

Questions for Scientist B – Civil candidates

Duration : 1 hour

Date : 09 October. 2021

Total marks: 100

Instructions

1. Choose the best suitable answer from the given multiple choices and mark in the OMR sheet provided. Do not answer anywhere else.
2. Please write your name, Roll.No and all other data in the OMR sheet; The OMR sheet shall be duly signed.
3. Rough sheet is provided for working.
4. Question paper, OMR sheet and work sheets should be handed over back to the official-in-charge.
5. Please see that this question paper contains 50 (fifty) distinct questions.
6. **Each correct answer carries 2 marks.**
7. **There shall be negative marking of -0.5 for every wrong answer.**

QUESTION PAPER

1. A steel wire of 20mm diameter is bent into a circular shape of 10m radius. If the modulus of elasticity is $2 \times 10^6 \text{ kg/cm}^2$, then the maximum stress induced in the wire is

- (a) 10^3 kg/cm^2 (b) $2 \times 10^3 \text{ kg/cm}^2$ (c) $4 \times 10^3 \text{ kg/cm}^2$ (d) $6 \times 10^3 \text{ kg/cm}^2$

2. A rectangular block of size 200 mm x 100 mm x 50 mm is subjected to a shear stress of 500 kg/cm^2 . If the modulus of rigidity of the material is $1 \times 10^6 \text{ kg/cm}^2$, the strain energy stored will be

- (a) 1000 kg-cm (b) 500 kg-cm (c) 125 kg-cm (d) 100 kg-cm

3. Pick out the correct statement out the following:

1. When a member is subjected to uniaxial tensile force, the maximum normal stress is the external load divided by the maximum cross sectional area
2. When a structural member is subjected to uniaxial loading, the shear stress is zero on plane where the normal stress is maximum;
3. In a member subjected to uniaxial loading, the normal stress on the planes of maximum shear stress is less than the maximum

- (a) 1 and 2 (b) 1 and 3 (c) 2 and 3 (d) 1, 2 and 3

4. A simply supported beam 'A' carries a point load at its mid span. Another identical beam 'B' carries the same magnitude of load but it is uniformly distributed over the entire span. The ratio of the maximum deflections of beams 'A' and 'B' will be:

- (a) $8/3$ (b) $2/3$ (c) $3/5$ (d) $8/5$

5. Match List-1 (Load Case) with List II (Expression for slope / Deflection) and select the correct answer using the codes given below the list. (Flexural Rigidity = EI)

List I

- A. Slope for tip load of W
- B. Deflection for tip load of W
- C. Slope for total UDL of W
- D. Deflection for total UDL of W

List II

- 1. $WL^3/8EI$
- 2. $WL^3/6EI$
- 3. $WL^3/3EI$
- 4. $WL^2/2EI$

Codes

	A	B	C	D
(a)	4	2	3	1
(b)	1	3	2	4
(c)	4	3	2	1
(d)	1	2	3	4

6. A timber beam is 100mm wide and 150 mm deep. The beam is simply supported and carries a central concentrated load W. If the maximum stress in shear is 2 N/mm^2 , what would be the corresponding load W on the beam?

- (a) 20 kN (b) 30 kN (c) 40kN (d) 25kN

7. If a point load acting at the mid span of a fixed beam of uniform section produces fixed end moments of 60 kN-m then the same load spread uniformly over the entire span will produce fixed end moments equal to:

- (a) 20 kN-m (b) 30 kN-m (c) 40 kN-m (d) 45 kN-m

8. A cantilever beam fixed at 'B' with a prop at 'A' of length 'L' carries a UDL of w/m; Match List 1 with List II with respect to the beam data and select the correct options using the codes provided below

List I

- A. Moment at B
- B. Slope at A
- C. Reaction at A
- D. Stiffness of AB

List II

- 1. $3/8wL$
- 2. $4EI/L$
- 3. $1.5M$ where $M = wL^2/12$
- 4. $ML/4EI$ where $M = wL^2/12$

Codes

	A	B	C	D
(a)	2	1	4	3
(b)	3	1	4	2
(c)	3	4	1	2
(d)	2	4	1	3

9. A beam is hinged at end X and fixed at end Y. A moment M is applied at end X. What is the moment developed at end Y?

- (a) -M (b) M (c) M/2 (4) -M/2

10. A uniform beam of span 'l' is rigidly fixed at both supports and carries a uniformly distributed load 'w'/unit length. The bending moment at mid span is

- (a) $wl^2/8$ (b) $wl^2/12$ (c) $wl^2/16$ (d) $wl^2/24$

11. Which one of the following pairs is correctly matched?

- (a) Truss : Bending
(b) Beam : Twisting
(c) Column : Buckling
(d) Shaft : Shortening

12. A cantilever steel beam of 3m span carries a uniformly distributed load of 20 kN/m inclusive of self-weight. The beam comprises ISLB200@198 N/mm flange 100 mm x 7.3mm, web thickness 5.4mm

($I_{xx} = 1696.6 \text{ cm}^4$ $I_{yy} = 115.4 \text{ cm}^4$)

Bending and shear stresses in the beam respectively are:

- (a) 530.47 N/mm^2 and 55.55 N/mm^2
(b) 3899.48 N/mm^2 and 82.19 N/mm^2
(c) 132.62 N/mm^2 and 41.1 N/mm^2
(d) 1949.74 N/mm^2 and 41.10 N/mm^2

13. The slenderness ratio in tension member as per BIS code where reversal of stress is due to loads other than wind or seismic shall not exceed

- (a) 350 (b) 180 (c) 100 (d) 60

14. Consider the following statements:

Statement (1): In the working stress design method, the internal stresses at a section of member are computed for Factored Loads

Statement (2): In the working stress design method, it is ensured that the internal stresses due to working loads are less than the allowable stresses

- (a) Both 1 and 2 are true and Statement 2 is the correct explanation of statement 1
(b) Both 1 and 2 are true but Statement 2 is the NOT a correct explanation of Statement 1
(c) Statement 1 is TRUE but Statement 2 is FALSE
(d) Statement 1 is FALSE but Statement 2 is TRUE

15. Consider the following statements in respect of gantry girders

1. Gantry girders are designed for 23% extra load of crane capacity for impact
2. Maximum deflection for dead and imposed loads without impact is limited to span/500

Which of the following statements is / are correct?

- (a) 1 only (b) 2 only (c) Both 1 and 2 (d) Neither 1 nor 2

16. The main reinforcement of a RC slab consists of 10mm bars at 10 cm spacing. If it is desired to replace 10 mm bars by 12 mm bars, then the spacing of 12 mm bars should be

- (a) 12 cm (b) 14cm (c) 14.4 cm (d) 16 cm

17. In case of two-way slab, limiting deflection of the slab is

- (a) primarily a function of the long span
- (b) primarily a function of the short span
- (c) independent of long or short spans
- (d) dependent on both long and short spans

18. In a reinforced concrete retaining wall, a shear key is provided, if the

- (a) shear stress in the vertical stem is excessive
- (b) shear force in the toe slab is more than that in the heel slab
- (c) retaining wall is not safe against sliding
- (d) retaining wall is not safe against overturning

19. Combination of partial safety factors for loads under limit state of collapse and limit state of serviceability will be

- (a) 1.5 (DL + LL) or 1.5 (DL + WL) or 1.2(DL+LL+WL) and DL+0.8 (LL+WL)
- (b) 1.5 (DL + LL) and DL + 0.8 (LL+WL)
- (c) 1.5 (DL+LL) or 1.5 (DL+WL) or 1.2 (DL+LL+WL) and 1.0 (DL+LL) or 1.0 (DL+WL) or DL + 0.8 (LL+WL)
- (d) 1.2 (DL+LL+WL) and 1.0 (DL+LL) or 1.0 (DL + WL) or DL + 0.8(LL+WL)

20. Match List-1 with List II and select the correct answer using the codes given below

List I

- A. Min. % of tension reinforcement of RC beam
- B. Min. % of shear reinforcement of RC beam
- C. Max. allowable % of tension reinforcement of RC beam
- D. Max. allowable % of compression reinforcement of RC beam

List II

- 1. 4
- 2. $85/f_y$
- 3. $40 S_v/f_y d$

Codes

	A	B	C	D
(a)	2	1	3	1
(b)	2	3	1	1
(c)	1	3	1	2
(d)	3	2	1	1

21. Two small orifices A and B of diameters 1 cm and 2 cm respectively, are placed on the sides of a tank at depths of h_1 and h_2 below the open liquid surface. If the discharges through A and B are equal, then the ratio of h_1 and h_2 (assuming equal C_d values) will be

- (a) 16:1 (b) 8:1 (c) 4:1 (d) 2:1

22. A channel bed slope 0.0009 carries a discharge of $30 \text{ m}^3/\text{s}$ when the depth of flow is 1 m. What is the discharge carried by an exactly similar channel at the same depth of flow if the slope is decreased to 0.0001?

- (a) $10 \text{ m}^3/\text{s}$ (b) $15 \text{ m}^3/\text{s}$ (c) $60 \text{ m}^3/\text{s}$ (d) $90 \text{ m}^3/\text{s}$

23. The water depth in a river is 4.8 m, the water surface slope is 1 in 10000 and the discharge in the stream is $600 \text{ m}^3/\text{s}$. If the water depth remains the same and the water surface slope is 1 in 14,400, then the discharge in the stream will be

- (a) $300 \text{ m}^3/\text{s}$ (b) $400 \text{ m}^3/\text{s}$ (c) $600 \text{ m}^3/\text{s}$ (d) $500 \text{ m}^3/\text{s}$

24. The procedure to be followed in solving for discharge in a simple pipe problem, when h_f , L , D , V and ϵ are given is to [Note: R_e is Reynolds number, f – friction coefficient, ϵ/D – Relative roughness, V – velocity]

- (a) Assume f , compute: V , R_e , ϵ/D and calculate f ; repeat if necessary
- (b) Assume R_e , compute f , check ϵ/D
- (c) Assume V , compute R_e and calculate f , V again
- (d) Assume ϵ , compute V , R_e and calculate f

25. Which one of the following statements is correct?

- (a) Dynamic viscosity of water is nearly 50 times that of air
- (b) Kinematic viscosity of water is 30 times that of air
- (c) Water in soil is able to rise a considerable distance above the ground water table due to viscosity
- (d) Vapor pressure of a liquid is inversely proportional to the temperature

26. A retaining wall retains a sand stratum with $\phi = 30^\circ$ up to its top. If a uniform surcharge of 12 t/m^2 is subsequently put on the sand strata, then the increase in the lateral earth pressure intensity on the retaining wall will be

- (a) 1 t/m^2
- (b) 2 t/m^2
- (c) 4 t/m^2
- (d) 8 t/m^2

27. A fill having a volume of $1,50,000 \text{ cum}$ is to be constructed at a void ratio of 0.8. The borrow pit soil has a void ratio of 1.4. The volume of soil required (in cubic meters) to be excavated from the borrow pit will be

- (a) 1,87,500
- (b) 2,00,000
- (c) 2,10,000
- (d) 2,50,000

28. In the consolidated drained test on a saturated soil sample, pore water pressure is zero during

- (a) Consolidation stage only
- (b) shearing stage only
- (c) Both consolidation and shearing stage
- (d) loading stage

29. In a Direct shear test, the shear stress and normal stress on a dry sand sample at failure are 0.6 kg/cm^2 and 1 kg/cm^2 respectively. The angle of internal friction of the sand will be nearly

- (a) 25°
- (b) 31°
- (c) 37°
- (d) 43°

30. In a shear test on cohesionless soils, if the initial void ratio is less than critical void ratio, the sample will

- (a) Increase in volume
- (b) initially increase in volume and then remain constant
- (c) Decrease in volume
- (d) initially decrease and then increase in volume

31. In the case of a pile foundation, negative skin friction may occur at a load which is

- (a) Lower than the design load (b) Higher than the design load
(c) Equal to the design load (d) Of any magnitude

32. A 30 m metric chain is found to be 0.1 m too short throughout the measurement. If the distance measured is recorded as 300 m, then the actual distance measured will be

- (a) 300.1 m (b) 301.0 m (c) 299.0 m (d) 310.0 m

33. To find the RL of a roof slab of building, staff readings were taken from a particular set-up of the levelling instrument. The readings were 1.050 m with staff on the Bench mark and 2.300 m with staff below the roof slab and held inverted. Taking the RL of the Bench Mark as 135.15 m, the RL of the roof slab will be

- (a) 129.800 (b) 131.900 (c) 134.400 (d) 138.500

34. Which one of the following surveys employs alidade?

- (a) Contour survey (b) Archaeological survey
(c) Plane table survey (d) Reconnaissance survey

35. A scale of 1 inch = 50 ft. is mentioned on an old map. What is the corresponding equivalent scale?

- (a) 1 cm = 5 m b) 1 cm = 6m c) 1 cm =10 m d) 1 cm = 12 m

36. The average of P numbers is 'x' and the average of N numbers is 'y'. What is the average of all P+N numbers

- (a) $(Px + Ny) / (P+N)$ (b) $x+y$
(c) $(Py + Nx) / (xy(P+N))$ (d) $(x+y) / (P + N)$

37. If 0.6 is the average of four numbers 0.2, 0.8, 1.0 and x, what is the numerical value of 'x'?

- (a) 0.2 (b) 0.4 (c) 0.67 (d) 1.3

38. The area of a square is equal to the area of a rectangle. If the side of the square is 6m and the side of the rectangle is 4m, then the perimeter of the rectangle is

- (a) 13m (b) 16m (c) 24m (d) 26m

39. The diameter of the smaller circle is equal to the radius of the larger circle. If the area of the larger circle is 144π , what is the area of the smaller circle?

- (a) 72π (b) 36π (c) 24π (d) 12π

40. The length of a rectangle is decreased by 15% and its width is increased by 40%. Does the area of the rectangle decrease or increase and by what percent?

- (a) Decreases by 19% (b) Decreases by 25% (c) Increases by 6%
(d) Increases by 19%

41. Joe's average (Arithmetic Mean) test score across 4 equally weighted tests was 80. He was allowed to drop his lowest score. After doing so, he average test score improved to 85. What is the lowest test score that was dropped?

- (a) 20 (b) 25 (c) 55 (d) 65

42. If 5 machines can produce 20 units in 10 hours, how many hours would it take 20 machines to produce 100 units?

- (a) 50 (b) 40 (c) 12.5 (d) 12

Questions 43 -46 :

Read the following and answer questions 43 to 46 given below

Laboratory evidence indicates that life originated through chemical reactions in the primordial mixture (water, hydrogen, ammonia and hydrogen cyanide) which blanketed the earth at its formation. These reactions were brought about by the heat, pressure, and radiation conditions then prevailing. One suggestion is that nucleosides and amino acids were formed from the primordial mixture, and the nucleosides produced nucleotides which produced the nucleic acids (DNA, the common denominator of all living things and RNA). The amino acids became polymerized (chemically joined) into proteins, including enzymes and lipids were formed from fatty acids and glycerol like molecules. The final step appears to have been the gradual accumulation of DNA, RNA, proteins, lipids and enzymes into a vital mass, which began to grow, divide and multiply.

The evolution of the various forms of life from this biochemical mass must not be considered a linear progression. Rather, the fossil record suggests an analogy between evolution of species and a bush, which branches. Like branches, some evolutionary lines simply end, and others branch again. Many biologists believe the pattern to have been as follows: bacteria emerged first and from them branched viruses, red algae, blue-green algae, and green flagellates. From the latter branched green algae, from which higher plants evolved and colorless rhizoflagellates, from which diatoms, molds, sponges, protozoa evolved. From ciliated protozoa (ciliophora) evolved multinucleate (syncytial) flatworms. These branched into five lines, one of which leads to the echinoderms and chordates. The remaining lines lead to most of the other phyla of the animal kingdom.

43. From the language of the First paragraph, it can be inferred that

- I. Some scientists accept the theories of the origin of life based on evidence
- II. The reactions that produced life required a unique combination of heat, pressure and radiation.
- III. Some living forms are without DNA.

(a) I only (b) I and II only (c) I and III only (d) II and III only

44. Which of the following best expresses the analogy between evolution and a bush?

- (a) species : evolution :: bush : branching
- (b) species : branching :: bush : evolution
- (c) evolution : species :: bush : branched viruses
- (d) evolution : species :: bush : branches

45. Which of the following can we infer to be the least highly evolved?

(a) green algae (b) blue-green algae (c) molds (d) flatworms

46. According to the passage, the evolutionary line of sponges in its proper order is
- (a) bacteria – green flagellates – rhizoflagellates – sponges
 - (b) bacteria – viruses – rhizoflagellates – sponges
 - (c) bacteria – red algae – blue – green algae – rhizoflagellates – sponges
 - (d) bacteria – blue – green algae – green flagellates – rhizoflagellates – sponges

47. ADCP is

- (a) Acoustic Doppler Current Profiler
- (b) Acoustic Dispersion Current Parameter
- (c) Accurate Doppler Current Processor
- (d) None of the above

48. Littoral drift is defined as:

- (a) Neo tectonic movement of land masses
- (b) Sediment movement in the nearshore regions
- (c) Transport of solid wastes disposed in coastal waters
- (d) Vertical movement of phytoplankton during the daily cycle

49. Jack up platforms are:

- (a) Fixed structures resting on piles installed in increasing water depths
- (b) Mobile units resting on the sea bottom during operations and used for drilling
- (c) Gravity structures used as production platforms for storage at sea
- (d) A jetty structures extending from the shore for berthing of vessels

50. The Nishkin sampler is an equipment for

- a) Sediment collection
- b) Water collection
- c) Plankton filtration
- d) In-situ Salinity measurement

END OF QUESTION PAPER (A)
