SUMMER – 2015 EXAMINATION

MODEL ANSWER

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.

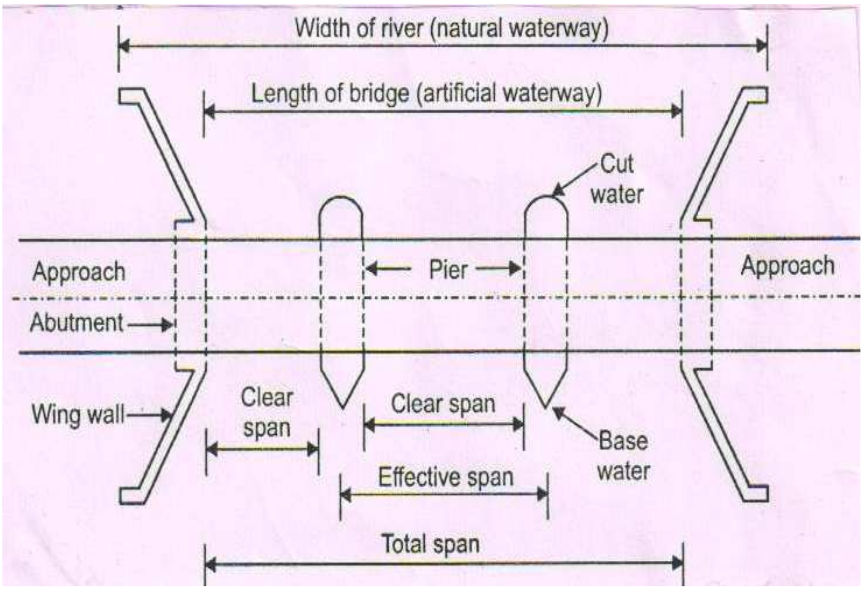
Model Answer

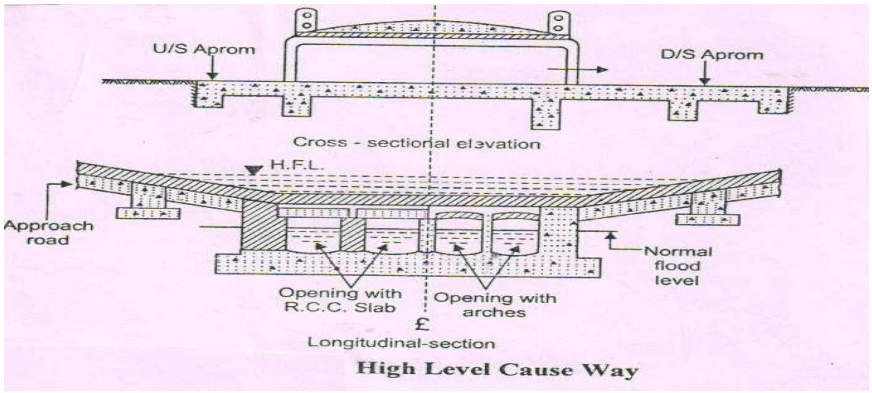
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q1.	**a)** **(i)**	**State role of transportation in development of India.** **Ans.** Transportation plays a very important role in development of India in the following ways. 1. Easy and quick transportation of men, machines, animals, material, and goals can be made. 2. Transportation system increases the social awareness among people. 3. Transportation is essential for strategic movement in emergency for defense of the country and to maintain better law and order. 4. Transportation Network creates job opportunities for millions of people. 5. Transportation through air ways plays an important role of communication to the people staying in remote area and also helps the people in difficulties during floods.	½ Mark each (any four)	02
	(ii)	**Enlist necessity of cross drainage works.** **Ans.** 1. Excess Moisture content causes reduction in bearing strength of base course bed materials. 2. Excess moisture content in layers of road way causes permanent failure. 3. Due to poor drainage, waves and corrugations are formed in flexible pavements. 4. At places where temperature often reaches to freezing point frost action of water entering the pavements structure may cause the damage.	½ Mark each (any four)	02

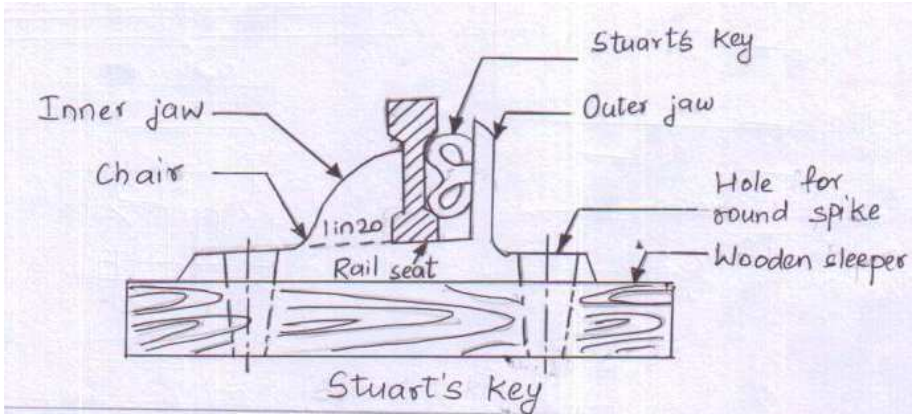
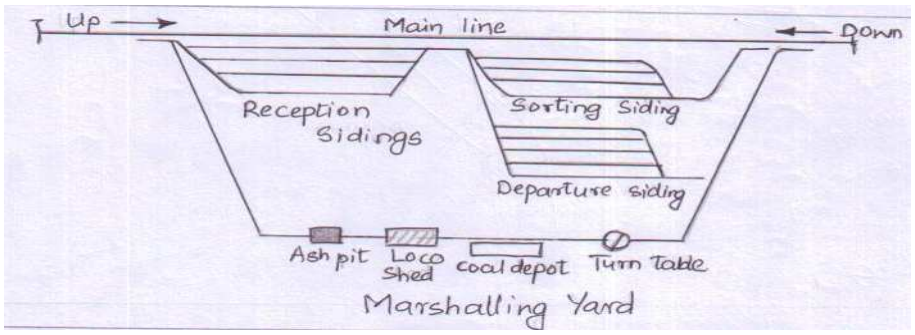
<table>
<tr><th>Que. No.</th><th>Sub. Que.</th><th>Model Answers</th><th>Marks</th><th>Total Marks</th></tr>
<tr><td>Q1.</td><td>a)
(iii)</td><td>Compare demerits of roadways and railways.
Ans.
<table>
<tr><th>Sr. No.</th><th>Demerits of Roadways</th><th>Sr. No.</th><th>Demerits of Railways</th></tr>
<tr><td>1.</td><td>Roadways are not suitable for bulk cargo movement.</td><td>1.</td><td>Railways are suitable for bulk cargo movement.</td></tr>
<tr><td>2.</td><td>More width of right-of-way.</td><td>2.</td><td>Less Width of right-of-way.</td></tr>
<tr><td>3.</td><td>High tractive resistance.</td><td>3.</td><td>Less tractive resistance.</td></tr>
<tr><td>4.</td><td>Low employment potential.</td><td>4.</td><td>High employment potential</td></tr>
<tr><td>5.</td><td>More traffic effort is required.</td><td>5.</td><td>Traffic effort of railway route is less.</td></tr>
</table></td><td>½ mark each (any four)</td><td>02</td></tr>
<tr><td></td><td>(iv)</td><td>Explain coning of wheels.
Ans.
The wheels are coned at a slope of 1 in 20 to prevent from rubbing the inside face of the rail head and to prevent lateral movement of the angle with it. This is known as coning of wheel.
On correct path, the outer wheels of the train have to travel greater distance than the inner wheels. When train moves on horizontal curve, due to Centrifugal force, vehicle is shifted to outer side of curve and due to coning of wheel; outer wheels cover greater distance than the inner wheels.</td><td>02</td><td>02</td></tr>
</table>

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q1.	**a)**			
	(v)	**State factors affecting selection of site for railway station.** **Ans.** The following factors affects selection of site for railway station 1. It should have fairly level ground. 2. It should be closed to town. 3. It should provide good drainage facility. 4. It should not be in low lying area otherwise water well be filled in the yards. 5 It should be preferred if roads already exists at the site connecting towns and villages. 6 Sufficient vast area should be available for future development of the station.	½ mark each (any four)	02
	(vi)	**State functions of wing wall and abutment.** **Ans.** The functions of wing walls are as follows: 1. To retain the earth banks of the river. 2. To protect the earth banks from the action of water. The functions of abutment are as follows: 1. To retain the earth pressure of embankment of the approaches. 2. To support the bridge superstructure and to transmit the load from it to the subsoil lying underneath.	½ mark each ½ mark each	02
	(vii)	**State component parts of substructure and superstructure.** **Ans.** Component parts of substructure of bridge 1. Foundation 2. Piers 3. Abutment 4. Wing walls 5. Approaches ***Note: any four points 1 mark.*** Component parts of superstructure of bridge 1. Railing 2. Girders (Bridge) 3. Beams 4. Arches 5. Bridge floor 6. Suspension cables carrying communication roots. ***Note: any four points 1 mark.***	01 01	02

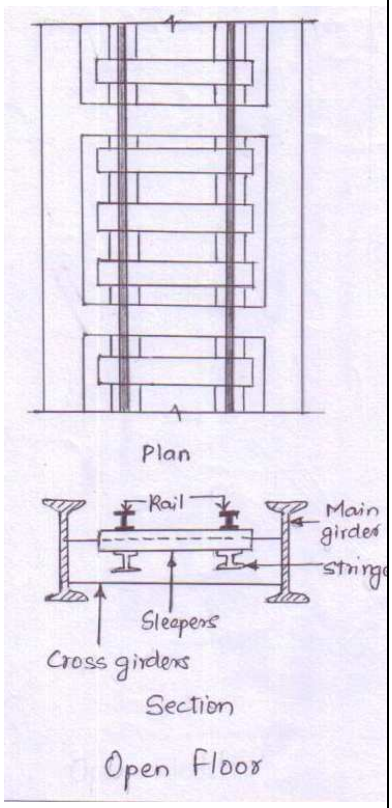
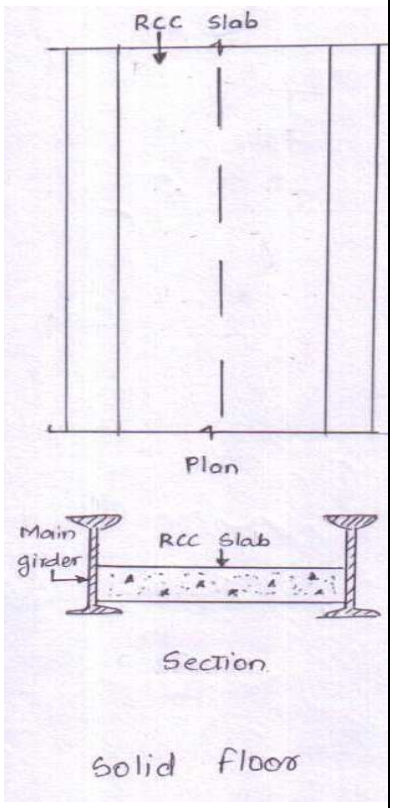
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q1.	**a) (viii)**	**State merits and demerits of tunnels.** **Ans.** Merits of Tunnel: 1. Tunnel connects the two terminal stations of shortest roots. 2. Tunnel provides free movement of traffic throughout the year even during snow fall and landslide. 3. Tunnel facilities conduction of water to generate the power. 4. Tunnel helps in avoiding acquisition of costly land and property for railway or road projects. Demerits of Tunnel: 1. Tunnel requires special equipment and method for the construction. 2. Skilled labour and supervision are required. 3. Tunnel requires more time in construction. 4. If not properly ventilated, tunnel causes suffocations. ***Note: Any other relevant point could be considered.***	½ mark each (any two) ½ mark each (any two)	02
	b) (i)	**State causes and effects of creep of rail.** **Ans.** Causes of creep of rail: 1. Ware action. 2. Percussion theory. 3. Accelerating and starting of train. 4. DE accelerating or stopping the train. 5. Intensity of traffic. 6. Alignment of track. 7. Gradient of track. 8. Expansion and contraction of rails due to variation in temperature. Effects of creep of rail: 1. Sleepers moves out of position affecting the gauge and align. 2. The rail joints are jammed and prevent expansion. 3. Operation of switches becomes difficult. 4. The surface of track is disturbed, results in uncomfortable riding.	½ Mark each (any four) ½ Mark each (any four)	04

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q1.	**b)**	**Explain with sketch, effective span, clear span, economical span and waterway of bridge.** **Ans.** 1. Effective span: The center to center distance between any two adjacent supports of the bridge superstructure is called effective span. 2. Clear span: The clear distance between two adjacent supports of the bridge superstructure is called clear span. 3. Waterway of bridge: It is the area of opening, which should be sufficient to pass the maximum flood discharge that would ever parts under bridge, without increasing velocity to a dangerous limit. 4. Economical span: The span for which the total cost of the bridge will be minimum is known as economical span of a bridge.  	½ Mark each 02	04

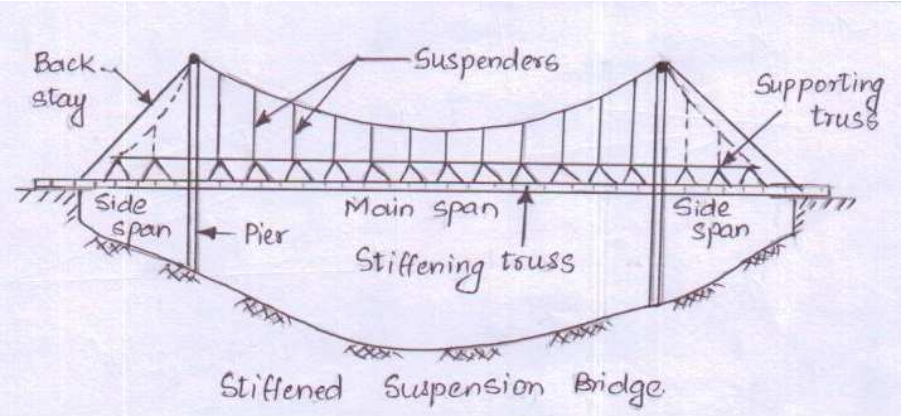
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q1.	**b) (iii)**	**Explain high level causeway with sketch.** **Ans.**  High Level Cause Way High level causeway: 1. It is also known as submersible bridge. The main purpose of providing high level causeway is to reduce the cost of construction. 2. The formation level of high level causeway is so fired that the normal flood is passed through the openings and the high flood may pass over the bridge. 3. On a high level causeway, during high flood vehicles may be allowed through 25-30 cm deep water on the causeway. 4. If wire rope is swing along the upstream wall of the causeway pedestrian can walk upto 40cm deep cut water on the causeway. 5. Opening below the causeway should be about 1.25 m. high of rectangular section.	02 ½ Mark each (any four)	04
Q2.	**a)**	**State various types of keys in rail joint. Explain Stuart's Key with sketch.** **Ans.** The different types of keys are: 1. Timber Keys 2. Metal Keys a) Stuart's Key b) Spring Coiled Key c) Morgan Key <u>Stuart's Key</u>: It is a steel plate bent in the form of letter E as shown in figure. Steel wedge is introduced at the ends to keep the keys tight against the rail web and the outer jaw of the chair.	01 01	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q2.	**a)**		02	04
	b)	**Explain functions of Marshalling yard with sketch.** **Ans.** The important functions of a marshalling yard are as follows: 1. Reception of empty and loaded wagons. 2. Sorting of wagons. 3. Departure of wagons in the forms of trains. 4. New trains are formed and dispatched. 5. Distribution centre for trains. 	½ Mark each (any four) 02	04

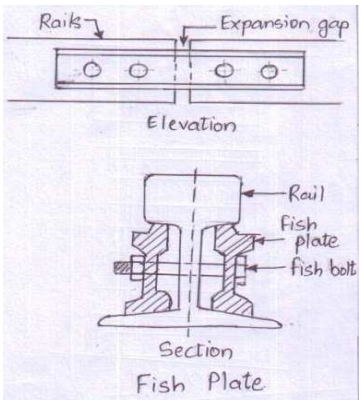
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q2.	**b)**	**State various types of track maintenance and explain special maintenance.** **Ans.** The maintenance of track is divided into the following categories: a) Routine Maintenance. b) Daily Maintenance. c) Periodic Maintenance. d) Special Maintenance. <u>Special Maintenance</u>: 1. The track maintenance is carried out whenever necessity arises is called special maintenance. 2. This type of maintenance arises in case of derailment or accident of train when some components are to be replaced due to wear and tear. 3. It includes mainly: Replacement of all types of defective components i.e. sleepers, rails, fixture and fastening etc.	½ Mark each (any four) 02	04
	c)	**State types of investigating survey conducted for bridge construction. Explain geological survey.** **Ans.** The investigations for the major bridges are of following types; a) Reconnaissance survey b) Preliminary survey c) Detailed survey d) Geological survey <u>Geological Survey</u>: i. Geological survey gives reliable information about the depth, thickness and composition of rock. ii. Geological survey is used in preparing a geological map showing character of material and different rock strata. iii. In the geological survey it gives the safe bearing capacity of foundation soil. iv. Liability of the site to earthquake disturbances and its magnitude can be checked.	½ Mark each ½ Mark each (any four)	04

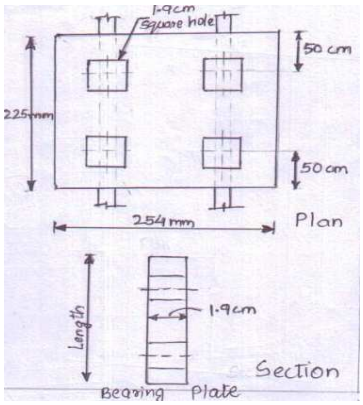
<table>
<tr><th>Que. No.</th><th>Sub. Que.</th><th>Model Answers</th><th>Marks</th><th>Total Marks</th></tr>
<tr><td>Q2.</td><td>e)</td><td>Differentiate between open and solid floors with sketch.
Ans.
<table>
<tr><th></th><th>Open Floors</th><th></th><th>Solid Floors</th></tr>
<tr><td>1.</td><td>The bridge floor which does not cover the total space between the main girders is known as open floor.</td><td>1.</td><td>The bridge floor which covers the total space between the main girders is known as solid floor.</td></tr>
<tr><td>2.</td><td>No flooring material is required for open floor.</td><td>2.</td><td>Flooring materials are required for solid floors.</td></tr>
<tr><td>3.</td><td>The open floors do not need drainage arrangements.</td><td>3.</td><td>The solid floors need drainage arrangements.</td></tr>
<tr><td>4.</td><td>These types of floors are used only for railway bridges.</td><td>4.</td><td>This type of bridge floor is suitable for all types of land routes and is mos used for road bridges</td></tr>
<tr><td>5.</td><td>Sketch
 
</td><td>5.</td><td>Sketch
 
</td></tr>
</table>
Note: Plan or section for sketch may be considered for each.</td><td>½ Mark each

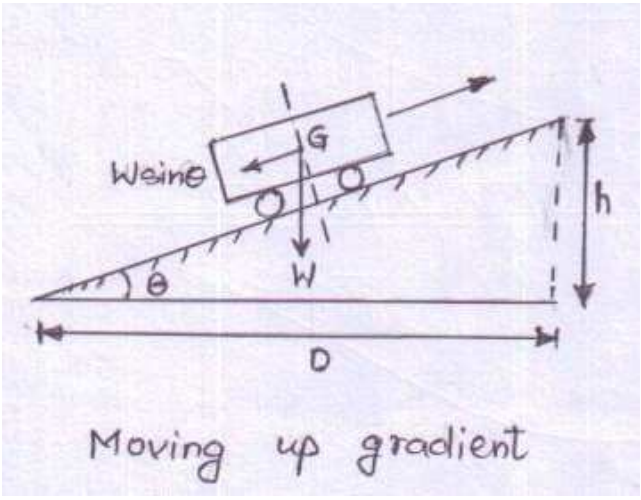
01</td><td>04</td></tr>
</table>

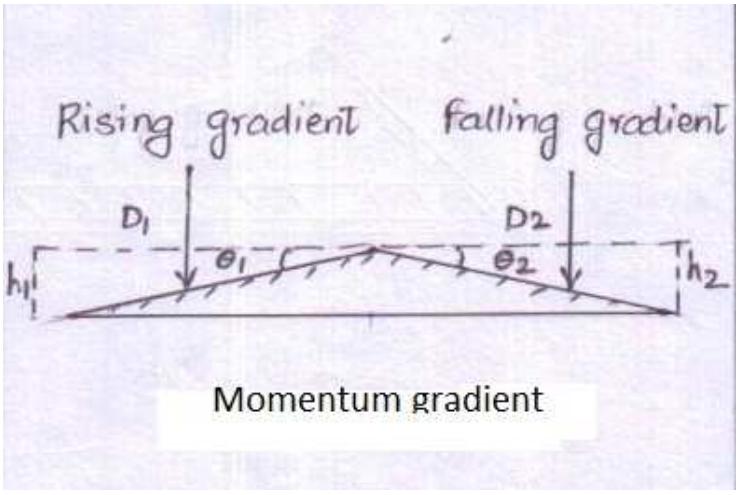
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q2.	**f)**	**Explain stiffened suspension bridge.** **Ans.** Definition: The bridge having its superstructure consisting of one or two set of cables which carry the bridge floor by means of suspenders is known as steel suspension bridge. Stiffened suspension bridge: a) When the stiffening trusses are provided at the floor level of the bridge then the bridge is known as stiffened suspension bridge. b) Stiffening is also done by braced chains in order to make the bridge more rigid as shown in figure below. Advantages of suspension bridge are as follows: 1. Easy to construct. 2. The design is comparatively simple. 3. They are light in weight. 4. They require less construction time. 5. They are economical. 6. They provide good architectural appearance.  Stiffened Suspension Bridge	01 01 ½ each (any two) 01	04

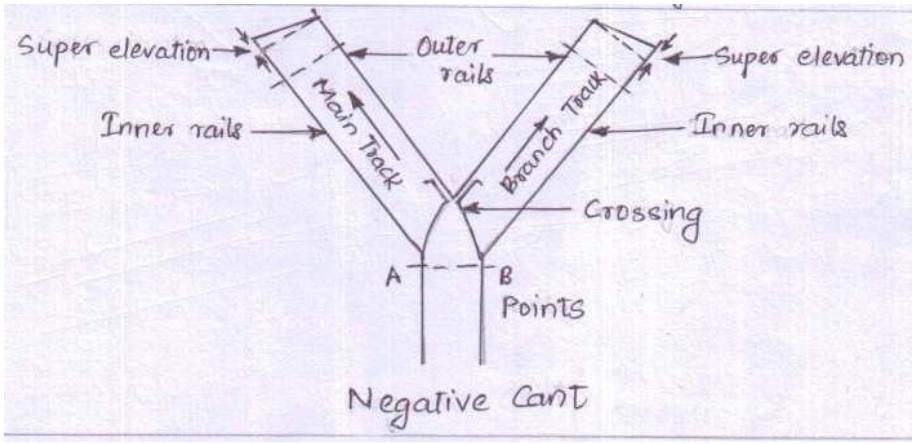
<table>
<tr><th>Que. No.</th><th>Sub. Que.</th><th>Model Answers</th><th>Marks</th><th>Total Marks</th></tr>
<tr><td>Q3.</td><td>a)</td><td>
What is difference between fish plate and bearing plate? Draw labeled sketches of fish plate and bearing plate.
Ans.
<table>
<tr><th></th><th>Fish plate</th><th></th><th>Bearing plate</th></tr>
<tr><td>1.</td><td>These plates are used to join one rail with other rail.</td><td>1.</td><td>These are provided in between the flat footed rail and wooden sleepers.</td></tr>
<tr><td>2.</td><td>Two fish plates are placed on either sides of the rail.</td><td>2.</td><td>Bearing plates are normally used under at rail joints.</td></tr>
<tr><td>3.</td><td>Fish plates are used at every rail joint.</td><td>3.</td><td>Bearing plates are used on curves and under points and crossing.</td></tr>
<tr><td>4.</td><td>It helps in maintaining alignment of railway track.</td><td>4.</td><td>It helps in protecting sleeper from sinking and damage.</td></tr>
<tr><td>5.</td><td>It helps in minimizing variation caused by temperature and prevents expansion and contraction of rails.</td><td>5.</td><td>It helps in fastening to remain in position under varying load.</td></tr>
<tr><td>6.</td><td>By providing fish plates, points and crossings are properly maintained.</td><td>6.</td><td>It increases life of sleepers and helps for smooth running of trains.</td></tr>
<tr><td>7.

8.</td><td>Sketch
 
</td><td>7.

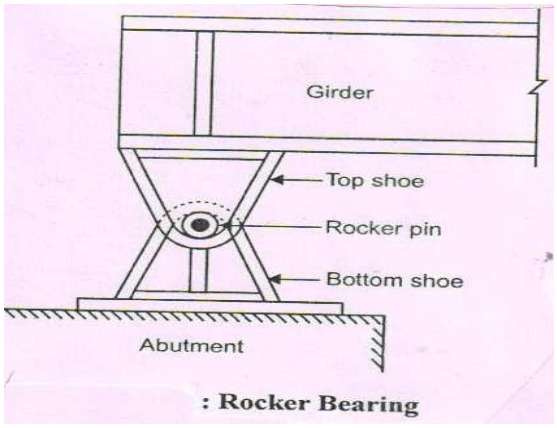
8.</td><td>Sketch
 
</td></tr>
</table>
</td><td>1 Mark each</td><td>08</td></tr>
</table>

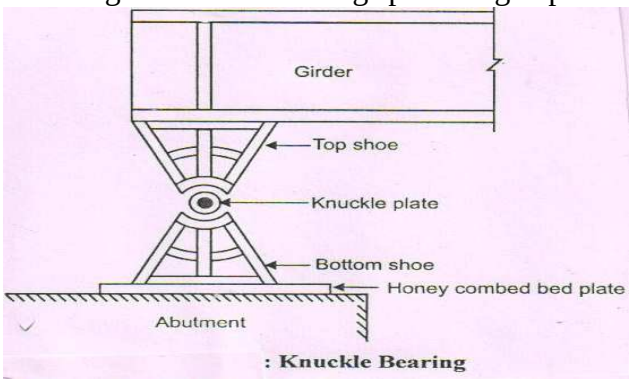
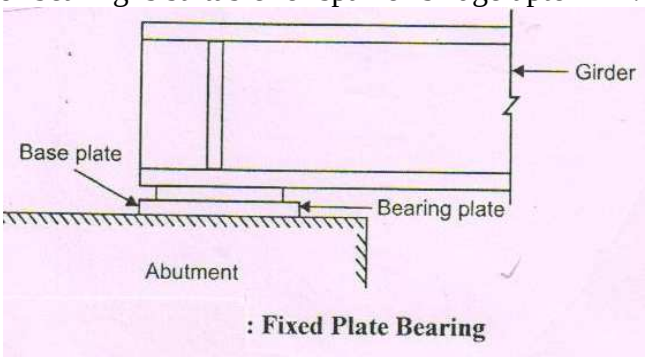
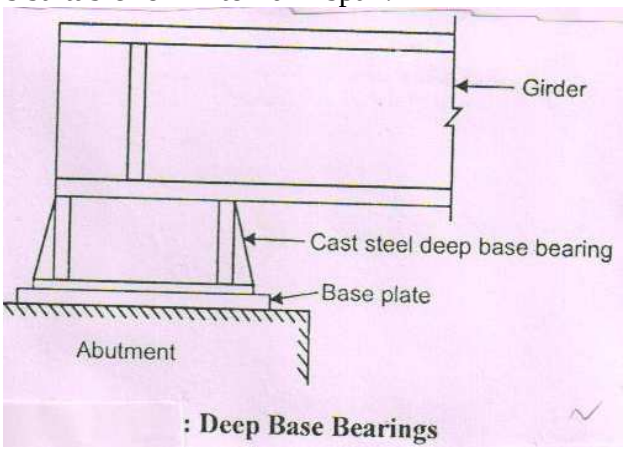
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q3.	**b)**	**Explain four types of gradients with sketches.** **Ans.** In railways, gradient are classified into the following types: a) Ruling gradient b) Pusher gradient c) Momentum gradient d) Station yard gradient a) <u>Ruling gradient</u>: 1. The permissible gradient usually provided in railway track is known as Ruling gradient. 2. This is the maximum permissible gradient to which railway track may be laid in particular section. 3. Ruling gradient mainly depends upon the power of locomotive which shall be able to pull up the train load along the gradient. 4. It is generally 1:150 to 1:200 for plain and 1:100 to 1:150 for hilly areas.  Moving up gradient b)<u>Pusher gradient</u>: 1. If gradient is steeper than ruling gradient an extra engine is used to push the train is known as Pusher gradient. 2. It is provide on the track on mountainous region to avoid heavy cutting through rocks to reduce route length. 3. In India, gradient of 1:25 at Darjeeling and 1:37 at Bhor ghat. 4. Generally, 1:75 to 1:100 gradients is sufficient with one engine. ***Note: 2 marks for explanation with slope specified.***	01 01 02	

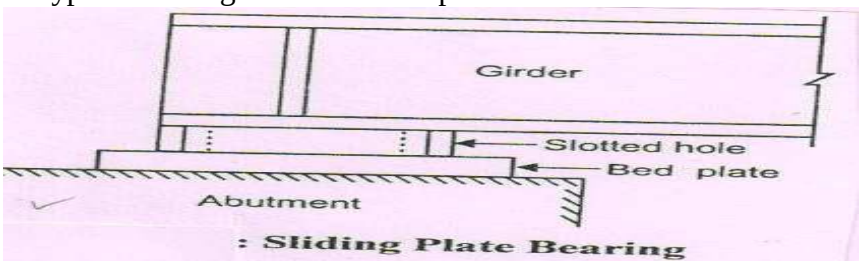
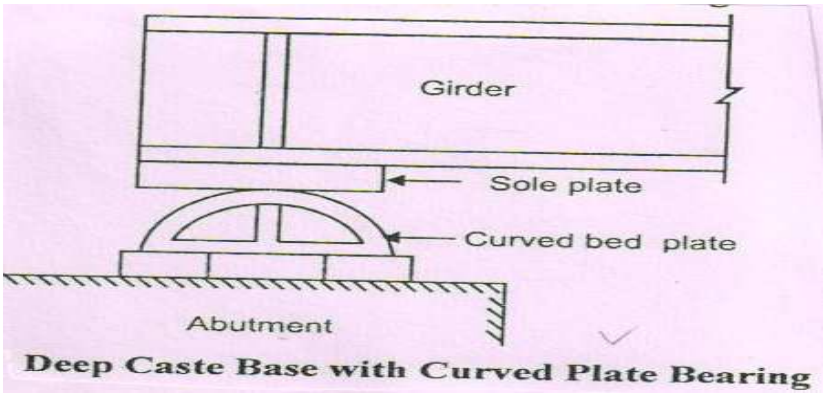
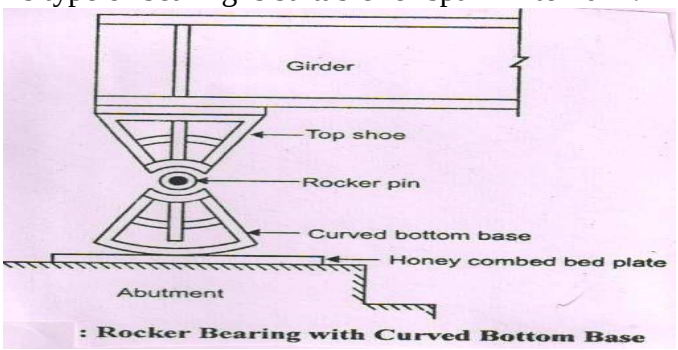
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q3.	**b)**	c)Momentum gradient: 1. Sometimes rising gradient is followed by falling gradient, in that case when train travelling due to following gradient, it acquires momentum and due to which it becomes easy to travel in rising gradient is known as Momentum gradient.	01	
			01	
		d)Station yard gradient: 1. The gradient provide in station yard for easy drainage is known as station gradient. 2. It has been recommended for easy drainage of rain water in between 1:400 to 1:100 for maximum and minimum respectively. ***Note: 2 marks for explanation with slope specified.***	02	08

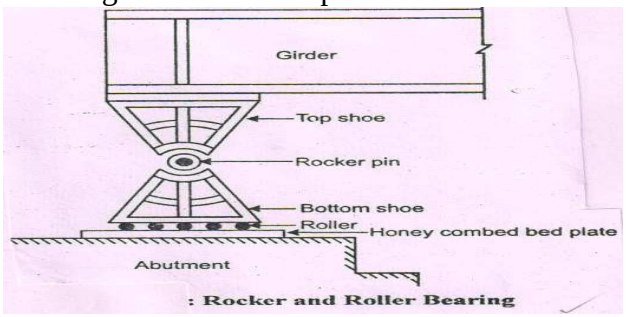
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q3.	**c)**	**Explain cant deficiency and negative cant with sketch.** **Ans.** Cant Deficiency: 1. The difference between equilibrium cant necessary for maximum permissible speed on curved track and the actual cant provided is known as cant deficiency. 2. It should be as low as possible, as higher cant deficiency result in extra pressure, more side wear and creep of outer track and results in discomfort to passengers. 3. Higher cant deficiency results in extra pressure and lateral thrust on outer rails which requires strong track and more fastenings for stability. 4. For different gauges, cant deficiency prescribed by Indian Railway for speed upto 100 km/hrs is 7.6 cm, 5.1 cm, 3.8 cm for B.G, M.G and N.G respectively and for speed more than 100 km/hr, it will be 10 cm for B.G only. Negative Cant: 1 On the curve where main track and branch track meets then the stage occurs such that the outer rail is below the inner rail, then it is called as negative cant or negative super elevation. 2 The negative cant helps the locomotive to change its direction from main line to branch line irrespective that the outer rail should be kept at higher level.  	1 Mark each 1 Mark each 02	08

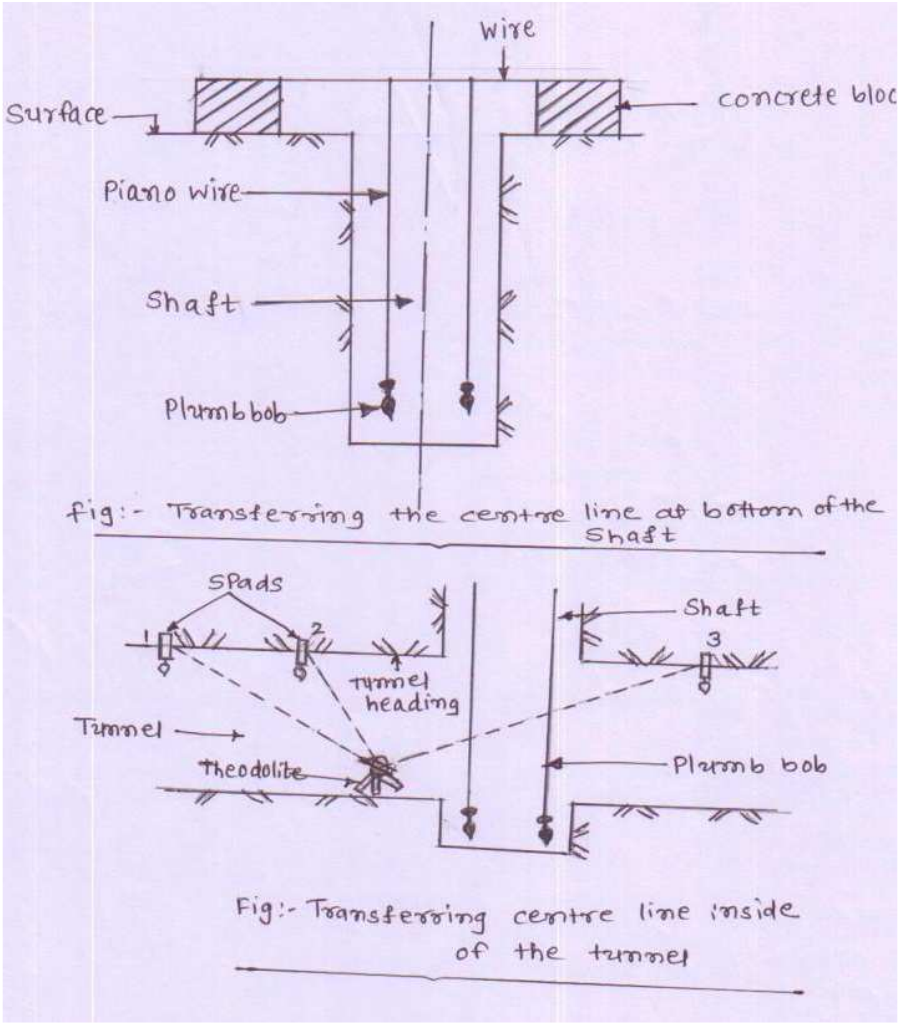
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q4.	**a)**	**Explain various data required for design of bridge.** **Ans.** Following data are required for design of the bridge. 1. <u>General Data</u>: i. This data includes maps, plans and topographical features of the proposed bridge site. Various drawing are required at the time of investigation like under map, contour survey plan, site plan, cross sections, longitudinal sections, catchment area map. 2. <u>Geological Data</u>: This data includes following information. ii. Nature & properties of existing soil in bed, banks and approaches. iii. Safe bearing capacity of the foundation soil. iv. Liability of the site to earthquake disturbances and its magnitude. 3. <u>Hydraulic Data</u>: This data includes following information. i. Intensity and frequency of rainfall in the catchment area. ii. Hydrograph for one or more years. iii. Size, shape and surface characteristic of catchment area including percolation and interception. iv. Observed maximum depth of scour. 4. <u>Climate Data</u>: This data includes information regarding annual temperature range, cyclones, wind velocity, rainfall, characteristics, and relative humidity. 5. <u>Loading and other data</u>: i. Live load for which the bridge is to be designed as per IRC Code of practice. ii. Type of Stream. iii. LWL, HFL, ordinary flood level. iv. Type and nature of stream. v. Velocity of stream. vi. Seismic conditions of area.	2 Marks each (any four)	08

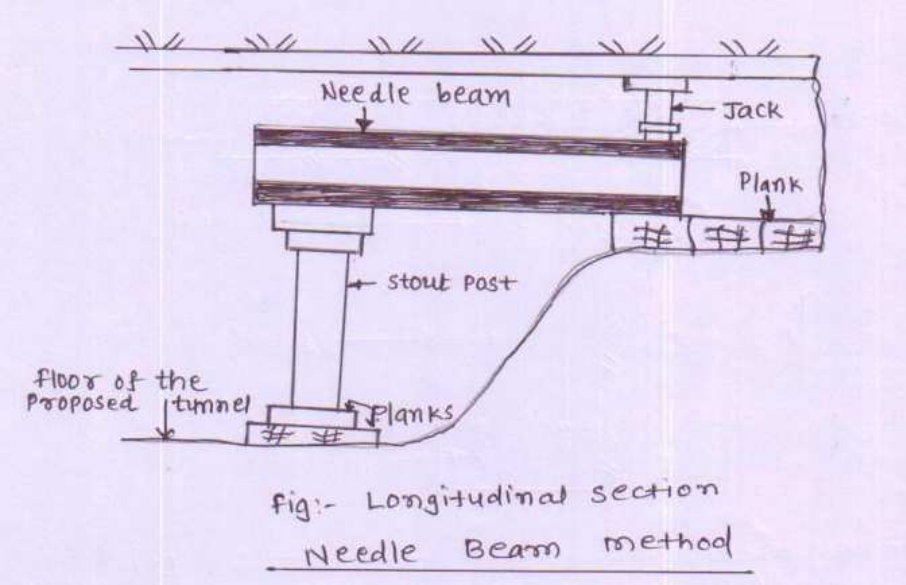
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q4.	**b)**	**What is bearing? State requirements and types of bearing. Explain any one bearing with sketch.** **Ans.** Bearing: It is component part of bridge by which load coming from superstructure of a bridge is transmitted to substructure such that stresses induced remain within permissible limits. Requirements of Bearing: a. It should be capable to distribute the superimposed load uniformly on substructure. b. The maintenance cost should be minimum. c. It should be easy to install & compact in size. d. It should provide greater stability to the structure. Types of Bearing: A. Fixed Bearing: 1. Fixed Plate Bearing 2. Deep Base Bearing 3. Rocker Bearing 4. Knuckle Bearing B. Expansion Bearing: 1. Sliding Plate Bearing 2. Deep cast with curve plate 3. Rocker bearing with curved base 4. Rocker & roller bearing A.Fixed Bearing: Rocker Bearing:  : Rocker Bearing This type of bearing consists of top inverted shoe & a bottom with a rocker pin provided in between the shoe. This type of bearing is suitable for long span over 80 m.	01 ½ Mark each ½ Mark each (any two) ½ Mark each (any two)	

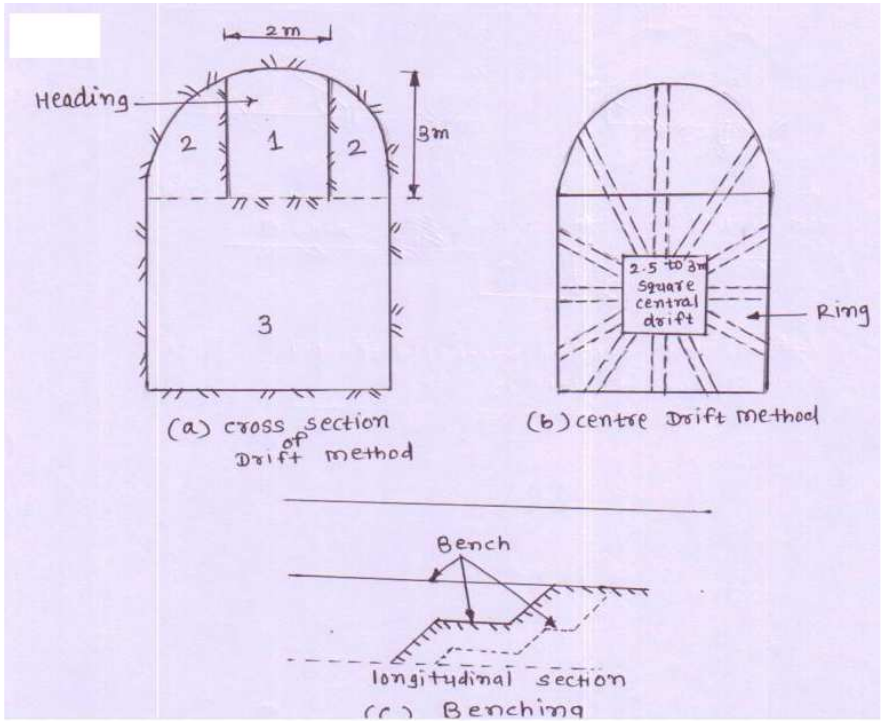
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
		Knuckle Bearing: This type of bearing, rocker pin is eliminated by casting the top of the bottom shoe in the shape of a hemisphere to function as rocker pin. This type of bearing is suitable for long span bridge upto 20m.  **: Knuckle Bearing** Fixed Plate Bearing: This is the simplest type of fixed bearing. It consists of flat rectangular steel plate attached to the underside of the lower flange of the girder. This type of bearing is suitable for span of bridge upto 12m.  **: Fixed Plate Bearing** Deep Based Bearing: This is an important form of shallow of fixed plate bearing. This type of bearing is suitable for 12 to 20 m span.  **: Deep Base Bearings**		

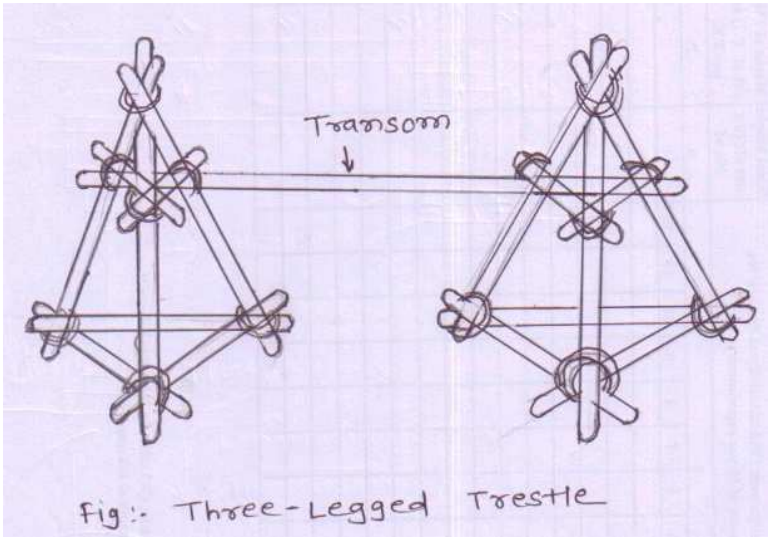
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q4.	**b)**	B.Expansion Bearing- Sliding Plate Bearing-This is the simplest type of expansion bearing. It consists of a sole plate attached to the main bridge girder, which is free to slide over the wall plate, anchored to the masonry abutment. This type of bearing is suitable for span 12 to 20 m.  **: Sliding Plate Bearing** Deep cast base with Curved Plate Bearing- This type of bearing consists of a sole plate which is attached to underside of bridge girder. This type of bearing is suitable for span 12 to 20 m.  **Deep Caste Base with Curved Plate Bearing** Rocker bearing with curved base- This is a type of rocker bearing but in this bearing, bottom shoe is provided with curved bottom which offers minimum resistance to the longitudinal movement of the bridge girder. This type of bearing is suitable for span 12 to 20 m.  **: Rocker Bearing with Curved Bottom Base**		

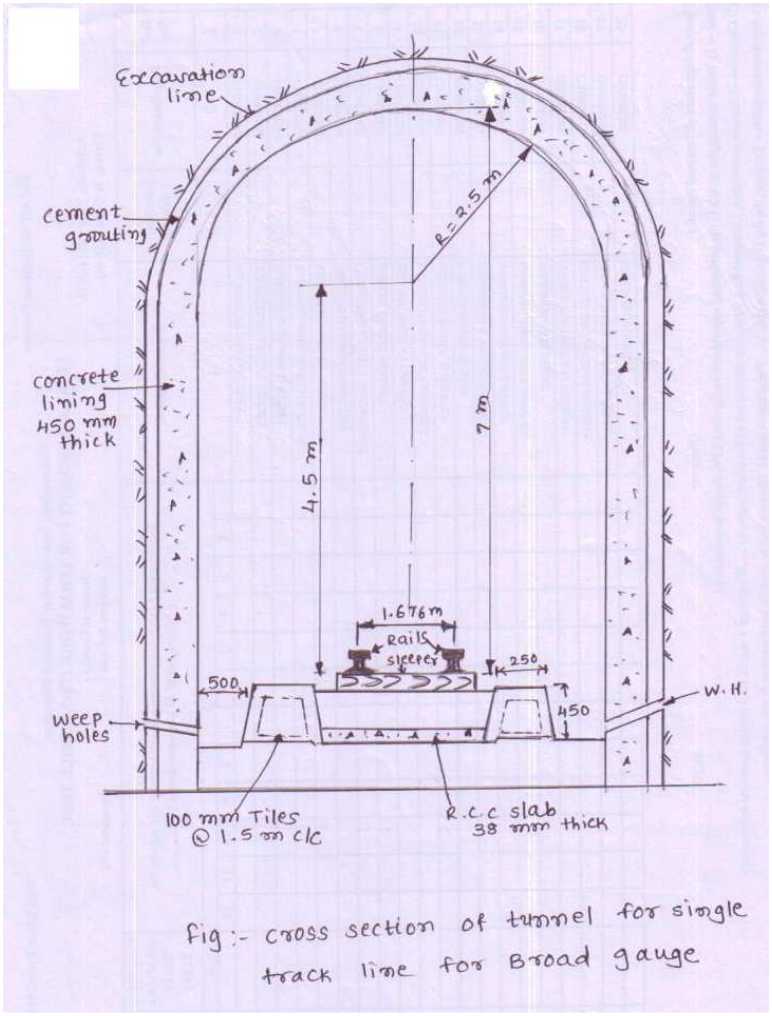
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q4.	**b)**	Rocker & Roller Bearing- This type of bearing consists of rocker bearing having its bottom shoe resting on a number of steel rollers which in turn roll on a honey combed bed plates is anchored to the top of masonry of abutment. This type of bearing is suitable for span more than 20 m.  : Rocker and Roller Bearing ***Note: 2 Marks for explanation and 1 Mark for sketch of any one type.***		08
	c)	**Define piers. State function, requirements and types of piers.** **Ans.** Piers: The intermediate supports provided for bridge superstructure are known as piers.	1	
		Functions of piers: a. To divide the length of bridge into suitable number of spans. b. To transfer the load from bridge superstructure to subsoil through foundations.	1 Mark for each	
		Requirements of piers: a. It should be easily and cheaply constructed. b. It should involve less maintenance cost. c. It should be constructed of a durable material. d. It should be enough to transfer the load of superstructure to the subsoil lying underneath.	½ Mark for each	
		Types of piers: a. Solid piers: It is classified into two types: i.Solid masonry piers ii.Solid R.C.C. piers	½ Mark for each	
		b. Open piers: It is classified into following types: i.Column bents ii.Pile bents iii.Cylindrical piers iv.Trestle piers	½ Mark for each	08

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q5.	**a)**	**Explain the process of transforming the alignment to inside of tunnel with sketch.** **Ans.**  fig:- Transferring the centre line at bottom of the Shaft Fig:- Transferring centre line inside of the tunnel 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.	02 04	08

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q5.	**b)**	**Explain needle beam method of constructing tunnel w.r.t. construction steps, sketch, merits and demerits.** **Ans.** Construction steps: i. About 1 x 1m small drift is prepared on the working face of tunnel ii. Roof of drift is supported on lagging provided on wooden segments which are carried on the trench jacks as shown in figure below. iii. The needle beam is placed horizontally whose front end rests on drift and the rear end is supported on vertical stout post. iv. After excavation, the lining is provided to the tunnel section and mucking is done. Sketch:  fig:- Longitudinal section Needle Beam method Merits: 1. This method is economical 2. Brick lining can be easily done by this method. Demerits: 1. Concrete lining by mechanical method is difficult. 2. Pushing of beam by hand is difficult.	1 Mark for each 02 ½ Mark for each ½ Mark for each	08

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q5.	**c)**	**State methods of tunneling in hard rock. Explain drift method with sketch.** **Ans.** Methods of tunneling in hard rock: 1. Full-Face heading method 2. Heading and bench method 3. Drift method <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. The main operations involved in this method are as follows: i. Boring or blasting a top centre heading of drift ii. Widening and enlarging iii. Benching in stages 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.  	½ Mark for each 01 ½ Mark for each 02 02	08

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q6.	**a)**	**What do you mean by timber trestle? Draw sketch of three legged timber trestle.** **Ans.** Timber trestles are constructed of sal wood ballies round or square in section or from tree trunks when heavy section is required. Trestles with round section are fixed together by ropes or steel wires at their joints but in case of square sections, spikes and nails are used for this purpose. Trestles are used as piers of timber bridges when the bed of the stream is sufficiently hard and the depth of water as well as velocity of water is less.  Fig :- Three-Legged Trestle	02 02	 04
	b)	**Explain hydrological investigation of railway.** **Ans.** The hydrological investigation of railway include following information. i. The intensity and frequency of rainfall in the area. ii. The ground water table which affects the construction of railway track. iii. The size, shape and surface characteristic of catchment area of river on which Railway Bridge is to be provided. iv. The maximum depth of scour with corresponding level or any other special causes responsible for the scour has to be investigated.	1 Mark for each	04

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q6.	**c)**	**Explain mucking process of construction of shaft.** **Ans.** Definition: The process of removing excavated material of a shaft and dumping it at a predetermined site is known as mucking. Mucking is usually done in the following three steps. a. Loading the muck b. Hauling c. Unloading and dumping Mucking can be done by manually or mechanically. For construction of shaft hand mucking is used. Muck is hoisted by buckets of 9 cu.m capacity. Generally two bucket is being loaded and other can be hoisted for removal operation of the material out of shaft.	01 ½ Mark for each 1½ Mark	04
	d)	**Draw cross section of tunnel for single track lane for Broad Gauge.** **Ans.**  Fig :- cross section of tunnel for single track line for Broad gauge ***Note: Sketch- 3 Marks and labeling- 1 Mark.***	04	04

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q6.	**e)**	**State detailed classification of tunnels.** **Ans.** (a)Traffic tunnel: i. Railway tunnel ii. Highway tunnel iii. Pedestrian tunnel iv. Navigation tunnel v. Subway tunnel (b) Conveyance tunnel i. Hydro power tunnel ii. Water supply tunnel iii. Sewage tunnel iv. Tunnel for industrial use (c) According to type of material i. Tunnel in hard rock ii. Tunnel in soft rock iii. Tunnel in quick sand iv. Tunnels under river bed (d)According to the position of alignment i. Saddle and base tunnel ii. Spiral tunnel iii. Off spur tunnel iv. Slope tunnels ***Note: 1 Mark for each type with minimum two sub types***	1 Mark for each	04
	f)	**State objects and methods of tunnel ventilation.** **Ans.** <u>Objectives of tunnel ventilation</u>: i. To supply fresh air inside the tunnel. ii. To remove poisonous gases, dust smoke etc. iii. To reduce temperature in tunnel situated as great depths. iv. By providing ventilation in tunnel which helps to reduce suffocation produce during and after construction of it. <u>Methods of tunnel ventilation:</u> i. Natural ventilation ii. Mechanical method :Three system of mechanical ventilation (a) Blowing process (b) Exhausting process (c) Combination of blowing and exhausting	½ Mark for each ½ Mark for each	04