BPSC AE
(Civil)

Previous Year Paper
(General Engg) Paper-IV
11 Nov, 2022

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Booklet Series

Candidate's Roll Number

D

Serial No. 404681

Question Booklet

Paper—IV

GENERAL ENGINEERING SCIENCE

Time Allowed : 1 Hour | **(Objective)** | **Maximum Marks : 100**

Read the following instructions carefully before you begin to answer the questions.

IMPORTANT INSTRUCTIONS

BPSC AE (CIVIL)
Advt. No - 07/2020
Exam date: 11/11/2022

1. This Question Booklet contains **50** questions in all.
2. **All** questions carry equal marks.
3. Attempt **all** questions.
4. **Immediately after commencement of the examination, you should check up your Question Booklet and ensure that the Question Booklet Series is printed on the top right-hand corner of the Booklet and the Booklet contains 12 printed pages and no page or question is missing or unprinted or torn or repeated. If you find any defect in this Booklet, get it replaced immediately by a complete Booklet of the same series.**
5. You must write your Roll Number in the space provided on the top of this page. Do not write anything else on the Question Booklet.
6. An Answer Sheet will be supplied to you separately by the Invigilator to mark the answers. **You must write your Name, Roll No. and other particulars on the first page of the Answer Sheet provided, failing which your Answer Sheet will not be evaluated.**
7. You will encode your **Roll Number** and the **Question Booklet Series A, B, C or D** as it is printed on the top right-hand corner of this Question Booklet with Black/Blue ballpoint pen in the space provided on **Page–2** of your Answer Sheet. **If you do not encode or fail to encode the correct series of your Question Booklet, your Answer Sheet will not be evaluated correctly.**
8. Questions and their responses are printed in English only in this Booklet. Each question comprises **four** responses—(A), (B), (C) and (D). You are to select ONLY ONE correct response and mark in your Answer Sheet. In case you feel that there are more than one correct response, mark the response which you consider the best. In any case, choose ONLY ONE response for each question. Your total marks will depend on the number of correct responses marked by you in the Answer Sheet.
9. In the Answer Sheet, there are **four** brackets—(A), (B), (C) and (D) against each question. To answer the questions you are to **mark with Black/Blue ballpoint pen** ONLY ONE bracket of your choice for each question. Select one response for each question in the Question Booklet and mark in the Answer Sheet. If you mark more than one answer for one question, the answer will be treated as wrong. **Any erasure or change is not allowed.**
10. You should not remove or tear off any sheet from the Question Booklet. You are not allowed to take this Question Booklet and the Answer Sheet out of the Examination Hall during the examination. **After the examination has concluded, you must hand over your Answer Sheet to the Invigilator.** Thereafter, you are permitted to take away the Question Booklet with you.
11. Failure to comply with any of the above instructions will render you liable to such action or penalty as the Commission may decide at their discretion.

SEAL

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1. Distortion energy theory as one of the theories of failure was proposed by

(A) Guest and Tresca

(B) Haigh

(C) von Mises and Hencky

(D) Rankine

2. At a certain speed, revolving shafts tend to vibrate violently in transverse direction. This speed is known as

(A) critical speed only

(B) whipping speed only

(C) critical or whirling or whipping speed

(D) whirling speed only

3. Three main chemical constituents of wood are

(A) cellulose 40%–50%, hemi-cellulose 20%–35%, lignin (phenyl group) 15%–35%

(B) cellulose 15%–35%, hemi-cellulose 50%–60%, lignin (phenyl group) 10%–18%

(C) cellulose 15%–35%, hemi-cellulose 40%–50%, lignin (phenyl group) 20%–35%

(D) cellulose 20%–35%, hemi-cellulose 40%–50%, lignin (phenyl group) 10%–15%

4. The approximate composition of Portland cement is

(A) tricalcium silicate 30%, dicalcium silicate 45%, tricalcium aluminate 8%, tetracalcium aluminoferrite 10% and other bonding agents 7%

(B) tricalcium silicate 10%, dicalcium silicate 40%, tricalcium aluminate 35%, tetracalcium aluminoferrite 5% and other bonding agents 10%

(C) tricalcium silicate 58%, dicalcium silicate 17%, tricalcium aluminate 8%, tetracalcium aluminoferrite 10% and other bonding agents 7%

(D) tricalcium silicate 45%, dicalcium silicate 30%, tricalcium aluminate 10%, tetracalcium aluminoferrite 8% and other bonding agents 7%

5. Nodular cast iron

(A) has graphites precipitated in the form of flakes

(B) has graphites precipitated in the form of rounded particles called spheroids

(C) is very brittle

(D) contains carbon exclusively in the form of cementite

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6. In steels, silicon as an alloying element

(A) improves fatigue strength, makes the steel more resistant to shock and corrosion, increases tensile strength but has no effect on ductility

(B) makes the steel more resistant to corrosion, wear and abrasion

(C) improves creep strength under dynamic loading and at high-temperature conditions

(D) acts as deoxidising agent, improves the surface grain structure, increases toughness and promotes magnetic properties

7. Steels used for making tools that machine the material with heavy cuts at high speed are

(A) plain-carbon steel

(B) low-carbon steel

(C) high-speed tool

(D) medium-carbon steel

8. Delta metal is an alloy of

(A) nickel, copper, iron and manganese

(B) copper, zinc, lead and iron

(C) tin, copper and antimony

(D) copper and aluminium

9. The factor which converts a future requirement of fund into equal payment of annuity is called

(A) capital recovery factor

(B) present value factor

(C) unicost present value factor

(D) sinking fund factor

10. Gantt chart

(A) consists of two axes, on x-axis generally activities and on y-axis facilities are represented

(B) is a very useful graphical tool and one of the first scientific techniques for project planning and scheduling

(C) is related to operating characteristic curve to understand how well a particular sampling plan is effective

(D) is unsuitable for any non-production activity, where work is similar to a project involving many activities

11. Crash cost in project management is associated with

(A) an activity when it is completed in the possible time, which is lesser than the expected or normal time

(B) allocation of resources and inventory control

(C) complete revision of project schedule after completion without revised information

(D) queueing theory and simulation techniques

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12. For an activity, the estimates for optimistic, pessimistic and most likely times are 2, 12 and 5 days. The expected time and variance of this activity are

(A) 5·5 days and 3·2 respectively assuming beta-distribution for time estimates

(B) 6·7 days and 4·5 respectively assuming beta-distribution for time estimates

(C) 5 days and 3·5 respectively assuming beta-distribution for time estimates

(D) 6 days and 4 respectively assuming beta-distribution for time estimates

13. Fulkerson rule

(A) is applicable for the use of dummy nodes only

(B) provides the scheme for numbering the events on a network

(C) determines float, helps in relocating resources

(D) is applicable for the use of dummy activities

14. A tap discharges water of constant density uniformly in a jet at a velocity of 2 m/s at the tap outlet. The jet flows down smoothly in a vertical direction as compact smooth stream. The velocity of the jet at 0·6 m below the tap outlet considering acceleration due to gravity as $10\ m/s^2$, is

(A) 4·5 m/s

(B) 4 m/s

(C) 5·5 m/s

(D) 5 m/s

15. In Borda mouthpiece, the coefficient of contraction is

(A) 0·707

(B) 0·58

(C) 0·5

(D) 0·60

16. In case of incompressible flow, for flow around immersed bodies

(A) Froude number of the model and prototype should be equal

(B) Weber number of the model and prototype should be equal

(C) Mach number of the model and prototype should be equal

(D) Reynolds number of the model and prototype should be equal

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17. A wall of a furnace is made up of inside layer of silica brick 119 mm thick covered with a layer of magnesite brick 240 mm thick. The temperatures at the inside surface of silica brick wall and outside surface of magnesite brick wall are 780 °C and 102 °C respectively. The contact thermal resistance between the two walls at the interface is 0·003 °C/W per unit wall area. Thermal conductivities of silica and magnesite bricks are 1·7 W/m °C and 6 W/m °C. The rate of heat loss per unit area of the wall is

(A) 5600 W/m^2

(B) 6000 W/m^2

(C) 5200 W/m^2

(D) 5300 W/m^2

18. In free convection, Nusselt number is the function of

(A) Prandtl number and Grashof number

(B) Stanton number and Prandtl number

(C) Peclet number and Stanton number

(D) Prandtl number and Reynolds number

19. For an opaque body

(A) absorptivity = 1

(B) reflectivity = 1

(C) transmissivity+absorptivity=1

(D) absorptivity + reflectivity = 1

20. When a gas or vapour is allowed to escape through a minute aperture such as leakage of steam through the safety valve of a pressure cooker, the leakage process is called

(A) adiabatic

(B) throttling

(C) isothermal

(D) constant pressure

21. A system comprising of 2 kg of fluid undergoes a reversible process at 500 K during which it receives 1 MJ of heat. The change in specific entropy of system for this case and for the other case where heat supply had been doubled for the same initial and final states are

(A) 1 kJ/kgK and 1 kJ/kgK respectively

(B) 2 kJ/kgK and 1·5 kJ/kgK respectively

(C) 1 kJ/kgK and 2·5 kJ/kgK respectively

(D) 1 kJ/kgK and 2 kJ/kgK respectively

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22. The efficiency of Rankine cycle is lower than that of corresponding Carnot cycle because

(A) the Carnot cycle has gas as working substance and Rankine cycle has steam as working substance

(B) the Rankine cycle efficiency depends upon properties of working substance whereas Carnot cycle efficiency is independent of the properties of working substance

(C) the temperature range of Carnot cycle is greater than that for Rankine cycle

(D) the average temperature at which heat is supplied in Rankine cycle is less than that corresponding to Carnot cycle

23. In Pelton turbine

(A) the pressure in the runner is constant at atmospheric level

(B) all buckets are engaged by the jet at a time

(C) the speed ratio for best efficiency is not fixed

(D) potential energy available is partly converted to kinetic energy by the nozzle before the water enters the runner

24. In a single-acting reciprocating pump, the acceleration head

(A) is maximum at the middle of suction stroke

(B) is affected by length of pipe

(C) is zero at the beginning of delivery stroke

(D) affects the work done during a cycle

25. Thevenin's theorem

(A) fails to simplify a complicated series and parallel linear two-terminal network

(B) states that a two-terminal electrical circuit (linear) can be replaced by an equivalent circuit consisting of a voltage source V_{th} in series with a resistor known as equivalent resistance of entire network

(C) says to ignore internal resistance of voltage sources

(D) is applicable to both linear and non-linear electrical circuits

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26. Parallel electrical circuits

(A) refer to a circuit in which current is same throughout the circuit

(B) show only a single path for the current

(C) connect the components in such a way that if any fault happens in the circuit, the current will not flow through the circuit

(D) refer to a circuit with more than one path through which current flows

27. The RMS voltage of a sinusoidal waveform having peak voltage of 20 volts is

(A) 20 V

(B) 15 V

(C) 15·5 V

(D) 14·14 V

28. In DC motor

(A) the classification is done according to the connection of the field winding to the armature

(B) the resistance of armature is very high

(C) back e.m.f. does not depend on the number of poles

(D) back e.m.f. is inversely proportional to the speed of rotor

29. One/Some of the products of combustion of fossil fuels, which act(s) like the glass in a greenhouse, causing the earth's atmosphere to warm up is/are

(A) NO_2

(B) CO and NO

(C) CO_2

(D) SO_2 and H_2O

30. There are pollutants which are formed during combustion at high temperature. They pollute air which when inhaled, turns into acid in lungs which eats away at the lungs spongy structure causing it to lose the capacity to absorb oxygen from the air as a result of which person suffers from shortness of breath. These pollutants penetrate deep into the lungs. Such pollutants are

(A) various oxides of nitrogen

(B) carbon dioxide and carbon monoxide

(C) methane and carbon dioxide

(D) compounds containing sulphur

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31. Purification of flue gases from sulphur oxides with a view to control atmospheric pollution, is achieved

(A) by recirculating flue gases into furnace

(B) by injecting water and steam into the combustion zone

(C) by providing two-stage combustion of fuel

(D) by using lime

32. The dam's lakes

(A) change markedly the local ecological conditions, vary the pressure applied to the land and groundwater level

(B) do not affect plant and animal life in the nearby region

(C) submerge very little area

(D) of hydroelectric plants are usually regarded as dirty and harmful

33. Wastewater can be made potable and usable by employing

(A) filtration and sedimentation as chemical methods for purification

(B) sedimentation as physical method and oxidising agent like chlorine or ozone as chemical method for purification

(C) screening and skimming as biological methods for purification

(D) physical methods such as aerobic and anaerobic processes for purification

34. In alternator

(A) having three-phase circuit, the power in watt is $W = \left(\frac{V}{\sqrt{3}}\right) I \cos\phi$

(B) the amount of heat produced is dependent on square of the current which in turn varies directly with the power factor

(C) of three-phase type, if windings are connected with star system, phase voltage is $\frac{V}{\sqrt{3}}$

(D) generation of single-phase power involves less losses compared to three-phase power generation

where

V = line voltage

I = current in ampere

$\cos\phi$ = power factor

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35. Forces equal to P, $2P$, $3P$ and $4P$ act along the sides AB, BC, CD and DA of a square $ABCD$. The magnitude of resultant and the angle which the resultant makes with the horizontal are respectively

(A) $\frac{\sqrt{3}}{2}P$ and 60°

(B) $\frac{\sqrt{3}}{4}P$ and 60°

(C) $2\sqrt{3}P$ and 30°

(D) $2\sqrt{2}P$ and 45°

36. Two blocks weighing 200 N and 300 N are hung to the ends of a rope passing over an ideal pulley. The velocity of the system at time $t = 0$ is 3 m/s and velocity of the system at time t becomes 5 m/s. The block weighing 200 N shows an upward displacement of h. Acceleration due to gravity is $10\ m/s^2$. According to work-energy method, the tensions in the rope on its sides and the value of h are

(A) 280 N, 300 N and 2·5 m respectively

(B) 240 N, 240 N and 4 m respectively

(C) 240 N, 250 N and 2 m respectively

(D) 250 N, 230 N and 3 m respectively

37. A balloon weighing W descends with an acceleration of a. When weight w is removed from the balloon, the balloon has an upward acceleration of a. In such a situation, the value of w should be

(A) $\frac{2Wa}{3(a+g)}$

(B) $\frac{Wa}{2(a-g)}$

(C) $\frac{aW}{2(a+g)}$

(D) $\frac{2aW}{a+g}$

where g is acceleration due to gravity.

38. A motorist is travelling at a speed of 25 m/s. He suddenly applies the brakes and comes to rest after skidding to a distance of 100 m. Acceleration due to gravity is $10\ m/s^2$. The time required for the car to stop and coefficient of friction of kinetic type between the tyre and the road are

(A) 8 s, 0·3125 respectively

(B) 6 s, 0·27 respectively

(C) 9 s, 0·40 respectively

(D) 5 s, 0·25 respectively

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39. Work done by a non-conservative force

(A) acting on a particle would be zero, if the moving particle comes back to its original starting position

(B) is always positive

(C) would be negative, will lead to loss in energy

(D) is independent of the path followed by the particle it acts upon

40. In the driving system of energy meter

(A) there is a permanent magnet which is excited by the current flow through the coil

(B) the core of electromagnet is absent

(C) the series electromagnet does not play any role

(D) the coil of shunt electro-magnet is called pressure coil

41. The braking system of an energy meter

(A) makes use of permanent magnet for reducing rotation of aluminium disc

(B) makes use of temporary magnet which is adjustable

(C) also records the number of rotations of aluminium disc

(D) makes use of temporary magnet for reducing rotation of aluminium disc

42. The instrument used to compute the area of irregular region on a map or photograph is

(A) rotameter

(B) planimeter

(C) tachometer

(D) odometer

43. Theodolite is

(A) a precise optical instrument used for measuring the distance between two planets

(B) an electronic machine for measuring the surface roughness

(C) a precise optical instrument for measuring the angle between designated visible points in the horizontal and vertical planes

(D) an inaccurate instrument used in surveying

44. Dumpy level

(A) has a firmly secured telescope which can rotate only in horizontal plane

(B) has a firmly secured telescope which can rotate only in vertical plane

(C) has no rotational arrangement

(D) cannot be used for checking points in the same horizontal plane

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45. Ratchet is the part of

(A) sine bar

(B) dial bevel protractor

(C) clinometer

(D) micrometer

46. Permanent magnet moving-coil ammeter

(A) is used for the measurement of direct current

(B) is used for the measurement of both alternating and direct currents

(C) produces torque for the deflection of pointer proportional to I^2, where I is the total current flowing in circuit in ampere

(D) is used for the measurement of alternating current

47. In generalized three-dimensional state of stress, the number of independent stress components is

(A) 4

(B) 6

(C) 8

(D) 9

48. A cylindrical specimen of length L and cross-sectional area A extends by δ under a gradually applied tensile load P. The strain energy of the specimen is

(A) $\left(\frac{1}{2}\right) P\delta$

(B) $\frac{1}{2}\left(\frac{P}{A} \times \frac{\delta}{L}\right)$

(C) (stress on the cross-section) × (strain along the axis) × (volume of specimen)

(D) $P\delta$

49. A beam of uniform rectangular cross-section is under a transverse load. The stress along the neutral axis of central cross-section is

(A) only bending stress

(B) maximum bending stress and minimum shearing stress

(C) maximum shearing stress only

(D) bending stress and shearing stress

50. The crippling load for a direction-fixed strut is

(A) four times that of a strut with one end direction-fixed and other end free for the same length

(B) directly proportional to the square of the length of strut

(C) three times that of a strut with one end fixed and other pinned

(D) four times that of a pin-ended strut for the same length