MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC-270001 – 2005 certified)

WINTER -14 EXAMINATION

Subject code: 17418 **Model Answer** **Page No: 1/17**

Important Instructions to examiners:

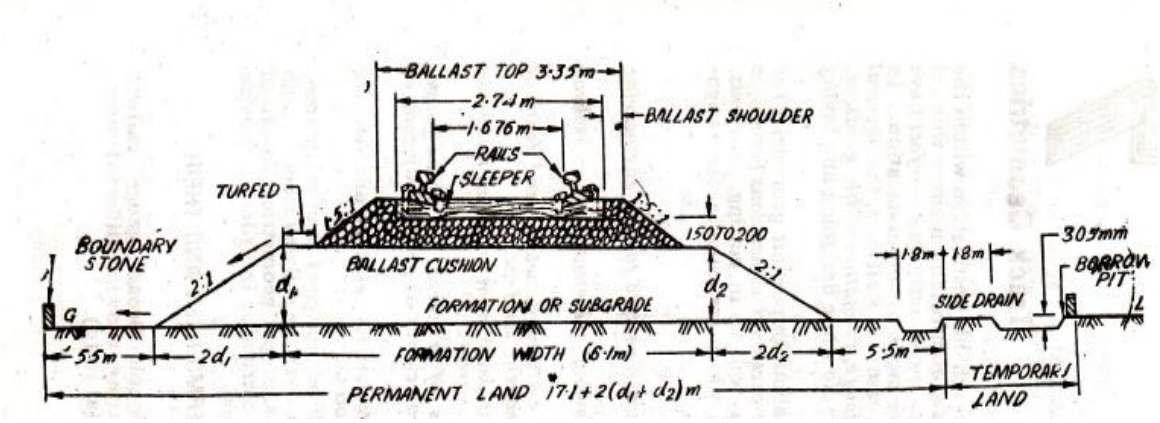
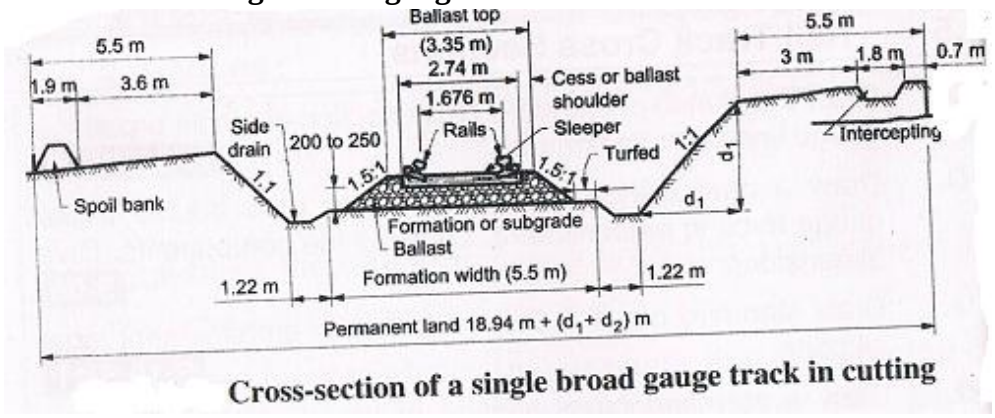
1) The answer should be examined by keywords and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language error such as grammatical, spelling errors 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.

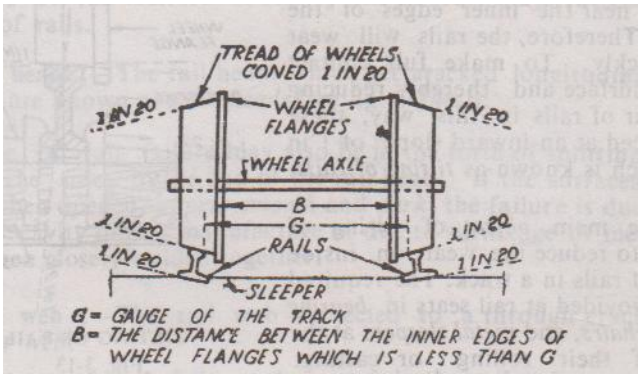
Q.1 Attempt any TEN of the following	**20**
a) Define the term 'Rail gauge'.	
Ans:-The clear horizontal distance between the inner faces of two rails forming a track is known as gauge.	**02**
b) Write two advantages of tunnels	
Ans:- Advantages of tunnels:- 1) Tunnels carry railway lines ,roads and public utilities like water ,oil ,gas etc .across streams and mountains economically . 2)They tunnels connect two terminal stations by the shortest rout . 3)They help in avoiding acquisition of costly land and property for railway and road projects 4)They provide free movement of traffic throughout the year even during snowfall and land slides . 5)They facilitate conduction of water to generate the power . **(*Note-any two, one mark each)**	*

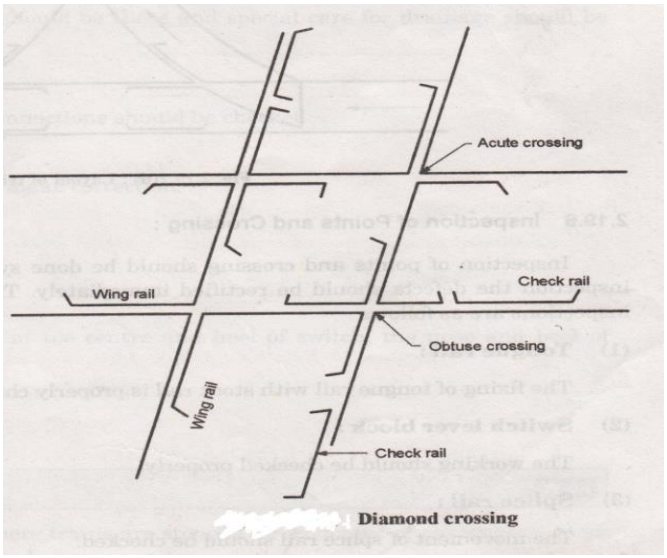
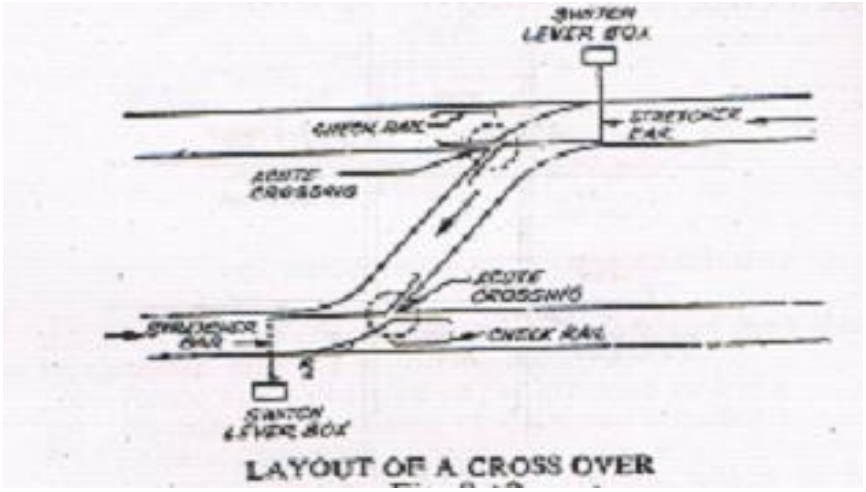
c) Enlist four types of Rail joint.	
Ans:-1)Supported rail joints. 2)Suspended rail joints . 3)Bridge rail joints . 4)Welded rail joints . 5)Square rail joints. 6)Staggered rail joints . 7)Compromise rail joints . 8)Insulated rail joint . ***(*Note- any four types , ½ mark each)***	*
d) Define 'Gradient' and 'Super elevation'	
Ans:- Gradient:-The rate of rise or fall provided to the formation of railway track along its alignment is known as gradient or grade . **Super elevation:-**The raised elevation of the outer rail above the inner rail at a horizontal curve in case of railway track is called super elevation.	**01** **01**
e) Define point and crossing.	
Ans:-The arrangements by which different routes either parallel or diverging from the first track are connected to facilitate the diversion of trains from one track to anther track without any obstruction are known as points and crossing.	**02**
f) Enlist four types of yards.	
Ans:- 1) Passenger bogie yards. 2) Goods yards. 3) Marshaling yards. 4) Locomotive yards. ***(*Note-1/2 marks for each point)***	*
g) Define Tunnel Engineering.	
Ans:- Tunnel Engineering:-The branch of civil engineering which deals with the design , construction and maintenance of tunnels is known as tunnel Engineering .	**02**
h) Write two requirements of Piers.	
Ans:- Requirement of Piers:- 1) It should be easily and cheaply constructed. 2) It should he constructed of a durable material. 3) It should have sufficient bearing area at its top to receive the bearings supporting the bridge girders. 4) It should have pleasing appearance. 5) It should be strong enough to take and transfer the load of superstructure to the sub soil lying underneath 6) It should be quite stable against lateral and longitudinal thrusts of water. 7)It should involve less maintenance cost ***(*Note-1 mark of each, any two)***	*
i) Enlist two function of Abutment.	
Ans:- Function of Abutment:- 1)To transmit the load from the bridge superstructure to the sub-soil laying underneath. 2)To provide final formation level to the bridge superstructure . 3)To retain the earth pressure of embankment of the approaches **.** ***(*Note-1 mark of each, any two)***	*

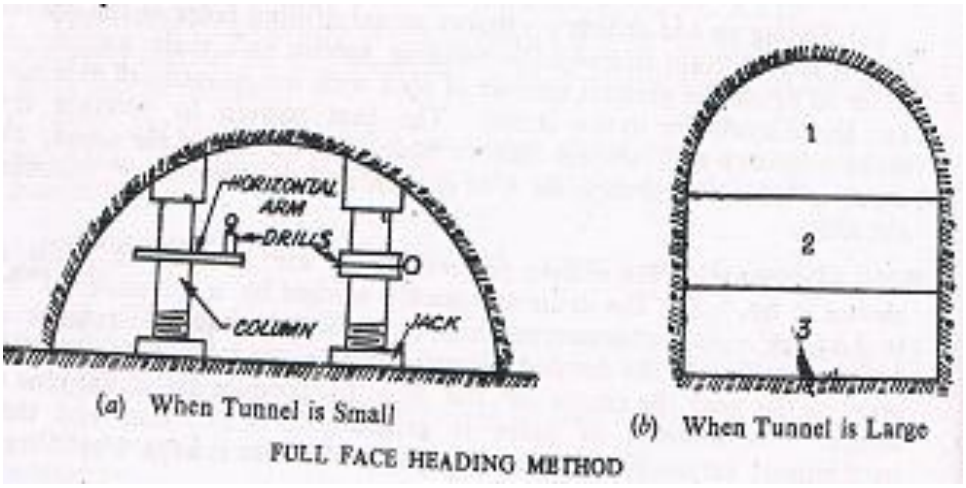
J) Enlist the explosive commonly used in tunneling work.	
Ans:-1) Power explosives. 2) Disruptive explosives. 3) Liquid air **.**	**02**
k) What do mean by Mucking.	
Ans:- Mucking.:- After blasting and scaling, the blasted material is removed from the tunnel and dumped at a suitable site .This operation of removing the excavated or blasted material from the tunnel and dumping the same at predetermined site is known as mucking.	**02**
I) Define H.F.L. and culvert.	
Ans:- H.F.L -The level of the highest flood ever recorded or the calculated level for the highest possible flood discharge in a stream or river is called highest flood level . **Culvert:-**The bridge having total length six meter or less is called as a culvert.	**01** **01**
m) Define Negative cant.	
Ans:- Negative cant:-The elevation of outer rail below the inner rail of a turn out or branch track at the place where it meets the main track on a curve is called negative super elevation or negative cant.	**02**
n) State the purpose of fish plate.	
Ans:- Purpose of fish plate:- 1)To maintain the continuity of railway track or to connect two rails at their ends. 2)To allow expansion and contraction of a railway track .	 **01** **01**
o) State types of bridge floorings.	
Ans:- Types of bridge floorings:- **1) Open floors .** **2) Solid floors-** a)Timber or wooden floors .b)Rein forced cement concrete slab floors . c)Trough floors .d) Buckle plate floors . ***(*Note-1/2 mark of each, any four types)***	 *****
Q.2. Attempt any FOUR of the following:	**16**
a) State the role of transportation in the development of nation.	
Ans:- Role of transportation:- 1) It provide convenient and safe means of transporting people and goods over large distances in a country 2) It helps in uniting the people of different religions, customs and traditions living in different parts of a country and thus strengthens national unity. 3) It help in developing cultural and social ties among the people living in different part of a country. 4) It sets a special boon to pilgrims and travelers who wish to visit far places of their interest with safety, comfort, and economy in time and money . 5) It facilitate cheap and convenient communication of bulks of letters ,parcels and	 *****

heavy goods like raw materials ,coal ,ores etc. from mine and manufacturing concerns within a country. 6) It helps in growth of trade and industrial development in a country. 7) It helps in increases the value of land due to industrial development which results in increase of national wealth. 8) It helps in providing efficient distribution of natural resources and agricultural product all over the country. 9) It helps in removing distress of people in famine affected areas by transporting food and clothing on a large scale. 10) I help in price stabilization of commodities due to mobility of products in all parts of country. 11) It provides employment opportunities to people on a large scale and thus reduces unemployment problem of the country. 12) It helps in maintaining better law and order in country. 13) It helps in national defense of country by transporting army and ammunition quickly on large scale during war days. 14) It forms a main source of revenue to a country without any taxation. ***(*Note –any four, 1 mark each)***	
b) Compare bridge approaches in cutting and embankment.	
Ans:- 1) In case high level bridges and culverts the approaches are constructed in embankment 2) For submersible bridges or causeways approaches are constructed in cutting. 3) The approaches should be straight for a minimum length of 15 m on the either side of the bridge, where horizontal curve have to be provided on the approaches beyond the straight portion on the either side with necessary radius of curvature and super elevation. 4) Top level of the approaches is up to the level of bridge floor .	 **01** **01** **01** **01**
c) What are the various zones of Indian Railways?	
Ans:- Indian Railways zones:- 1) Eastern Railways (E.R.) 2) Central Railway (CR.) 3) South Eastern Railways (S.E.R.) 4) Western Railway (W.R.) 5) Northern Railways (N.R.) 6) North East Frontier Railway (N.F.R) 7) North Eastern Railway (N.C.R.) 8) South Central Railway (S.C.R.) 9) Southern Railway (S.R.) ***(*Note-1/2 mark each, any eight)***	 *****
d) State any four factors affecting the Rail Alignment.	
Ans:- Factors governing the rail alignment. 1) Length of the track should be as short as possible. 2) Construction charges should be minimum. 3) It should be cheap in maintenance. 4) It should have easy gradients so that locomotive can haul more load and transport charges	 *****

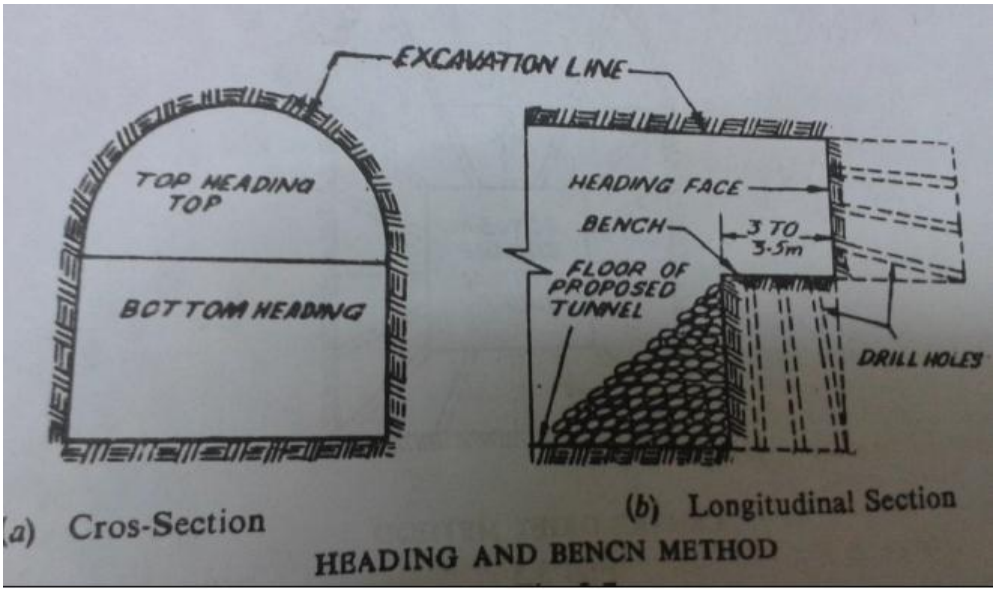
may be minimum 5) It should have easy curves. 6) It should give maximum safety to the passengers without any chance of accident. 7) It should pass through important cities and industrial areas. 8) It should pass through aesthetic areas so that passengers may enjoy their journey. ***(*Note – 1 mark each , any four)***	
e) Draw neat sketch of standard c/s of B.G. in cutting and embankment.	
Ans:-  **Single broad gauge line in embankment.**  **Cross-section of a single broad gauge track in cutting**	**02** **02**
f) State types of bridge foundations.	
1) Open foundation :- a) Wall footing, b) Isolated footing, c) Combined footing, d) Inverted arch footing, e) Continuous footing, f) Cantilever footing, g) Grillage footing, and h) Stepped footing. **2) Pile foundation :-** a) Bearing Pile. b) Friction Pile. c) Screw Pile. d) Compaction Pile. e) Uplift Pile. f) Batter Pile. g) Sheet Pile. **3) Raft foundation**. **4) Well foundation :-** a) Box caissons. b) Open caissons or well caissons . c) Pneumatic caissons. ***(*Note -1/2 mark for each , any eight from all)***	*****

Q.3. Attempt any FOUR of the following:	**16**
a) Define creep of Rails? What are its causes.	
Ans:-Creep of rails:- The longitudinal movement of rails in a track is known as creep of rails. **Causes of Creep of rails**:- i) Wave action or wave theory ii) Accelerating or starting of train iii) De-accelerating or stopping of train iv) Percussion theory v) Expansion and contraction of rails due to variation in temperature. vi) Intensity of traffic. vii) Alignment of the track viii) Gradient of track.	**02** **02 (for any four)**
b) Explain with sketch coning of wheels.	
Ans:- sketch coning of wheels  Figure coning of wheels **Coning of wheel**:- The art of providing an outward slope of 1 in 20 to the treads of wheels of rolling stock is known as coning of wheels. The wheels of rolling stock are provided with flanges on the inner side of rails forming the track.	**02** **02**
C) Write any four functions of Ballast.	
Ans:- **Functions of Ballast**:- i) To provide cushion effect to the track since it acts as elastic medium in between the sleepers and the formation. ii) To provide firm bed for the slippers to rest upon. iii) To uniformly distribute the load of train from the sleepers on a large area of the subgrade or formation. iv) To hold the sleepers in the correct position and thus preventing their lateral and longitudinal movements. v) To provide an easy means of maintaining the required level of the two rails in a track and correcting track alignment.	*

vi) To drain off the rain water from the track quickly and to provide a well-drained foundation bed immediately below the sleepers. vii) To protect the top surface of formation. viii) To prevent growth of weeds inside the track. ***(*Note -1 mark for each , any four from all)***	
d) Define gradient and State its types.	
Ans:- **Gradient**:- The rate of rise or fall provided to the formation of railway track along its alignment is known as gradient **Types of gradient**:- i) Ruling gradient ii) Momentum gradient iii) Pusher gradient iv) Station yard gradient	**02** **(1/2 mark each)**
e) Draw the line sketch of diamond crossing and cross over.	
Ans:-  Fig. Diamond crossing  	**02** **02**

f) Explain clear span, effective span and economical span of bridges.	
Ans:- 1)Clear span- The clear distance between any two adjacent supports of bridge superstructure is called clear span. **2)Effective span** – The centre to centre distance between any two adjacent supports (abutment and pier or between two piers) of bridge superstructure is called effective span. **3)Economical span** – The span for which the total cost of bridge is minimum is known as economical span.	**01** **02** **01**
Q. 4. Attempt any TWO of the following:	**16**
a) Name methods used for tunnelling in hard rock. Explain any one with sketch.	
Ans:- Methods of tunneling in hard rock 1. Full-face heading method. 2. Heading and bench method 3. Drift method. **1) Full face heading method :—**This method is so called because in this method, the whole section of the tunnel is attacked at the same time. In this method, drilling is done on the whole section of the proposed tunnel and the drill holes are charged with explosive and blasted at a time. After excavating one round or pull of the tunnel, drilling is started for the next round or pull and this process is repeated till the whole tunnel is drived . Tunneling by full face heading is done in the following steps: (a) Setting up and drilling (b) Charging and blasting. (c) Scaling (d) Mucking (e) Tunnel supporting (f) Grouting and lining.  (a) When Tunnel is Small (b) When Tunnel is Large FULL FACE HEADING METHOD ---------- **OR** ---------- **2) Heading and bench method of tunneling** In this method, the driving of tunnel is done in two portions of its section. The driving of top portion is done in advance of the bottom portion After driving the top portion 3.0 to 3.5m , holes are driven into the head & bench. Then these holes are loaded together with explosives for blasting. Firing of these bench holes is just done before the heading holes are fired. After this mucking is done manually.	**02** *** (See Note)**

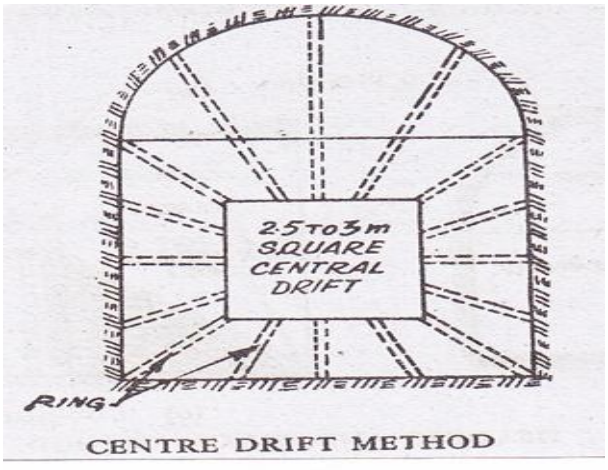
This method is suitable for large tunnels & where quality of rock is not very satisfactory



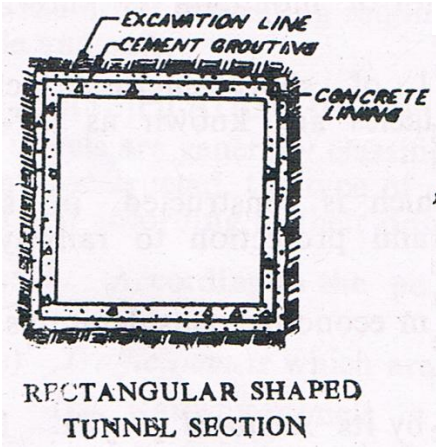
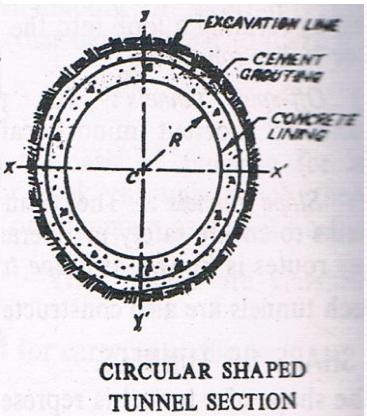
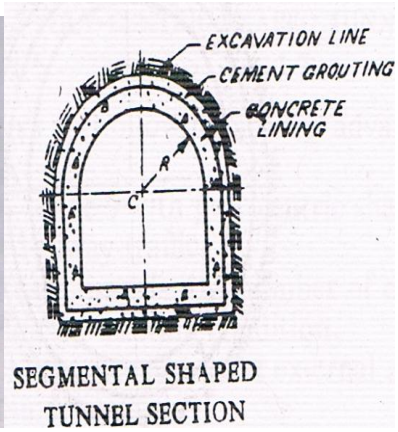
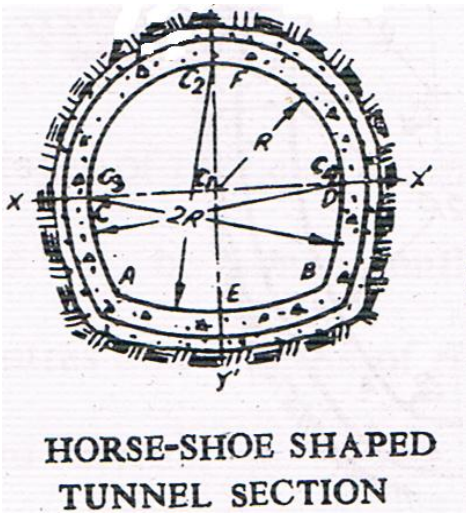
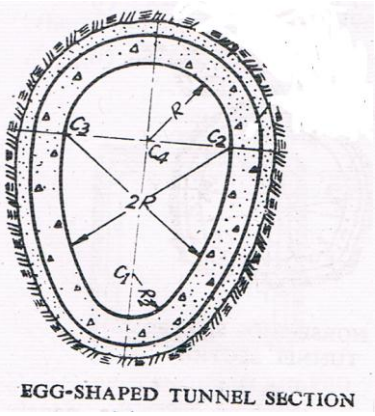
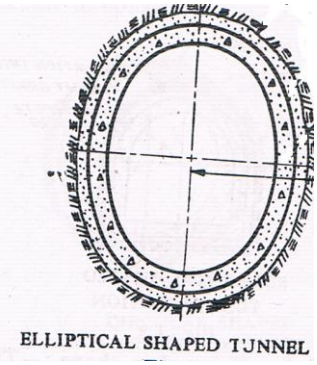
---------- OR ----------

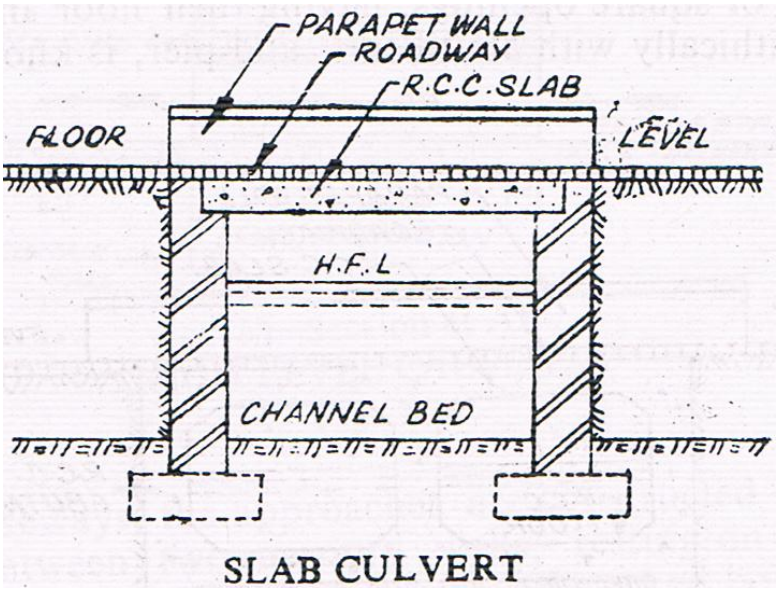
3) Drift method :-A drift means a hole of considerable size, driven in the face of the proposed tunnel. In this method, since a drift is made first which is further widened for driving any section of the tunnel, it is called Drift method. The position of drift may be in the side or center, but central drift is the best.

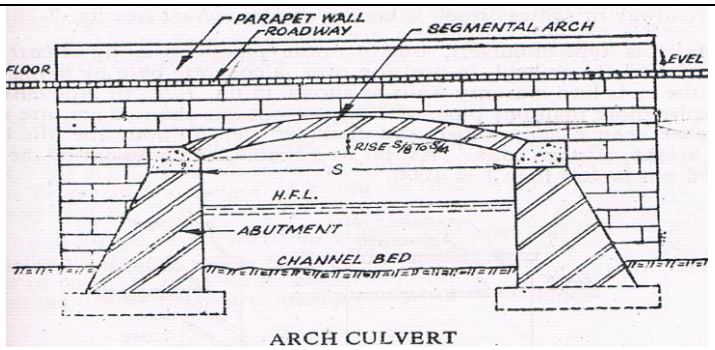
For tunneling by this method, a drift is driven usually in the center of the proposed tunnel. The size of the drift is kept sufficient to accommodate the tunneling machinery, labour and mucking equipment's etc. After making the central drift, holes are drilled for widening the face of the proposed tunnel. These drilled holes are then loaded with a suitable explosive and fired step by step as shown in fig.



(*Note- for any one method , 03 marks for explanation and 03 marks for sketch)

b) Classify tunnels based on shape and purpose. Draw four types of shapes of tunnels used in highways.	
Ans:- Classification of tunnels based on purpose:- **a) Traffic tunnels:-** 1)Railway tunnels 2) Highway tunnels. 3) Pedestrian tunnels. 4) Navigation tunnels. 5)Subway tunnels. **b) Conveyance tunnels:-** 1)Hydro-power tunnels. 2)Water supply tunnels. 3) Tunnels for intake and conveying public utilities . 4)Sewage tunnels. 5)Transporting tunnels use in industrial plans**.** **Classification of tunnels based on shapes :-** 1) Rectangular or box type shape 2) Circular shape 3) Segmental shape 4) Horse shoe shape. 5) Egg type shape 6)Elliptical shape 7) Poly-centric shape.  RECTANGULAR SHAPED TUNNEL SECTION  CIRCULAR SHAPED TUNNEL SECTION  SEGMENTAL SHAPED TUNNEL SECTION  HORSE-SHOE SHAPED TUNNEL SECTION  EGG-SHAPED TUNNEL SECTION  ELLIPTICAL SHAPED TUNNEL	**02** **02** ***1 mark each (any Four)**

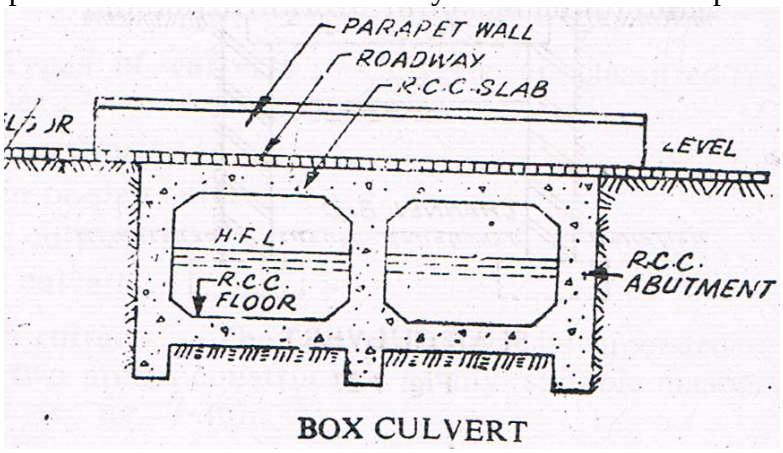
c) State points to be considered in special maintenance of bridge.	
Ans:- Special maintenance of bridges includes the following maintenance and jobs - (a) Repairs to formation of cracks, developed in R. C .C piers and abutments due to settlement or due to the absence of expansion joints' (ii) Repairs to breaking of surfaces as a result of using b or stones of insufficient strength (iii) Repairs to exposed reinforcement due to disintegration- concrete.' (iv) Any such repair of special character like preventive measure for excessive scour causing undermining, etc.	**02** **02** **02** **02**
Q.5. Attempt any FOUR of the following:	**16**
a) Define culvert ? Explain any one type with neat sketch.	
Ans:- Culvert – A culvert is defined as a small bridge constructed over stream which remains dry for most part of the year. **Slab culvert-** a slab culvert consist of stone slab or R.C.C. slab. The slab culvert of simple type are suitable up to a maximum span of 2.5 m or so. The RCC culvers of deck slab type can be economically be adopted up to span of about 8 m . The construction of slab culvert is relatively simple as the frame work can easily be arranged , reinforcement can be suitably placed and concreting be done easily. This type of culvert can be used for highway as well as railway bridges.  SLAB CULVERT ---------- OR ---------- **Arch culvert**-The culvert having its superstructure consisting of one or two arches constructed of any suitable masonry is known as arch culvert In this culvert segmental arches consisting of brick masonry, Stone masonry or concrete are commonly used.	**01** **01** **02**



ARCH CULVERT

---------- OR ----------

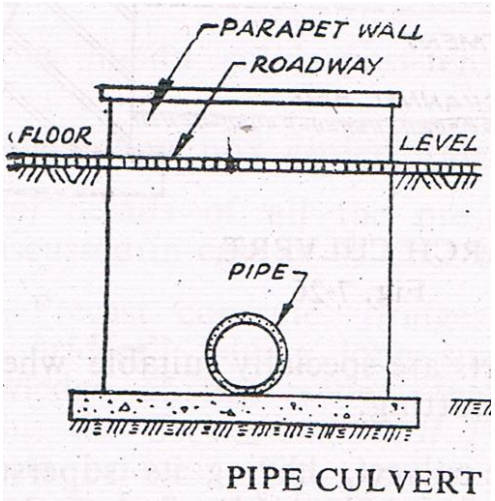
Box culvert-This consist of one or more numbers of rectangular or square openings, having their floor and top slabs constructed monolithically with abutments and pier.



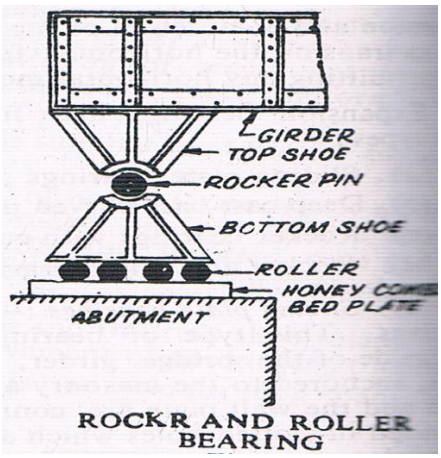
BOX CULVERT

---------- OR ----------

Pipe culvert-This consist of one or more pipes, placed side by side over concrete base, below the embankment of road way or railway track The gradient of pipe should not be less than 1 in 1000.



PIPE CULVERT

b) What is Rocker-Roller bearing? Draw a neat sketch of it.	
Ans:- It is a end bearing provided below the girder of bridge having span more than 25m. It has 20 cm radius circular rocker pin placed between top shoe and bottom shoe. The bottom shoe rests on cylindrical rollers which are free to roll on bottom steel plate.  ROCKR AND ROLLER BEARING **(*Note –Explanation 2 mark and 2 mark for sketch)**	*
C) State the factors governing the selection of a bridge site.	
Ans:- Factors governing the selection of a bridge site: 1)Straight reach of the stream. 2)Well defined firm banks. 3)Stream line flow. 4)Minimum width and right angle crossing. 5)Firm Foundation. 6)Dry bed of approach embankments. 7)Availability of construction materials. 8)Availability of labours from local and nearby area. **(*Note-1/2 marks for each point)**	*
d) Write a note on Inspection of bridge.	
Ans:- Inspection of bridge: It is the most important job to be done by the experts so that defects can be noticed and then the defects should be removed as early as possible. Following component parts of the bridge are inspected.	
1)Foundations: Sinking of foundations, bed level of river as compared with original bed level, depth of scoring, cracks in masonry work, etc. are inspected.	**01**
2)Sub Structure: Proper function of weep holes, pointing work of masonry, cracks in masonry, water proofing coats etc. are inspected.	**01**
3)Super structure: free action of expansion joints, corrosion of steel structures, condition of paints, anchorage cables etc., cracks in R.C.C. work, masonry works, side drains, foot path, approaches etc. are inspected.	**01**
4)Protective works: Settlement of protective bunds, width of service road at top, side	**01**

slopes, side erosion, pitching works etc. are inspected**.** After the preparation of inspection report, the repairing is done at the required places in bridges.

e) Compare R.C.C. bridge and Steel bridge (any four).

Ans:-

	RCC Bridge	Steel Bridge
Construction	**01 -** Construction is more strong and durable. **02 -**It requires more time to construct.	Construction is strong but not more durable. It requires less time to construct.
Maintenance	**03** -1Maintenance of R.C.C. bridge is less. **04 -**It resists corrosion Hence no need to paint.	Maintenance of steel bridge is more. It needs frequent painting work to avoid corrosion.
Situation	**05** -Where the traffic is heavy but does not cause sudden impact. **06 -**Generally preferred for Road Ways	Where the loads are very heavy causing vibrations and impacts. Generally preferred for Railways.

(*Note-1 marks for each point , any four)

*

I) List the important equipment's and machines used in tunnel construction with their use.

Ans:-

Sr.	**Equipment's/Machine**	**Uses of equipment's/ Machine**
1	Theodolite	For making the alignment of tunnels.
2	Plumb-bobs with piano wires	For transferring the alignment (center line) of tunnel to the bottom of shaft.
3	Spads	For making the center line inside the proposed tunnel.
4	Electrical detonators	For firing the holes drilled and loaded with explosives.
5	Drilling equipment's	To drill the holes.
6	Trench jacks	For centering and formwork of tunnels.
7	Locomotives	For hauling the muck.
8	Travelling forms	For lining.
9	Grouting machines	For placing grout to seal-off water entering the tunnel
10	Loading machines such as shovels, fully revolving shovel, crawler shovel, con-way digger, mine car loaders etc.	For mucking.

(*Note- 1 mark for each point, minimum 4 points)

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Q.6. Attempt any FOUR of the following:	16
a) What is the necessity of ventilation of tunnels? Write four points, name methods of ventilation.	
Ans:-. a) Necessity of ventilation of tunnels. 1) To immediately remove the poisonous gases produced by blasting 2) To keep the whole tunnel free from dangerous gas fumes. 3) To remove the dust produced due to drilling operations 4) To develop the comfortable atmosphere at the face of the tunnel**.** **Methods of ventilation of tunnel:** **Mechanical Method:** 1)Blowing air inside the tunnel 2)By exhausting the air from the tunnel 3) By combination of blowing and exhausting the air. **Natural Ventilation:** The natural flow of air can be increased by constructing shafts at the various places over the tunnel.	**02** **01** **01**
b) Explain the type of survey required during tunnel construction including laying its center line.	
Ans:- The survey-work of a tunnel involves the following operations 1)Locating center line on the ground. 2)Constructing the shafts over the center line. 3) Transferring the center line inside the tunnel**.** **1) Locating Center Line on the Ground:** After deciding the route for the tunnel, its center line is accurately set out on the hills or ground by means of a common theodolite on a calm and clear day when the length of the tunnel is short. If the tunnel is long and to be constructed under high mountains**,** the alignment is set out by triangulation preferably with the help of a micrometer transit theodolite. The alignment is then finally set out by permanent monuments of stone or concrete**.** The position of such permanent monuments should be located by taking offsets from the nearby permanent structures for controlling or checking the alignment till the tunnel project is complete**.** **2. Constructing the Shafts Over the Centre Line:** After setting out the alignment on the ground shafts are constructed at suitable intervals for the transferring the center line to inside of the tunnel**.** **3. Transferring the Center Line Inside of the Tunnel:** After constructing the shafts, the center line of the 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 these pillars, the points corresponding to the center line are correctly marked and a wire is then stretched between them. After this, two plumb-bobs are suspended by piano-wire inside the shaft.	 **01** **01** **01** **01**

C) Write four points about necessity of tunnels.	
Necessity of tunnels :— The provision of tunnels becomes necessary under following circumstances: I) When the surface route of railway track or road for reaching the other side of a hill is much longer and, therefore, costlier in cons ruction than a tunnel. ii) When depth of open cut for reaching the other side of a hill is more and it is costlier to construct and maintain it than tunnel. iii) When the provision of a bridge for carrying road or railway traffic across the river is more inconvenient and costlier than a tunnel under the river bed. iv) When the two terminal stations, separated by a mountain, areto be connected by the shortest route. v) When holding up of traffic for long periods due to traffic congestion is to be avoided and rapid transportation is to be provided in big cities. vi) When acquisition of valuable land and property for a railway or road project is to be avoided. vii) When the route of a railway track or road at high altitude is to be protected from blockage due to snowfall or land slides. viii) When there is necessity of conduction of water for the generation of power.. ix) When there is necessity of carrying public amenities like water , oil, gas etc, across, a stream or mountain economically. x) When damage to transportation system of strategic importance is to be avoided and safety of traffic is desired during aerial warfare. **(*Note- 1 mark for each ,any four point)**	*****
d) Write advantages and disadvantages of tunnel construction (two each).	
Ans:- Advantages :— Following are the advantages of. providing tunnels (1) They carry railway lines, roads and public utilities like water, oil, gas etc., across streams or mountains, economically. (ii) They eliminate excessive cost of maintenance of an open cut subjected land slides. (iii) They connect the two terminal stations by the shortest route. (iv) They help in avoiding holding up of traffic for long periods due to traffic congestion and provide rapid transportation in big cities. (v) They help in avoiding acquision of costly land and, property for a railway or road projects (vi) They provide protection to the railway track or road pavements from the effects of rain and other weathering agencies and thus require less maintenance. (vii) They provide free movement of traffic throughout the year even during snowfall and land slides. (yin) They facilitate less route length, with lighter grades and thus result in less transportation cost (ix) They provide protection to communication routes against damage during aerial warfare (x) They facilitate conduction of water to generate power. **Disadvantages** — Following are the disadvantages of providing tunnels - (i) They may be costlier in construction as compared to open cut (ii) They require more time in their construction as compared to open cut.	**02 (any two)** **02**

(iii) They require special equipment and methods for their construction. (iv) They require skilled labour and supervision in their construction (v) They may cause suffocation if not properly ventilated and thus, result inconvenience to The passengers.	**(any two)**
e) State classification of tunnels.	
Ans:- Tunnels are generally classified on the basis of (a) Purpose for which they are constructed. (b) According to type of materials (Type of soil through with they are driven). (c) According to position of alignment. **(a) Classification of tunnels according to the purpose for which they are constructed** : **They are classified as** 1. Railway Tunnels 2. Highway Tunnels • 3. Navigation Tunnels 4. Subway Tunnels 5. Pedestrian Tunnels **Conveyance Tunnels :** 1) Water Supply Tunnels 2) Hydropower Tunnels 3) Sewage Tunnels 4)Tunnels for Industrial Use 5) Tunnels for Intake and Conveying Public Utilities **(b) Classification of tunnel according to the type of materials (Types of Soil through which they are driven).** 1)Tunnels in Hard Rock 2) Tunnels in Soft Rock 3) Tunnels in Quick Sand . 4) Tunnels under River Bed (Submarine Tunnels) 5) Open-Cut Tunnels **(c) Classification of tunnels according to. Position of alignment.** 1) Saddle and Base Tunnels. 2) Spiral Tunnels. 3) Off-Spur Tunnels. 4) Slope Tunnels.	**01** **01** **01** **01**
f) Define the following terms: **(i) Pier (ii) Approaches (iii) Wing wall (iv) Causeway**	
Ans:-**i) Pier**- Pier are intermediate support for the superstructure for multi-span bridges .These are provided to transmit the load from superstructure of the bridge to the foundation. **(ii) Approaches:-**The portion of the road constructed the reach the bridge from there general route or height is known as approaches**.** **(iii) Wing wall:-** The wall constructed on either side of an abutment to support and protect the embankment are known as wing wall. **(iv) Causeway:-**It denotes a submersible road bridge across stream which is design bad built in such a way that normal dry weather flow passes through vents and occasional floods pass through the vent and over the roadways **.**	**01** **01** **01** **01**