Ref	Part	Date	QNo	Question	Category	Topic area
21	1	20-May-87	3.0	BS12 gives an expression from which the lime saturation factor for a Portland cement can be calculated. Explain the basis of this expression. Discuss the significance of lime saturation factor in the technology of Portland cement. What difference may be apparent in the behaviour of two consignments of ordinary Portland cement from the same works, having the same fineness but dissimilar time saturation factors? Three cements were analysed and the following results obtained: Calculate the compound composition of these cements based on the Bogue Formulae given on the data sheet supplied. Identify the three types of cement explaining fully the reasons for your conclusions.	01.00.00	Cements
93	1	25-Apr-96	3.1	Describe the important effects of the following clinker components on the properties of Portland cement concrete: (I) C_3A (ii) C_3S	01.02.00	Cements
148	1	13-Apr-00	7.1	The composition of Portland cement may be expressed in terms of oxides. List the main oxides and state typical percentages of each.	01.02.00	Cements
165	1	18-Apr-02	6.1	From the following table, listing properties of four CEM 1 cements (according to EN 197-1), state, giving reasons, which cement would be expected to give: (I) the highest early strength (ii) the lowest early strength (iii) the lowest long term (>56 days strength) (iv) the darkest colour concrete	01.02.00	Cements
166	1	18-Apr-02	6.2	Calcium sulfate in the form of gypsum ($CaSO_4$) is added to Portland cement clinker during the milling process. Explain the reasons for this addition and briefly describe the interactions that take place between the clinker minerals and calcium sulfate when cement is mixed with water.	01.02.00	Cements
167	1	18-Apr-02	6.3	Briefly explain why all cement standards have upper limits for the following parameters (i) SO_3 (ii) MgO (iii) Loss on ignition (LOI) (iv) insoluble residue (IR)	01.02.00	Cements
174	1	31-Mar-03	3.1	From Table 1 (properties of 4 CEM 1 cements according to EN 197-1) state, giving reasons, which cement would be expected to give (i) the highest early strength (ii) the lowest early strength (iii) the lowest long term (>56 days) strength (iv) the darkest colour concrete	01.02.00	Cements
175	1	31-Mar-03	3.2	Calcium sulfate in the form of gypsum is added to Portland cement clinker during the milling process. Explain the reasons for this addition and briefly describe the interactions that take place between the clinker minerals and calcium sulfate when cement is mixed with water	01.02.00	Cements
176	1	31-Mar-03	3.3	Briefly explain why all cement standards have upper limits for the following parameters: (i) SO_3 (ii) MgO (iii) Loss on ignition (iv) Insoluble residue	01.02.00	Cements

68	1	21-Apr-94	1.1	Describe the important effects of the following clinker components on the properties of Portland cement concrete: (I) C_3A (ii) C_3S	01.04.00	Cements
69	1	21-Apr-94	1.2	Suggest mechanisms to account for: (I) the retardation of C_3A hydration in the presence of gypsum. (ii) the induction (or dormant) period in the hydration of C_3S.	01.04.00	Cements
70	1	21-Apr-94	1.3	Illustrating your answer with a graph, show how the basic Portland cement hydration reactions can be understood by monitoring the time-dependent heat evolution.	01.04.00	Cements
94	1	25-Apr-96	3.2	Suggest reasons for: (I) the retardation of the hydration of C_3A in the presence of gypsum (ii) the induction (or dormant) period of C_3S	01.04.00	Cements
149	1	13-Apr-00	7.2	Show, using a graph, the differences in rates of hydration, over a six-month period, of the four major cement compounds in a pure state.	01.04.00	Cements
150	1	13-Apr-00	7.3	Explain why the hydration of C_3S does not proceed at a constant rate.	01.04.00	Cements
151	1	13-Apr-00	7.4	Discuss the reaction between gypsum and C_3A when water is added.	01.04.00	Cements
152	1	13-Apr-00	7.5	Outline TWO possible causes of false set.	01.04.00	Cements
95	1	25-Apr-96	3.3	Illustrating your answer with a graph, show how the basic Portland cement hydration reactions can be followed by monitoring the time dependent heat evolution.	01.07.00	Cements
48	1	18-Apr-91	6.1	Give an account of the main features of hydration and strength development of calcium aluminate cement	01.08.00	Cements
58	1	22-Apr-93	4.0	The hydration of calcium aluminate cement produces a strength development curve that is distinctly different from that of Portland cement. (a) Discuss the effect of water/cement ratio on the shape of the strength development curve of calcium aluminate cement concrete and the concept of temporary strength. (b) Discuss the hydrates formed and the changes that they may undergo.	01.08.00	Cements
121	1	12-Apr-99	4.0	The hydration of calcium aluminate cement produces a strength development curve that is distinctly different from that of Portland cement. (a) (i) Discuss the effect of water cement ratio on the shape of the strength development curve of calcium aluminate cement concrete (ii) Discuss the concept of temporary strength. (b) Discuss the hydrates formed and the changes they may undergo. (c) Discuss the principles of mix design for workable concrete mixes using calcium aluminate cement.	01.08.00	Cements
59	1	22-Apr-93	4.0	Discuss the principle of mix design for workable calcium aluminate cement concrete mixes.	01.09.00	Cements

1	1	21-May-86	1.0	It is intended to incorporate ground granulated blastfurnace slag in a designed mix which is to be produced by a ready-mixed concrete supplier. The concrete is to be used in the construction of a sea wall in North East England. The specification limits the cement replacement level to a maximum of 60% and laboratory trials show that the strength requirements can be readily achieved at the maximum replacement level. The concreting work will commence in April and will continue for 10 months. What advice would you give and what precautions would you recommend to (a) the ready-mixed concrete supplier? (b) the contractor?	02.00.00	Additions
33	1	19-Apr-89	2.0	Discuss the use of each of the following as cement replacements in concrete: (a) pulverised fuel ash (b) ground granulated blastfurnace slag (c) microsilica	02.00.00	Additions
81	1	12-Apr-95	2.0	List four forms in which microsilica may be purchased. Give a typical value for one physical property for each form which helps to distinguish between those you have listed. You are the technologist responsible for six ready mixed concrete batching plants from which occasional deliveries of concrete containing microsilica are made. Which of the forms you have listed would you recommend for such an application? Give reasons for your choice, listing any additional problems associated with the storage and handling of the microsilica and the production and delivery of the concrete. List the practical problems that a contractor, inexperienced in the use of ready mixed concrete containing microsilica, might encounter.	02.03.00	Additions
119	1	12-Apr-99	2.0	Discuss the use of each of the following as cementitious components in concrete: (a) Ground granulated blastfurnace slag (b) Metakaolin (c) Pulverised fuel ash.	02.09.00	Additions
86	1	12-Apr-95	5.0	Explain the physical and chemical actions by which the following admistures affect the properties of the fresh and hardened concrete in which they are incorporated: (a) set-retarders (b) water-reducers (c) air-entraining agents.	03.00.00	Admixtures
132	1	13-Apr-00	2.1	Discuss and explain how the deflocculating components of water reducing admixtures affect the performance of the admixtures in concrete.	03.00.00	Admixtures
133	1	13-Apr-00	2.2	Admixtures may be added at any time during the concrete production cycle. Explain how the time of addition can affect the performance of: - water reducing agents - air-entraining agents - retarders.	03.00.00	Admixtures
87	1	12-Apr-95	5.0	In a hot and arid climate there is a need to pump grade C30 concrete into large foundation pours. The ambient temperature during concreting is expected to be about 40°C. State which type, or types, of admixture you would use for this application. Give reasons for your choice.	03.10.00	Admixtures

36	2	20-Apr-89	4.2.0	Discuss the uses of admixtures in such grouts.	03.20.00	Admixtures
154	1	18-Apr-02	1.2	Discuss how superplasticisers and viscosity modifying admixtures modify plastic viscosity and yield stress.	03.22.00	Admixtures
37	1	19-Apr-89	5.0	Describe three natural properties of rock that can reduce its suitability for concrete aggregate explaining how each property may cause the rock to be rejected. You are presented with a 56kg sample of rock fragments, all of the same rock, from a proposed source. How would you investigate the suitability of this material as a concrete aggregate?	04.00.00	Aggregates
43	1	18-Apr-91	2.0	A metal sulphide ore is being extracted from a recently opened mine. As well as the main component of the ore, trace quantities of lead, zinc, copper and arsenic are present. The ore body is present in an igneous intrusion through country rock consisting of thinly bedded siliceous sedimentary tock. To win the ore it is necessary to tunnel through the country rock and the igneous intrusion. The ore-rich material is separated by a flotation system. The waste is washed and graded and is available as an aggregate for concrete. You are the chief concrete technologist for the company which markets the aggregate from this new source. (a) List standard and ad-hoc tests that you would apply to the aggregates to assess their suitability for use in a wide range of concrete. (b) Explain why each of the listed tests is necessary (c) How would you use the data obtained to help you advise on a marketing strategy? What quality control procedures would you adopt for the production of these aggregates?	04.00.00	Aggregates
71	1	21-Apr-94	2.0	Describe three natural properties of rock that can reduce its suitability for concrete aggregate explaining how each property may cause the rock to be rejected. You are presented with a 56kg sample of rock fragments, all of the same rock, from a proposed source. How would you investigate the suitability of this material as a concrete aggregate?	04.00.00	Aggregates
30	1	19-Apr-89	1.3	Define voids ratio of a particulate material and state a typical range for fine aggregates to BS 882 1083.	04.07.00	Aggregates
172	1	31-Mar-03	2.1	Compare and contrast four tests to evaluate the mechanical properties of a coarse aggregate.	04.07.00	Aggregates
110	1	17-Apr-97	4.1	A destructive reaction may occur between certain siliceous aggregates and the alkalis from cement or external sources. Describe the reaction involved and discuss the factors influencing the occurrence of damage.	04.09.00	Aggregates
177	1	31-Mar-03	4.1	A destructive reaction may occur between certain siliceous aggregates and the alkalis from cement or external sources. Describe the reason involved and discuss the factors influencing the occurrence of damage	04.09.00	Aggregates

173	1	31-Mar-03	2.2	Describe and explain the effect of aggregate shape and surface texture on the properties of (i) fresh concrete (ii) hardened concrete	04.10.00	Aggregates
29	2	21-May-87	6.2.0	Examine and describe, including a visual petrological classification, each of the three coarse aggregate specimens provided, labelled A, B and C. These aggregates are being considered for use in a large post-tensioned concrete bridge project. The fine aggregate will be a natural sand. (i) Discuss the investigations that should be made at the aggregate source before a choice of aggregates can be made. (ii) Discuss the types of test needed before making the final selection.	04.11.00	Aggregates
59	2	22-Apr-94	3.1.0	A new precast works is to be set up for the manufacture of prestressed concrete floor units using an extrusion machine to cast a continuous section the full length of the bed, for subsequent sawing to the required unit lengths. In investigating possible aggregate sources, what particular aggregate features would be considered to be of major importance?	04.12.00	Aggregates
2	1	21-May-86	2.1	Illustrating your answer by suitable graphs distinguish between the flow behaviour of (i) a Newtonian liquid and (ii) a Bingham body	05.00.00	Fresh concrete
3	1	21-May-86	2.2	Explain why the workability of concrete cannot be fully characterised by a "single point" test.	05.00.00	Fresh concrete
4	1	21-May-86	2.3	The curves shown in Figure 1 were obtained using Tattersall's two point test for the workability of fresh concrete on two different concrete mixes A and B. Giving your reasons, state: (I) how the slumps of the two mixes would be likely to compare (ii) which mix would be likely to compact more readily by vibration	05.00.00	Fresh concrete
5	1	21-May-86	2.3	By drawing curve on Figure 1, show how the flow behaviour of mix A would be altered by increasing its water/cement ratio while maintaining constant its aggregate/cement ratio.	05.00.00	Fresh concrete
153	1	18-Apr-02	1.1	Using diagram(s) explain the theological principles involved in achieving self-compacting concrete (SCC)	05.00.00	Fresh concrete
98	1	25-Apr-96	5.2	Illustrating your answer with suitable graphs, distinguish between the flow behaviour of (1) a Newtonian liquid (2) a Bingham fluid (body).	05.01.00	Fresh concrete
142	1	13-Apr-00	5.1	Illustrating your answer with suitable graphs, distinguish between the flow behaviour of (1) a Newtonian liquid (2) a Bingham fluid.	05.01.00	Fresh concrete
77	1	21-Apr-94	6.2	Compare the merits and limitations of the following empirical workability tests (i) slump (ii) flow (iii) VeBe.	05.03.00	Fresh concrete
134	1	13-Apr-00	3.1	With regard to transport of fluids within concrete, define the following terms: (I) permeability (ii) sorption (iii) diffusivity (iv) porosity (v) penetrability.	05.03.00	Fresh concrete

76	1	21-Apr-94	6.1	Explain the principles upon which Tattersall's two-point test for workability is based.	05.04.00	Fresh concrete
78	1	21-Apr-94	6.3	The curves shown in Figures 1 and 2 were obtained using the two-point workability test. The four mixes A, B, C and D were similar, apart from differences in water content. Mixes E and F were nominally the same concrete. Giving reasons for your answers: (i) list mixes A, B, C and D in order of increasing W/C ratio (ii) comment on the relative slump and workability of mixes E and F.	05.04.00	Fresh concrete
97	1	25-Apr-96	5.1	Explain why the workability of concrete cannot be fully characterised by a "single point" test.	05.04.00	Fresh concrete
99	1	25-Apr-96	5.3	The curves shown in Figure 1 were obtained using Tattersall's two point test for the workability of fresh concrete on two different concrete mixes A and B. Giving your reasons, state: (I) how the slumps of the two mixes would be likely to compare (ii) which mix would be likely to compact more readily under vibration. By drawing a curve on Figure 1, show how the flow behaviour of mix A would be altered by increasing its water/cement ratio while maintaining constant its aggregate/cement ratio.	05.04.00	Fresh concrete
143	1	13-Apr-00	5.2	Explain why the workability of concrete cannot be fully characterised by a "single point" test.	05.04.00	Fresh concrete
144	1	13-Apr-00	5.3	The lines shown in Figure 1 were obtained using a two point workability test for fresh concrete on two different concrete mixes, A and B. Giving your reasons state (1) how the slumps of the two mixes would be likely to compare (2) which mix would be likely to compact more readily by vibration.	05.04.00	Fresh concrete
145	1	13-Apr-00	5.4	By drawing appropriate lines on Figure 1, show how the flow behaviour of mix A would be altered by: (1) increasing its water cement ratio while maintaining its aggregate cement ratio (2) adding a superplasticiser.	05.05.00	Fresh concrete
79	1	21-Apr-94	7.0	Write notes on EACH of the following topics: (i) measurement of bleeding of concrete (ii) concrete incorporating super-plasticizers (iii) assessment of crushed concrete and masonry for use as a concrete aggregate.	05.06.00	Fresh concrete
105	1	17-Apr-97	1.0	Explain what is meant by "bleeding of concrete" and discuss the effects of bleeding on the properties of concrete. State the main factors influencing the bleeding of concrete and discuss the significance of EACH factor.	05.06.00	Fresh concrete
106	1	17-Apr-97	1.1	Discuss the role of bleeding in: (i) plastic settlement cracking (ii) plastic shrinkage cracking. Describe a method for the measurement of bleeding of concrete	05.07.00	Fresh concrete

92	1	25-Apr-96	2.2	Write notes on the effects of the following on the likely occurrence of early age thermal cracking: (i) cementitious material (ii) formwork (iii) aggregate (iv) casting sequence	06.03.00	Setting & hardening
22	1	20-May-87	4.0	Describe a method for the adiabatic temperature-matched curing of concrete speciments. Discuss the uses, both on site and in the laboratory, for such a system detailing the advantages and the limitations of such a system.	06.04.00	Setting & hardening
68	2	22-Apr-94	6.1.0	You are consulted about cracking in a low, reinforced concrete wall along the central reservation of a rnotorway. The cracking reflects the pattern of the reinforcement on either side of the wall and spalling has exposed one of the reinforcing bars. Discuss the possible causes of the damage.	06.04.00	Setting & hardening
100	2	26-Apr-96	5.0.0	(a) Describe a method for the temperature matched curing of concrete specimens. (b) .Discuss the uses, both in the laboratory and on site, for such a system detailing its advantages and limitations	06.04.05	Setting & hardening
124	2	14-Apr-00	2.2.0	State and explain the measures that should be taken to protect tilt-up panels from the effects of cold weather during the curing period.	06.08.06	Setting & hardening
46	2	23-Apr-93	1.0.0	A heavily reinforced bridge pier, 2.0 m by 4.0 m and 8.0 m high is to be constructed in a hot arid environment. The concrete is specified as grade C50, and the required slump is 125 mm, to permit compaction around the congested reinforcement. Facilities for artificially cooling the materials are not available. Describe the foreseeable difficulties in producing and placing the concrete, and avoiding early-age blemishes or defects; discuss the various measures that might be taken to overcome them. You may assume that any materials you require are available.	06.09.00	Setting & hardening
114	2	18-Apr-97	7.0.0	The specification for in situ, site-batched concrete on a 30 km long road and bridges contract in west Africa states that the temperature of the concrete at the time of placing shall not exceed 20°C and that, once placed, its maximum temperature shall not exceed 60°C and the temperature difference within any pour shall not be greater than 20°C. The air temperature can reach 40°C during the day and can fall to 5°C at night. The concrete production rate is expected to average 45 m^3/h. List and explain the actions you would take to ensure compliance with these specification requirements.	06.09.00	Setting & hardening

142	2	19-Apr-02	7.1.0	(a) List and explain the factors which need to be taken into account when designing a concrete mix to ensure the adequate performance of a reinforced concrete structure for use in a very hot aggressive marine environment. (b) For the structure noted in (a), discuss the special areas of concern during the construction process and describe what additional measures can be introduced to enhance the durability of the structure.	06.09.00	Setting & hardening
145	2	01-Apr-03	2.0.0	A heavily reinforced bridge pier, 2 m x 4 m in plan and 8 m in height, is to be constructed in a hot, arid environment. The concrete is specified as Grade C50 and the required slump is 125 mm to permit compaction around congested reinforcement. Facilities for artificially cooling the materials are NOT available. You may assume that any materials you require are available. Describe the foreseeable difficulties in producing and placing the concrete and avoiding early-age blemishes or defects; discuss the various measures that might be taken to overcome them.	06.09.00	Setting & hardening
125	2	14-Apr-00	2.3.0	State and explain the measures that should be taken to protect tilt-up panels from the effects of hot weather during the curing period.	06.09.05	Setting & hardening
9	1	21-May-86	4.1	Explain with the aid of a graph what is meant by the secant moduls of elasticity of concrete.	07.01.00	Hardened properties
10	1	21-May-86	4.2	For the parallel model applied to concrete, derive the following expression for the modulus of elasticity of concrete, Ec	07.01.00	Hardened properties
11	1	21-May-86	4.3	(I) Show by means of a graph how the value of Ec obtained from the above expression varies with changing volume fraction of aggregate (Assume values for Ea and Ep of 60 kN/m2 and 10 kN/mm2 respectively). (ii) Indicate on your graph the lower bound values of Ec which would be obtained using the series model applied to concrete.	07.01.00	Hardened properties
12	1	21-May-86	4.4	Show on the graph which you have drawn the range of values of Ec likely to be found in practice for (I) concretes containing the above aggregate and paste. (ii) concretes containing expanded polystyrene aggregate and the same paste (assume values of Ea in this case = 0.	07.01.00	Hardened properties
72	1	21-Apr-94	3.0	Describe a mechanism of drying shrinkage in concrete. Discuss the influence of the following on the drying shrinkage of concrete (a) mix proportions (b) properties of the aggregates (c) curing (d) cycles of humidity.	07.01.00	Hardened properties

89	1	12-Apr-95	7.0	What effect does the rate of loading have on the recorded strains and the curvature of the stress-strain curve in Figure 1 if the time of loading is increased from 5 seconds to 2 minutes? Explain the significance of the secant modulus. How is the initial tangent modulus normally determined? Draw a graph to indicate the relationship between stress/strength ratio and strain for concretes of different strength. Figure 2 shows the stress-strain relationship for cement paste, aggregate and concrete. Explain why the relationship for concrete is non-linear.	07.01.00	Hardened properties
112	1	17-Apr-97	5.1	Describe and explain the effects of the following factors on the measured compressive strength of moulded concrete test specimens (I) shape and size of specimen (ii) interaction between the specimens and machine platens (iii) moisture condition of the specimens	07.01.00	Hardened properties
168	1	18-Apr-02	7.1	Describe and explain the effects of the following factors on the measured compressive strength of moulded concrete test specimens (I) shape and size of specimen (ii) interaction between the specimens and machine platens (iii) moisture condition of the specimen.	07.01.00	Hardened properties
40	2	20-Apr-89	6.1.0	Discuss the mechanism which appears to link the processes of failure of an element of concrete subjected to loading of any type.	07.01.07	Hardened properties
41	2	20-Apr-89	6.2.0	Describe typical deformation and failure characteristics for a specimen made with 20mm gravel aggregate concrete of height/width ratio between 2 and 3 when loaded to failure under short-term uniaxial compressive stress between steel subsidiary platens.	07.01.07	Hardened properties
19	1	20-May-87	1.0	Describe a mechanism of drying shrinkage in concrete. Discuss the influence on the drying shrinkage of concrete of the following: (a) mix proportions (b) properties of the components (c) curing (d) carbonation.	07.02.00	Hardened properties
41	1	19-Apr-89	7.2	Discuss the effects of creep in precast reinforced concrete floor and beam units.	07.02.00	Hardened properties
45	1	18-Apr-91	4.0	Describe a possible mechanism for the creep of concrete. State the main factors affecting creep in concrete and explain how these are taken into account in ONE method for predicting the magnitude of creep. Give TWO practical examples of EACH of the following effects of concrete creep in structures (i) beneficial effects and (ii) detrimental effects.	07.02.00	Hardened properties
96	1	25-Apr-96	4.0	Describe a mechanism to account for drying shrinkage in concrete. Discuss the influence on the drying shrinkage of concrete of the following: (I) mix proportions (ii) properties of the components (iii) curing	07.02.00	Hardened properties

130	1	13-Apr-00	1.1	List and explain the factors which govern the drying shrinkage of concrete made with Portland cement	07.02.00	Hardened properties
107	1	17-Apr-97	2.1	Describe a mechanism to account for the creep of concrete. State the main factors affecting creep in concrete and discuss the significance of EACH factor. Illustrate your answer with graphs.	07.02.01	Hardened properties
108	1	17-Apr-97	2.2	Give TWO practical examples of EACH of the following effects of concrete creep in structures: (i) beneficial effects (ii) detrimental effects.	07.02.05	Hardened properties
57	1	22-Apr-93	3.2	A tall reinforced concrete ventilation tower is to be positioned in a coastal environment. Discuss the factors which can affect the long term durability of the structure.	08.02.00	Durability
56	1	22-Apr-93	3.1	Define porosity and permeability as they relate to concrete. With the aid of diagrams, explain the processes by which liquids, gases and ions can pass through concrete. Explain why concretes of the same compressive strength may have different permeabilities.	08.03.00	Durability
135	1	13-Apr-00	3.2	Discuss the relationship between concrete pore structure and penetrability.	08.03.00	Durability
136	1	13-Apr-00	3.3	For a reinforced concrete sea wall: (1) identify and define <u>two</u> possible primary transport mechanisms which could occur in the tidal zone (2) briefly describe a suitable test for assessing chloride ion diffusion in the splash zone.	08.03.03	Durability
114	1	17-Apr-97	6.1	Describe and explain the corrosion of reinforcing steel in concrete due to the effects of (I) carbonation (ii) chlorides.	08.04.00	Durability
115	1	17-Apr-97	6.2	Describe the appearance of general corrosion, pitting corrosion and "black" corrosion and explain how they occur.	08.04.00	Durability
139	2	19-Apr-02	6.1.0	Describe the mechanism of reinforcement corrosion due to salt from external sources.	08.04.00	Durability
73	1	21-Apr-94	4.0	Discuss the factors affecting the corrosion of steel reinforcement in concrete. In your answer you will be expected to include consideration of the following: (I) carbonation of concrete (ii) action of chlorides. Explain how adequate protection of steel reinforcement is provided in a structure in both the design and construction phases.	08.04.01	Durability

140	2	19-Apr-02	6.2.0	The 30-year old approach ramp to a bridge crossing an inland river consists of a concrete deck resting on a series of thirty supports, each of which consists of a crossbeam and two columns and which range in total height from 2 m to 15 m. Saline water has run through the deck joints on to the flat tops of the crossbeams and down the faces. Saline spray has also reached the faces of the columns and the porous ground surrounding them. A preliminary visual inspection has revealed some spalling and cracking. Some of the supports were cast in winter and calcium chloride was used as an accelerator. Describe briefly what effect this might have on the corrosion process.	08.04.04	Durability
37	2	20-Apr-89	5.1.0	You are consulted about cracking in a low, reinforced concrete wall along the central reservation of a motorway. The cracking reflects the pattern of the reinforcement on either side of the wall and spalling has exposed one of the reinforcing bars. Discuss the possible causes of the damage.	08.04.06	Durability
109	1	17-Apr-97	3.0	An underground railway tunnel, lined with precast gravel aggregate concrete units, has been damaged by a fire in one of the freight wagons. The fire had taken hold for several minutes before the train slowed down and eventually stopped in the tunnel. The fire continued to burn for about 60 minutes before the emergency services arrived. The fire was brought under control and extinguished in 20 minutes. (a) detail the investigation you would undertake to obtain a full assessment of the fire damage to the precast units. What tests would you carry out in the laboratory? (b) Discuss the advantages and disadvantages of reinfoced concrete in fire resistant construction.	08.05.00	Durability
158	1	18-Apr-02	3.1	Describe a mechanism of explosive spalling which may occur when concrete is subjected to fire.	08.05.02	Durability
90	1	25-Apr-96	1.0	Describe in detail a probable mechanism to account for the disruption of plain concrete by repeated cycles of freezing and thawing. How is the mechanism you have described modified by the application of de-icing salt to the surface of concrete? Describe a test procedure normally used for seessing the freeze-thaw resistance of concrete containing an air-entraining agent. List the critical requirements for ensuring the frost resistance of an exposed concrete slab.	08.06.00	Durability
125	1	12-Apr-99	6.1	Describe in detail the mechanisms for surface scaling of plain concrete by repeated cycles of freezing and thawing.	08.06.00	Durability
26	1	20-May-87	7.1	Describe, and account for, the effects of sulphates in soil and groundwater upon concrete foundations.	08.07.00	Durability

27	1	20-May-87	7.2	Test results from samples uniformly distributed over the area of a site gave the following values for SO_3 content at foundation level. (I) Explain the relative importance of the groundwater and soil samples. (ii) Using Table 6.1 from BS 8110 (supplied), state and justify fully the recommendations you would make for the concrete to be used for the construction of a reinforced concrete foundation which is to be in contact with the soil and groundwater. (iii) If on a different site, in gypsum-bearing ground, the groundwater level was never less than 2m below the foundations but the total sulphate content of the soil was similar to the figures above, what would you recommend with respect to the concrete to be used?	08.07.00	Durability
85	1	12-Apr-95	4.0	Describe and account for the effects of sulfates from external sources on concrete and list the factors that influence attack on concrete in contact with sulfate bearing soils and groundwaters. How would you assess the severity of site conditions before recommending a mix for casting a reinforced concrete foundation in contact with soil and groundwater believed to contain sulfates? What precautions should you recommend if the concrete will be in cold damp conditions? Explain why the precaution is necessary.	08.07.00	Durability
122	1	12-Apr-99	5.1	Describe the chemical effects of sulfates from external sources on concrete.	08.07.00	Durability
123	1	12-Apr-99	5.2	List the factors that influence attack on concrete in contact with sulfate bearing soils and groundwaters.	08.07.00	Durability
124	1	12-Apr-99	5.3	A reinforced concrete foundation which will be in cold damp conditions throughout its service life is to be cast in clay soil known to contain sulfates and sulfides. When construction work is complete the excavated material is to be used as backfill to the foundation and the lower parts of the superstructure. How would you assess the severity of these conditions and what recommendations would you make for the concrete mix.	08.07.00	Durability
157	1	18-Apr-02	2.0	With regard to the thaumasite form of sulfate attack; (a) discuss the associated primary risk factors (b) discuss the associated secondary risk factors (c) describe the role of pyrite-bearing soils (d) list the measures that could be taken during construction to minimise the risk.	08.07.04	Durability
13	1	21-May-86	5.1	A destructive reaction may occur between certain siliceous aggregates and the alkalis from cement or external sources. Describe the reaction involved and discuss the factors influencing the occurrence of damage.	08.08.00	Durability

14	1	21-May-86	5.2	A road bridge and a pedestrian underpass are to be constructed in in-situ reinforced concrete. What steps might be taken during the design, specification and detailing of these structures to reduce the risk of damage by alkali-silica reaction?	08.08.00	Durability
15	1	21-May-86	5.3	The available coarse aggregates are a crushed granite and a locally occurring flint gravel. The only fine aggregate available is that associated with the gravel deposit. The ordinary Portland cement to be used has an average alkali content of 0.77% (expressed as equivalent Na_20). As a concrete technologist, how would you assess the available materials?	08.08.00	Durability
111	1	17-Apr-97	4.2	A covered reinforced concrete reservoir is to be constructed in an area where some evidence of alkali-silica reaction has been reported. Discuss the advice you would give regarding trhe specification of the concrete and its constituent materials	08.08.05	Durability
178	1	31-Mar-03	4.2	A covered reinforced concrete reservoir is to be constructed in an area where some evidence of alkali-silica reaction has been reported. Discuss the advice you would give regarding the specification of the concrete and its constituent materials	08.08.05	Durability
28	1	19-Apr-89	1.1	Discuss the three properties of a particulate material which determine void filling capability when mixed with another particulate material	09.00.00	Mix design
32	1	19-Apr-89	1.5	Discuss the following relationships and represent them diagramatically: (i) water demand and cement content (ii) Percentage fines of total aggregate and cement content (iii) Concrete plastic density and cement content.	09.00.00	Mix design
63	1	22-Apr-93	5.4	For a particular combination of materials explain: (i) how the water demand of concrete is related to cement content and how the relationship is influenced by changes in the mean size of the coarse aggregate (ii) how the relationship is influenced by the variations in voids ratio and mean size of the cement taken separately and together.	09.00.00	Mix design
43	2	20-Apr-89	7.1.0	Discuss the terms ‘prescribed mix' and 'designed mix' and indicate reasons for the use of each type.	09.04.00	Mix design
44	2	20-Apr-89	7.2.0	In what way are these types considered in the method of mix design outlined in 'Design of normal concrete mixes’ (Published by Department of the Environment 1988)?	09.04.00	Mix design
2	2	22-May-86	1.1.0	Outline the procedure you would adopt for the design of a suitable mix.	09.05.00	Mix design
19	2	22-May-86	7.1.0	Grade 55 concrete is required for the manufacture on site of precast prestressed concrete bridge beams. Describe how you would undertake the selection of materials and the mix design for this concrete.	09.05.00	Mix design

45	2	20-Apr-89	7.3.0	Describe the principal processes involved in designing a concrete mix for strength and durability using the above method of mix design and indicate how you would attempt to ensure that any mix proposed is acceptable for full-scale production with the minimum delay.	09.05.00	Mix design
49	2	23-Apr-93	3.1.0	The cross section through an airport taxiway is shown in Figure 1. It is necessary to gain access all round the service pipes as shown in Figure 1. As soon as work on the service pipes is finished, the taxiway is to be reinstated to the level shown and must be ready to receive the asphalt wearing course in 4 hours. There must be no subsequent settlement of the reinstatement or surrounding ground. In addition, the reinstatement material must be easy to break out to permit future access to the services. Discuss the composition and properties of a suitable mix for the reinstatement and the methods you would adopt to ensure compliance with the requirements.	09.05.00	Mix design
50	2	23-Apr-93	3.2.0	The cross section through an airport taxiway is shown in Figure 1. It is necessary to gain access all round the service pipes as shown in Figure 1. As soon as work on the service pipes is finished, the taxiway is to be reinstated to the level shown and must be ready to receive the asphalt wearing course in 4 hours. There must be no subsequent settlement of the reinstatement or surrounding ground. In addition, the reinstatement material must be easy to break out to permit future access to the services. What laboratory and/or field trials would you carry out to justify your choice?	09.07.00	Mix design
105	2	18-Apr-97	2.0.0	A school for approximately 2000 pupils is to be built. Site mixed, in situ lightweight coarse aggregate concrete, using sintered pulverised fuel ash aggregate, is to be used for the structural frame and the 210 mm thick external walls, together with steel reinforcement. The structure consists of 450 mm square columns and load-bearing crosswalls; the suspended floors and roofs are solid flat slabs without beams. External surfaces are generally ribbed, either horizontally or vertically, depending on position. Internal faces, including soffits to floor slabs, are smoothly finished and will be decorated directly with textured paint. Floor slabs will receive a plastic tiled finish. All the 5500 m^3 of concrete is specified as Grade 30 with a slump of 100 mm. (a) Describe the characteristics of the sintered pulverised fuel ash coarse aggregate which will have to be taken into account in the construction of this structure, (b) State the actions to be taken to accommodate these characteristics during mixing, transporting, placing, finishing and curing of the concrete, paying particular attention to the achievem	10.01.07	Special concretes

110	2	18-Apr-97	5.2.0	The project manager on a large port development site has been out of mainstream engineering for ten years and has asked to be updated on the following topics. Write notes for his information on high strength concrete,	10.02.00	Special concretes
51	1	18-Apr-91	6.4	Give an account of the main features of heavyweight concrete	10.04.00	Special concretes
130	2	14-Apr-00	4.0.0	(a) Identify and explain properties of concrete which make it suitable for radiation shielding. (b) Discuss the use of TWO aggregates for the production of high-density (heavyweight) concrete and state the effects each one has on the hardened concrete. (c) State the special precautions that need to be taken in the production, transportation and compaction of high-density concrete.	10.04.00	Special concretes
137	1	13-Apr-00	4.1	State three categories of steel fibre.	10.06.00	Special concretes
138	1	13-Apr-00	4.2	Identify the factors considered to have the greatest influence on the performance of steel fibres in concrete.	10.06.00	Special concretes
139	1	13-Apr-00	4.3	Explain the mechanism behind the increase in post-crack toughness generally associated with steel fibre reinforced concrete.	10.06.00	Special concretes
159	1	18-Apr-02	3.2	Describe how the use of polypropylene fibres can reduce the risk of explosive spalling.	10.06.03	Special concretes
160	1	18-Apr-02	3.3	Describe, using a diagram, how the use of steel fibre reinforcement enhances the post-crack toughness of industrial ground floors.	10.06.03	Special concretes
140	1	13-Apr-00	4.4	Outline briefly the benefits associated with the use of steel fibre reinforced concrete for floor slabs.	10.06.04	Special concretes
141	1	13-Apr-00	4.5	Discuss briefly any mix design implications which may arise as a result of the inclusion of steel fibres.	10.06.04	Special concretes
161	1	18-Apr-02	3.4	Discuss briefly the advantages of combining steel fibres and polypropylene fibres in concrete for external paving applications.	10.06.04	Special concretes
137	2	19-Apr-02	4.0.0	A new plant for the production of retarded ready-to-use mortar is to be located in one of several possible quarries/pits. (a) Describe in detail those properties of the sand that will have to be taken into account when selecting the most appropriate source from a technical point of view and the way in which each of those properties will influence the mortars produced. A sample of the material proposed for use is attached. (b) Discuss the suitability of this sand for the production of retarded ready-to-use mortar.	10.07.02	Special concretes
82	2	13-Apr-95	5.2.0	Write notes on the assessment of crushed concrete and masonry for use as a concrete aggregate	10.08.00	Special concretes

111	2	18-Apr-97	5.3.0	The project manager on a large port development site has been out of mainstream engineering for ten years and has asked to be updated on the following topics. Write notes for his information on the use recycled concrete for use as an aggregate	10.08.00	Special concretes
118	1	12-Apr-99	1.0	A recycling company produces aggregates from construction materials obtained from the demolition of a wide range of industrial, commercial and domestic buildings. You are the chief concrete technologist fot ehis company which intends to market the aggregate to the ready mixed concrete industry. (a) What quality control procedures would you adopt for the production of these aggregates, to ensure an acceptably low level of variability. (b) List standard and ad-hoc tests that you would apply to the aggregates to assess their suitability for use in a wide range of concretes. Explain why each test is necessary.	10.08.00	Special concretes
148	2	01-Apr-03	5.0.0	A client, wishing to make full use of recycled and secondary materials, requires a high performance concrete for structural applications and a lower grade concrete for foundations. (a) Discuss the options available with particular reference to: (i) cementitious materials, (ii) coarse aggregate, (iii) fine aggregate. (b) Outline the measures which should be put in place at a ready mixed concrete plant to control the quality of crushed recycled concrete aggregate (RCA).	10.08.00	Special concretes
50	1	18-Apr-91	6.3	Give an account of the main features of rolled concrete as used for dam construction	10.09.00	Special concretes
112	2	18-Apr-97	5.4.0	The project manager on a large port development site has been out of mainstream engineering for ten years and has asked to be updated on the following topics. Write notes for his information on foamed concrete.	10.09.01	Special concretes

77	2	13-Apr-95	3.0.0	An old brick railway tunnel has been inspected and found to be in need of relining with concrete inside the existing brickwork. The surface has been eroded away by up to 70mm in places and there is some water weeping through joints in the brickwork. The tunnel has vertical walls and a semi-circular roof; overall it is 6.8m wide, 5.3m high and 1.2km long. There are no overhead power lines or other obstructions. The lining cannot be more than 100mm inside the profile of the original tunnel and possession of the track is only possible between 01.15h and 04.45h each night. The nearest access is from some sidings at a distance of 0. 8km from one tunnel entrance. Figure 2 shows a cross section through the tunnel. Describe in detail a method for placing the reinforced lining, from producing the concrete through to completion ready for handover .	11.01.00	Special processes
133	2	14-Apr-00	7.0.0	A horseshoe shaped tunnel 1 km long has been constructed in rock and the roof has been made safe by rock-bolting. The tunnel section has a flat invert 4 m wide and is 3 m high with a roughly circular crown. The tunnel is to be lined with reinforced concrete approximately 100 mm thick, which is to be placed by spraying, using the wet process. The concrete will be supplied ready mixed in 4 m^3 loads to a holding hopper at one portal of the tunnel, from where it is to be transported to the pump which supplies the spraying nozzle. Concrete is to be sprayed at a rate of 0.75 m^3/h. (a) Outline and discuss the plant requirements for the transportation and spraying of the concrete. (b) Discuss a suitable mix design and note any admixtures and additions to be used, stating reasons. (c) Discuss the concrete -related precautions that need to be taken to ensure the health and safety of operatives working within the tunnel. (d) On completion of the works, some of the cores taken from the tunnel lining were found to be of low strength and low density. Discuss possible reasons for this.	11.01.00	Special processes
113	1	17-Apr-97	5.2	Describe quality control and test procedures for sprayed concrete	11.01.03	Special processes
169	1	18-Apr-02	7.2	Describe quality control and test procedures for sprayed concrete	11.01.03	Special processes
67	2	22-Apr-94	5.3.0	Write notes on underwater concreting.	11.02.00	Special processes
109	2	18-Apr-97	5.1.0	The project manager on a large port development site has been out of mainstream engineering for ten years and has asked to be updated on the following topics. Write notes for his information on underwarer concreting,	11.02.00	Special processes

101	2	26-Apr-96	6.0.0	A designer is concerned about casting a foundation slab (5m x 5m x 2.5m deep) in one placement of concrete. State how you would reassure him that this is possible, detailing the measures to be taken, from design and concrete specification through to completion of the work on site.	11.04.00	Special processes
116	2	13-Apr-99	2.0.0	A heavily reinforced concrete foundation 50 m long, 15 m wide and 2.5 m deep has been proposed for a structure. (a) State and explain the special considerations on which the successful construction of a pour of this size depends. (b) Discuss the factors which determine whether or not cracking could occur in this pour. (c) Describe the precautions to be taken during construction to ensure successful completion of the foundation.	11.04.00	Special processes
115	2	13-Apr-99	1.0.0	The tower of a North Sea oil platform is to be cast in a dry dock using slipforrning. The 71 m tall tower has an outside diameter of 16 m at the base and tapers to 12 m diameter at a height of 15 m from the base, from where the wall rises vertically. The wall thickness is 450 mm throughout. It is intended that the casting level of the concrete in the tower will rise at about 500 mm per hour, giving a concrete requirement of about 11 m^3/h at the start of the slipforming. Crushed rock aggregate, natural sand, bulk Portland cement and PF A are supplied by sea. It is planned that concreting will take place whilst the ambient temperature is between 5 and 20°C. (a) Outline briefly the method(s) of transporting the concrete to the forms from the production unit, which is adjacent to the dry dock, (b) State the desired properties of the fresh concrete and how these are to be achieved, (c) List the constituents of the concrete and their approximate quantities per cubic metre. (d) With the use of sketches, describe how the taper in the tower is formed, (e) At one point, the concrete is observed to bulge outward	11.05.00	Special processes
134	2	19-Apr-02	1.1.0	(a) Compare and contrast the slip-form and jump-form methods of concrete construction in high-rise building applications. (b) Using diagrams, discuss the advantages and disadvantages of the tunnelform method of multi-storey concrete structure construction.	11.05.00	Special processes
11	2	22-May-86	5.1.0	It is proposed to slipform a reinforced concrete tower as a continuous operation lasting 10 days, during summer. The concrete will be produced on site, and lifted to working platform level using a wire-guided hoist. Discuss the following aspect of the job : Mix design, and control of concrete properties	11.05.05	Special processes
12	2	22-May-86	5.2.0	It is proposed to slipform a reinforced concrete tower as a continuous operation lasting 10 days, during summer. The concrete will be produced on site, and lifted to working platform level using a wire-guided hoist. Discuss the following aspect of the job : Supply of materials	11.05.06	Special processes

13	2	22-May-86	5.3.0	It is proposed to slipform a reinforced concrete tower as a continuous operation lasting 10 days, during summer. The concrete will be produced on site, and lifted to working platform level using a wire-guided hoist. Discuss the following aspect of the job : Plant required for concrete handling and compaction	11.05.06	Special processes
14	2	22-May-86	5.4.0	It is proposed to slipform a reinforced concrete tower as a continuous operation lasting 10 days, during summer. The concrete will be produced on site, and lifted to working platform level using a wire-guided hoist. Discuss the following aspect of the job : Staff required for concrete production control	11.05.07	Special processes
79	2	13-Apr-95	4.2.0	Discuss the implications of using a static pump to place concrete on a civil engineering site and comment on the mix design aspects of concrete for pumping.	11.06.00	Special processes
121	2	13-Apr-99	7.0.0	List the factors which can give rise to problems when using a pump to transport concrete in hot weather and describe how these problems may be overcome.	11.06.03	Special processes
9	2	22-May-86	3.2.0	A contractor is tendering for the construction of a 36-storey office block in the UK. Materials handling is generally to be by a tower crane anchored to the exterior of the building. It has been suggested that, above the 20th floor, the concrete should be pumped from ready-mixed concrete trucks at ground level to one or more wet hoppers at upper levels, and then handled by crane and skip. In the event it is decided to use the method of concrete distribution given in 3.1.0 above. Describe the steps the contractor should take to ensure a reliable pumping operation.	11.06.04	Special processes
25	2	21-May-87	2.1.2	(i) Assuming that the concrete will be tested usinq the RAM, indicate what your minimum requirements would be for a pumpable mix. (ii) State how these might vary for different types of pump and discharge conditions. (iii) What safety precautions should be considered before pumping concrete?	11.06.05	Special processes
29	1	19-Apr-89	1.2	For a Portland cement, which three commonly measured properties can serve for the three properties of a particulate material which determine void filling capability when mixed with another particulate material.	11.06.06	Special processes
31	1	19-Apr-89	1.4	Show diagramatically theoretical and actual relationships between voids ratio and the proportion of fine aggregate in a maxture of fine and coarse aggregates having voids ratios of 0.60 and 0.80 respectively , to illustrate the effects of particle interference.	11.06.06	Special processes
60	1	22-Apr-93	5.1	Two important properties of any particulate material are voids ratio and mean size. Define each of these properties in general terms.	11.06.06	Special processes

61	1	22-Apr-93	5.2	For calculations relating to concrete or mortar, discuss the choice of test methods which may be used to assess the voids ratio of: (i) cement (ii) sand	11.06.06	Special processes
62	1	22-Apr-93	5.3	Explain by reference to voids ratio diagrams how the voids ratio of a mixture of two materials is influenced by: (I) the voids ratio of each material (ii) the ratio, r, of the mean size of the smaller material to the mean size of the larger material.	11.06.06	Special processes
183	1	31-Mar-03	7.1	Two important properties of any particulate material are voids ratio and mean size. Define each of these properties in general terms.	11.06.06	Special processes
184	1	31-Mar-03	7.2	For calculations relating to concrete or mortar, discuss the choice of test methods which may be used to assess the voids ratio of: (i) cement (ii) sand	11.06.06	Special processes
185	1	31-Mar-03	7.3	Explain, by reference to voids ratio diagrams, how the voids ratio of a mixture of two materials is influenced by (i) the voids ratio of each material (ii) the ratio (r) of the mean size of the smaller material to the mean size of the larger material	11.06.06	Special processes
186	1	31-Mar-03	7.4	For a particular combination of materials explain: (i) how the water demand of concrete is related to cement content and how the relationship is influenced by changes in the mean size of the coarse aggregate (ii) how the relationship is influenced by the variations in voids ratio and mean size of the cement taken separately and together	11.06.06	Special processes
24	2	21-May-87	2.1.0	Describe various methods of judging the potential pumpability of concrete.	11.06.07	Special processes
106	2	18-Apr-97	3.0.0	A water storage reservoir, 55 m x 90 m in plan and 6m high, is set half-way into ground, which has Class 2 sulfates. A part plan is shown in Figure 2 and a part section in Figure 3. The floor consists of a 125 mm thick lower slab and a 150 mm thick upper slab, separated by 1000 gauge polythene sheeting. The roof, supporting columns and all walls are in reinforced concrete, whilst the floor slab is of plain concrete. The whole will ultimately be covered with soil and grassed over. (a) Determine the casting sequences for both the structure and its elements (walls, columns and roof), stating reasons for your choices. (b) Outline the types of formwork to be used. (c) All construction joints are to be waterproof. Produce annotated sketches of (i) a horizontal joint at the wall kicker, (ii) a vertical joint through the lower floor slab, (iii) a vertical wall joint. (d) Describe how production may be speeded up to complete the work ahead of schedule .	11.07.00	Special processes

119	2	13-Apr-99	5.0.0	(a) Discuss the factors which should be considered when designing a concrete mix for use in a reinforced concrete water retaining structure above ground. (b) Discuss the advantages and disadvantages of casting reinforced concrete reservoir walls in alternate bays. (c) Outline the possible causes of water leakage from a reinforced concrete water retaining structure.	11.07.00	Special processes
91	1	25-Apr-96	2.1	Write notes on a mechanism to account for the formation of efflorescence on cast vertical concrete surfaces and the effects of climate on the likelihood of this surface blemish occuring	11.09.02	Special processes
126	1	12-Apr-99	6.2	Describe a mechanism to account for the formation of efflorescence on cast vertical concrete surfaces and the effects of climate on the likelihood of efflorescence occurring.	11.09.02	Special processes
53	2	23-Apr-93	5.1.0	(a) Discuss the factors which affect the efficiency of mixing in ready-mixed concrete trucks. (b) Describe a procedure that may be used to determine the mixing efficiency of a truck mixer. (c) For the procedure you have described what values would you specify to confirm adequate mixing efficiency? Give reasons for your choice of values.	12.00.00	Ready mixed
1	2	22-May-86	1.0.0	Dry lean concrete is to be supplied from a ready-mixed concrete plant to a large road building contract. The concrete is to comply with the requirements of the Department of Transport Specification.	12.02.00	Ready mixed
3	2	22-May-86	1.2.0	A designed mix is to have an aggregate/cement ratio of 19 and a fine aggregate content of 35%. The fine and coarse aggregates have apparent relative densities of 2.65 and 2.60 respectively. What is the minimum acceptable dry density of the compacted material?	12.02.00	Ready mixed
4	2	22-May-86	1.3.0	What factors within the control of the supplier could affect the contractor's ability to comply with the specification?	12.02.00	Ready mixed
30	2	21-May-87	7.1.0	Because of traffic delays concrete remains in the rotatinq drum of a truck mixer for 4.5 hours. The cement content of the concrete is 300 kg/m^3 and the initial slump was 75 mm. (a) Discuss, using graphs where appropriate, the influence of this prolonged agitation on the following properties of the concrete: (i) workability, (ii) compressive strength, (iii) drying shrinkage, (iv) temperature of the plastic concrete (b) Discuss the effect on compresslve strength of re-tempering the concrete to 75 mm slump.	12.03.00	Ready mixed
87	2	13-Apr-95	7.1.0	Centrally mixed concrete is agitated in a truck mixer during transportation to site. Discuss the effects of journey time on the properties of the concrete. How do ambient weather conditions and the quality of concrete in the truck mixer drum affect these properties?	12.03.00	Ready mixed

88	2	13-Apr-95	7.2.0	Centrally mixed concrete is agitated in a truck mixer during transportation to site. Describe how the properties of the constituent materials and the composition of the mix affect the properties of concrete which is subjected to prolonged agitation.	12.03.00	Ready mixed
89	2	13-Apr-95	7.3.0	Concrete remains in the rotating drum of a truck mixer for 41/2 hours. The cement content of the concrete is 300 kg/m^3 and the initial slump was 75mm. Discuss the effects of retempering the concrete to a slump of 75mm.	12.03.00	Ready mixed
51	2	23-Apr-93	3.3.0	The cross section through an airport taxiway is shown in Figure 1. It is necessary to gain access all round the service pipes as shown in Figure 1. As soon as work on the service pipes is finished, the taxiway is to be reinstated to the level shown and must be ready to receive the asphalt wearing course in 4 hours. There must be no subsequent settlement of the reinstatement or surrounding ground. In addition, the reinstatement material must be easy to break out to permit future access to the services. How would you specify the material you have chosen to an off-site materials supplier?	12.05.00	Ready mixed
76	2	13-Apr-95	2.0.0	An underpass on a dual carriageway road is at the design development stage. The continuous bored piles, which form the retaining walls, are to be covered with a minimum thickness of normal in situ concrete. The surface of this concrete is to have a textured face to assist weathering. The height of the walls in places makes it necessary to incorporate horizontal joints and their length dictates that construction, contraction and expansion joints will be needed. The structural engineer is seeking advice on which type of finish to use on the concrete and has asked for four alternative proposals from you. Outline your proposals, highlighting the benefits and disadvantages of each, to combat weathering. For each of the proposed finishes list the precautions that must be taken during construction to achieve a good end product under the headings: joint details, formwork, release agent, mix design, concreting methods and any other aspect particular to your choice of finish.	13.00.00	Exposed finishes

146	2	01-Apr-03	3.0.0	An order has been received by the precast concrete company for which you work as a concrete technologist, for 368 exposed aggregate panels, of the type shown in Figure 2. These will form the external cladding of a car parking structure and will be required on site during the last 4 weeks of the 18 month construction contract. (a) Produce notes for a meeting with the designers recommending a method of producing the exposed aggregate finish. Substantiate your recommendations by listing the advantages and disadvantages of your recommended method compared with two other methods. (b) Detail the production schedule for your recommended method and outline the precautions you will take to ensure that the appearance of all the units is consistent.	13.00.00	Exposed finishes
39	2	20-Apr-89	5.3.0	You are consulted about cracking in a low, reinforced concrete wall along the central reservation of a motorway. The cracking reflects the pattern of the reinforcement on either side of the wall and spalling has exposed one of the reinforcing bars. Discuss appropriate methods of repair and give details of the technique you would select.	14.00.00	Repairs
47	2	23-Apr-93	2.1.0	Discuss the factors to be taken into account when choosing a repair method and repair materials for a concrete structure damaged by reinforcement corrosion, giving reasons for your choice	14.00.00	Repairs
48	2	23-Apr-93	2.2.1	Giving reasons for your choice suggest suitable repair methods and materials for the following cases: (a) a concrete structure where carbonation has depassivated the steel reinforcement and extensive spalling has occurred. Original concrete cover to the reinforcement ranged from 25 to 40mm, (b) a marine jetty which has begun to show signs of cracking and some spalling over small areas in the splash zone. A cover meter survey of the affected concrete indicates cover of 10mm.	14.00.00	Repairs

75	2	13-Apr-95	1.2.0	A 60-year old circular reinforced concrete sludge digester at a sewage treatment works has been kept filled to within a few centimetres of the domed roof for all its life. Figure 1 shows a cross section on the diameter of the digester. As part of a redevelopment scheme for the works the tank is to be emptied and cleaned prior to refurbishment. Some spalling has been reported on the outside of the wall, exposing reinforcing steel with about 10mm of cover. A preliminary visual inspection of the inside indicated that the walls appeared sound but the roof soffit appeared powdery and had an undulating " quilted " effect which was highlighted by regular lines of rust staining in two directions at right angles. Describe in detail methods for the repairs you consider should be undertaken..	14.00.00	Repairs
118	2	13-Apr-99	4.0.0	As a concrete technologist, you have been asked to propose the composition of a cementitious patch repair material for steel reinforced concrete on soffits where carbonation is the problem and areas up to 2 m x 3 m have delaminated from the reinforcement level. The full circumferential area of the reinforcing bars has corroded over most of the locations to be treated. (a) Describe the desired properties of the repair material, (b) List ALL the constituents with the approximate quantities, which you would include in this material. It is to be supplied pre-packed, (c) State the effect each constituent material will have on the finished product in its plastic, hardening and mature state, as appropriate, (d) List the key points to be printed on the packaging to guide the operative in the use of this material.	14.02.00	Repairs
70	2	22-Apr-94	6.3.0	You are consulted about cracking in a low, reinforced concrete wall along the central reservation of a rnotorway. The cracking reflects the pattern of the reinforcement on either side of the wall and spalling has exposed one of the reinforcing bars. Discuss appropriate methods of repair and give details of the technique you would select.	14.03.00	Repairs
104	2	18-Apr-97	1.0.0	The columns shown in Figure 1 are part of a new Assembly Hall and, as they will be on view, are to have excellent off-the-form finishes. To help achieve this each one will be cast in situ in one pour of concrete. The concrete will be a normal mix containing PC 42.5 and ggbs. Discuss the formwork, falsework and concreting implications.	15.00.00	Formwork
62	2	22-Apr-94	4.1.0	Give the factors affecting the pressure exerted by concrete on formwork indicating in EACH case how they affect the maximum pressure occurring.	15.03.00	Formwork
96	2	26-Apr-96	4.1.0	List six main factors which determine the maximum lateral pressure of concrete on formwork.	15.03.00	Formwork

99	2	26-Apr-96	4.4.0	Sketch pressure diagrams which could be used for the design of the sloping formwork shown in Figure 4 and comment on any factors affecting pressure. (Numerical values for pressures are not required).	15.04.00	Formwork
63	2	22-Apr-94	4.2.0	Explain how concrete pressures are taken into account in the design of formwork.	15.05.00	Formwork
93	2	26-Apr-96	2.2.0	The jetty shown in Figure 2 is on a power station site located beside a major river. Sketch an arrangement for the beam soffit formwork.	15.05.00	Formwork
97	2	26-Apr-96	4.2.0	Apart from concrete pressure, list four different types of load associated with formwork design. Where appropriate, indicate the composition of these loads.	15.05.00	Formwork
98	2	26-Apr-96	4.3.0	Whilst the design of formwork involves the same structural principles as the design of permanent works there are fundamental differences in approach between them. Describe these differences and comment on them.	15.05.00	Formwork
144	2	01-Apr-03	1.2.0	The jetty shown in Figure 1 is for a power station located beside a major river. Sketch an arrangement for the beam soffit formwork.	15.05.00	Formwork
126	2	14-Apr-00	2.3.0	Discuss the relative advantages and disadvantages of using a flexible sheet formliner to create a textured finish on the outside face of the tilt-up panels.	15.06.00	Formwork
64	2	22-Apr-94	4.3.0	Due to a tie-bolt fracture, formwork designed by a well-established proprietary formwork supplier failed during concreting of a 5m high wall. Failure occurred when the level of the concrete was nearing the top of the wall. Subsequent examination of the failed tie-bolt revealed that it had not been defective. Giving your reasons, suggest possible causes of this failure.	15.08.00	Formwork
8	2	22-May-86	3.1.0	A contractor is tendering for the construction of a 36-storey office block in the UK. Materials handling is generally to be by a tower crane anchored to the exterior of the building. It has been suggested that, above the 20th floor, the concrete should be pumped from ready-mixed concrete trucks at ground level to one or more wet hoppers at upper levels, and then handled by crane and skip. Discuss this suggestion, and consider alternatives.	16.04.00	Plant
32	2	20-Apr-89	2.0.0	A large 20-storey in situ concrete tower block is to be constructed on a confined site in a congested city using ready mixed concrete. (a) Discuss the factors which should be taken into account in considering the handling of the concrete, made with normal weight aggregates, from truck to form. Refer to both the concrete and the plant. (b) What would be the differences if lightweight aggregate concrete were to be used?	16.04.00	Plant

58	2	22-Apr-94	2.0.0	A large 20-storey in situ concrete tower block is to be constructed on a confined site in a congested city using ready mixed concrete. (a) Discuss the factors which should be taken into account in considering the handling of the concrete, made with normal weight aggregates, from truck to form. Refer to both the concrete and the plant. (b) What would be the differences if lightweight aggregate concrete were to be used?	16.04.00	Plant
65	2	22-Apr-94	5.1.0	Write notes on immersion vibrators for concrete.	16.04.00	Plant
78	2	13-Apr-95	4.1.0	List and briefly explain the factors which you would consider when determining the plant for transporting concrete on a large site such as a power station with a central batching plant.	16.04.00	Plant
80	2	13-Apr-95	4.3.0	List the advantages and disadvantages of using a belted conveyor system, compared to using pumps.	16.04.00	Plant
92	2	26-Apr-96	2.1.0	The jetty shown in Figure 2 is on a power station site located beside a major river. The approach structure and the pipe supports are complete and construction of the jetty head is about to start in the Spring. Access roads to and on the site are good. The floating crane can lift 15t at an outreach of 20m radius and is available for 75% of each day for concreting operations. The existing site batching plant can supply only $50m^3$ of concrete per week for the jetty head and availability is spasmodic. High tide is just below downstand beam soffit level on the jetty head. (a) Outline a scheme for the construction of the concrete works on the jetty head, describing the basic methods to be used and the sequence of operations. Pile driving will always be at least 25m ahead of the concreting works. (b) Determine, giving reasons, the method(s) of concrete supply, transportation and placing.	16.04.00	Plant

143	2	01-Apr-03	1.1.0	The jetty shown in Figure 1 is for a power station located beside a major river. The approach structure and the pipe supports are complete and construction of the jetty head is about to start and no weather problems are anticipated Access roads to and on the site are good. The floating crane can lift 15 t at an outreach of 20 m radius and is available for 75% of each day for concreting operations. The existing site batching plant can supply only 50 m3 of concrete per week for the jetty head and availability is spasmodic. High tide is just below the soffit level of the downstand beams on the jetty head. It can be assumed that pile driving is always at least 25 m ahead of the concreting work. (a) Outline a scheme for the construction of the concrete works on the jetty head, describing the basic methods to be used and the sequence of operations. (b) Determine, giving reasons, the method(s) of concrete supply, transportation and placing. .	16.04.00	Plant
83	2	13-Apr-95	5.3.0	Write notes on immersion vibrators .	16.05.00	Plant
81	2	13-Apr-95	5.1.0	Write notes on the manufacture and properties of concrete paving blocks	17.01.02	Precast
138	2	19-Apr-02	5.1.0	(a) List the properties of concrete paving slabs that most affect their fitness for purpose and saleability and briefly state how these properties may be achieved. (b)Bearing in mind the manufacturing process for paving slabs (vacuum press), list the mix constituents and typical mix proportions (in kg/m^3). (c) Make recommendations for pavement construction that will avoid problems during the laying of paving slabs and in service. Give reasons for each recommendation.	17.01.02	Precast
28	2	21-May-87	5.0.0	An undersea machine-driven tunnel, 7 km long, is to be lined with pre-cast reinforced concrete segments which will be made by the tunnelling contractor (see drawing below). The linings are to be produced over a period of two and a half years. Discuss fully the measures that should be taken during the production of these units, including the provision of facilities, to ensure adequate quality.	17.02.01	Precast
60	2	22-Apr-94	3.2.0	A new precast works is to be set up for the manufacture of prestressed concrete floor units using an extrusion machine to cast a continuous section the full length of the bed, for subsequent sawing to the required unit lengths. Discuss the requirements which would govern the design of the mix.	17.02.02	Precast
31	2	20-Apr-89	1.0.0	Describe and discuss the relationship between quality assurance and quality control, in the context of the production of reinforced precast concrete elements at an established precasting works.	17.02.07	Precast

61	2	22-Apr-94	3.3.0	A new precast works is to be set up for the manufacture of prestressed concrete floor units using an extrusion machine to cast a continuous section the full length of the bed, for subsequent sawing to the required unit lengths. How could the production of concrete be controlled?	17.02.07	Precast
113	2	18-Apr-97	6.0.0	A producer of precast concrete, with an established reputation for quality but without a formal QA scheme, is producing normally reinforced units for a contractor who is himself operating under BS EN ISO 9002 (BS 5750: 1987 Part 2). The producer was assessed by the contractor before the order was placed. As the contractor's quality engineer, produce an inspection list for your surveillance inspectors to use on random visits to the precast works, under the following headings: Organisation, Information, Programme, Moulds, Reinforcement, Concrete Production and Handling, Casting, Curing, Striking, Handling and Storage, Repairs, Loading, Inspection, Tests and Calibration.	17.02.07	Precast
117	2	13-Apr-99	3.0.0	(a) Describe ONE technique and the associated equipment used for the construction of a continuously reinforced concrete motorway. Where appropriate, illustrate your answer with sketches. (b) For a continuously reinforced concrete motorway, describe how a longitudinal joint may be formed. (c) Describe how an exposed aggregate running surface, for reduced noise level on a road is produced and discuss its advantages over conventional concrete road finishes.	18.02.00	Roads
21	2	21-May-87	1.0.0	Sand-cement floor screeds are a frequent source of expensive failure.	19.00.00	Floors
33	2	20-Apr-89	3.1.0	A large, unreinforced, direct finished warehouse floor is to be constructed on a formation of natural, dense, sandy gravel. The floor will carry heavily loaded steel-wheeled trolleys. Discuss the main features of the specification for the concrete and also for the construction of this floor from the stage when the formation has.been trimmed to level.	19.00.00	Floors
64	1	22-Apr-93	6.0	(a) Discuss the factors which affect the abrasion resistance of horizontal concrete wearing surfaces (roads, pavings and floors). (b) Describe a test procedure for the measurement of the abrasion resistance of such concrete wearing surfaces. Using the test desribed in (b) how would warehouse floors trafficked as follows be specified: (i) trafficked by steel wheeled vehicles (ii) trafficked by lightweight pneumatic tyred vehicles.	19.00.00	Floors

57	2	22-Apr-94	1.0.0	It is proposed to construct a reinforced concrete floor inside a VNA (very narrow aisle) warehouse to take fork-lift trucks. In the area under consideration, the trucks are able to move freely, and a category 1 standard of flatness is required. (a) Discuss the following (i) Selection of aggregates (assume the available materials all comply with the relevant national Standard (ii) Concrete mix specification (iii) Type and construction of movement joints (iv) Choice of construction techniques (v) Measurement of, and factors affecting, abrasion resistance. (b) From Table 7.1 of the Concrete Society's Technical Report No.34 deduce the allowable flatness limits.	19.00.00	Floors
94	2	26-Apr-96	3.1.0	List and explain the factors which influence the achievement of close surface tolerances in a concrete ground floor slab constructed in bays in a warehouse.	19.01.00	Floors
127	2	14-Apr-00	2.4.0	Explain how and why the casting and erection of tilt-up panels might conflict with the client's requirement for a 'Superflat' (SF) floor.	19.01.00	Floors
34	2	20-Apr-89	3.2.0	A large, unreinforced, direct finished warehouse floor is to be constructed on a formation of natural, dense, sandy gravel. The floor will carry heavily loaded steel-wheeled trolleys. Write brief notes on, and sketch, the different types of joints employed in concrete ground floor construction.	19.02.00	Floors
95	2	26-Apr-96	3.2.0	Describe why and how stanchions are accommodated in a floor slab during construction and during the life of a floor .	19.02.00	Floors
22	2	21-May-87	1.1.0	Sand-cement floor screeds are a frequent source of expensive failure. Identify the factors that cause this to be so.	19.06.00	Floors
136	2	19-Apr-02	3.0.0	Briefly describe the principal mechanisms and issues associated with each of the following defects which may be found in concrete floor construction: (i) Crazing, (ii) Delamination, (iii) Dusting, (iv) Finishing defects, (v) Joint spalling, (vi) Plastic shrinkage cracking, (vii) Pop-outs.	19.06.00	Floors
10	2	22-May-86	4.0.0	Discuss the factors which influence the abrasion resistance of industrial concrete floors, how to specify adequate abrasion resistance for such floors, and how to measure it.	19.07.00	Floors
23	2	21-May-87	1.2.0	Sand-cement floor screeds are a frequent source of expensive failure. Explain how you would investigate the soundness of a floor screed laid in a large sports hall. How would you establish the causes of areas of unsoundness? What tests would you use and how would you interpret the results?	19.07.00	Floors
49	1	18-Apr-91	6.2	Give an account of the main features of testing for screed quality	19.07.00	Floors
66	2	22-Apr-94	5.2.0	Write notes on testing of sand cement floor screeds.	19.07.00	Floors
103	2	26-Apr-96	7.2.0	As a designer, state and explain the loads you would consider for the design of a multi-storey, reinforced concrete frame office block with a pitched roof.	20.03.00	RC & PSC

123	2	14-Apr-00	2.1.0	The design team for a distribution warehouse has decided that tilt-up concrete panels will be used for the external walls of the facility. The tilt-up panels are 6 m wide, 8 m high and 0.2 m thick, and will have a painted, textured finish on the outside face. The panels will be cast with the textured face-down on the ground slab. A high-bay racking system will be installed later. A mobile crane (located on the slab) is available to lift the panels, which will be propped until the roof structure is in place. Figure 1 shows a section through the external wall of the warehouse. Describe the various forces acting on the tilt-up concrete panel during installation and service.	20.03.00	RC & PSC
18	1	21-May-86	7.2	Describe how EACH of the following is taken into account in the limit state design of reinforced concrete members (I) collapse (ii) cracking (iii) deflection.	20.05.00	RC & PSC
17	1	21-May-86	7.1	Describe the behaviour of simply supported reinforced concrete beams of rectangular section under increasing load up to failure in bending for (I) an under-reinforced beam and (ii) an over-reinforced beam.	20.08.00	RC & PSC
131	1	13-Apr-00	1.2	List and explain briefly the additional factors which influence the cracking tendency of a reinforced concrete beam in service.	20.08.00	RC & PSC
84	2	13-Apr-95	6.1.0	Describe briefly the reasons for prestressing concrete beams.	20.10.00	RC & PSC
35	2	20-Apr-89	4.1.0	Discuss the reasons for grouting post-tensioning tendons in prestressed concrete and the practical difficulties that should be taken into account.	20.11.00	RC & PSC
85	2	13-Apr-95	6.2.1	Describe briefly the methods used to produce prestressed beams by:the following methods: (a) pre-tensioning, (b) post-tensioning	20.11.00	RC & PSC
86	2	13-Apr-95	6.2.2	Give, with reasons, two typical applications for each type of prestressed beam produced by the following methods: (a) pre-tensioning, (b) post-tensioning	20.12.00	RC & PSC
52	2	23-Apr-93	4.0.0	In pre-tensioned prestressed concrete units which are several months old, some of the force which was applied to the steel before the concrete was cast will have reduced. (a) Discuss the ways in which such losses arise. (b) How can the concrete mix design be selected to minimise some of these losses?	20.13.00	RC & PSC
102	2	26-Apr-96	7.1.0	Describe, using sketches as appropriate, how reinforcement is maintained in position in (i) the top mat of an elevated floor slab, (ii) the top mat of a road laid by a paving train, (iii) a circular bored pile driven at an angle of 20° to the vertical, (iv) the back of an earth retaining wall cast with one sided formwork	20.16.00	RC & PSC

34	1	19-Apr-89	3.0	The individual results of a comparative cube test between a works compression test machine and the BCA ref machine are given in Table 1. For each batch calculate: (a) the estimate of the difference in the indicated compressive strength between the two machines (use the Reference Machine as the datum to allocate the sign of the difference). (b) Confidence limits for 95% probability for each estimate of difference. In the event of non-compliance with the criteria given in Table 1 what simple checks may be carried out on the work's machine to investigate the cause of non-compliance? What additional checks would be appropriate if the standard deviation of Batch No 2 for tests on the works machine was 3.5 N/mm^2?	21.00.00	Test methods
42	1	18-Apr-91	1.0	To enable compression testing machines to be used for testing concrete cube specimens correctly, it is necessary to ensure that certain requirements are met: (a) List the requirements related to the control, measurement and application of load that must be met to ensure that concrete cubes are correctly tested. (b) Explain why each of the requirements in your list is important. You should include consideration of the interaction between the specimen and the machine in your answer. (c) Which of the requirements might be considered less important if tests of low aspect ratio capped cylinders (1:1) were to be carried out? Explain why.	21.02.00	Test methods
80	1	12-Apr-95	1.0	List the requirements relating to the control, measurement and application of load that must be met to ensure that a compression testing machine is suitable for testing concrete cubes. Cubes tested in a compression test machine fail abnormally with a horizontal crack in the bottom face as cast. List defects in the machine and the test procedures which could account for such a failure mode. Using diagrams where appropriate, explain how each defect causes the observed failure. The bearing surfaces of the platens of a compression testing machine which are in contact with the specimen are concave. State the effect this could have on the observed strength of: (a) high strength cubes and (b) low strength cubes. In each case explain, with the aid of diagrams, how these effects occur.	21.02.00	Test methods

42	2	20-Apr-89	6.3.0	Compared with typical deformation and failure characteristics for a specimen made with 20mm gravel aggregate concrete of height/width ratio between 2 and 3 loaded to failure under short-term uniaxial compressive stress between steel subsidiary platens what differences, if any, would you expect if such a test were repeated with another specimen but with the following changes made? Give reasons for any differences suggested. (i) the rate of loading is increased significantly, (ii) the rate of loading is decreased significantly, (iii) the height/width ratio is decreased, (iv) the steel platens are replaced with rubber pads, (v) the coarse aggregate is replaced with lightweight expanded clay aggregate particles.	21.02.08	Test methods
46	1	18-Apr-91	5.1	Give guidelines to be followed when sampling hardened concrete to provide specimens for chemical analysis for cement content	21.04.00	Test methods
47	1	18-Apr-91	5.2	A concrete member contains one 6 m^3 batch of concrete, the composition of which is disputed. The specification for the concrete calls for a minimum cement content of 280 kg/m^3. Four 100 mm diameter cores were extracted from the concrete and were analysed for cement content. The results obtained are given below:- (i) Using the formulae given in the extract from BS 1881: Part 124 provided, calculate the cement content of each core. (ii) Discuss the results obtained in relation to the specified minimum cement content. What do the results indicate about the quality of mixing of the batch?	21.04.00	Test methods
74	1	21-Apr-94	5.1	Give guidelines to be followed when sampling hardened concrete to provide specimens for chemical analysis for cement content	21.04.00	Test methods
75	1	21-Apr-94	5.2	A concrete member contains one 6 m^3 batch of concrete, the composition of which is disputed. The specification for the concrete calls for a minimum cement content of 280 kg/m^3. Four 100 mm diameter cores were extracted from the concrete and were analysed for cement content. The results obtained are given below:- (i) using the formulae given in the extract from BS 1881: Part 124 provided, calculate the cement content of each core. (ii) Discuss the results obtained in relation to the specified minimum cement content. What do the results indicate about the quality of mixing of the batch?	21.04.00	Test methods

182	1	31-Mar-03	6.2	A concrete member contains one 6 m^3 batch of concrete, the composition of which is disputed. The specification for the concrete calls for a minimum cement content of 280 kg/m^3. Four 100 mm diameter cores were extracted from the concrete and were analyzed for cement content. The results obtained are given in Table 3. (i) Using the formulae given in the extract from BS 1881:Part 124 (provided) calculate the cement content of each core. (ii) What do the results indicate about the quality of mixing of the batch?	21.04.00	Test methods
181	1	31-Mar-03	6.1	Give guidelines to be followed when sampling hardened concrete to provide specimens for chemical analysis for cement content	21.04.03	Test methods
120	2	13-Apr-99	6.1.0	(a) Discuss the factors governing the choice of partially destructive tests over destructive and non-destructive tests. (b) Describe in detail ONE partially destructive test method. (c) State how the results obtained by the method chosen may be used.	21.06.01	Test methods
35	1	19-Apr-89	4.1	State the advantages and limitations of each of the following non-destructive tests for concrete: (I) ultra-sonic pulse velocity (ii) rebound hammer (iii) gamma radiography (iv) BRE internal fracture test	21.07.00	Test methods
88	1	12-Apr-95	6.0	There is doubt about the quality of concrete in a structure. Discuss the planning of an investigation to assess the in-situ strength of the concrete. As part of the investigation it may be necessary to drill cores from the structure. Describe the procedures involved in carrying out such an investigation.	21.07.00	Test methods
5	2	22-May-86	2.1.0	It becomes clear after 7-day testing that a batch of Grade C15 concrete has inadvertently been cast into a bridge pier 1.5m x 4m on plan and 15m high. The appearance of the concrete is sensibly uniform throughout the height of the pier. Giving reasons for your choice, state which test or tests you would use to locate the low grade concrete. (CORING WILL NOT BE PERMITTED.)	21.07.02	Test methods
6	2	22-May-86	2.2.0	It becomes clear after 7-day testing that a batch of Grade C15 concrete has inadvertently been cast into a bridge pier 1.5m x 4m on plan and 15m high. The appearance of the concrete is sensibly uniform throughout the height of the pier. Explain in detail the procedures you would use to determine the position in the pier of the low quality concrete, emphasising any precautions needed to ensure accuracy.	21.07.02	Test methods

71	2	22-Apr-94	7.1.0	It becomes clear after 7-day testing that a batch of concrete of characteristic strength 15 N/mm2 has been cast into a bridge pier 1.5m x 4m on plan and 15m high, instead of the specified 40 N/mm2. The appearance of the concrete is sensibly uniform throughout the height of the pier. Giving reasons for your choice, state which test or tests you would use to locate the low grade concrete. (Coring will not be permitted.)	21.07.02	Test methods
72	2	22-Apr-94	7.2.0	It becomes clear after 7-day testing that a batch of concrete of characteristic strength 15 N/mm^2 has been cast into a bridge pier 1.5m x 4m on plan and 15m high, instead of the specified 40 N/mm^2. The appearance of the concrete is sensibly uniform throughout the height of the pier. Explain in detail the procedures you would use to determine the position in the pier of the low quality concrete, emphasising any precautions needed to ensure accuracy.	21.07.02	Test methods
101	1	25-Apr-96	6.2	Describe how you would carry out an investigation using non-destructive tests to establish: (1) the location of a batch of very poor quality concrete in a bridge pier 1.8m x 4.5m in cross section and 15m high (2) the location of columns cast from ONE of four batches of concrete where 28 day tests of cubes cast from THAT batch at the time of construction indicate substantial non-compliance with the specification.	21.07.02	Test methods
128	2	14-Apr-00	3.1.0	You are a technical manager of a ready mixed concrete supplier, supplying a large sea defence wall contract. The specified characteristic cube strength of the wall in question is C50. Owing to a number of low cube results reported by the test house, concern has been expressed by the consulting engineer over the quality of the concrete in the structure. The average cube results are shown in Table 3. Core testing is not permitted. Discuss how you would investigate the quality of the in situ concrete utilising ultrasonic testing techniques. Outline the limitations associated with the techniques and comment on any assumptions made.	21.07.03	Test methods
100	1	25-Apr-96	6.1	State the advantages and limitations of each of the following non-destructive tests for concrete: (1) rebound hammer (2) ultra sonic pulse velocity (3) BRE internal fracture test	21.07.04	Test methods
7	2	22-May-86	2.3.0	It becomes clear after 7-day testing that a batch of Grade C15 concrete has inadvertently been cast into a bridge pier 1.5m x 4m on plan and 15m high. The appearance of the concrete is sensibly uniform throughout the height of the pier. How would you use the data obtained in your investigation to estimate the strength of the low quality concrete.	21.07.05	Test methods

73	2	22-Apr-94	7.3.0	It becomes clear after 7-day testing that a batch of concrete of characteristic strength 15 N/mm^2 has been cast into a bridge pier 1.5m x 4m on plan and 15m high, instead of the specified 40 N/mm^2. The appearance of the concrete is sensibly uniform throughout the height of the pier. How would you use the data obtained in your investigation to estimate the strength of the low quality concrete?	21.07.05	Test methods
27	2	21-May-87	4.0.0	A number of concrete piers carrying a motorway viaduct are showing rust staining and cracking along the lines of reinforcement. Describe a suitable investigation programme to ascertain the cause (or causes) of this failure. Discuss the information that you would expect to obtain from each element of your programme, and how this might influence your subsequent investigations. You may assume that access presents no difficulty, and there is sufficient time available for any work you require.	21.09.00	Test methods
38	2	20-Apr-89	5.2.0	You are consulted about cracking in a low, reinforced concrete wall along the central reservation of a motorway. The cracking reflects the pattern of the reinforcement on either side of the wall and spalling has exposed one of the reinforcing bars. Describe the methods which you would use to investigate the problem.	21.09.00	Test methods
69	2	22-Apr-94	6.2.0	You are consulted about cracking in a low, reinforced concrete wall along the central reservation of a rnotorway. The cracking reflects the pattern of the reinforcement on either side of the wall and spalling has exposed one of the reinforcing bars. Describe the methods which you would use to investigate the problem.	21.09.00	Test methods
141	2	19-Apr-02	6.3.0	The 30-year old approach ramp to a bridge crossing an inland river consists of a concrete deck resting on a series of thirty supports, each of which consists of a crossbeam and two columns and which range in total height from 2 m to 15 m. Saline water has run through the deck joints on to the flat tops of the crossbeams and down the faces. Saline spray has also reached the faces of the columns and the porous ground surrounding them. A preliminary visual inspection has revealed some spalling and cracking. Outline the actions that need to be taken to determine the extent and severity of the problem.	21.09.00	Test methods
55	2	23-Apr-93	7.1.0	Define, and discuss, the meaning of, the following terms: (i) quality, (ii) quality control, (iii) quality assurance, (iv) first, second and third party accreditation of a quality system, (v) product conformity certification.	22.01.00	Quality concepts

149	2	01-Apr-03	6.1.0	Define and discuss the meaning of the following terms:(i) quality, (ii) quality control, (iii) quality assurance, (iv) fIrst, second and third party accreditation of a quality system.	22.01.00	Quality concepts
56	2	23-Apr-93	7.2.0	Describe an existing quality assurance scheme for the supply of ONE of the following: (i) cement, (ii) admixtures, (iii) ready mixed concrete, (iv) precast concrete, (v) steel for reinforcing or prestressing, (vi) laboratory testing services, dealing with concrete or its constituent materials.	22.05.00	Quality concepts
150	2	01-Apr-03	6.2.0	Describe an existing quality assurance scheme for the supply of ONE of the following: (i) cement, (ii) admixtures, (ii) ready-mixed concrete, (iii) precast concrete, (iv) steel for reinforcing or prestressing, (v) laboratory testing services dealing with concrete or its constituent materials.	22.05.00	Quality concepts
162	1	18-Apr-02	4.0	Write notes on the following (a) the characteristics of silica fume (SF) which make it suitable for use in concrete (b) the pozzolanic reaction of SF with portlandite (calcium hydroxide) (c) the effect of SF on fresh concrete (d) the durability of SF concrete exposed to hot climates (e) the limitations on the use of SF concrete.	22.07.00	Quality concepts
147	2	01-Apr-03	4.0.0	A new European Standard for Concrete, EN206, permits the sampling of fresh concrete at the batching plant for assessment of consistence (workability) and compressive strength. (a) Critically discuss plant sampling for assessment of consistence and compressive strength. (b) Outline a suitable method for obtaining a representative sample of concrete at the batching plant.	23.03.00	Quality control
20	2	22-May-86	7.2.0	Grade 55 concrete is required for the manufacture on site of precast prestressed concrete bridge beams. Discuss the practical steps necessary to ensure that the quality of the concrete is maintained throughout the production of the beams, which will continue over 6 months.	23.04.00	Quality control
24	1	20-May-87	6.1	Explain the following terms as applied to significance testing: (I) Type 1 error (ii) Type 2 error (iii) Significance level (iv) power of test.	24.00.00	Statistics
25	1	20-May-87	6.2	A research worker wishes to know if there is a significant fall in strength when he adds a certain admixture to concrete. In order to test this he arranges some tests and the statistics from these tests are given below: What conclusions should the research worker draw?	24.00.00	Statistics
54	2	23-Apr-93	6.0.0	Discuss the importance of statistical methods for the concrete technologist of the 1990s.	24.00.00	Statistics
65	1	22-Apr-93	7.1	Write brief notes about each the following statistical concepts or measures: (I) Type 1 error (ii) Type II error (iii) Standard error (iv) Level of significance.	24.02.01	Statistics

66	1	22-Apr-93	7.2	Describe tests to determine whether any statistically significant difference in strength exists between concretes compacted by two different methods. Report those issues you consider important in selecting the tests.	24.03.01	Statistics
67	1	22-Apr-93	7.3	The following results were obtained from some trials when a jolting table and a vibrating table were used to compact concrete from the same batches. Show whether there are any significant differences at the 5% level between strengths obtained using the two methods of compaction.	24.03.01	Statistics
103	1	25-Apr-96	7.2	A certain daily test is thought to be unreliable because differences in test results appear to have occurred between days. Describe how you would determine whether systematic differences do exist. What, if any, statistical tests would you prescribe to assess any differences? Why would such tests be appropriate?	24.03.01	Statistics
104	1	25-Apr-96	7.3	The quality control of a certain material requires a daily analysis using an XRF machine. The results derived from this machine indicate a variable material. Technologists were surprised by the apparently large amount of variation and were concerned that the test method itself might be the cause of the perceived variation rather than the process or the materials used. As part of a study to establish the possible causes of the variation a batch of material was selected and five samples were taken at each of three phases during the production of the batch. The results are shown in Table 1. Each of the samples was cut into two halves and each half labelled "a" or "b". All of the "a" labelled halves were analysed on the first day and the results are given below. Additionally the "b" labelled halves from the first phase were also tested on the first day with the "a" labelled halves. The "b" labelled halves from the second phase were tested on the second day and those from the third phase were tested on the third day. The results are also shown in Table 1. Do the results indicate any significant differences between the days? Give reason for your answer	24.03.01	Statistics
129	2	14-Apr-00	3.2.0	Ultrasonic pulse velocity testing on two areas (one suspect) yielded the results in Table 4. (i) using statistical analysis techniques determine if the quality of concrete in the suspect area is significantly different from the quality of the acceptable concrete, (ii) comment on the results of the analysis in relation to the strengths given in Table 3.	24.03.01	Statistics
116	1	17-Apr-97	7.1	Explain what is meant by (I) linear regression (ii) curvilinear regression (iii) multiple regression	24.03.02	Statistics
38	1	19-Apr-89	6.1	Discuss the uses of linear regression equations in concrete technology and indicate any limitations to which they are subject.	24.03.03	Statistics

39	1	19-Apr-89	6.2	A concrete technologist has been investigating the relationship between accelerated concrete strength and actual 28 day strength. The collected data are shown in Table 2. Calculate the appropriate coefficients and thus obtain an expression relating accelerated strength and actual 28 day strength.	24.03.03	Statistics
44	1	18-Apr-91	3.0	Explain how to derive a linear regression equation relating one variable to another using experimental data. An experimental determination of the relation between the normal stress and shear resistance of a cement stabilised soil yielded the following results: Find the equation to the linear regression of y on x and calculate the correlation coefficient. In the light of the correlation coefficient what comments would you make on the tests.	24.03.03	Statistics
117	1	17-Apr-97	7.2	A Testing Authority has responsibilities for testing aggregates from quarries throughout the European Community. The Authority proposes to use a cheaper and more convenient "alternative" test instead of the "reference" test given in the European Standard for the determination of resistance to fragmentation. Typical values obtained from the "reference" test for the quarries served by the Testing Authority range from 5 to 32. Comparative tests using the two procedures are carried out using aggregates from a limited number of quarries. The results of these tests are given in Table 1. Show, by means of linear regression analysis, how the data are related. Is the Testing Authority justified in using the "alternative" test instead of the "reference" test? Give reasons.	24.03.03	Statistics
147	1	13-Apr-00	6.2	The presence of certain clay minerals in sand used in concrete is known to increase the water demand of the concrete and to reduce its compressive strength. In a series of trials designed to quantify the effect of such material on strength, tests were carried out to determine the methylene blue adsorption value (MBV) of a range of sands. Concrete mixes were then prepared using each of the sands in turn and the compressive strength determined at 28 days. The results obtained are given below. Illustrate the relalationship between the two parameters and carry out a linear regression analysis. Determine the correlation coefficient of the data and comment on the results.	24.03.03	Statistics

164	1	18-Apr-02	5.2	Hydraulic pressure meters have been used for a number of years to estimate the workability of fresh concrete in ready-mixed concrete truck mixers. During trials to evaluate two new pressure meters data were obtained, as shown in Table 1, which contains pairs of values of measured slump and hydraulic pressure for each meter. Illustrate the relationship between the results obtained and, using linear regression analysis with determination of correlation coefficients, comment on the performan e of the two devices with regard to monitoring workability.	24.03.03	Statistics
180	1	31-Mar-03	5.2	Hydraulic pressure meters have been used for a number of years to estimate the workability of fresh concrete in ready-mixed concrete truck mixers. During trials to evaluate two new pressure meters data were obtained, as shown in Table 2, which constrains pairs of values of measured slump and hydraulic pressure for each meter. Illustrate the relationship between the results obtained and, using linear regression analysis with determination of correlation coefficients, comment on the performance of the two devices with regard to monitoring workability.	24.03.03	Statistics
83	1	12-Apr-95	3.2	Describe how a precision experiment should be organised for the determination of sulfate in Portland cement amongst different laboratories. What precautions should be taken in the organisation of the experiment, the data collection, the analysis and the reporting of the results? How would you report the findings and to whom would you report them? What actions would you propose as a result of such an investigation?	24.04.01	Statistics
52	1	18-Apr-91	7.0	In the context of testing, define the terms: (I) Repeatability (ii) Reproducibility. Explain the importance of repeatability and reproducibility in testing. How would you plan a trial to determine the precision of the test for the determination of the water absorption of corase aggregate. Laboratory A is engaged in the routine testing of the aggregate crushing value of a source of carboniferous limestone and wishes to check the precision of its testing. Four sub-samples drawn from a bulk sample were prepared for testing. Two of the samples were tested by Laboratory A and two were tested by Laboratory B. The following results were obtained:- The values for repeatability and reproducibility given in BS 812: Part 110 are 0.8 and 2.9 respectively. Do the results indicate that the testing is satisfactory?	24.05.00	Statistics
82	1	12-Apr-95	3.1	Write notes, using sketches as appropriate, on the following statistical terms: repeatability, reproducibility, accuracy, linearity, and stability.	24.05.00	Statistics
102	1	25-Apr-96	7.1	What is meant by the statistical terms: (i) significance level (ii) power?	24.05.00	Statistics

129	1	12-Apr-99	7.3	A laboratory engaged in particle density testing is required to check repeatability and reproducibility. Two representative sub-samples of Thames Valley flint aggregate drawn from a large sample were prepared and the values of particle density obtained were 2.61 Mg/m^3 and 2.58 Mg/m^3. Two further tests were conducted by another laboratory with the results 2.57 Mg/m^3 and 2.58 Mg/m^3. The values for repeatability and reproducibility given in BS 812: Part 2 :1995 for this test are 0.02 Mg/m^3 and 0.04 Mg/m^3 respectively. Do the results indicate that the testing is satisfactory? Justify your conclusions.	24.05.00	Statistics
146	1	13-Apr-00	6.1	Define the statistical terms Precision, Accuracy and Bias.	24.05.01	Statistics
163	1	18-Apr-02	5.1	Distinguish between the terms Precision, Accuracy and Bias.	24.05.01	Statistics
84	1	12-Apr-95	3.3	A laboratory wishes to establish values for the within laboratory repeatability and reproducibility of a test it routinely performs. An experiment is organised to establish such values. Three operators (A, B and C) are involved. The material upon which the test is carried out is destroyed during each determination and so samples have been taken from thirteen different batches of the material and six specimens have been prepared from each sample. It may be assumed that there has been additional error introduced from the sampling method used and that the material from each batch is homogeneous. Each operator is asked to test two specimens from each sample (the results of which are known as a and b). The results are given in the table on the attached sheet. Determine values for repeatability and reproducibility of the test. Show your calculations and state what, if any, assumptions have been made in performing the calculations. What actions would you advise following the experiment?	24.05.02	Statistics
127	1	12-Apr-99	7.1	Define the terms repeatability and reproducibility.	24.05.02	Statistics
128	1	12-Apr-99	7.2	Explain the importance of repeatability and reproducibility in testing.	24.05.02	Statistics
179	1	31-Mar-03	5.1	Distinguish between repeatability and reproducibility	24.05.02	Statistics
6	1	21-May-86	3.1	Explain the terms producer's risk, consumer's risk and operating-characteristic curve.	24.07.00	Statistics
7	1	21-May-86	3.2	Produce an operating-characteristic curve for the following compliance rule for the strength of concrete: "The mean strength of two test results obtained from separate batches shall be greater than or equal to the characteristic strength." Assume that the producer's standard deviation is 5 N/mm2 and that sampling will be done randomly.	24.07.00	Statistics

8	1	21-May-86	3.3	Use your operating-characteristic curve to determine the producer's risk when the margin is 1.64 standard deviations and the consumer's risk when the mean strength is 5 N/mm2 lower than the target strength.	24.07.00	Statistics
16	1	21-May-86	6.0	Discuss the following statement:- "Adequate specification of concrete mixes by performance alone is not feasible".	25.00.00	Standards
20	1	20-May-87	2.0	Write an essay on British Standard Specifications and Codes of Practice. Consider the following points: (a) the differences between them, their purpose, their legal and contractual status (b) the use made of them by the different parties involved in a construction project (c) the advantages and disadvantages of Standardisation. List the main sections necessary in a British Standard Specification for a construction material (eg a cement or an aggregate) and comment briefly on each.	25.00.00	Standards
23	1	20-May-87	5.0	Discuss the following statement:- "Specification of concrete mixes by performance alone is not adequate".	25.00.00	Standards
170	1	31-Mar-03	1.1	Critically evaluate the use of minimum cement content in specifications for concrete	25.04.00	Standards
36	1	19-Apr-89	4.2	Describe how you would carry out an investigation using non-destructive tests to establish: (1) the location of a batch of very poor quality concrete in a bridge pier 1.8m x 4.5m in cross section and 15m high (2) the location of columns cast from ONE of four batches of concrete where 28 day tests of cubes cast from that batch at the time of construction indicate substantial non-compliance with the specification.	26.00.00	Assessment of construction
74	2	13-Apr-95	1.1.0	A 60-year old circular reinforced concrete sludge digester at a sewage treatment works has been kept filled to within a few centimetres of the domed roof for all its life. Figure 1 shows a cross section on the diameter of the digester. As part of a redevelopment scheme for the works the tank is to be emptied and cleaned prior to refurbishment. Some spalling has been reported on the outside of the wall, exposing reinforcing steel with about 10mm of cover. A preliminary visual inspection of the inside indicated that the walls appeared sound but the roof soffit appeared powdery and had an undulating " quilted " effect which was highlighted by regular lines of rust staining in two directions at right angles. Describe briefly the testing regime that you propose to identify fully the problems and their extent, together with any consequent actions.	26.00.00	Assessment of construction

90	2	26-Apr-96	1.0.0	A cursory inspection of a prestressed concrete overbridge crossing a dual three-lane carriageway motorway indicated that further inspection would be advisable and, possibly, repairs would need to follow. The overbridge, shown in Figure 1, carries two lanes of frequent traffic and two footways. It comprises several pretensioned precast hollow box sections, which are adjacent to each other, giving a flat soffit. The outer bridge bearings sit on almost vertical abutments which are set back 2 metres from the edges of the hard shoulders and run the full width of the bridge. At the centre of the motorway twin circular columns support a crosshead on which the precast beams rest on bearing pads. Outline an inspection and testing regime for this structure showing what tests should be carried out in which areas.	26.02.00	Assessment of construction
15	2	22-May-86	6.0.0	Examine the three numbered photographs supplied, which show defects on concrete surfaces. For EACH photograph :	26.03.00	Assessment of construction
16	2	22-May-86	6.1.0	State the cause of the defect giving reasons for your answer	26.03.00	Assessment of construction
17	2	22-May-86	6.2.0	Discuss the possible effect on the durability of the concrete, assuming outdoor exposure in an industrial environment in the UK.	26.03.00	Assessment of construction
18	2	22-May-86	6.3.0	State and explain measures that might be taken for future casts to reduce the incidence of the defect.	26.03.00	Assessment of construction

26	2	21-May-87	3.0.0	Concrete is being supplied for the construction of the vertical wing walls to a bridge abutment. The walls are 10 m high and the concrete is to be placed in a single lift by tremie. The concrete is specified as 30 N/mm^2 characteristic strength with a minimum cement content of 300 kg/m^3 and a maximum free W/C ratio of 0.55. The workability is specified as 0.93 compacting factor. Tests confirm that the concrete complies with the specification. The Engineer is dissatisfied with the quality of the surface finish of the concrete in the first of the walls. The surface defect shown in photograph 1 is present to a large extent and that shown in photograph 2 is present to a lesser extent. The surface defect shown in photograph 3 is present in some of the upper parts of the wall. Details of the mix proportions used and the aggregate gradings are given below. (a) Identify the surface defects and state the probable causes, (b) giving reasons, state how you would minimise the problem in the construction of further walls	26.03.00	Assessment of construction
120	1	12-Apr-99	3.0	Identify the surface defects shown in photographs 1 to 5 and state the probable causes of the defects. Giving reasons, state how you would minimise the occurrence of each defect.	26.03.00	Assessment of construction
131	2	14-Apr-00	5.0.0	(a) Define and describe efflorescence, laitance and lime bloom in relation to masonry and mortar. (b) For each of the above effects, state possible causes and appropriate preventative and remedial measures. (c) State how the phenomenon shown in Photograph 1, which is one of the above phenomena, may be clearly differentiated from the other two.	26.03.00	Assessment of construction
91	2	26-Apr-96	1.2.0	Indicate. the likely cause of each of the following problems encountered: (i) a delaminated area 2.5 square metres on one abutment face at location A, (ii) spalling and rust staining of the vertical face of the crosshead, near the top, at location B; (iii) 45° cracks on the face of the edge beam at location C. What further action would be prompted by each problem?	26.04.00	Assessment of construction
122	2	14-Apr-00	1.0.0	With reference to the Egan Report "Rethinking Construction" critically examine how innovations in concrete technology will assist in ensuring concrete's sustainability as a construction material.	Sustainability	Sustainability
135	2	19-Apr-02	2.0.0	Discuss concrete as a sustainable construction material.	Sustainability	Sustainability
171	1	31-Mar-03	1.2	Discuss the environmental sustainability of concrete as a construction material	Sustainability	Sustainability

40	1	19-Apr-89	7.1	Figure 1 shows part of a reinforced concrete wall adjacent to a reinforced concrete pavement. The structure is suffering from four different types of non-structural cracking as illustrated in the diagram. For each type, list the possible causes, starting with the most likely and discuss the implications of such cracking for the future performance of the structure.	Non-structural cracking	Non-structural cracking
107	2	18-Apr-97	4.0.0	Figure 4 shows four instances of cracking which may occur in a mature sea wall and promenade structure. (i) Name each type of crack, (ii) State the probable cause of each type of crack, (iii) Outline how each crack might have been prevented, (iv) Indicate briefly appropriate remedial measures.	Non-structural cracking	Non-structural cracking
132	2	14-Apr-00	6.0.0	Twenty reinforced concrete columns (see Figure 2) are to support a large atrium roof to a city centre shopping mall. The contract is running behind schedule and it has been decided to use self compacting concrete (SCC) to cast all of these columns. There are two principal architectural requirements: no joints are allowed in the main body of the columns; only a high quality 'as-struck' finish will be accepted - no remedial measures will be tolerated. (a) Describe the key features and benefits of SCC which underpin its suitability in this application. (b) The dry batch batching facility is 45 minutes away from the site (by truck mixer). Produce a method statement to cover the key production and transportation aspects of the SCC in question. State any assumptions made. (c) Briefly discuss TWO test methods available for assessing the fresh properties of SCC and comment on their weaknesses. (d) Describe a site quality control regime to monitor the degree of compaction achieved.	SCC	SCC
155	1	18-Apr-02	1.3	Discuss the statement that modern superplasticisers are more effective in the production of SCC than traditional superplasticisers.	SCC	SCC
156	1	18-Apr-02	1.4	The surface finish achieved using SCC on a wall element of a structure is shown in Plate 1. List the factors that have contributed to the surface characteristics shown.	SCC	SCC
151	2	01-Apr-03	7.1.0	(a) Discuss the use of self-compacting concrete (SCC) in precast concrete applications. (b) Discuss the requirements that would govern the design of the concrete in (a). © How can the production of SCC be controlled?	SCC	SCC