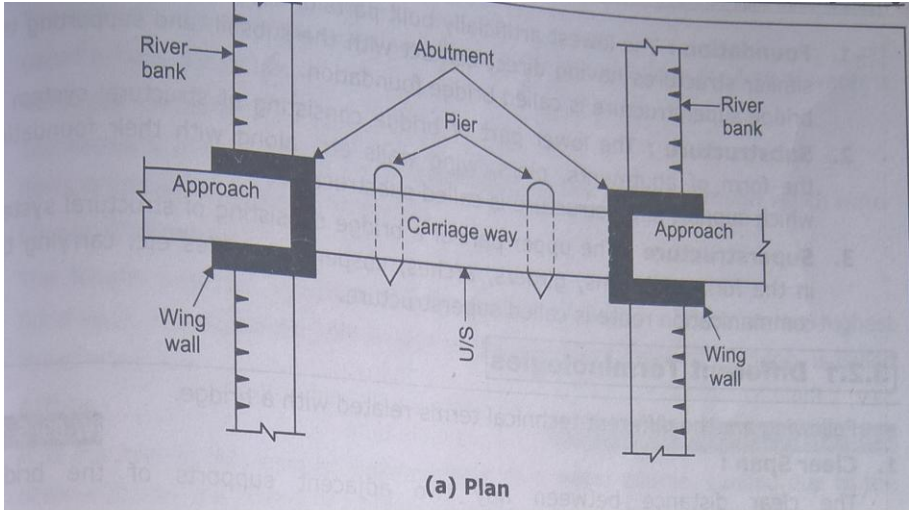
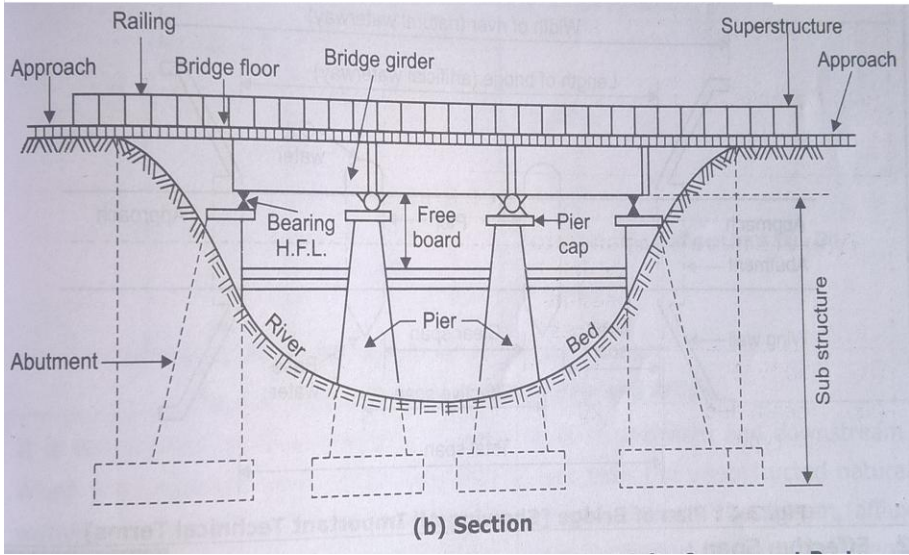
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
<b>Q.2</b>	<b>e)</b>	<p><b>State and explain two situations where causeways are provided.</b></p> <p><b>Ans.</b></p> <p><u>Causeway:</u> Road level is below the surrounding ground level or very near to bed level of the stream.</p> <p><u>Flush Causeway:</u> Provided in hilly roads where maximum depth of flood water does not exceed about 1.75 m.</p> <p><u>Low Level Causeway:</u> For passing the small discharge through them during dry season.</p> <p><u>High Level Causeway:</u> Normal flood is passed through the openings and the high flood may pass over the bridge. Vehicles may be allowed through 25-30 cm deep water on the causeway.</p> <p><b>What is the necessity of ventilation in tunnel and state methods of ventilation?</b></p> <p><b>Ans.</b> The necessities of ventilation in tunnel are as follows;</p> <ol style="list-style-type: none"><li>1. To supply fresh air inside the tunnel.</li><li>2. To remove poisonous gases smokes etc.</li><li>3. To remove safely the dust caused by drilling, blasting and mucking.</li><li>4. To reduce temperature in tunnel situated at great depth.</li></ol> <p>The methods of ventilation in tunnel are as follows;</p> <ol style="list-style-type: none"><li>1. Natural Method</li><li>2. Mechanical Method<ol style="list-style-type: none"><li>a. Blowing Process</li><li>b. Exhausting Process</li><li>c. Combination of Blowing and Exhausting process</li></ol></li></ol>	<p><b>2 marks (Any two)</b></p> <p><b>2 marks</b></p> <p><b>2 marks</b></p>	<p><b>4</b></p> <p><b>4</b></p>



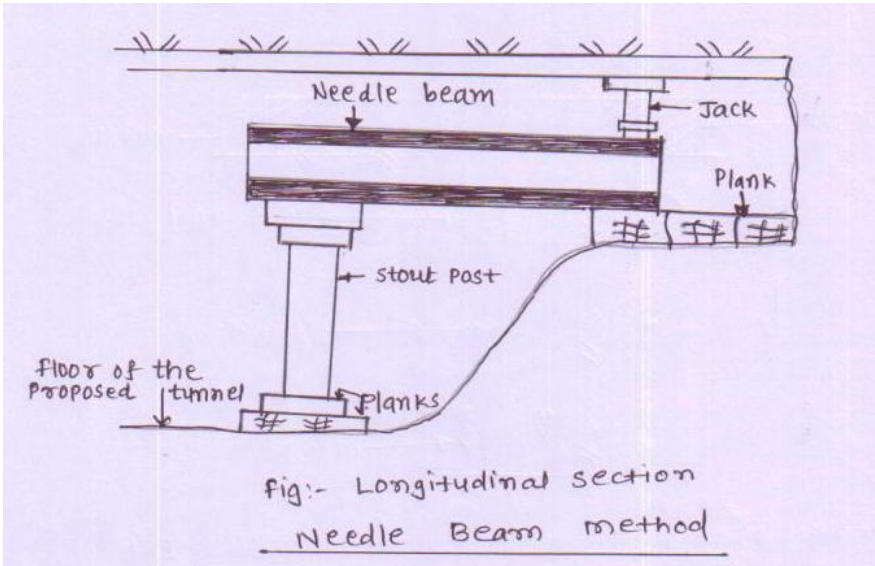


Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.3		<p><b>Attempt any <u>TWO</u> of the following:</b></p> <p>a) <b>List various types of foundation of bridges and explain any two types of foundation provided for RCC Bridge.</b></p> <p><b>Ans.</b> Depending upon the nature and depth, bridge foundations of different categories are of the following types;</p> <ol style="list-style-type: none"> <li>1. Spread or Open foundation</li> <li>2. Raft foundation</li> <li>3. Grillage foundation</li> <li>4. Inverted Arch foundation</li> <li>5. Pile foundation</li> <li>6. Well foundation</li> <li>7. Caisson foundation</li> </ol> <p><b>Spread foundation:</b> This type of foundation in shape is similar as provided for walls. It is best suited in situations where the scouring of the river bed is minimum and good hard soil is available within 2 to 3 m below river bed level. This type of foundation can be provided even if the bed contains erodible material as sand, but the scouring is prevented by driving sheet piles on upstream and downstream side and floor pitching.</p>  <p><b>Well foundation:</b> The foundation constructed by sinking a single large well, a twin well or a number of small well close together, under each abutment or pier is known as well foundation. This is the most common type of foundation used for bridges in our country. The wells are generally made of concrete or masonry. They may also be consisting of iron and steel, in which case, the foundation is known as tubular foundation. Deep well foundation and shallow well foundation are the two types of well foundation.</p>  <p><b>Note:</b> Sketch and explanation of any above mentioned types should be considered.</p>	<p><b>2 marks</b></p> <p><b>1 mark</b></p> <p><b>2 marks</b></p> <p><b>1 mark</b></p> <p><b>2 marks</b></p>	<p><b>16</b></p> <p><b>8</b></p>

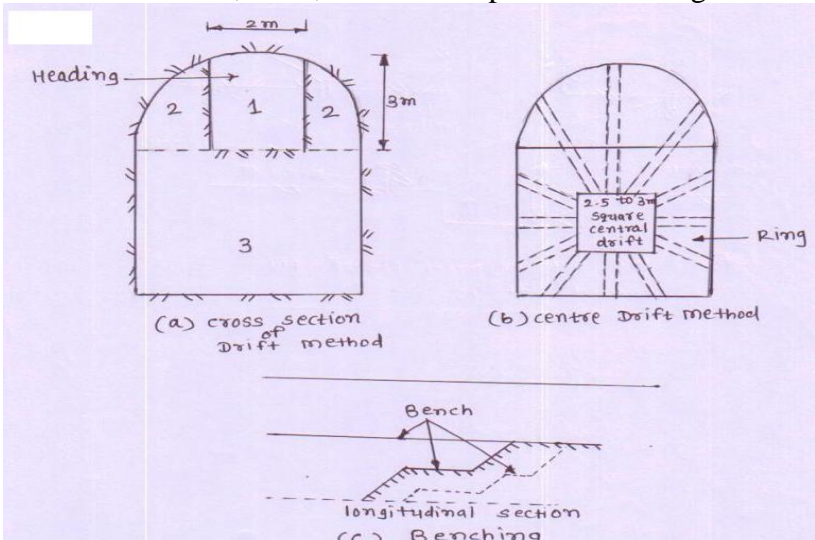


Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.3	b)	<p><b>Draw a neat sketch of plan and longitudinal section of bridge and show component parts of it.</b></p> <p><b>Ans.</b></p>  <p>(a) Plan</p>  <p>(b) Section</p> <p><i>Note: 3 marks – Sketch and 1 mark – Labeling for each diagram</i></p>	4 marks	8



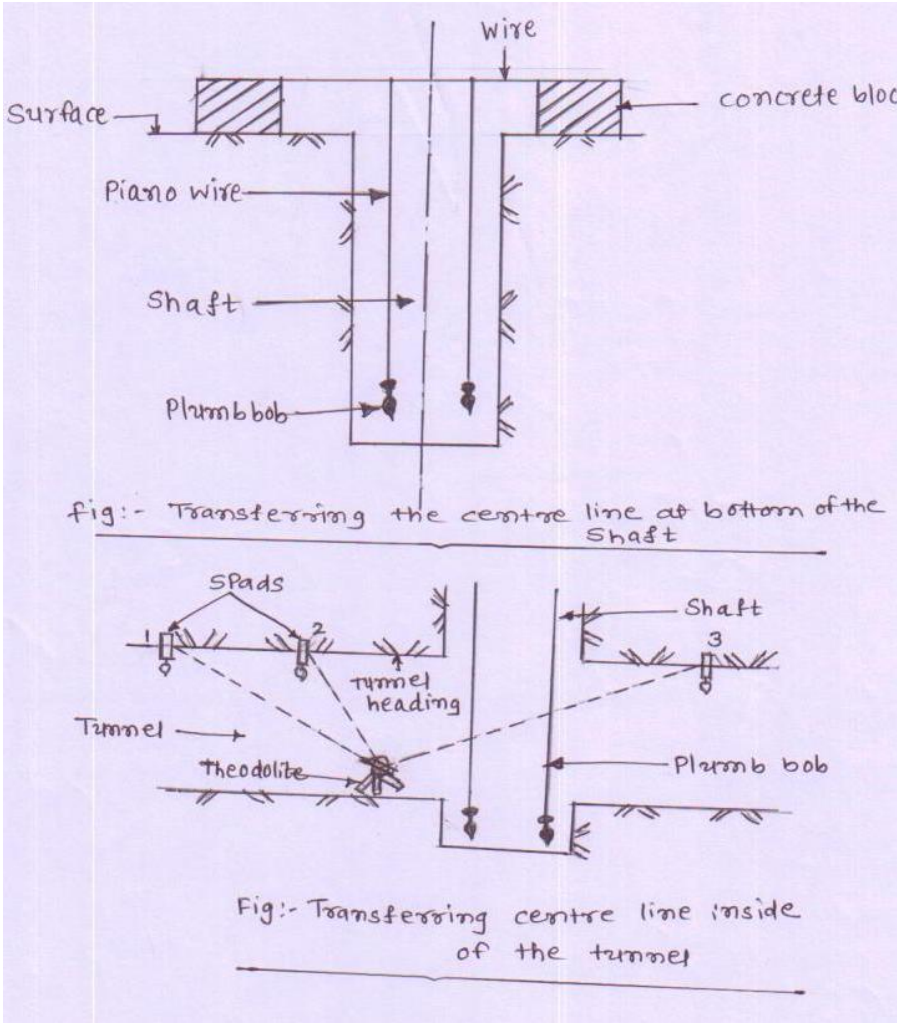
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.3	c)	<p><b>List various methods of tunneling and explain any one with sketch.</b></p> <p><b>Ans.</b></p> <p><u>(A) Method of tunneling in soft rock:</u></p> <ol style="list-style-type: none"><li>1. Needle beam method</li><li>2. Fore poling method</li><li>3. Linear plate method</li><li>4. Shield method</li><li>5. American method</li><li>6. English Method</li></ol> <p><u>(B) Method of tunneling in hard rock:</u></p> <ol style="list-style-type: none"><li>1. Full face heading method</li><li>2. Heading and benching method</li><li>3. Drift method</li></ol> <p><u>Needle beam method:</u></p> <ol style="list-style-type: none"><li>i. About 1 x 1m small drift is prepared on the working face of tunnel</li><li>ii. Roof of drift is supported on lagging provided on wooden segments which are carried on the trench jacks as shown in figure below.</li><li>iii. The needle beam is placed horizontally whose front end rests on drift and the rear end is supported on vertical stout post.</li><li>iv. After excavation, the lining is provided to the tunnel section and mucking is done.</li></ol> <p><b>Merits:</b></p> <ol style="list-style-type: none"><li>1. This method is economical</li><li>2. Brick lining can be easily done by this method.</li></ol> <p><b>Demerits:</b></p> <ol style="list-style-type: none"><li>1. Concrete lining by mechanical method is difficult.</li><li>2. Pushing of beam by hand is difficult.</li><li>3.</li></ol> 	2 marks	8
			3 marks	



Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.3		<p style="text-align: center;"><b>OR</b></p> <p><u>Drift method:</u> This method consists of driving of small heading, centrally at top or bottom of the face, which is later enlarged by widening and benching.</p> <p>The main operations involved in this method are as follows:</p> <ol style="list-style-type: none"> <li>Boring or blasting a top centre heading of drift</li> <li>Widening and enlarging</li> <li>Benching in stages</li> </ol> <p>In this method, a drift of 2.5 m x 3 m size or sufficient to accommodate the tunnel machinery, labour and mucking equipment is first driven end to end of the tunnel. As the heading work proceeds, the centre line is checked and then widening operation is done by blasting the sides of the drift to the required section. Drift may be provided at the centre, sides, bottom or top as shown in figure.</p>  <p><i>Note: Sketch and explanation of any above mentioned types should be considered.</i></p>	3 marks	
Q.4	a)	<p>Attempt any <b>TWO</b> of the following:</p> <p><b>Classify the tunnels according to their functions.</b></p> <p><b>Ans.</b> Classification of tunnels according to their functions are as follows;</p> <p><u>(i) Traffic Tunnels:</u></p> <ol style="list-style-type: none"> <li>1. Railway Tunnels</li> <li>2. Highway Tunnels</li> <li>3. Navigation Tunnels</li> <li>4. Subway Tunnels</li> <li>5. Pedestrian Tunnels</li> </ol> <p><u>(ii) Conveyance Tunnels:</u></p> <ol style="list-style-type: none"> <li>1. Water supply Tunnels</li> <li>2. Hydropower Tunnels</li> <li>3. Sewage Tunnels</li> <li>4. Tunnels for Industrial use</li> <li>5. Tunnels for Intake and conveying public utilities</li> </ol>	1 mark each (Any four)	16
			1 mark each (Any four)	8



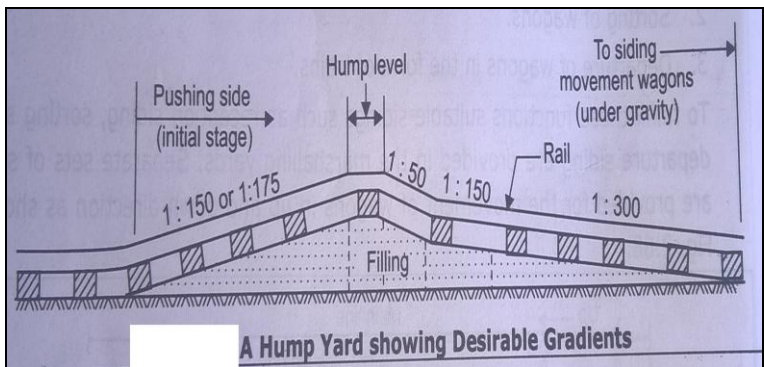


Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.4	b)	<p><b>Explain with sketch method of transferring the centre line from the ground inside the tunnel.</b></p> <p><b>Ans.</b></p>  <p>First of all shaft is constructed. After construction of shafts, the center line of tunnel is to be transferred down the shafts. For this purpose, generally two small pillars are constructed on opposite edges of the shaft along the center line of the tunnel. On the top of pillars, the points corresponding to the centre line are correctly marked and a wire is then stretched between them. After this two plumb bob are suspended by piano wire inside the shaft as shown in figure above. Two points are then marked by lowering plumb bob to the bottom of the shaft. The line joining the two points represents the center line of the tunnel marked on the ground. These lines are further extended into the tunnel heading as the work advances, by a theodolite placed in the shafts. Points along the centre line are marked by a peg provided with plumb bobs (spads), fixed to the roof of the tunnel as shown in figure above.</p>	4 marks	8



Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
<b>Q.4</b>	<b>c)</b>	<p><b>Explain the duties of permanent way inspector.</b></p> <p><b>Ans.</b> The duties of permanent way inspector are as follows;</p> <ol style="list-style-type: none"><li>1. The PWI is personally responsible for maintaining the track in good condition for the passage of trains. For this purpose, he travels over the track by push trolley and watches the defects of the track and arranges the repair of the defective track by his gang.</li><li>2. He is responsible to carry out the renewals of rails and sleepers.</li><li>3. He should maintain the record of wear of rails in his section. He should chalk out the programme for lubrication of rail joints in such a way that the entire rail joint are lubricated on a year during winter season.</li><li>4. He is responsible to maintain the correct gauge, super elevation on curves and removal of creep etc.</li><li>5. He should supervise the work of his gang regularly.</li><li>6. He should see the welfare of his gangman.</li><li>7. Level crossing under his charge must be maintained in perfect condition. During this visit to level crossing, he should check the working of gateman also. If necessary he should issue instructions to the gateman.</li><li>8. At the time of accident, he is responsible to store the traffic in the shortest possible time. He should also find out the causes of accident.</li><li>9. He should prepare the estimates of the maintenance work and should report the progress to his seniors.</li></ol>	<b>1 mark each (Any four)</b>	<b>4</b>



Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.5		<p><b>Attempt any <u>FOUR</u> of the following:</b></p> <p><b>a) State the types of track maintenance.</b>  <b>Ans.</b> The maintenance of track can be divided into two parts;            (a) Daily Maintenance            (b) Periodic Maintenance</p> <p><u>(a) Daily Maintenance</u>            The daily maintenance is carried out by the full time staff maintained throughout the year. The use of maintenance gangs, all along the railway track is made. The railway track is divided in suitable sections 5-6 km length. One gang is attached to each section for maintaining that section in good condition.</p> <p><u>(b) Periodic Maintenance</u>            Periodic maintenance is carried out in an interval of two to three years. During periodic maintenance the gauge, levels, alignment, points and crossings etc. are thoroughly checked, the defects are detected, the causes are determined and remedial measures are taken. The track is made in perfect condition by removing all its major and minor defects. It includes;            1. Surface of rails            2. Track alignment            3. Proper drainage            4. Points and crossings</p> <p><b>b) Explain with neat sketch the functioning of hump yards.</b>  <b>Ans.</b> Hump yard is a type of marshalling yard. In this type, humps or summits of artificial hills are constructed at the entrance to the sidings. The wagons are pushed upon a hump by the engine and then they are allowed to move into sidings down the hump under the action of gravity. The desirable up and down gradient for effective working of the type of yard is as shown in figure. Modern practice is to use hump yards as the shunting operations can be done more quickly than flat or gravitational yards.</p>	<p><b>2 marks</b></p> <p><b>2 marks</b></p> <p><b>2 marks</b></p> <p><b>2 marks</b></p>	<p><b>16</b></p> <p><b>4</b></p> <p><b>4</b></p>
		 <p><b>2 marks</b></p>		



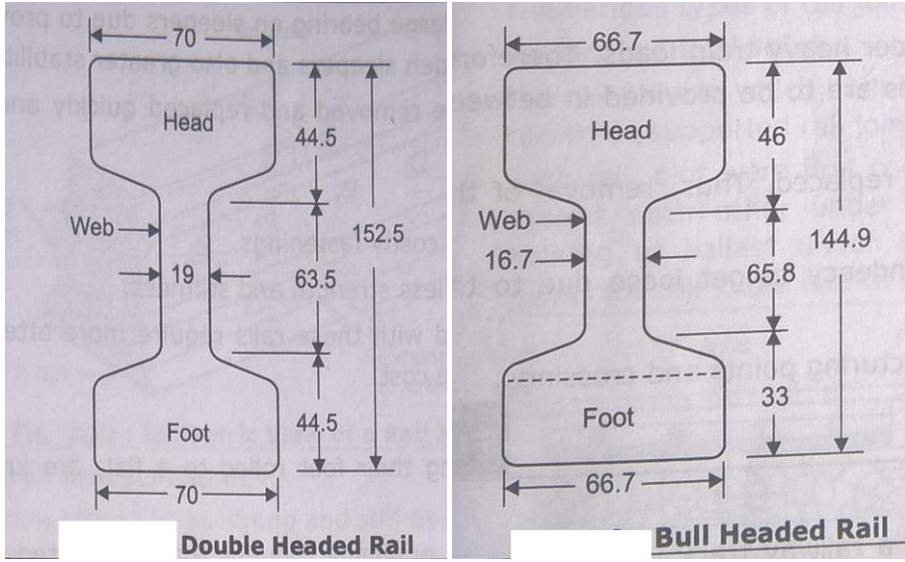
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
<b>Q.5</b>	<b>c)</b>	<b>Define wing wall and list different types of wing walls.</b> <b>Ans. Wing wall:</b> The walls constructed at both ends of the abutments to retain the earth banks of the river or of the bridge approaches are known as wing walls. These are provided at both ends of the abutments to retain the earth filling of the approach road. The different types of wing walls are as follows; (a) Masonry Wing Walls (b) Reinforced Concrete Wing Walls 1. Straight Wing Walls 2. Return Wing Walls 3. Splayed Wing Walls	<b>2 marks</b>	<b>4</b>
	<b>d)</b>	<b>List any eight factors needed for selection of ideal site for bridge.</b> <b>Ans.</b> Generally, following factors affect the selection of site for a bridge; 1. Sub soil conditions of the bed of the river. 2. Nature of the river. 3. Grades and alignment. 4. Approaches. 5. Banks of stream. 6. Scouring and silting. 7. Obstruction to waterways. 8. River training works. 9. Construction works inside water. 10. Availability of free board. 11. Workers and construction materials availability.	<b>1/2 mark each (Any eight)</b>	
	<b>e)</b>	<b>State the factors on which shape and size of tunnel depend.</b> <b>Ans.</b> The factors on which the shape and size of tunnel depends are as follows; 1. It is largely governed by the type and nature of ground through which it is driven. 2. Depends upon the purpose for which it is to be used. 3. Internal and external pressures to which it is subjected. 4. Easy drainage should be possible. 5. Construction whether in hard rock or soft rock. 6. Ease in construction. 7. Size of a tunnel is also affected by the thickness and allowance for settling down of lining, since it reduces the size of the tunnel.	<b>1 mark each (Any four)</b>	<b>4</b>
	<b>f)</b>	<b>Enlist different steps followed in tunneling in hard rock method.</b> <b>Ans.</b> For tunneling in a hard rock, the following operations are usually carried out; 1. Setting – up and drilling. 2. Loading holes and firing the explosives. 3. Ventilation and removing dust. 4. Mucking. 5. Removing ground water. 6. Timbering if necessary. 7. Grouting. 8. Lining.	<b>1/2 mark each</b>	



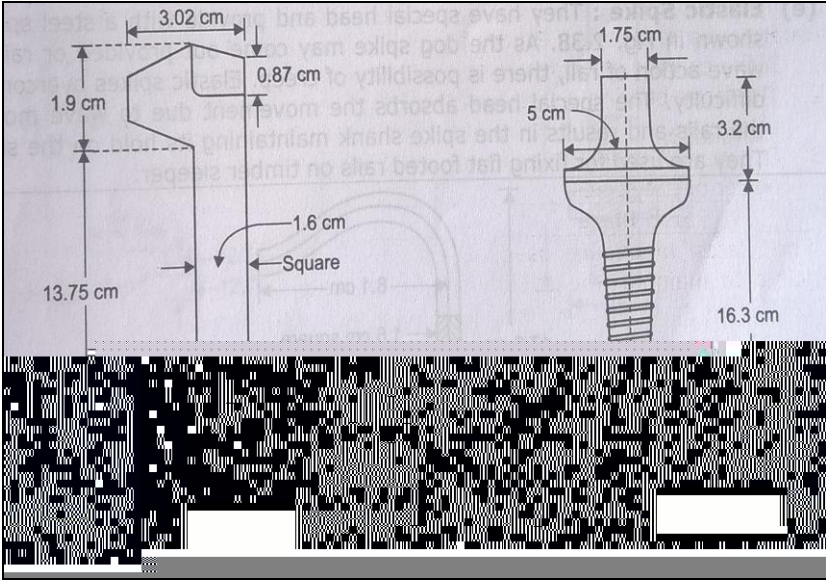


Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.6		<p><b>Attempt any <u>FOUR</u> of the following:</b></p> <p>a) <b>List any four points for inspection of bridge substructure and superstructure.</b>  <b>Ans.</b> The following points should be kept in view while inspecting a bridge;</p> <ol style="list-style-type: none"> <li>1. Condition of wearing coat and its thickness.</li> <li>2. Condition of kerbs and railings.</li> <li>3. Condition of expansion joints, whether functioning well or not in case of concrete bridge.</li> <li>4. Condition of concrete, whether in good condition or spalling in case of concrete bridge.</li> <li>5. Condition of reinforcement, whether exposed anywhere or not in case of concrete bridge.</li> <li>6. Condition of paint in case of steel and iron bridge.</li> <li>7. Condition of steel work, material, members and connections in case of steel or iron bridge.</li> <li>8. Condition of material used in arches in case of arch bridge.</li> <li>9. Condition of masonry, whether good or weathered.</li> <li>10. Condition of mortar joints in case of masonry arch bridge.</li> <li>11. Condition of bearings, whether functioning properly or not.</li> <li>12. Any sign of development of cracks in masonry or concrete immediately below the bearings.</li> <li>13. Condition of abutments, piers and wing walls, whether good weathered or bulged.</li> <li>14. Any sign of development of cracks in concrete abutments and piers.</li> <li>15. Any sign of settlement of foundation.</li> <li>16. Any sign of scour along with maximum depth of scour.</li> </ol> <p><b>Note:</b> <math>\frac{1}{2}</math> mark each (Any four) – Superstructure and <math>\frac{1}{2}</math> mark each (Any four) – Substructure.</p> <p>b) <b>Explain with sketch roller rocker bearing.</b>  <b>Ans.</b> Rocker &amp; Roller Bearing-  This type of bearing consists of rocker bearing having its bottom shoe resting on a number of steel rollers which in turn roll on a honey combed bed plates is anchored to the top of masonry of abutment.  This type of bearing is suitable for span more than 20 m.</p> <div data-bbox="459 1771 1126 2119"> </div> <p><b>Note:</b> 1 mark – sketch and 1 mark – labeling.</p>	<p><b>16</b></p> <p><b>1 mark each (Any four)</b></p> <p><b>2 mark</b></p> <p><b>2 mark</b></p>	<p><b>4</b></p> <p><b>4</b></p>



Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.6	c)	<p><b>Draw the cross sections of double headed and bull headed rail.</b> <b>Ans.</b></p>  <p><b>Note: 1 mark – Sketch and 1 mark – Labeling for each figure.</b></p>	4 marks	4
	d)	<p><b>State the requirements of ideal sleepers.</b> <b>Ans.</b> The ideal requirements of ideal sleepers are;</p> <ol style="list-style-type: none"> <li>1. The sleepers should be economical in their initial as well as maintenance cost.</li> <li>2. They should have long life.</li> <li>3. They should be able to maintain correct gauge.</li> <li>4. They should be quite durable i.e. they should offer sufficient resistance to weathering agencies.</li> <li>5. They should be suitable to each type of ballast.</li> <li>6. They should be suitable for track circulating.</li> <li>7. They should have such fittings that they can be easily removed or replaced, lifted and packed when required.</li> <li>8. They should have sufficient weight for their stability. They should not be too heavy for excessively light.</li> <li>9. They should provide sufficient bearing area below the rail seat over the ballast.</li> <li>10. They should be sufficiently strong to take bending stress under the moving wheel loads.</li> <li>11. They should be of such a design so as to facilitate, easy removal and replacement of ballast.</li> <li>12. They should be such a design that they are not damaged during packing and boxing of the ballast.</li> <li>13. They should have high scrap value.</li> </ol>	1 mark each (Any four)	4



Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.6	e)	<p><b>Mention where the following types of ballast are suitable on rail track.</b></p> <p>(i) Gravel (ii) Cinder (iii) Brick (iv) Earth</p> <p><b>Ans.</b> (i) <u>Gravel</u> – This type of ballast is also used in large quantity in India and many other countries. It is cheaper and has excellent drainage property. (ii) <u>Cinder</u> – This type of ballast is excellent for station yards, footpaths but cannot be used for main tracks. (iii) <u>Bricks</u> – This type of ballast is used where other good material is available for use as ballast. (iv) <u>Earth</u> – The main object of using earth as ballast in the beginning while laying track is to prevent the loss of good and expensive ballast by sinking into soft formation.</p>	1 mark each	4
	f)	<p><b>List and draw dog spike and screw spike in railways.</b></p> <p><b>Ans.</b> Types of Spikes are;</p> <ol style="list-style-type: none"><li>1. Dog Spike.</li><li>2. Screw Spike.</li><li>3. Round Spike.</li><li>4. Standard Spike.</li><li>5. Elastic Spike.</li></ol> 	1 mark  3 marks	4

*Note: 1 ½ marks for each figure.*