

Name:
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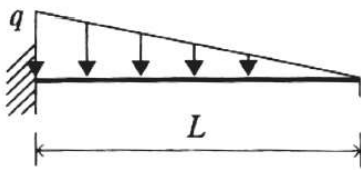
(公社) 土木学会 土木技術検定試験 2級検定試験トライアル
Qualification Examination for Professional Engineers, JSCE
Trial Examination for Associate Professional Civil Engineers

Q1. Choose the correct statement among the following regarding concrete compressive strength.

- (1) Concrete compressive strength decreases as loading rate increases.
- (2) Concrete compressive strength increases in proportion to the water-cement ratio (W/C).
- (3) If specimens are dried right before a compression test, their compressive strength will increase.
- (4) If the volume of a cylindrical specimen increases while keeping the ratio of its diameter to its height constant, its compressive strength increases.

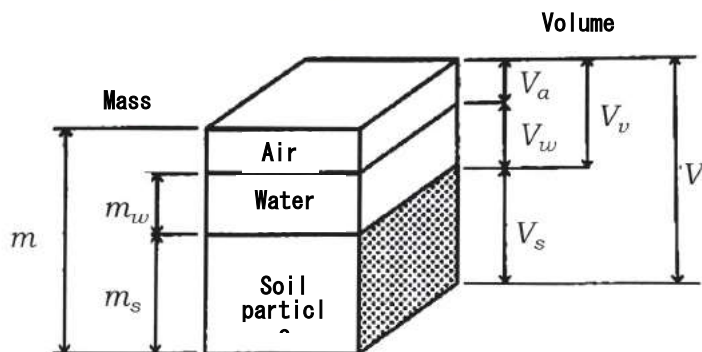
Q2. Choose the correct magnitude of the moment reactions at the support when a triangular distributed load acts on a cantilever beam as shown in the following figure. Ignore the self-weight of the beam.

(1) $\frac{qL^2}{2}$ (2) $\frac{qL^2}{3}$ (3) $\frac{qL^2}{4}$ (4) $\frac{qL^2}{6}$



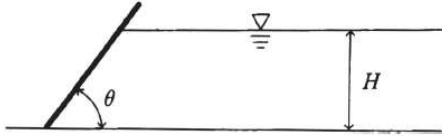
Q3. The diagram below illustrates the proportion of volume or mass occupied by the three phases of soil: soil particles, water, and air. Using these symbols, select the correct equation to represent the physical quantity related to volume, the pore ratio e .

(1) $e = \frac{V_a}{V}$ (2) $e = \frac{V_v}{V}$ (3) $e = \frac{V_a}{V_s}$ (4) $e = \frac{V_v}{V_s}$



Q4. Choose the correct total hydrostatic pressure P acting on the slanted plate shown in the figure, where L is the width of the plate perpendicular to the figure, ρ is the water density, and g is the gravitational acceleration.

(1) $P = \rho g H^2 L \sin \theta$ (2) $P = \frac{\rho g H^2 L}{\cos \theta}$ (3) $P = \frac{\rho g H^2 L}{2 \cos \theta}$ (4) $P = \frac{\rho g H^2 L}{2 \sin \theta}$



Q5. It is known that the reliability probability (the probability of that link is healthy) of existing link on road network during the event of a disaster is r , and that the bypass will never be damaged (reliability is 1). The linkage reliability probability that a route exists between cities A and B is then [a] for the current network, and the increase in this reliability due to the bypass construction is [b]. Choose the correct combination of [a] and [b].

[a]	[b]
(1) $1 - (1 - r^2)^2$	$2r^2(1 - r)^2$
(2) $\{1 - (1 - r^2)\}^2$	$2r^2(1 - r)^2$
(3) $1 - (1 - r^2)^2$	$r^2(1 - r)^2$
(4) $1 - (1 - r^2)^2$	$r^2(2 - r)^2$



Fig 1. Current road network

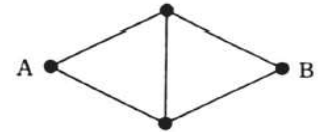


Fig 2. After the construction of bypass road network

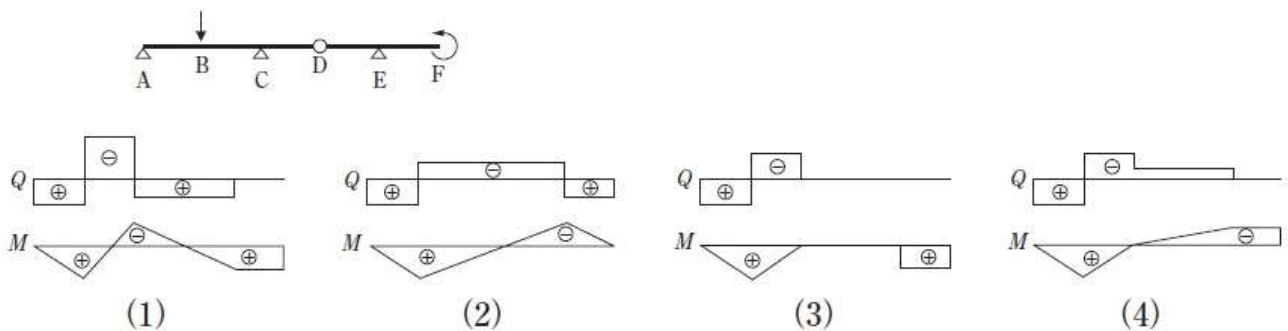
Q6. Choose the most appropriate description of each facility in the water supply process from the source to the supply area.

- (1) Since the construction of a water storage facility will create a riparian zone, the impact on the surrounding environment will be small. So there is no particular need to consider environmental degradation.
- (2) It is important for water intake facilities to be able to collect the planned amount of water, and there is no particular need to consider water quality since it can be treated by water purification facilities.
- (3) Water purification facilities are the core water supply facilities, and treatment methods include disinfection, slow filtration, rapid filtration, membrane filtration, and advanced water treatment.
- (4) The water transmission facility transports raw water from the water source to the water purification plant, and is composed of water pipes, water pumps, regulating reservoirs, valves, and other auxiliary facilities.

Q7. Choose the correct statement among the following regarding the effect of aggregates on the deterioration of reinforced concrete.

- (1) River gravel do not produce an alkali-silica reaction.
- (2) The use of sea sand can cause salt damage.
- (3) The use of aggregates with large water absorption increases the freezing-thaw resistance of concrete.
- (4) Increasing the maximum size of coarse aggregate accelerates the carbonation of concrete.

Q8. When a concentrated load is acting at point B and a moment load at point F of the beam as shown in the figure, choose the correct combination of the approximate shape of the shear force (Q) and the bending moment diagram (M).



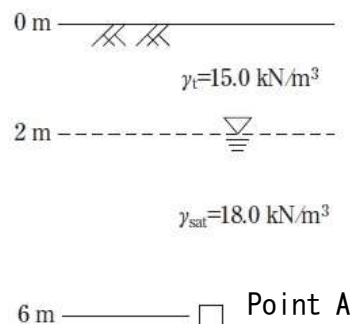
Q9. What is the vertical effective stress at Point A? Select the most appropriate answer among the answers (1) to (4). The wet and saturated unit volume weight of the soil is indicated in the diagram, and the unit volume weight of water is 9.8 kN/m^3 .

(1) 43 kN/m^2

(2) 63 kN/m^2

(3) 83 kN/m^2

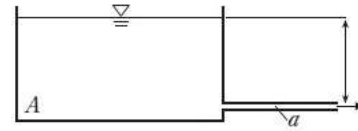
(4) 103 kN/m^2



Q10. There is a water tank with a bottom area of A , as shown in the figure, and the water in the tank flows out into the atmosphere through a conduit with a cross-sectional area of a . This causes lowering of the water level in the tank. What is the rate of change in height of water level H in the tank at an arbitrary time? Assume that the value of a/A is small enough as compared to 1, and g is the gravitational acceleration.

$$(1) \frac{dH}{dt} = - \left[\frac{A}{a} \right] \cdot \sqrt{2gH} \quad (2) \frac{dH}{dt} = \left[\frac{A}{a} \right] \cdot \sqrt{2gH}$$

$$(3) \frac{dH}{dt} = - \left[\frac{a}{A} \right] \cdot \sqrt{2gH} \quad (4) \frac{dH}{dt} = \left[\frac{a}{A} \right] \cdot \sqrt{2gH}$$



Q11. A road construction project has a present value of benefits of 10 billion yen and a present value of costs of 5 billion yen when the social discount rate is 4 %. If the social discount rate is increased to 12 %, the present value of both benefits and costs are estimated to be 4.5 billion yen. Choose the correct value for all three valuation indicators for this project.

	Cost-benefit ratio	Economic net present value	Economic internal rate of return
(1)	0.5	5 billion yen	12 %
(2)	1	10 billion yen	4 %
(3)	2	5 billion yen	12 %
(4)	2	5 billion yen	4 %

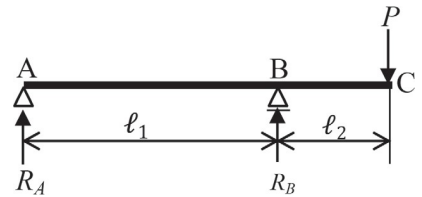
Q12. A sewage treatment plant has a standard activated sludge process with an aeration tank volume of 2,800 m³, and MLSS concentration is 1,500mg/L. The BOD concentration in the influent is 140mg/L and a daily wastewater flow is 6,000 m³. Choose the most appropriate value for the BOD-SS load (kg-BOD/kg-SS/day).

- (1) 0.10 (2) 0.15 (3) 0.20 (4) 0.30

Q13. Choose the correct statement among the following statement regarding cracking of concrete.

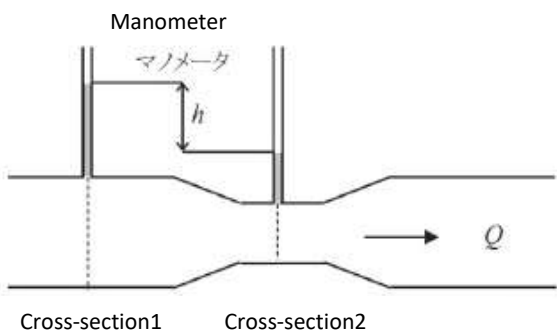
- (1) Concrete with high unit water content is less prone to drying shrinkage cracking.
- (2) Concrete with low unit cement content is prone to thermal cracking.
- (3) Concrete with high unit water content is prone to settlement cracking around reinforcing bars.
- (4) Plastic shrinkage cracking generally occurs after one month of age.

Q14. Choose the correct reaction forces R_A and R_B at fulcrums A and B when a concentrated load P acts on point C of the overhanging beam as shown in the figure. Ignore the dead weight of the beam.



- | | | | | | |
|-----|--|--|-----|--|--|
| (1) | $(R_A) = -\frac{\ell_2}{\ell_1} \cdot P$ | $(R_B) = \frac{\ell_1 + \ell_2}{\ell_1} \cdot P$ | (3) | $(R_A) = \frac{\ell_2}{\ell_1} \cdot P$ | $(R_B) = \frac{\ell_1 - \ell_2}{\ell_1} \cdot P$ |
| (2) | $(R_A) = \frac{\ell_1 + \ell_2}{\ell_1} \cdot P$ | $(R_B) = -\frac{\ell_2}{\ell_1} \cdot P$ | (4) | $(R_A) = \frac{\ell_1 - \ell_2}{\ell_1} \cdot P$ | $(R_B) = \frac{\ell_2}{\ell_1} \cdot P$ |

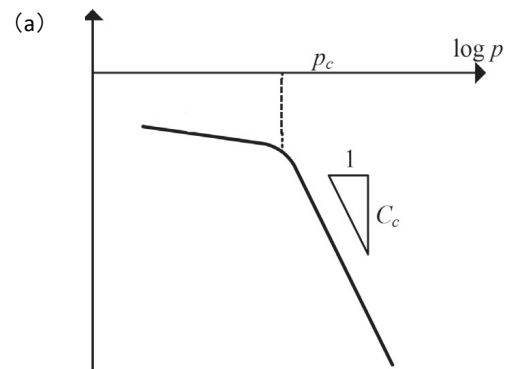
Q15. The pressure difference between Cross-section 1 and Cross-section 2 in the pipeline is measured as shown in the figure, and the measured value is ρgh . Let ρ be the density of water and g is the gravitational acceleration. In addition, assume that the pipeline is laid horizontally and that the cross-sectional area at Cross-section 2 is $A/2$, while the cross-sectional area at Cross-section 1 is A . In this case, what is the discharge Q flowing in the pipeline? Choose the answer from the following. Energy loss is assumed to be negligible



- | | | | |
|-----|------------------------------------|-----|--------------------------|
| (1) | $Q = A \cdot \sqrt{\frac{2gh}{3}}$ | (3) | $Q = A \cdot \sqrt{2gh}$ |
| (2) | $Q = A \cdot \sqrt{\frac{gh}{2}}$ | (4) | $Q = A \cdot \sqrt{gh}$ |

Q16. For the following statements regarding soil consolidation properties, select the appropriate combination of technical terms that apply to (a) to (e).

In the "Test method for one-dimensional consolidation properties of soils using Incremental loading," a consolidation ring (standard inner diameter 6 cm, height 2 cm) is filled with soil and the (a) of the soil is examined each time as the top load p is increased in sequence. The top load p is plotted on the horizontal axis (normal logarithm) and (a) on the vertical axis, the consolidation curve shown on the right is obtained. The stress p_c at the bending point of the consolidation curve is denoted by (b), and the slope C_c after bending is denoted by (c). In general, ground with a (b) equal to the current effective overburden pressure is called (d), while ground with (b) (e) than the current effective pressure is called overconsolidated ground.



(a)	(b)	(c)	(d)	(e)
(1) Moisture content ratio	Leading yield stress	Consolidation factor	Secondary consolidation Ground	Smaller
(2) Pore ratio	Consolidation yield stress	Compression index	Normally consolidated ground	Bigger
(3) Pore ratio	Leading yield stress	Consolidation factor	Normally consolidated ground	Smaller
(4) Moisture content ratio	Consolidation yield stress	Compression index	Secondary Consolidation Ground	Bigger

Q17. Among the following statements, choose the one that best describes the characteristics of Neighborhood Unit Theory advocated by C.A.Perry, an American urban planner and sociologist.

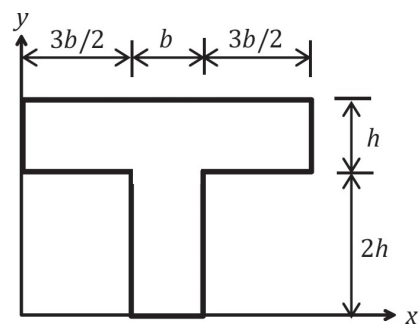
- (1) The size of the residential district is considered to be the number of units corresponding to the population that would require one middle school.
- (2) The principle is to enclose the boundaries of the residential area with a greenbelt.
- (3) Open space in the residential area will be concentrated in one location and will not have small parks.
- (4) The street network within the residential area should be laid out in such a way as to prevent passing traffic.

Q18. Choose the correct one of the following statements regarding aggregates.

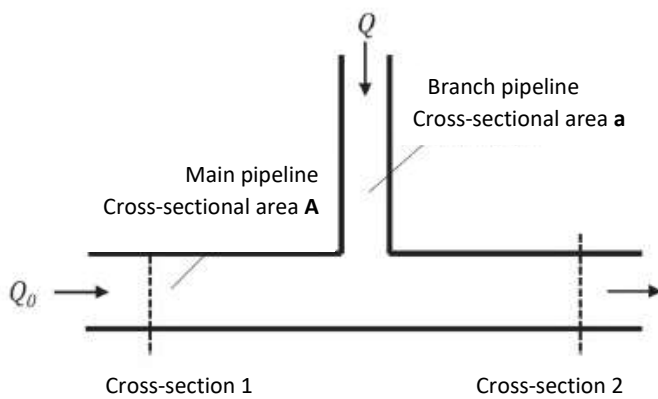
- (1) Aggregates with a grain size of 10 mm or less are called Fine aggregates
- (2) Fine aggregate should not contain fines with a grain size of 75 μm or less.
- (3) The fineness modulus of coarse aggregate is higher than that of fine aggregate.
- (4) The lower the percentage of absolute volume occupied by coarse aggregate in concrete, the better the flowability of the concrete.

Q19. Choose the correct cross-sectional quadratic moment about the figure-center axis parallel to the x-axis for a T-shaped cross-section as shown in the figure.

- (1) bh^3
- (2) $2bh^3$
- (3) $4bh^3$
- (4) $8bh^3$



Q20. Between Cross-sections 1 and 2 along the main pipeline, a branch pipeline is connected as shown in the figure. The cross-sectional area of the main conduit is A , and the water discharge Q_0 is supplied from the left side of the main pipeline. On the other hand, the water discharge Q is flowing from above into the branch pipeline with a cross-sectional area of a . When considering the momentum change in the downstream direction of the main channel flow, it is assumed that the inflow from the branch pipeline has no effect, and the frictional forces acting on the wall surface can be ignored. In this case, what is the relationship for the difference of the pressure head at Cross-section 1 minus that at Cross-section 2? Choose the correct one. Let g be the acceleration of gravity.

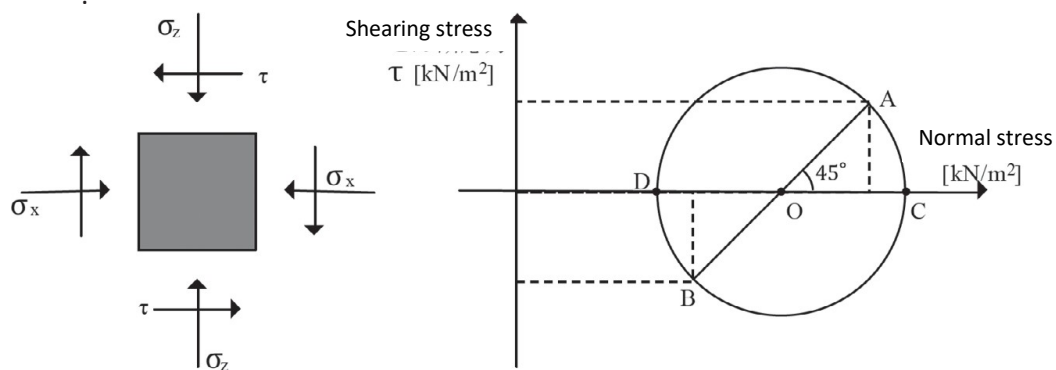


- | | |
|---|---|
| (1) $\frac{Q_0 \cdot (2Q_0 + Q)}{gA^2}$ | (3) $\frac{Q \cdot (Q_0 + 2Q)}{gA^2}$ |
| (2) $\frac{Q \cdot (2Q_0 + Q)}{gA^2}$ | (4) $\frac{Q_0 \cdot (Q_0 + 2Q)}{gA^2}$ |

Q21. As shown in the diagram below, vertical stress $\sigma_z = 200 \text{ kN/m}^2$, horizontal stress $\sigma_x = 100 \text{ kN/m}^2$, and shear stress $\tau = 50 \text{ kN/m}^2$ are acting on soil elements in the ground. Note that the shear stress is positive (+) in counterclockwise direction.

Select the appropriate combination of the following statements representing this stress state with Mohr's stress circle shown below.

- (a) The coordinates of Point B are (100, -50), indicate the stress in the plane where the horizontal normal stress acts.
- (b) Point C represents the stress on the maximum principal stress surface, and its coordinates are (250, 0).
- (c) The maximum shear stress acting on this soil element is $25\sqrt{2} \text{ kN/m}^2$
- (d) The angle between the plane where the vertical stress acts and the plane where the maximum shear stress acts is 90° .

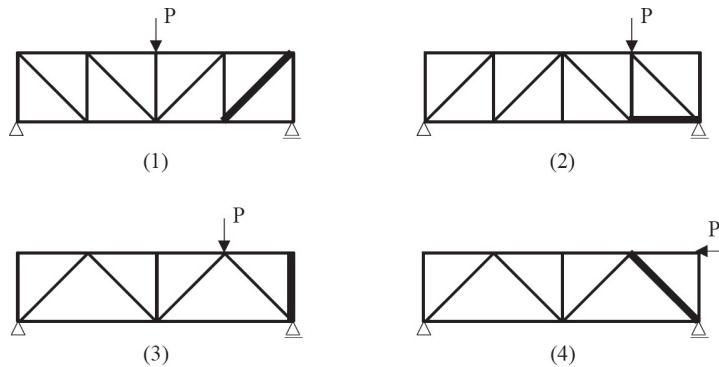


(a)	(b)	(c)	(d)
(1) Correct	False	False	False
(2) Correct	Correct	Correct	False
(3) False	False	Correct	Correct
(4) False	Correct	False	Correct

Q22. Choose the correct statement among the following regarding reinforced concrete members.

- (1) The reinforcement ratio is the ratio of the cross-sectional area of the main tensile bar to the total cross-sectional area of concrete.
- (2) In the case of multi-layer reinforcement distribution, the effective height is the distance from the compression edge of the member section to the center of the cross-section of the furthest tensile bar.
- (3) Cover is the distance from the surface of the concrete to the center of the cross-section of the reinforcement bar.
- (4) The development length is the length of embedment required to transmit reinforcement stresses in the design cross-section.

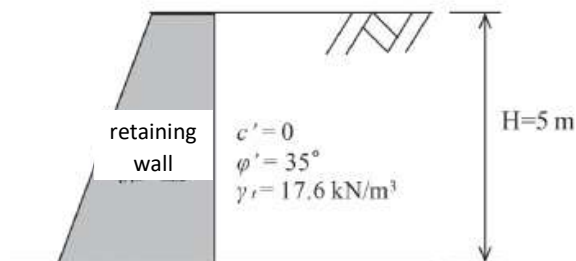
Q23. Among the following truss structures, choose the correct one in which the force acting on the member indicated by the bold line is not a tensile force.



Q24. There is a retaining wall with a smooth wall surface and a height of 5 m. When this retaining wall supports the backfill soil shown in the diagram (cohesion $c'=0$, shear resistance angle $\phi'=35^\circ$, wet unit volume weight $\gamma_t = 17.6 \text{ kN/m}^3$), what is the combined Rankine active earth pressure?

Select the value that is closest to the correct value. The values of the active earth pressure coefficient K_A and the passive earth pressure K_P , used in the calculation should be selected from the table.

- (1) 60 kN/m
- (2) 110 kN/m
- (3) 160 kN/m
- (4) 225 kN/m



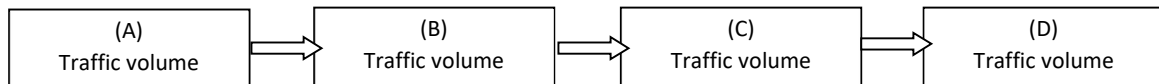
ϕ'	K_A	K_P
15°	0.89	1.70
20°	0.49	2.04
25°	0.41	2.46
30°	0.33	3.00
35°	0.27	3.66
40°	0.20	4.60

Q25. In the following statements regarding the observation of water levels and discharge in rivers, choose the most appropriate combination of correct and incorrect.

- (a) In order to accurately determine river discharge, it is preferable to have the cross section to be measured in the straight section of the river channel rather than in the curved section of the channel.
- (b) Gauging station should be placed where subsequent changes in the riverbed conditions can be comprehensively observed, and where scouring and sand bars are likely to occur.
- (c) River discharge data is generally obtained by deriving the relationship curve between water level and discharge in advance and using this relationship from observed water level values.
- (d) Discharge observation during floods is measured using propeller anemometer and electromagnetic flow meter, but not using floats any longer.

(a)	(b)	(c)	(d)
(1) Correct	False	Correct	False
(2) Correct	Correct	False	False
(3) False	False	Correct	Correct
(4) False	Correct	Correct	False

Q26. Choose the correct combination of terms in (A) through (D) of the well-known four-step travel demand forecasting model.



	(A)	(B)	(C)	(D)
(1)	Trip generation/ concentration	Distribution	Modal split	Route assignment
(2)	Route assignment	Trip generation/ concentration	Distribution	Modal split
(3)	Departure	Modal split	Assigned traffic volume	Arrival
(4)	Transportation demand	Departure	Supply	Arrival

Q27. Choose the most appropriate statement among the following regarding global warming and ozone layer depletion.

- (1) Both carbon dioxide and methane are major ozone-depleting substances.
- (2) CFCs (chlorofluorohydrocarbons) have an ozone-depleting effect but do not have a global warming effect.
- (3) The average surface temperature at radiative equilibrium without taking into account the greenhouse effect of the atmosphere is considered to be approximately -18°C .
- (4) Depletion of the ozone layer is caused by the sun's harmful ultraviolet radiation.

Q28. Choose the most appropriate statement among the following regarding admixture.

- (1) As admixtures are used in large quantities, their volume must be taken into account in mix design.
- (2) Silica fume is a type of admixture.
- (3) The water reducer can be coupled with entrained air.
- (4) Accelerators are admixtures used to accelerate cement setting.

Q29. From the following statements, choose the correct one concerning the calculation assumptions when calculating the bending capacity of reinforced concrete beams.

- (1) The compressive stress of concrete is proportional to its distance from the neutral axis.
- (2) The tensile stress of the concrete shall be ignored even if it is below the tensile strength of the concrete.
- (3) The bond between the reinforcement and concrete on the tensile side is neglected, and the strains of the two are not equal.
- (4) If stirrups are placed around the tensile reinforcement, the strength of the tensile bars will increase.

Q30. When slope stability analysis is performed using the limit equilibrium method, the degree of stability of a slope is generally expressed in terms of the "slip stability ratio. For the following statements (A) to (D), select the appropriate combination of correct and false.

- (A) The rate of slip stability of a slope is defined as the rate of safety being 1 when the slope is suspended in the limit state, and the higher the value, the greater the degree of stability.
- (B) In the slip stability analysis, the amount of slip displacement can be determined at the same time as the rate of slip stability is determined.
- (C) When considering loads such as seismic forces that occur infrequently and act for a short time, it is common to take a larger factor of safety than when only the dead weight of the slope is considered.
- (D) The slip safety factor is related to the slope gradient but not to the location of the groundwater table.

	(A)	(B)	(C)	(D)
(1)	False	Correct	False	Correct
(2)	Correct	False	Correct	False
(3)	Correct	False	False	False
(4)	Correct	Correct	False	False

Q31. For the following statements (A) through (D) regarding tsunamis, choose the correct combination of Correct and False.

- (A) Tsunami wave length is very long, so they are not refracted in shallow coastal areas.
- (B) Tsunami protection can be adequately handled by installing structures to the fullest extent, and the formulation of evacuation plans is a secondary measure.
- (C) The speed of a tsunami propagating at 250 m water depth is about 180 km/h.
- (D) A tsunami always starts with a return flow.

	(A)	(B)	(C)	(D)
(1)	Correct	False	False	Correct
(2)	False	Correct	False	Correct
(3)	False	Correct	Correct	False
(4)	False	False	Correct	False