Booklet Serial No.

22/AE/CM/M – 2024-04

Booklet Series

W

Question Booklet
GENERAL ENGINEERING SCIENCE
Paper – IV

Candidate's Roll Number

Time Allowed : 01 Hour

Maximum Marks : 100

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

IMPORTANT INSTRUCTIONS

1. This Question Booklet contains **50** questions in all.

2. **All** questions carry equal marks.

3. Attempt **all** questions.

4. An Answer Sheet has been supplied inside the question booklet to mark the answers. **You must write your Roll Number and encode it and write other particulars in the space provided in the Answer Sheet, failing which your Answer Sheet will not be evaluated.**

5. **Immediately after commencement of the examination, you should check up your Question Booklet and attached answer sheet and ensure that the Question Booklet Series is printed on the top left-hand corner of the Booklet and the series encoded in answer sheet are same. Also please check that the Booklet contains 12 printed pages including two pages (Page Nos. 11 and 12) for Rough Work and no page or question is missing or unprinted or torn or repeated or question booklet and answer sheet have different series. If you find any defect in this Booklet and attached answer sheet, get it replaced immediately by a complete Booklet with OMR sheet of the same series.**

6. 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.

7. Questions and their responses are printed in English version in this Booklet. Each question comprises of **four** responses — (A), (B), (C) and (D). You are to select ONLY ONE correct response and mark it 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.

8. In the Answer Sheet, there are **four** circles — (A), (B), (C) and (D) against each question. To answer the questions, you are to mark with **Black/Blue ink ballpoint pen ONLY ONE circle** of your choice for each question. Select only one response for each question and mark it in your Answer Sheet. If you mark more than one circle for one question, the answer will be treated as wrong. **Use Black/Blue ink ballpoint pen only to mark the answer in the Answer Sheet. Any erasure or change is not allowed.**

9. 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.

10. 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.

11. Candidates must assure before leaving the Examination Hall that their Answer Sheets will be kept in Self Adhesive LDPE Bag and completely packed/sealed in their presence.

1. American Public Health Association formula for aeration time (T) in hours is

   (where, La = BOD of the aeration tank sewage influent (mg/litre) to be removed)

   (A) T = (La/4) – 1

   (B) T = (La/20) – 1

   (C) T = 2La – 1

   (D) T = (La/2) – 1

2. Rouse distance (x) required for establishment of a fully developed turbulent flow in a pipe of diameter D is given by

   (A) $\dfrac{x}{D} = \sqrt{50}$

   (B) $x = \dfrac{50}{D}$

   (C) $\dfrac{x}{D} = 50$

   (D) $\dfrac{x}{D} = (50)^2$

3. Newton's formula for convective heat transfer from a fluid to a metallic wall or from a metallic wall to a fluid is

   (where, Q = heat transfer by convection in J/S, h = heat transfer or film coefficient in J/m^2 Cs or W/m^2 C, a = surface area through which heat is transferred in m^2, t_s = temperature of the surface or wall in ºC and t_f = temperature of the fluid in ºC)

   (A) $Q = ha\sqrt{(t_s - t_f)^2}$

   (B) $Q = ha(t_s + t_f)$

   (C) $Q = ha(t_s - t_f)$

   (D) $Q = ha(t_f - t_s)$

4. The strain energy stored in a spring, when subjected to maximum load, without suffering permanent distortion, is known as

   (A) Modulus of resilience

   (B) Proof resilience

   (C) Impact energy

   (D) Proof stress

5. It is proposed that solar energy be used to warm a large collector plate. The energy would in turn, be transferred as heat to a fluid within a heat engine, and the engine would reject energy as heat to the atmosphere having assumed temperature of 20°C. Experiments indicate that about 1880 KJ/m^{2}h of energy can be collected when the plate is operating at 90°C. The minimum collector area that would be required for plant producing 1 KW of useful shaft power will be approximately

   (A) 30 m^2

   (B) 10 m^2

   (C) 20 m^2

   (D) 15 m^2

6. Which one of these joints are *not* used in C.I. pipes ?

   (A) Simplex joint

   (B) Flanged joint

   (C) Spigot and socket joint

   (D) Tyton joint

7. The strength of current in 2 H inductor changes at a rate of 3 A/s. The voltage across it and the magnitude of energy stored in the inductor after 4 seconds are

   (A) $V_L = 1.5$ V; $W_L = 144$ J

   (B) $V_L = 6$ V; $W_L = 72$ J

   (C) $V_L = 6$ V; $W_L = 144$ J

   (D) $V_L = 1.5$ V; $W_L = 12$ J

8. A thin cylindrical shell of diameter (d) and thickness (t) is subjected to an internal pressure (P). The ratio of longitudinal strain to volumetric strain is (where, $\dfrac{1}{m}$ = Poisson's ratio)

   (A) $\dfrac{m-2}{5m-4}$

   (B) $\dfrac{2m-1}{2m-1}$

   (C) $\dfrac{m-1}{2m-1}$

   (D) $\dfrac{m-2}{3m-4}$

9. Air at a temperature of 15°C passes through a heat exchanger at a velocity of 30 m/s where its temperature is raised to 800°C. It then enters a turbine with the same velocity of 30 m/s and expands until the temperature falls to 650°C. On leaving the turbine, the air is taken at a velocity of 60 m/s to a nozzle, where it expands until the temperature has fallen to 500°C. If the air flow rate is 2 kg/s, the rate of heat transfer to the air in the heat exchanger, by taking the enthalpy of air as h = C_pt, where C_p is the specific heat equal to 1.005 KJ/Kg and t being the temperature, is

   (A) 4500 KJ/sec
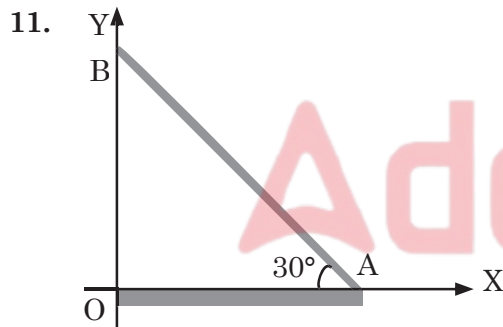
   (B) 1300 KJ/sec

   (C) 1580 KJ/sec

   (D) 1050 KJ/sec

10. The net heat transfer by radiation from a body at temperature (T_1) to another body or surrounding at temperature (T_2) is given by

(where, σ = Radiation constant for a perfect black body and ε = Emissivity of a body at a particular temperature)

(A) $Q = \sigma\,\varepsilon_1\left(T_1^4 + T_2^4\right) W/m^2$

(B) $Q = \sigma\,\varepsilon_2\left(T_1^4 - T_2^4\right) W/m^2$

(C) $Q = \sigma\,\varepsilon_1\left(T_1^4 - T_2^4\right) W/m^2$

(D) $Q = \sigma\,\varepsilon_2\left(T_1^2 - T_2^2\right) W/m^2$

11.

A rod AB rests with the end A on rough ground and the end B against a smooth vertical wall. The rod is uniform and of weight W. If the rod is in equilibrium in the position shown in figure, the normal reaction at B is

(A) $\dfrac{\sqrt{3}}{2} W$

(B) $\dfrac{W}{2}$

(C) W

(D) $\sqrt{3}W$

12. In the case of Rankine cycle, the specific volume of water in the pump is _____ of the steam expanding in the same turbine.

(A) Much less than that

(B) Equal to

(C) Much more than that

(D) Not related to that

13. Theoretical power required to drive a Single-acting Reciprocating Pump is

(where, ω is the specific weight of the liquid, A is the cross-sectional area of piston or the plunger, L is the length of the stroke, N is delivery stroke per minute, H_s is the static head, H_d is the delivery head)

(A) $P = \dfrac{\omega(ALN)\sqrt{(H_s - H_d)^2}}{60}$

(B) $P = \dfrac{\omega(ALN)(H_s - H_d)}{60}$

(C) $P = \dfrac{\omega(ALN)(H_s + H_d)}{60}$

(D) $P = \dfrac{\omega(ALN)\sqrt{(H_s + H_d)^2}}{60}$

14. The metallic oxide used in the form of powder in a paint is called

(A) Drier

(B) Base

(C) Extender

(D) Vehicle

15. The total inductance of two coils, A and B, when connected in series is 0.5 H or 0.2 H, depending upon the relative directions of the current in the coils. Coil A, when isolated from coil B, has a self-inductance of 0.2 H. The mutual inductance between the two coils is

(A) 0.05 H

(B) 0.15 H

(C) 0.075 H

(D) 0.25 H

16. The loss of head due to frictional resistance due to flow of liquid in a long straight pipe of length (L) and diameter (D) is given by

(where, f is the friction factor of the pipe and V is the mean velocity of flow in the pipe.)

(A) $\dfrac{fLV}{2gD}$

(B) $\dfrac{fV^2}{L\sqrt{2gD}}$

(C) $\dfrac{fLV^2}{2gD}$

(D) $2\dfrac{fLV^2}{gD}$

17. For the same compression ratio, the Brayton cycle efficiency as compared to that of the Otto cycle is

(A) Greater

(B) Equal

(C) Less

(D) Not related

18. The hot-wire ammeter

(A) reads equally well on d.c. and /or a.c. circuits

(B) is a high precision instrument

(C) is used only for d.c. circuits

(D) is used only for a.c. circuits

19. PERT is

(A) Work oriented technique

(B) Activity oriented technique

(C) Time oriented technique

(D) Event oriented technique

20. A stationary mass of gas is compressed without friction from an initial state of 0.3 m^3 and 0.105 MP$_a$ to a final state of 0.15 m^3 and 0.105 MP$_a$, the pressure remaining constant throughout the process. There is a transfer of 37.6 KJ of heat from the gas during the process. The internal energy of gas changes by

(A) –31.25 KJ

(B) –21.85 KJ

(C) –37.6 KJ

(D) 15.75 KJ

21. To the sum of the first and the last ordinates, add twice the sum of the intermediate ordinates. The total sum thus obtained is multiplied by the common distance between the ordinates. One-half of this product gives the required area. This rule of finding the area is called

    (A) Simpson's rule

    (B) Trapezoidal rule

    (C) Mid-ordinate rule

    (D) Average ordinate rule

22. The nodal method of circuit analysis is based on

    (A) KCL, KVL and Ohm's Law

    (B) KCL and Ohm's Law

    (C) KVL and Ohm's Law

    (D) KCL and KVL

23. If the cross slope of a country is 10%, the terrain is classified as

    (A) Steep

    (B) Rolling

    (C) Plain

    (D) Mountainous

24. Gypsum is added in the manufacturing of Portland Cement

    (A) At the end of grinding the clinker into powder

    (B) During burning in the rotary kiln

    (C) While mixing the raw material

    (D) At the beginning of grinding the clinker

25. Mean diameter or the pitch diameter (D) of the Pelton Wheel which rotates at N r.p.m. is given by

    (where, K_u is the speed of rotation and H is the net head)

    (A) $D = 60\, K_u \sqrt{\dfrac{2gH}{\pi N}}$

    (B) $D = \dfrac{\left(\sqrt{2K_u gH}\right)}{\pi N}$

    (C) $D = \dfrac{60\left(\sqrt{2K_u gH}\right)}{\pi N}$

    (D) $D = \dfrac{60\left(K_u \sqrt{2gH}\right)}{\pi N}$

26. Relative permeability of vacuum is

    (A) $\dfrac{1}{4}\pi$

    (B) 1 H/m

    (C) $4\pi\ 10^{-7}$ H/m

    (D) 1

27. When a body is subjected to bi-axial stress, i.e. direct stress (P_1) and (P_2) in two mutually perpendicular planes accompanied by a simple shear stress (q), then maximum normal stress is

(A) $\dfrac{P_1 - P_2}{2} - \dfrac{1}{2}\sqrt{(P_1 + P_2)^2 + 4q^2}$

(B) $\dfrac{P_1 + P_2}{2} - \dfrac{1}{2}\sqrt{(P_1 - P_2)^2 + 4q^2}$

(C) $\dfrac{P_1 + P_2}{2} + \dfrac{1}{2}\sqrt{(P_1 - P_2)^2 + 4q^2}$

(D) $\dfrac{P_1 - P_2}{2} + \dfrac{1}{2}\sqrt{(P_1 + P_2)^2 + 4q^2}$

28. The specific speed, (N_S) of a Centrifugal Pump is given by

(where, H_m is the available head from the pump and Q corresponding to the maximum efficiency of the pump at its normal working speed N)

(A) $N_S = \dfrac{Q\sqrt{N}}{H_m^{3/4}}$

(B) $N_S = \dfrac{\sqrt{NQ}}{H_m^{3/4}}$

(C) $N_S = \dfrac{N\sqrt{Q}}{H_m^{3/4}}$

(D) $N_S = \dfrac{N\sqrt{Q}}{H_m^{4/3}}$

29. If T_1 is the source temperature and T_2 is the sink temperature, the more effective way to increase the efficiency of a Carnot engine is

(A) Decrease T_1 keeping T_2 constant

(B) Increase T_2 keeping T_1 constant

(C) Increase T_1 keeping T_2 constant

(D) Decrease T_2 keeping T_1 constant

30. An angle made by a survey line with the prolongation of the proceeding line, is known as

(A) Deflection angle

(B) Vertical angle

(C) Direct angle

(D) Horizontal angle

31. Factors not affecting bacterial efficiency of chlorine are

(A) Coagulants used

(B) Presence of metallic compounds

(C) Turbidity

(D) Ammonia compounds

32. The friction factor (f) for laminar flow in a pipe is given by

(A) $f = \dfrac{8}{\sqrt{R_e}}$

(B) $f = \dfrac{64}{\sqrt{R_e}}$

(C) $f = \dfrac{64}{R_e}$

(D) $f = \dfrac{8}{R_e}$

33. When the magnetic bearing of the sun at noon is 185°20', the magnetic declination will be

(A) 5°20' South

(B) 5°20' West

(C) 5°20' East

(D) 5°20' North

34. The overall efficiency of Francis Turbine is given by

(where, W is the weight of water per second which strikes the runner, P is the power available at the runner shaft and H is the net head at the runner shaft)

(A) $\lambda_o = \dfrac{2P}{(WH)}$

(B) $\lambda_o = \dfrac{(WH)}{P}$

(C) $\lambda_o = \dfrac{P}{(WH)}$

(D) $\lambda_o = \dfrac{(2WH)}{P}$

35. A dummy activity

(A) is artificially introduced

(B) does not consume time

(C) is represented by dotted lines

(D) all of the above

36. A particle of mass 1 kg resting on rough contact with a plane inclined at 30° to the horizontal is just about to slip. The coefficient of friction between the plane and the particle will be

(A) $\dfrac{1}{3}$

(B) $\dfrac{1}{\sqrt{3}}$

(C) $\sqrt{3}$

(D) $2\sqrt{3}$

37. In the given circuit, the value of I is
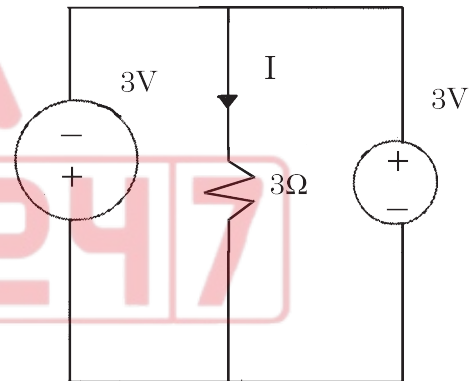
(A) Indeterminate

(B) −1 A

(C) 1 A

(D) 2 A

38. Vicat's apparatus is used to determine the

(A) Initial setting time of cement

(B) Normal consistency of cement
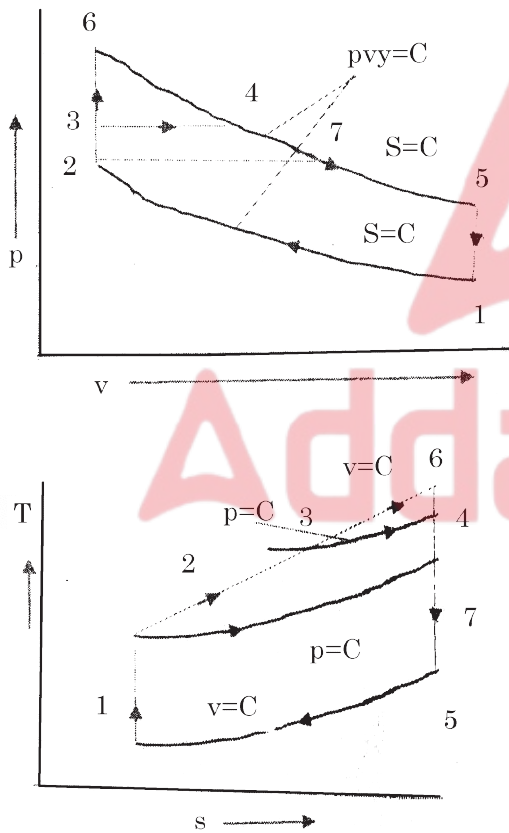
(C) Final setting time of cement

(D) All of the above

39. For complete similarity to exist between the model and its prototype, there should be

(A) Geometric, kinematic and dynamic similarity

(B) Only kinematic similarity

(C) Only geometric similarity

(D) Only dynamic similarity

40.

The figures show the compression of Otto, Diesel and Dual cycles for the same compression ratio and heat rejection. The Otto cycle is

(A) $3 - 6 - 4$

(B) $1 - 2 - 7 - 5$

(C) $1 - 2 - 6 - 5$

(D) $1 - 2 - 3 - 4 - 5$

41. The method of levelling in which the heights of mountains are found by observing the temperature at which water boils, is known as

(A) Hypsometry

(B) Reciprocal levelling

(C) Barometric levelling

(D) Longitudinal levelling

42. Emissivity factor for the energy emitted by a grey body is given by

(where, E = Energy emitted by a grey body per m^2 per unit time and E_B = Energy emitted by a perfect black body per m^2 per unit time)

(A) $\varepsilon = \dfrac{E_B - E}{E}$

(B) $\varepsilon = \dfrac{E_B}{E}$

(C) $\varepsilon = \dfrac{E}{E_B}$

(D) $\varepsilon = \dfrac{E_B - E}{E_B}$

43. A tank contains oil of specific gravity of 0.9. The depth of the point below free surface is (where, the pressure intensity is 9 kg(f)/cm^2)

(A) 1 m

(B) 100 m

(C) 1000 m

(D) 10 m

44. What is the chemical composition of quicklime ?

   (A) MgS

   (B) CaO

   (C) CaS

   (D) MgO

45. For prevention of dental caries in children, the recommended fluoride concentration in water should be in the range of

   (A) 1.7 – 2.2

   (B) 0.7 – 1.2

   (C) 0.2 – 0.7

   (D) 1.2 – 1.7

46. An object of mass 5 kg falls from rest through a vertical distance of 20 m and gains a velocity of 10 m/s. The work done by the resistance of the air on the object will be

   (A) – 750 J

   (B) – 550 J

   (C) 750 J

   (D) 550 J

47. Break-even point shows that

   (A) Variable cost = Fixed cost

   (B) Sales revenue < Total cost

   (C) Sales revenue > Total cost

   (D) Sales revenue = Total cost

48. Which of the following constituents, when present in excess quantity, changes the colour of the brick from red to yellow ?

   (A) Alkalis

   (B) Silica

   (C) Alumina

   (D) Limestone

49. A moving coil voltmeter measures

   (A) Only a.c. voltage

   (B) Only d.c. voltage

   (C) Both a.c. and d.c. voltage

   (D) Nothing

50. Dimension of circulation is

   (A) $\dfrac{L}{T}$

   (B) $\dfrac{L^2}{T}$

   (C) $\dfrac{L}{T^2}$

   (D) $\dfrac{L^2}{T^2}$

SPACE FOR ROUGH WORK