



SUMMER – 2015 EXAMINATION
MODEL ANSWER

Subject: Concrete Technology

Subject Code: 17504

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																				
Q.1	A)	Attempt any three of the following:		12																				
	a)	Enlist four Bogues compounds with their formula and % in OPC.																						
	Ans.	<table border="1"> <thead> <tr> <th>Sr. No.</th> <th>Name of compound</th> <th>Formula</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Tricalcium Silicate (C₃S)</td> <td>3 CaO SiO₂</td> <td>54.1</td> </tr> <tr> <td>2</td> <td>Dicalcium Silicate (C₂S)</td> <td>2 CaO SiO₂</td> <td>16.6</td> </tr> <tr> <td>3</td> <td>Tricalcium Aluminate (C₃A)</td> <td>3 CaO Al₂ O₃</td> <td>10.8</td> </tr> <tr> <td>4</td> <td>Tetracalcium Aluminoferrite (C₄AF)</td> <td>4 CaO Al₂ O₃ Fe₂ O₃</td> <td>9.1</td> </tr> </tbody> </table>	Sr. No.	Name of compound	Formula	Percentage	1	Tricalcium Silicate (C ₃ S)	3 CaO SiO ₂	54.1	2	Dicalcium Silicate (C ₂ S)	2 CaO SiO ₂	16.6	3	Tricalcium Aluminate (C ₃ A)	3 CaO Al ₂ O ₃	10.8	4	Tetracalcium Aluminoferrite (C ₄ AF)	4 CaO Al ₂ O ₃ Fe ₂ O ₃	9.1	<i>1 mark each</i>	4
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	b)	What do you mean by low heat cement and give two properties and two use of it.																						
	Ans.	<p>Low Heat Cement (LHC): It means the type of cement in which less heat is evolved in exothermic hydration reaction. In this cement C₃S and C₃A % is reduced which gives comparatively lesser heat of hydration than OPC.</p> <p>Properties of LHC :</p> <ol style="list-style-type: none"> Fineness = 3200 cm²/gm Soundness = Less than 10 mm Initial setting time = 60 minutes Final setting time = 600 minutes Compressive strength (28 days) = 35 MPa 	2																					
			<i>1</i>																					

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.1	A) b)	<p>Uses of LHC :</p> <ol style="list-style-type: none"> i. Mass concreting work such as Dam, Bridge construction ii. Nuclear power plant iii. Sea walls and break waters 	1	4
	c)	<p>Draw labelled sketch of Vicats apparatus with plunger and initial and final setting time needle.</p>		
	Ans.	<p><i>(Note: Correct labeled sketch of Vicat apparatus- 2 marks, Plunger- 1 mark, IST and FST needle- 1 mark)</i></p>	4	4
	d)	<p>List four physical properties of cement.</p>		
	Ans.	<p>Physical Properties of Cement :</p> <ol style="list-style-type: none"> i. Fineness ii. Normal or Standard consistency iii. Initial and Final setting time iv. Soundness v. Compressive strength 	1 mark each (any four)	4



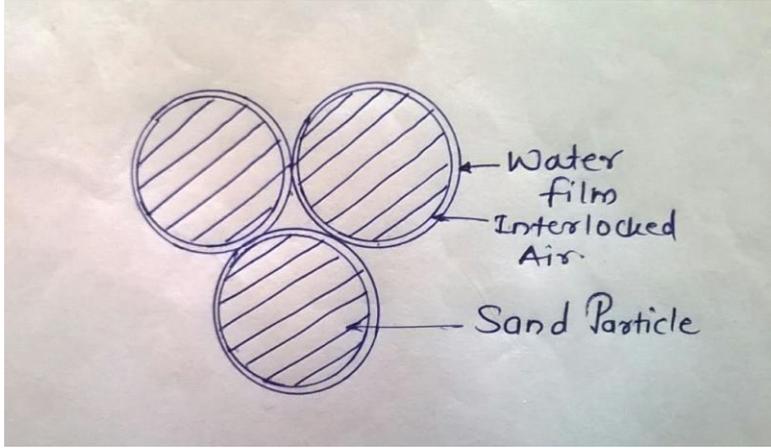
Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.1	B)	Attempt any one of the following.		6
	a)	Define terms- specific gravity, bulk density and % water absorption.		
	Ans.	Specific gravity: It is the ratio of density of aggregate to the density to water.		
		Bulk density: It is the ratio of weight of aggregate (including voids) to its unit volume.		
		% Water absorption: It is the ratio of weight of water absorbed to weight of dry aggregate; measured in percentage.		
	b)	Explain step by step procedure for determination of aggregate crushing value.		
	Ans.	Procedure for determination of aggregate crushing value : i. Take air dried aggregate passing through 12.5 mm and retained on 10 mm IS sieve. ii. Fill it in crushing mould within 3 layers. Compact each layer 25 times using tamping rod. iii. Calculate the weight of aggregate filled by subtracting empty weight of crushing mould as W1 gms. iv. Now, keep the mould under plunger of compression testing machine and apply load 4 ton per minute for total 10 minutes; so that aggregate will crush. v. Sieve the crushed material through 2.36 mm IS sieve and take the weight of aggregate retained on this sieve as W2 gms. vi. Finally calculate percentage Aggregate Crushing Value i.e. % ACV as $(W2 / W1) \times 100$.	2 marks each	6
Q.2		Attempt any four of the following.		16
	a)	State necessity of supervision for concrete operation.		
	Ans.	Necessity of supervision for concrete operation : i. Supervision is necessary to complete all concreting operations in standard manner. ii. It is necessary to avoid any type of delay in concrete work. iii. It is also beneficial to reduce wastage of concrete during concreting. iv. It is required to get overall quality in concrete work at site v. Supervision becomes essential in maintaining smooth flow of concreting operations at each stage of project. vi. It found very effective in controlling bad workmanship.	1 mark each (any four)	4



Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.2	b)	Define water cement ratio and give two different grade of concrete with strength value and nominal mix proportion.		
	Ans.	Water cement ratio: It is the ratio of weight of water to weight of cement. $W/C \text{ ratio} = W_w / W_c$ Different grade of concrete with nominal mix proportion and strength value : i. M 10 (1 : 3 : 6) = 10 N/mm ² ii. M 15 (1 : 2 : 4) = 15 N/mm ² iii. M 20 (1 : 1.5 : 3) = 20 N/mm ² iv. M 25 (1 : 1 : 2) = 25 N/mm ²	1	4
	c)	Define segregation and bleeding of concrete. List any one factor which affect above properties.		
	Ans.	Segregation: It is defined as the separation of constituents of concrete from each other. Bleeding: It is a particular type of segregation in which water comes out to the top surface of concrete. Factors affecting segregation and bleeding : i. Inaccurate water cement ratio ii. Improper mixing iii. More height of concrete placing iv. Excessive or over vibration	1 ½ 1 ½ 1 (any one)	4
d)	Define workability and list four factors affecting workability.			
Ans.	Workability: It is the ability of concrete for its easy handling in various concreting operations viz. Mixing, transportation, placing and compacting. Factors affecting workability : i. Water content (W/C ratio) ii. Mix proportions of concrete iii. Size of aggregate iv. Shape of aggregate v. Surface texture of aggregate vi. Grading of aggregate vii. Use of admixtures	2 ½ mark each (any four)	4	



Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.2	e)	Enlist two advantages of NDT and list four methods of NDT.		
	Ans.	Advantages of NDT : i. The strength can be tested without physical breaking of concrete; hence it is safe. ii. It can give internal flaws, cavities and homogeneity details of concrete within short period. iii. It avoids wastage of concrete, hence becomes economical up to certain extent. iv. It is applicable in any type and position of concrete members shows wide applicability. v. Its results are simple and easy to interpret.	1 mark each (any two)	4
		Methods of NDT : i. Surface hardness test using pistol and impact hammers ii. Rebound test using rebound hammer iii. Penetration and pullout technique using spit pin and Windsor probe iv. Dynamic or vibration test using ultrasonic pulse velocity v. Radioactive and nuclear method using X-ray and Gamma ray vi. Magnetic and electrical method using microwave absorption vii. Acoustic emission technique	1/2 mark each (any four)	
	f)	State two objectives of mix design and list six factors affecting concrete mix design.		
	Ans.	Objectives of mix design : Mix design is done for following objectives i. To achieve a specified compressive strength of concrete. ii. To reduce wastage of concrete by correct proportioning. iii. To achieve economy by selecting appropriate concrete ingredients. iv. To maintain workability of concrete mix throughout work. v. To obtain maximum possible yield per bag of cement.	1/2 mark each (any two)	4
		Factors affecting concrete mix design : i. Water-Cement ratio ii. Cement content iii. Grading of aggregates iv. Consistency v. Admixtures vi. Strength requirement vii. Field or site weather conditions.	1/2 mark each (any six)	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.3	b)	Explain with sketch bulking of sand.		
	Ans.	<p>i. Bulking of sand means increase in volume of sand due to surface moisture.</p> <p>ii. The volume of sand increases with increase in moisture content up to a certain limit and thereafter it begins to decrease.</p> <p>iii. Maximum increase in volume may be up to 20 to 40% when moisture content is 5 to 10% by weight.</p> <p>iv. Bulking is due to thin film of water around the sand grains and the interlocking of air between the sand grains and the film of water.</p> <p>v. The film of water produces surface tension and keeps the sand grains away from each other.</p> <div style="text-align: center;">  <p>Fig. Bulking of sand</p> </div>	2	4
	c)	Define Flaky and Elongated aggregate.		
	Ans.	<p>Flaky aggregate: The aggregate is said to be flaky when its least dimension is less than $\frac{3}{5}$th of its mean dimension. These aggregates are angular, having small thickness as compared to width where mean dimension is the average of size through which the aggregate passes and the sieve size on which it retained.</p> <p>Elongated aggregate The aggregate is said to be elongated when its length is $\frac{14}{5}$th times its mean dimension. These aggregates are angular, having small thickness as compared to length.</p>	2	4



Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.3	d)	Describe step by step procedure to determine aggregate impact value.		
	Ans.	<ol style="list-style-type: none">i. Prepare the test sample by sieving the given aggregate. The sample shall pass through 12.5mm sieve and retained on 10mm sieve.ii. Dry the sample in an oven at temperature between 100⁰c to 110⁰c for four hours and cool it.iii. Fill the cylindrical measure in three layers taking care to tamp each layer by tamping rod with 25 strokes.iv. Weigh this sample (A).v. Remove the sample from the measure and fill it in the metal cup fixed to base plate. Tamp it with 25 strokes. Weigh the metal cup. Find the weight of sample (W1) by deducting weight of empty cup from it.vi. Raise the hammer till its lower face is 380mm above upper surface of the sample and allow it to fall freely on the sample give 15 similar blows at an interval of not less than one second.vii. Remove the crushed aggregate from the cup and sieve it through 2.36mm sieve.viii. Weigh the fraction passing through 2.36mm sieve. (Recorded as W2)ix. The fraction retained on the sieve shall also be weighed (W3).x. If the total weight (w2+w3) is less than initial weight W1 by more than one gram, the result shall be discarded and fresh test is made. Two tests shall be carried out. Aggregate impact value = $(W2/W1) \times 100$ <p><i>(Note: Marks should be given as per written procedure)</i></p>	4	4



Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.3	e)	State the working of rebound hammer and list two limitation of it.		
	Ans.	Working of rebound hammer: i. It consists of spring control hammer that slides on a plunger within a tubular housing. ii. When the plunger is pressed against the surface of concrete, the mass is rebound from the plunger. iii. The hammer impacts against the concrete and the spring control mass rebound, taking the rider along with the guide scale. iv. By pushing a button the rider can be held in position to allow the reading to be taken. The distance travelled by the mass is called rebound hammer. v. The test can be conducted horizontally, vertically, upwards or downward or at any intermediate angle. Limitations of Rebound hammer test i. The results depend upon type of cement, coarse aggregates and their sizes. ii. It also depends upon age of specimen and moisture condition of the concrete.	3	4
Q.4	A)	Attempt any three of the following:		12
	a)	List two materials used for form work and give six good requirement of form work.		
	Ans.	The materials generally used for formwork are: i. Timber ii. Steel iii. Plywood iv. Aluminum Requirement of good formwork i. It should be strong enough to resist the weight of concrete, workers and machinery. ii. It should be economical compared to total cost of construction. iii. It should be possible to use the formwork for more number of times. iv. It should give smooth finish and shape to concrete faces. v. It should be possible to erect and dismantle the formwork very easily. vi. It should be easily and locally available. vii. It should be rigid enough to retain its shape without any deflection.	1 mark each (any two)	4



Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.4	A) b) Ans.	<p>List six precautions while placing of concrete.</p> <p>The precautions to be taken while placing concrete are as follows:</p> <ol style="list-style-type: none">All the loose earth must be removed from the bed before placing concrete.Any root of trees passing through foundation must be cut, charred or tarred effectively to prevent its further growth.The surface of earth, if dry, must be just made damp so that the earth does not absorb water from concrete.The concrete should not be thrown from a height of more than 1m to prevent segregation.The placement of concrete should be discontinued during rainy periods.The placing of concrete should start width wise in reinforced cement concrete slabs from one end.The concrete should be laid continuously in order to prevent the formation of irregular and unsightly lines.Before placing concrete it should be check that the reinforcement should be correctly tied.	4 marks (any six)	4
	c) Ans.	<p>Give two methods of batching and compaction.</p> <p>Methods of batching: Batching is done in following two ways;</p> <ol style="list-style-type: none">Volume batching:<ol style="list-style-type: none">In volume batching the ingredients to produce the concrete mix are measured by volume.It is not good method for proportioning the material because of the difficulty it offers to measure angular materials in terms of volume.This type of batching may be adopted for any small work.Weight batching<ol style="list-style-type: none">In weight batching the ingredients to produce concrete mix are measured by weight.Weight batching of aggregate is generally preferred because it is the correct method of measuring the material.This method of batching is much more accurate than volume batching.This type of batching is adopted where high quality concrete is required.	1 1	
		<p>Methods of compaction</p> <p>The following methods are adopted for compacting the concrete:</p> <ol style="list-style-type: none">Hand compaction<ol style="list-style-type: none">Hand compaction of concrete is adopted in case of unimportant work of small magnitude.Hand compaction consists of rodding, ramming or tamping.When hand compaction is adopted, the consistency of concrete is maintained at higher level.	1	



Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.4	A) c)	<p>ii. Compaction by vibration:</p> <p>a. Where high strength is required, it is necessary that stiff concrete, with low water/cement ratio be used.</p> <p>b. To compact such a concrete mechanically operated vibratory equipment must be used.</p> <p>c. The modern high frequency vibrators make it possible to place economically concrete which is impracticable to place by hand.</p>	<i>1</i>	4
	d) Ans.	<p>Give importance and need of water proofing.</p> <p>Importance of water proofing:</p> <p>i. It reduces permeability as well as damage to structures.</p> <p>ii. It increases durability and strength.</p> <p>iii. It keeps good sanitation of building.</p> <p>iv. It prevents paint and appearance of building from damage.</p> <p>Need of waterproofing</p> <p>i. Due to defective construction there is need of waterproofing.</p> <p>ii. Poor drainage at building site causes leakages in structure, therefore, need arises for waterproofing.</p> <p>iii. If ground water table is at shallow depth, then, in case of basement waterproofing is needed.</p> <p>In case of retaining wall to prevent the seepage from wall, waterproofing is necessary.</p>	<i>1 mark each</i>	4
			<i>2</i>	



Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.4	B)	Attempt any one:		6
	a)	Define curing and list four methods of curing and explain in brief any one.		
	Ans.	<p>Curing may be defined as the operation of maintaining humidity and temperature of freshly placed concrete during some definite period following placing, or finishing to assure satisfactory hydration of the cement and proper hardening of the concrete.</p> <p style="text-align: center;">Or</p> <p>Curing may be defined as the process of keeping the concrete moist and warm enough so that the complete hydration of the cement can take place</p> <p>Following are the methods of curing:</p> <ol style="list-style-type: none">i. Water curingii. Membrane curingiii. Application of heativ. Miscellaneous methods <p>i. Water curing:</p> <ol style="list-style-type: none">1. This is the best method of curing, because it satisfies all the requirements of curing.2. The precast concrete items are normally immersed in curing tanks for certain duration.3. Pavement slab, roof slab etc. are covered under water by making small pond.4. Water curing can be done in following ways:<ol style="list-style-type: none">a. Immersionb. Ponding methodc. Spraying or foggingd. Wet covering. <p>ii. Membrane curing</p> <ol style="list-style-type: none">1. Sometimes concrete works are carried out in places where there is acute shortage of water. Therefore lavish application of water for water curing is not possible for the reason of economy.2. Normally for making concrete more than sufficient water is used to hydrate the cement. But this water should not be allowed to get out from the body of concrete. For this reason concrete can be covered with membrane which will effectively seal the concrete.3. A membrane will prevent the evaporation of water from the concrete. The membrane can be either in solid or liquid form. It is also known as sealing compound.4. Other membrane curing sealing compounds are: Rubber latex emulsion, emulsion of resins, varnishes etc.	<i>1</i>	
			<i>1</i>	



Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.4	B) a)	<p>iii. Application of heat:</p> <ol style="list-style-type: none">1. The development of strength is not only a function of time but also that of temperature.2. Concrete subjected to higher temperature accelerates the hydration resulting in faster development of strength.3. Prefabricated members are normally steam cured.4. In this method the ingredients of concrete heated and the strength is gained at very fast rate. <p>This can be done in following manner:</p> <ol style="list-style-type: none">a. Steam curingb. Curing by infra-red radiationc. Electrical curing <p>iv. Miscellaneous method</p> <ol style="list-style-type: none">1. Calcium chloride is used either as a surface coating or as an admixture. It has been satisfactorily used as a curing medium.2. Both of these based on the fact that calcium chloride, being a salt shows affinity for moisture.3. The salt not only absorbs moisture from atmosphere but also retains it at the surface. <p>The moisture held at the surface prevents the mixed water from evaporation and thereby keeps the concrete wet for a long time to promote hydration.</p> <p><i>(Note: Any one of the above method could be considered)</i></p>	4	6



Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.4	B) b)	<p>List type of joints and give procedure for joining old and new concrete.</p> <p>Ans. Joints in concrete are categorized as under:</p> <ul style="list-style-type: none">i. Construction jointsii. Expansion jointsiii. Contraction jointsiv. Isolation joints <p>Joining old and new concrete: When new concreting is done in continuation with old concrete after a gap of some days, months or even years, then the new and old concrete must have a strong bond with each other. Hence some points should be kept in mind for joining old and new concrete.</p> <p>Procedure:</p> <ul style="list-style-type: none">i. Cleaning: The old concrete surface is first thoroughly cleaned with wire brush. Loose material if any, should be clean first.ii. Chiseling: The old concrete surface is made rough by denting it with a chisel for a strong bond with new concrete.iii. Application of cement slurry or paste with some admixtures: The surface is then wetted with rich cement slurry. Sometimes an admixture has to be added to give additional strength to the joints. Then fresh concrete is placed over the old concrete.iv. Providing overlap: To give homogeneity to the reinforcing bars, overlap is provided and the overlap portion is bound tightly with high tensile wire.	<p><i>1/2 mark each</i></p> <p><i>1 mark for each step</i></p>	6



Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.5		Attempt any four of the following:		16
	a)	What is an admixture? Enlist any three admixtures and its effect on concrete.		
	Ans.	Some materials are added in concrete to improve few properties & to get required results these materials added are known as admixtures.	<i>1</i>	
		Types of admixtures and its effect on concrete:		4
		1. Accelerating: a. Increase rate of hydration of cement b. Water reducing	<i>1</i>	
		2. Retarding: a. To delay setting time b. Water reducing	<i>mark each</i>	
		3. Water proofing: a. Damp-proofing b. Permeability reading		
	b)	Give four advantages of RMC & two uses of it.		
	Ans.	Advantages of RMC: i. RMC can be ordered in bulk amount at a time. ii. It has more homogeneity as compared to other concrete. iii. It becomes economical in large projects. iv. It can be easily transported at a longer distance without hardening.	<i>½ each (any four)</i>	
		RMC are used for following purposes:		4
		i. RMC is very useful in highly congested urban areas, where space for mixing is unavailable. ii. RMC helps to increase speed for construction in high rise building. iii. It also suits the requirements of mass concreting works like dams, bridges, roads, etc. iv. It is prepared in computerized machine plant, hence it is useful to reduce labour requirement up to some extent.	<i>1 mark each (any two)</i>	
	c)	List effect of hot weather on concrete.		
	Ans.	i. Accelerated settings ii. Reduction in strength iii. Increase tendency to cracking iv. Rapid evaporation during curing v. Difficulty controlling the air content	<i>1 mark each</i>	4
	d)	List trade names for different type of admixture.		
	Ans.	Trade names of admixture: 1. MURAPLAST – FK- 61 2. VINSOL RESIN DAROX 3. CONPLAST 4. DR. FIXIT	<i>1 mark each</i>	4



Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.5	e) Ans.	List eight different types of admixtures. i. Accelerating admixture ii. Retarding admixture iii. Water proofing iv. Air- entraining admixture v. Super-plasticizers admixture vi. Pozzolana admixture vii. Pigments admixture viii. Plasticizers admixture	<i>1/2 mark each</i>	4
	f) Ans.	List four types of special concrete & explain in brief about Self Compacting Concrete. Types of special concrete: i. Ready mix concrete ii. Reinforced concrete iii. Prestressed concrete iv. Light-weight concrete v. Fiber reinforced concrete vi. Precast concrete vii. High performance concrete viii. Polymer concrete Self compacting Concrete: Self compacting concrete is defined as the concrete which gets leveled under its own weight without any external vibration. It can be prepared by using suitable mineral admixture like flyash, silica fume and chemical admixtures like accelerators, super plasticizers, etc. It was first invented by Prof. Okamura in Japan (1988). It has wider applications in highly reinforced sections, thinner sections where ordinary compaction is not possible.	<i>1/2 mark each (any four)</i>	4



Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.6		Attempt any four of the following:		16
	a)	List method of transportation & give 4 precautions to be taken during transportation.		
	Ans.	Method of transportation: i. Mortar pan ii. Crane, bucket, rope way iii. Wheel barrow and hand cart iv. Truck mixer and dumper v. Belt conveyer vi. Skip and hoist vii. Transit mixer viii. Pump and pipe	<i>1/2 mark (any four)</i>	4
		Precautions to be taken during transportation: i. The distance between mixing plant and working site should be kept minimum as far as possible to avoid delay in progress. ii. While transportation, concrete should not get hardened. Hence, mix should have w/c ratio. iii. Concrete mix should be covered with polythene to avoid hardening in open trucks. iv. There should not be any leakage of cement slurry from mix.	<i>1/2 mark each</i>	
	b)	Draw a sketch of expansion joint with load transfer device.		
	Ans.	<p style="text-align: center;">Expansion joint with load transfer device</p>	<i>2 marks for sketch</i> <i>2 marks for labeling</i>	4

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
Q.6	e)	<p>Describe the slump cone test with sketch.</p> <p>Test Procedure:</p> <ol style="list-style-type: none"> i. Clean the mould from inside ii. Place the mould on smooth horizontal, rigid & non-absorbent surface or the centre of metallic tray. iii. Fill the mould with the concrete to be tested in four layers, tamping each layer 25 times with the tamping rod, taking care that the strokes are evenly distributed over the c/s. iv. Remove the mould by one smooth continuous vertical motion. v. The concrete subsides & this subsidence is called “slump.” Measure the slump in mm by using a metric scale. 	2	
	Ans.	<p>Figure:</p> <p style="text-align: center;">Fig. slump cone test</p>	1	4