E

Sr. No. 28742

SUBJECT CODE BOOKLET CODE

6 B

2014 (II)
ENGINEERING SCIENCES
TEST BOOKLET

Time : 3:00 Hours *Maximum Marks: 200*

INSTRUCTIONS

1. This Test Booklet contains one hundred and fifteen (20 Part 'A'+ 25 Part 'B' + 70 Part 'C') Multiple Choice Questions (MCQs). You are required to answer a maximum of 15, 20 and 20 questions from part 'A' 'B' and 'C' respectively. If more than required number of questions are answered, only first 15, 20 and 20 questions in Parts 'A' 'B' and 'C' respectively, will be taken up for evaluation.
2. **OMR** answer sheet has been provided separately. Before you start filling up your particulars, please ensure that the booklet contains requisite number of pages and that these are not torn or mutilated. If it is so, you may request the Invigilator to change the booklet of the same code. Likewise, check the **OMR** answer sheet also. Sheets for rough work have been appended to the test booklet.
3. Write your Roll No., Name and Serial Number of this Test Booklet on the **OMR** answer sheet in the space provided. Also put your signatures in the space earmarked.
4. **You must darken the appropriate circles with a black ball pen related to Roll Number, Subject Code, Booklet Code and Centre Code on the OMR answer sheet. It is the sole responsibility of the candidate to meticulously follow the instructions given on the Answer Sheet, failing which, the computer shall not be able to decipher the correct details which may ultimately result in loss, including rejection of the OMR answer sheet.**
5. Each question in Part 'A' carries **2** marks, Part 'B' **3.5** marks and Part 'C' **5** marks respectively. There will be negative marking @ 25% for each wrong answer.
6. Below each question in Part 'A', 'B' and 'C' four alternatives or responses are given. Only one of these alternatives is the "correct" option to the question. You have to find, for each question, the correct or the best answer.
7. Candidates found copying or resorting to any unfair means are liable to be disqualified from this and future examinations.
8. Candidate should not write anything anywhere except on answer sheet or sheets for rough work.
9. Use of scientific calculator without data connectivity is permitted.
10. **After the test is over, at the perforation point, tear the OMR answer sheet, hand over the original OMR answer sheet to the invigilator and retain the carbonless copy for your record.**
11. Candidates who sit for the entire duration of the exam will only be permitted to carry their Test booklet.

Roll No.................................

Name ....

OMR Answer Sheet No...............

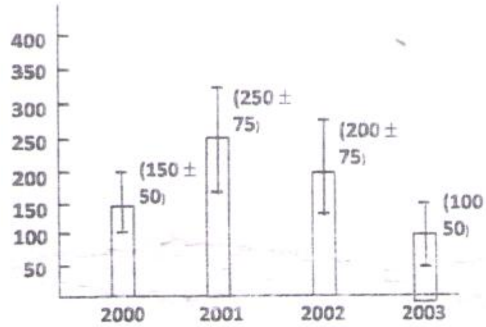
I have verified all the information filled in by the candidate.

....

Signature of the Invigilator

PART 'A'

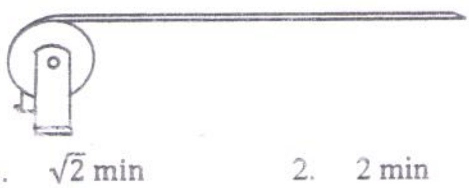
1. Average yield of a product in different years is shown in the histogram. If the vertical bars indicate variability during the year, then during which year was the percent variability over the average of that year the least?



1. 2000 2. 2001
3. 2002 4. 2003

2. A rectangle of length *d* and breadth *d*/2 is revolved once completely around its length and once around its breadth. The ratio of volumes swept in the two cases is
1. 1:1 2. 1:2
3. 1:3 4. 1:4

3. A long ribbon is wound around a spool up to a radius *R*. Holding the tip of the ribbon, a boy runs away from the spool with a constant speed maintaining the unwound portion of the ribbon horizontal. In 4 minutes, the radius of the wound portion becomes $\frac{R}{\sqrt{2}}$. In what further time, it will become *R*/2?



1. $\sqrt{2}$ min 2. 2 min
3. $2\sqrt{2}$ min 4. 4 min

4. If *n* is a positive integer, then
$n(n+1)(n+2)(n+3)(n+4)(n+5)(n+6)$
is divisible by
1. 3 but not 7
2. 3 and 7
3. 7 but not 3
4. neither 3 nor 7

5. The area (in m^2) of a triangular park of dimensions 50 m, 120 m and 130 m is
1. 3000 2. 3250
3. 5550 4. 7800

6. Lunch-dinner pattern of a person for *m* days is given below. He has a choice of a VEG or a NON-VEG meal for his lunch/dinner
(a) If he takes a NON-VEG lunch, he will have only VEG for dinner
(b) He takes NON-VEG dinner for exactly 9 days
(c) He takes VEG lunch for exactly 15 days
(d) He takes a total of 14 NON-VEG meals
What is *m*?
1. 18 2. 24
3. 20 4. 38

7. A bank offers a scheme wherein deposits made for 1600 days are doubled in value, the interest being compounded daily. The interest accrued on a deposit of Rs.1000/- over the first 400 days would be Rs.
1. 250 2. 183
3. 148 4. 190

8. What is the next number of the following sequence?
2, 3, 4, 7, 6, 11, 8, 15, 10 …
1. 12 2. 13
3. 17 4. 19

9. Two locomotives are running towards each other with speeds of 60 and 40 km/h. An object keeps on flying to and fro from the front tip of one locomotive to the front tip of the other with a speed of 70 km/h. After 30 minutes, the two locomotives collide and the object is crushed. What distance did the object cover before being crushed?

1. 50 km
2. 45 km
3. 35 km
4. 10 km

10. Weights (in kg) of 13 persons are given below:

70, 72, 74, 76, 78, 80, 82, 84, 86, 88, 90, 92, 94

Two new persons having weights 100 kg and 79 kg join the group. The average weight of the group increases by

1. 0 kg
2. 1 kg
3. 1.6 kg
4. 1.8 kg

11. A code consists of at most two identical letters followed by at most four identical digits. The code must have at least one letter and one digit. How many distinct codes can be generated using letters A to Z and digits 1 to 9?

1. 936
2. 1148
3. 1872
4. 2574

12. Two solid iron spheres are heated to 100°C and then allowed to cool. One has the size of a football; the other has the size of a pea. Which sphere will attain the room temperature (constant) first?

1. The bigger sphere
2. The smaller sphere
3. Both spheres will take the same time
4. It will depend on the room temperature

13. Find the missing letter:

A	?	Q	E
C	M	S	C
E	K	U	A
G	I	W	Y

1. L
2. Q
3. N
4. O

14. The least significant bit of an 8-bit binary number is zero. A binary number whose value is 8 times the previous number has

1. 12 bits ending with three zeros
2. 11 bits ending with four zeros
3. 11 bits ending with three zeros
4. 12 bits ending with four zeroes

15. A person sells two objects at Rs.1035/- each. On the first object he suffers a loss of 10% while on the second he gains 15%. What is his net loss/gain percentage?

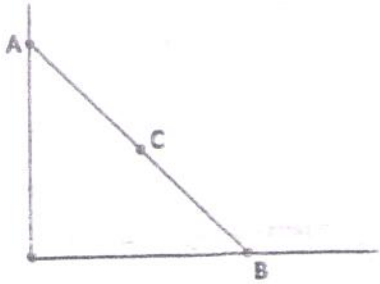
1. 5% gain
2. < 1% gain
3. < 1% loss
4. no loss, no gain

16. Continue the sequence

2, 5, 10, 17, 28, 41, –, –, –

1. 58, 77, 100
2. 64, 81, 100
3. 43, 47, 53
4. 55, 89, 113

17. A ladder rests against a wall as shown. The top and the bottom ends of the ladder are marked A and B. The base B slips. The central point C of the ladder falls along



1. a parabola
2. the arc of a circle
3. a straight line
4. a hyperbola

18. 20% of students of a particular course get jobs within one year of passing. 20% of the remaining students get jobs by the end of second year of passing. If 16 students are still jobless, how many students had passed the course?
1. 32 2. 64
3. 25 4. 100

19. Binomial theorem in algebra gives $(1 + x)^n = a_0 + a_1x + a_2x^2 + \ldots + a_nx^n$, where $a_0, a_1, \ldots, a_n$ are constants depending on n. What is the sum $a_0 + a_1 + a_2 + \ldots + a_n$?
1. 2^n 2. n
3. n^2 4. $n^2 + n$

20. A sphere is made up of very thin concentric shells of increasing radii (leaving no gaps). The mass of an arbitrarily chosen shell is
1. equal to the mass of the preceding shell
2. proportional to its volume
3. proportional to its radius
4. proportional to its surface area

PART 'B'

MATHEMATICS

21. A third order ordinary differential equation with $x, x\ln x$ and $x\ln^2 x$ as linearly independent solutions is given by
1. $x^3y''' + 2x^2y'' - xy' + y = 0$
2. $x^3y''' + xy' - y = 0$
3. $x^3y''' + 3x^2y'' - 2xy' + 2y = 0$
4. $x^3y''' + 4x^2y'' + xy' - y = 0$

22. The number of real solutions of the equation
$$2\sin^2 x + 10x^2 + x = 2\cos x$$
is
1. 0 2. 1
3. 2 4. more than 2

23. Let α be a real number such that $0 < \alpha < 1$. Then the value of
$$\lim_{n\to\infty} n\left(\alpha^{n+1} + e^{1/n} - 1\right)$$
is
1. 0 2. -1
3. 1 4. α

24. A solution of the first order differential equation
$$y' \cos(x + y) + \frac{\sin(x+y)}{x} = e^x - \cos(x + y)$$
is
1. $\sin(x + y) - e^x = \text{constant}$
2. $e^x \tan(x + y) = \text{constant}$
3. $x(\cos(x + y) - e^x) + e^x = \text{constant}$
4. $x(\sin(x + y) - e^x) + e^x = \text{constant}$

25. Let D be a region in $\mathbb{R}^2$ enclosed by a simple smooth closed curve C. Suppose C is oriented anticlockwise. If the value of the line integral

$$\int_C (2x + 3x^2)dx + (2x + 3y)dy$$

is 12 then the area of the region D is

1. 3
2. 6
3. 12
4. 24

26. Let $f(z) = \bar{z}$ and $g(z) = |z|^2$ for all $\in \mathbb{C}$. Then at $z = 0$

1. f is analytic and g is NOT analytic
2. g is analytic and f is NOT analytic
3. f and g are analytic
4. neither f nor g is analytic

27. Let A and B be two 3×3 matrices such that $A \neq B, A^2 = B^2, AB = BA$ and $A^2 + 2A + I = 0$ where I is the identity matrix. Let $|T|$ denote the determinant of any matrix T. Then

1. $|A| \neq 0$ and $|A + B| = 0$
2. $|A+B| \neq 0$ and $|A| = 0$
3. $|A| \neq 0$ and $|A + B| \neq 0$
4. $|A| = 0$ and $|A + B| = 0$

28. Let S be the unit sphere $x^2+y^2+z^2 = 1$. Then the value of the surface integral

$$\iint_S [(2x^2 + 3x) - y^2 + 5z^2]d\sigma$$

is

1. 2π
2. 4π
3. 8π
4. 12π

29. The rank of the matrix

$$\begin{pmatrix} 6 & 3 & 3 & 5 & 5 \\ 0 & 1 & 0 & 2 & 0 \\ 6 & 7 & 8 & 9 & 10 \\ 0 & 2 & 3 & 1 & 0 \\ 0 & 1 & 2 & 1 & 5 \end{pmatrix}$$ is

1. 4
2. 3
3. 2
4. 5

30. In a set of 4 dice, one is faulty with number 6 written as 5. All dice are thrown simultaneously. The probability of obtaining a sum greater than 21 is

1. $\frac{1}{144}$
2. $\frac{1}{54}$
3. $\frac{1}{72}$
4. $\frac{1}{81}$

ENGINEERING APTITUDE

31. In an ideal, 2-stage compressor with a perfect intercooler, air is compressed from an inlet pressure of 100 kPa (abs.) to a final pressure of 800 kPa. The inlet temperature of air is 300 K. What should be the pressure at the exit of the 1st stage compressor (in kPa) so that the total power input to the compressor is minimum? Assume air to behave as an ideal gas with a constant index of compression. (Atmospheric pressure = 101 kPa)

1. 282.8
2. 300.0
3. 425.6
4. 551.0

32. Pure Fe is polymorphic. What would be the approximate ratio of atomic radius of iron at 24°C (lattice parameter 0.287nm) and iron at 1000°C (lattice parameter 0.352 nm)?

1. 0.8
2. 1.0
3. 1.1
4. 1.2

33. Which of the following statements concerning air standard cycle are TRUE:

(i) For a given compression ratio and inlet conditions, Otto cycle has higher efficiency than Diesel cycle

(ii) For a given maximum cycle pressure and temperature and inlet conditions, Diesel cycle has higher efficiency than Otto cycle

(iii)The thermal efficiency of Otto cycle increases with compression ratio

(iv)For a given compression ratio and inlet conditions, the thermal efficiency of Diesel cycle increases with cut-off ratio

1. All of the above
2. Only (i), (ii) and (iii)
3. Only (ii) and (iii)
4. Only (ii), (iii) and (iv)

34. Which of the following thermodynamic properties can be measured in a laboratory?
(i) Specific enthalpy
(ii) Specific volume
(iii) Specific entropy
(iv) Specific heat
(v) Specific internal energy

1. Only (i), (ii) and (v)
2. Only (ii) and (iv)
3. Only (ii)
4. Only (i), (ii) and (iii)

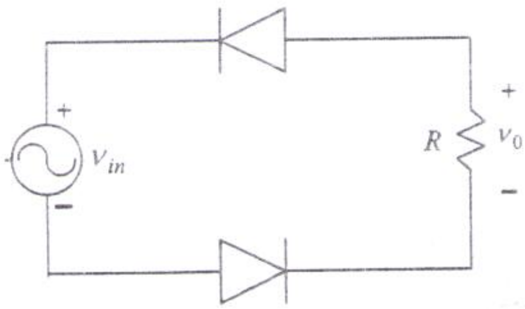
35. At room temperature, for silicon, the band gap (E_g) is 1.1 eV, the intrinsic concentration (n_i) is 10^{10} cm^{-3} and thermal voltage $\left(\frac{KT}{q}\right)$ is 26 mV. The probability that an energy state in the conduction band is occupied by an electron is 0.001. The type and doping concentration of this material are

1. N - type and 10^{13} cm^{-3}
2. P - type and 10^{13} cm^{-3}
3. N - type and 1.5×10^{16} cm^{-3}
4. P - type and 1.5×10^{16} cm^{-3}

36. Ten watts are required for a solar cell that produces 100 A/m^2 at 0.5 Volts. The area of the solar cell should be_______:

1. $0.2\ m^2$
2. $0.5\ m^2$
3. $1.0\ m^2$
4. $2.0\ m^2$

37. In the circuit shown, a $10V_{p\text{-}p}$ sinusoidal signal at 60 Hz is applied as V_{in}. Assume that, for the given load R, each diode has an average conduction drop of 0.4V and the cut-in voltages of the diodes are zero. The average value of the output voltage is



1. -0.79 V
2. $-2.38\ V$
3. $+0.79\ V$
4. $+2.38\ V$

38. Two waves of 1GHz are travelling in opposite directions on a transmission line. At x = 0 and t = 0, the amplitude and phase of the forward wave is 3V and zero, whereas the amplitude and phase of the backward wave is 1V and $\pi/3$ respectively. The propagation constant of the line at 1 GHz is $\gamma=0.05+j12$.

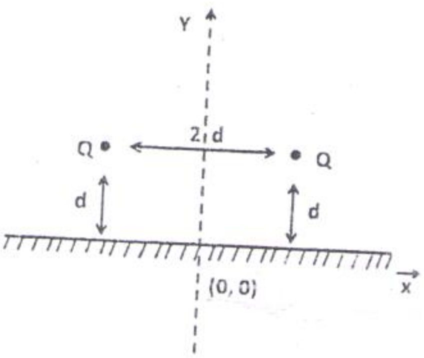
The peak voltage at x = 1 meter is

1. 0.95 volts
2. 3.91 volts
3. 4.95 volts
4. 5.05 volts

39. The magnetic flux density in a region is given by $B = (2\hat{i} + 3\hat{j} - 4\hat{k})e^{-2t}$ Wb/m^2. A square loop of 2 m side is placed in the region, with its center at the origin and its sider along the co-ordinate axes. The emf induced in the lopp at t = 1 sec is

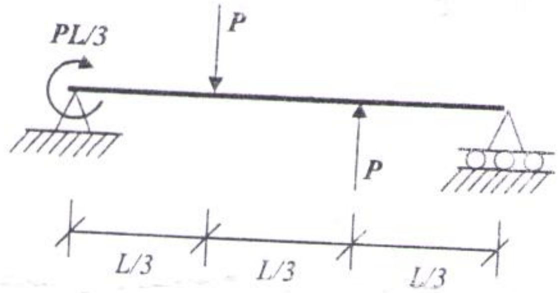
1. 1.35 Volts
2. 3.24 Volts
3. 4.33 Volts
4. 5.41 Volts

40. Two positive point charges Q are placed as shown in the figure a distance d away from a grounded conducting plane. The distance between the point charges is 2d. The net force on the point charges located at the point (d, d) is



1. $\frac{Q^2}{4\pi\epsilon_0(4d^2)}\,i$
2. $\frac{Q^2}{4\pi\epsilon_0(4d^2)}\left(\frac{2\sqrt{2}-1}{2\sqrt{2}}i - \frac{2\sqrt{2}+1}{2\sqrt{2}}j\right)$
3. $\frac{Q^2}{4\pi\epsilon_0(4d^2)}\left(\frac{1}{2}i - \frac{3}{2}j\right)$
4. $\frac{Q^2}{4\pi\epsilon_0(4d^2)}\left(\frac{\sqrt{2}+1}{\sqrt{2}}i - \frac{\sqrt{2}-1}{\sqrt{2}}j\right)$

41. A simply supported beam is loaded as shown in the figure. Find the magnitude of bending moment (BM) and shear force (SF) at the mid-span.

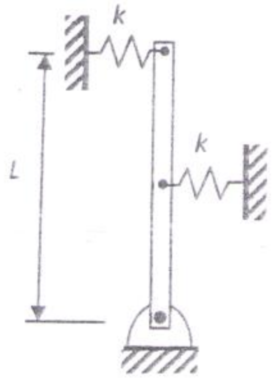


1. BM $= \frac{PL}{12}$; $SF = \frac{P}{2}$
2. BM $= \frac{PL}{12}$; $SF = \frac{2P}{3}$
3. BM $= \frac{PL}{6}$; $SF = P$
4. BM $= 0$; $SF = \frac{P}{3}$

42. Assume F_1 and F_2 are the buoyant forces acting on a rectangular iron block (density 7000 kg/m^3) having dimension of 2cm × 4cm × 8cm, and a 4-cm cubical aluminum block (density 3500 kg/m^3), respectively, both of which are immersed in the same fluid. The relation between F_1 and F_2 is

1. $F_1 = F_2$
2. $F_1 = 2F_2$
3. $F_1 = 4F_2$
4. $F_1 = 8F_2$

43. For the system shown, what is the natural frequency for small amplitudes of oscillations? The rod is uniform and has mass m.

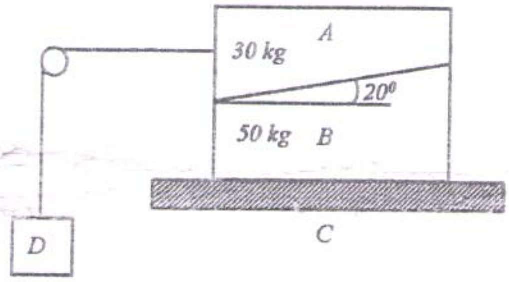


1. $\sqrt{\frac{15k}{4m} - \frac{3g}{2L}}$
2. $\sqrt{\frac{15k}{4m} + \frac{3g}{2L}}$
3. $\sqrt{\frac{3g}{2L} - \frac{15k}{4m}}$
4. $2\sqrt{\frac{15k}{4m} - \frac{3g}{2L}}$

44. A horizontal water jet from a nozzle of constant exit cross section impinges normally on a stationary vertical flat plate. A certain force 'F' is required to hold the plate against the water stream. If the water velocity is tripled, then the necessary holding force will be

1. 3F
2. 6F
3. 9F
4. 12F

45. Considering the case of block A only sliding over the block B, find the smallest weight of cylinder D which will cause the loss of static friction. Assume the coefficient of friction between block A and B is 0.6 and between the block B and the ground (C) is 0.4. Also assume that block B does not slide over surface C.



1. 64kg
2. 32kg
3. 12kg
4. 16kg

(FOR ROUGH WORK)

PART 'C'

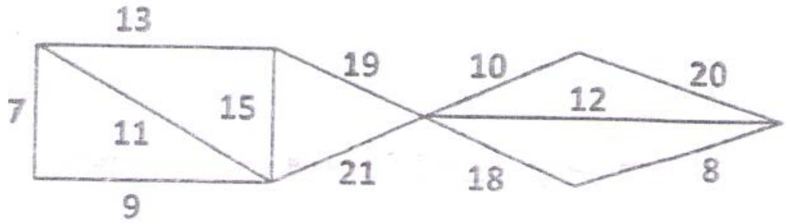
COMPUTER SCIENCE

46 . What is printed by the following program?

```
# include ⟨stdio.h⟩
void A (void);
void B (void);
void C (void);
int x = 1;
int main (void)
{ int x = 5;
  printf ("%d\n", x);
  { int x = 10 ;
    printf ("%d\n", x);
  }
  printf ("%d\n", x);
  A( ); B ( ); C ( );
  A( ); B ( ); C ( );
  printf ("%d\n", x);
  return 0;
 }
void A (void)
{ int x = 15;
  x++;
  printf ("%d\n", x);  }
void B (void)
 { static x = 50;
  x++;
  printf ("%d\n", x);
 }
void C (void)
 { x* = 10;  printf ("%d\n", x)}.
```

1.	2.	3.	4.
5	5	5	5
10	10	10	10
5	5	5	5
16	16	16	16
51	50	51	51
10	10	10	10
16	16	16	16
52	50	51	52
100	10	10	100
5	5	5	0

47. The cost of minimum cost spanning tree of the graph shown below is



1. 79
2. 78
3. 77
4. 76

48.

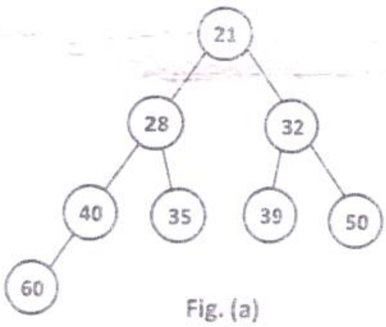


Fig. (a)

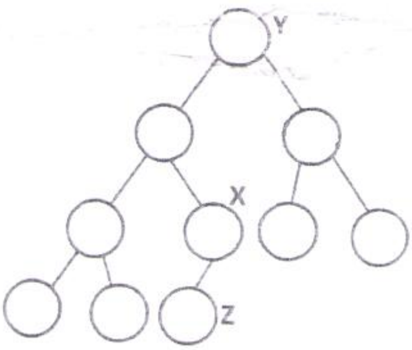


Fig. (b)

Let H be a heap shown in Fig(a). After performing Insert (45,H), Insert (27,H), Insert (10, H) and Deletemin (H), the structure of the heap will be as shown in Fig.(b). Let X, Y, Z denote the values in the nodes labeled by them in Fig.(b). The values of (X, Y, Z) are

1. (35, 21, 27)
2. (35, 10, 21)
3. (21, 28, 35)
4. (28, 21, 35)

49. Consider the creation of a Binary Search Tree for a set of keys that may have multiple copies of some keys. We create the tree by repeated insertion. For inserting distinct values, the usual insert procedure is followed. However, while inserting second and subsequent copies of a key, we always move to the right child of the first copy. The height of the Binary Search Tree we obtain when we insert

[23, 10, 10, 10, 23, 12, 23, 11, 10, 50, 8, 10, 30, 5, 8, 23] in that order is

1. 9
2. 8
3. 7
4. 6

50 . The statement $\sim(p \Leftrightarrow q)$ is equivalent to

1. $((p \wedge \sim q) \wedge (q \wedge \sim p))$
2. $((p \vee \sim q) \wedge (q \vee \sim p))$
3. $((p \wedge \sim q) \vee (q \wedge \sim p)$
4. $((p \vee \sim q) \vee (q \wedge \sim p))$

51 . In the machine *M*, suppose that the instructions for floating point operations can be enhanced to run 10 times faster. Assume that in a program P1, 85% of Instructions are floating point operations and in another program P1, 88% of its instructions are floating point operations. Which of the two programs can be made at least 4 times faster by enhancing *M*?

1. Only P1
2. Only P2
3. Neither P1 nor P2
4. Both P1 and P2

52 . What does the Boolean function
$F = (a \oplus b) \oplus (a \odot b) \oplus (\bar{a} \oplus b) \oplus (\bar{a} \odot b)$
Evaluate to if $\oplus$ stands for XOR and $\odot$ stands for XNOR operation?

1. $a \cdot b + \bar{a} \cdot \bar{b}$
2. $a \cdot b$
3. 0
4. $a + b$

53 . Consider a relation $R(A, B, C)$,with the following functional dependencies:$AB \longrightarrow C; AC \longrightarrow B$. *A* can take 20 distinct values, *B* can take 10 distinct values and *C* can take 100 distinct values. What is the maximum possible size (in tuples) of the self join of *R* on *C*.

1. 4000
2. 200
3. 4,00,000
4. 20000

54 . Consider an instance of the relation Sailors shown below:

sid	*Name*	*Rating*	*Age*
16	*jones*	3	20.0
32	*jonah*	4	56.0
24	*ahab*	7	43.0
65	*moby*	6	15.0

What does the following query return?

SELECT S. Name
FROM Sailors S
WHERE S.rating > ANY (SELECT S1. Rating FROM Sailors S1 WHERE S1. age < 21)

1. ahab
2. ahab, jonah, moby
3. ahab, jonah
4. moby

55 . Consider the following set of processes with the arrival times and the CPU burst times given in milliseconds.

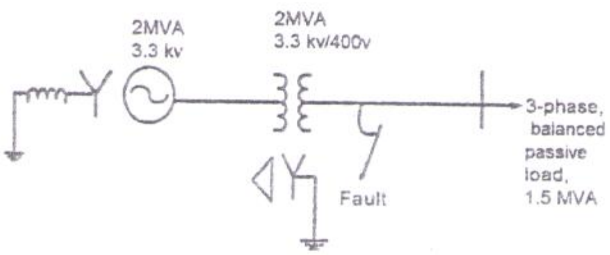
Process	Arrival Time	Burst Time
P1	0	5
P2	1	3
P3	2	3
P4	4	1

What is the average waiting time for these processes with pre-emptive shortest remaining time first scheduling algorithm?

1. 2.5 msec 2. 5.5 msec 3. 12.0 msec 4. 3.0 msec

ELECTRICAL SCIENCE

56 .



A 2MVA, 3.3kV, three-phase generator has the following reactance's on its own base:
+ve sequence reactance, $x_1 = j0.10$p.u
-ve sequence reactance, $x_2 = j0.10$p.u
zero sequence reactance, $x_0 = j0.05$p.u
reactance from neutral to ground , $x_n = j0.05$ p.u.

The generator supplies a 3-phase, 1.5 MVA balanced passive load through a 3-phase, 2.0 MVA, 3.3 kV/400V, delta-star transformer with leakage reactance of 10%, as shown in the figure. A single-line-to-ground fault takes place at the low voltage side of the transformer. The current flowing from the transformer to the fault is

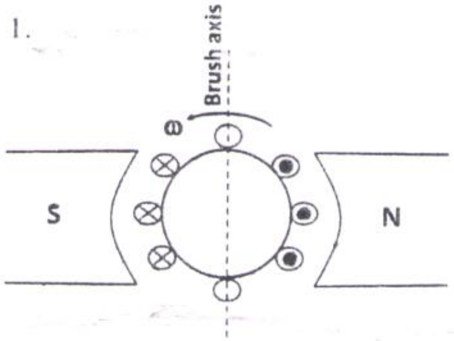
1. 5773.5A 2. 12371.8A 3. 14433.8A 4. 17320.5A

57 . Which one of the following dc to dc converters can be operated at steady state for any duty cycle, δ in the range $0 < \delta < 1$ without employing a closed loop feedback control?

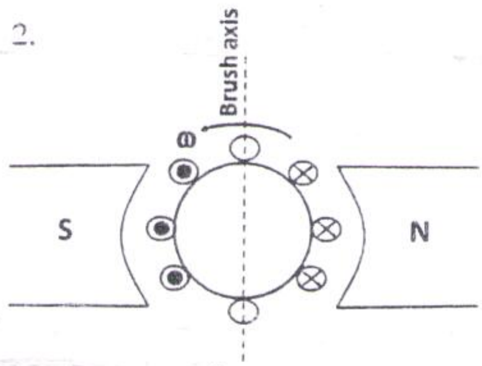
1. Buck converter
2. Boost converter
3. Buck boost converter
4. C'uk converter

58 . Current distribution (dot (•) representing current direction out of the plane of the paper and cross (×) representing current direction into the plane of the paper; absence of a dot or a cross means no current is present in those conductors) in armature conductors of a representative 2-pole fully compensated dc motor rotating in anticlockwise direction and operating under regenerative mode of braking is

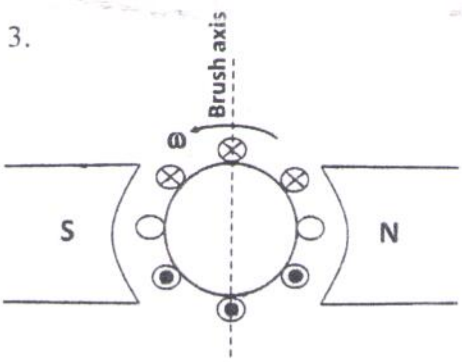
1.



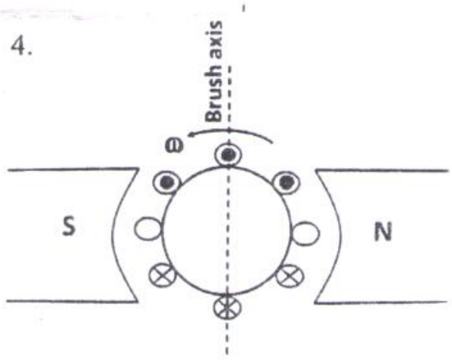
2.



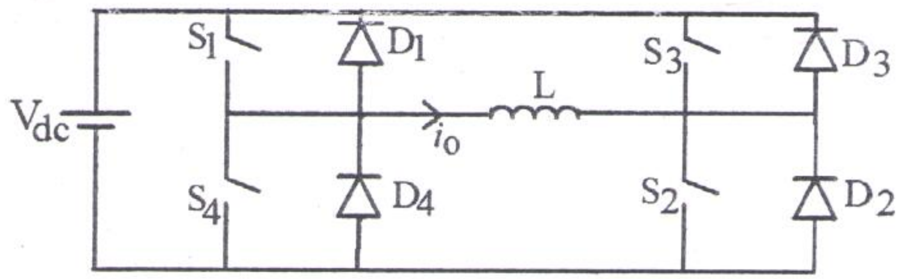
3.



4.

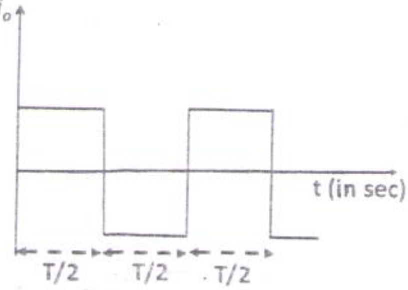


59 . An ideal lossless, single phase dc to ac square wave inverter having input dc voltage, V_{dc} is feeding a purely inductive load as shown in the Figure. Switches S_1, S_2 are ON and S_3, S_4 are OFF for the first half cycle ($T/2$ seconds) and S_3, S_4 are ON and S_1, S_2 are OFF for the subsequent half cycle, ($T/2$ seconds).

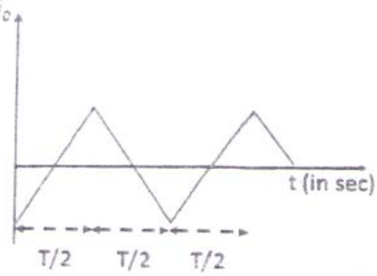


The waveform of the output current, i_o once the inverter is in operation for considerable duration of time is

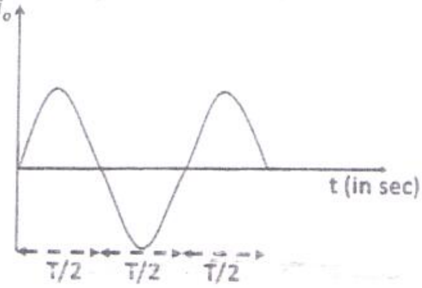
1.



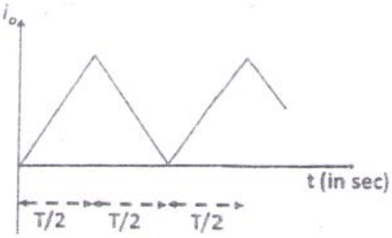
2.



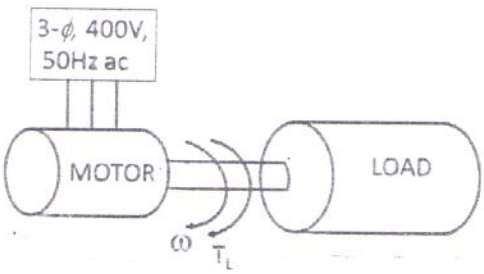
3.



4.



60 . A 400V, star connected, 3-Φ, 50 Hz, 4 pole, 1440 rpm squirrel cage induction motor is having per phase rotor resistance referred to the stator, $r_2' = 0.5\Omega$. The per phase stand-still rotor reactance, series stator impedance and the effect of the magnetizing branch of the machine can be neglected. This motor while being fed from a 400V, 3-Φ, 50 Hz, ac supply is coupled to a load whose torque, T_L = 20 Nm and is acting in the same direction as that of the direction of rotation of the motor load system as shown in the Figure. Neglecting friction, windage and other mechanical losses, the steady state speed of the system, ω in radians per second is

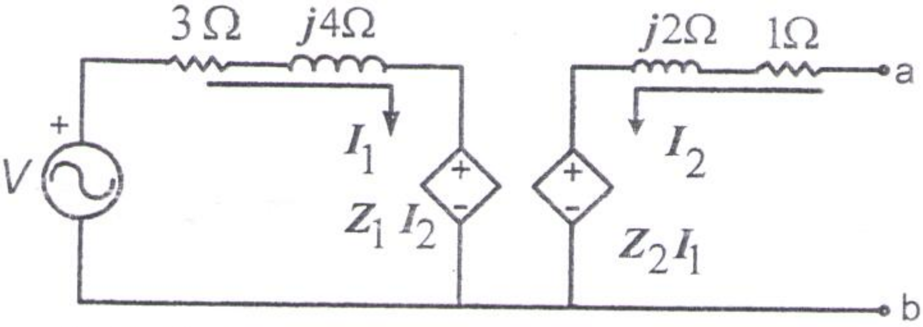


1. $\left(1 - \frac{\pi}{80}\right) 48\pi$
2. $\left(1 + \frac{\pi}{80}\right) 50\pi$
3. $\left(1 + \frac{\pi}{320}\right) 50\pi$
4. $\left(1 + \frac{\pi}{640}\right) 50\pi$

61 . A three phase, 50Hz, radial transmission line has a total series impedance of (15+j 160)Ω and a total shunt admittance of $0.8 \times 10^{-3} mho$. A shunt capacitor (C_{sh}) of admittance $0.6 \times 10^{-3} mho$ is connected at the receiving end of the line for providing reactive power support. When the sending end voltage is 400 kV and there is no load on the line, the magnitudes of the receiving end voltage and the sending end current are respectively

1. 476.13kV, 475.29A
2. 476.13kV, 636.12A
3. 427.34kV, 330.93A
4. 450.42kV, 475.29A

62 .

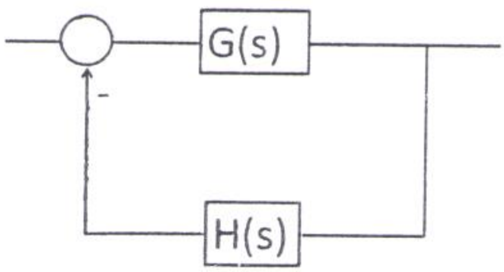


$V = 10\angle 0°$; $Z_1 = Z_2 = j2\Omega$;

For the circuit shown in the figure, a load impedance Z_L is connected across the terminals a–b such that the power transfer to Z_L is maximum. The value of Z_L is

1. $1.5504\angle 60.255°$
2. $2.2361\angle 63.435°$
3. $2.691\angle 78.86°$
4. $7.2111\angle 56.31°$

63 . A feedback control system as shown in the figure, has forward transfer $G(s) = \frac{5}{s(s+2)(s+3)}$ and feedback transfer function $H(s) = \frac{1}{s+1}$. The steady state error for a unit ramp input is

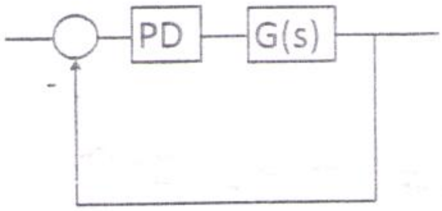


1. 0
2. 1/5
3. 6/5
4. ∞

64 . A 3-phase, 50Hz, 200MVA, 33 kV/220 kV, star-delta transformer is protected for inter-turn fault by a differential protection scheme. The possible pair of turns ratio for the current transformers to be connected to the high voltage and low voltage sides respectively is

1. 525:5 for h.v. side, 3500: 5 for l.v. side
2. 525:5 for h.v. side, 3500: $5\sqrt{3}$ for l.v. side
3. 525:5 for h.v. side, 3500: $5/\sqrt{3}$ for l.v. side
4. 525: $5/\sqrt{3}$ for h.v. side, 3500: 5 for l.v. side

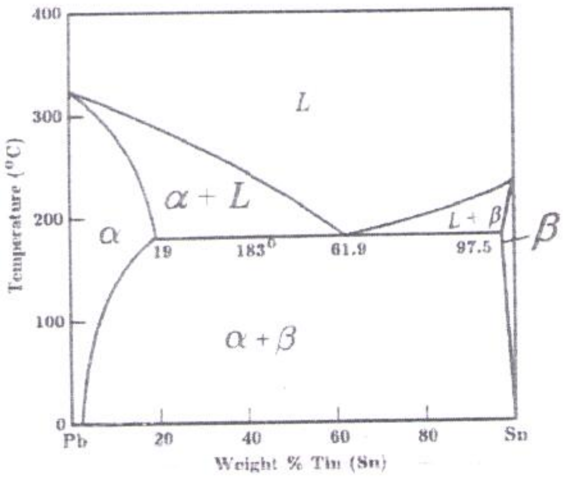
65 . A PD controller is added to the plant $G(s) = \frac{10}{s^2(s+5)}$ such that the resulting root locus passes through the point $-1 + j$. The position of the PD zero is at



1. -0.5 2. -0.75 3. -1.25 4. -1.5

MATERIALS SCIENCE

66 . Two Pb-Sn alloys undergo equilibrium cooling from the liquid state; one with 10 wt% Sn and balance Pb and the other with 10 wt% Pb and balance Sn. The phase diagram is shown in the figure below. The volume fractions of the pro-eutectic phases at these two compositions are closest to:



1. $f_\alpha = 50\%,\ f_L = 50\%$ & $f_\beta = 20\%,\ f_L = 80\%$
2. $f_\alpha = 100\%,\ f_L = 0\%$ & $f_\beta = 80\%,\ f_L = 20\%$
3. $f_\alpha = 25\%,\ f_L = 75\%$ & $f_\beta = 20\%,\ f_L = 80\%$
4. $f_\alpha = 20\%,\ f_L = 80\%$ & $f_\beta = 20\%,\ f_L = 80\%$

67 . A powder mixture of 80 wt% Al and 20 wt% ZrO_2 is prepared in an attritor mill and is compacted to a green density of 80% of theoretical density. The densities of Al, Al_2O_3 and ZrO_2 are 2.7, 3.96 and 5.6 g/cm^3, respectively. The atomic weights of Al, O and Zr are 26.98, 16 and 91.22, respectively. The green body is oxidized prior to sintering. If ¾th of the aluminum is oxidized, the final compact will have:

1. 0% porosity 2. 2.7% porosity 3. 3.9% porosity 4. 2.7% swelling

68 . Assume carbon atoms sit in the $\frac{1}{2},\frac{1}{2},0$ position in a bcc metal. Using radius of carbon atom, $r_c = 0.77$ Å and radius of metal atom, $r_m = 1.24$ Å, by what distance, each of the nearest metal atom be displaced to accommodate the carbon atom?

1. 0.2 Å 2. 0.3 Å 3. 0.6 Å 4. 1.0 Å

69 . In silicon the Fermi level measured from the intrinsic Fermi level at 300 K is 0.358 eV. What is the approximate donor concentration in the silicon? (Given: Intrinsic carrier density in Si at 300 K is $9.65 \times 10^9/cm^3$; Boltzmann constant $k_B = 8.614 \times 10^{-5}\ eV/K$)

1. $10^5/cm^3$ 2. $10^{12}/cm^3$ 3. $10^{16}/cm^3$ 4. $10^{20}/cm^3$

70 . The Pilling-Bedworth ratio of aluminum and tantalum oxides are 1.28 and 2.33, respectively. The characteristics of oxidation resistance and oxidation kinetics for Al_2O_3 and Ta_2O_5 can be described as:

1. Aluminium exhibits better oxidation resistance than tantalum, and the kinetics of oxidation for both the metals follow the parabolic rate law.
2. Inferior oxidation resistance of tantalum is due to its porous oxide layer, and it follows the linear oxidation rate law unlike aluminum which follows the parabolic oxidation rate law.
3. Inferior oxidation resistance of tantalum is due to its cracked oxide layer, and it follows linear oxidation rate law unlike aluminum which follows the logarithmic oxidation rate law.
4. Aluminum and tantalum show nearly equal oxidation resistance, and the kinetics of oxidation for both the metals are controlled by the logarithmic law.

71 . In transmission electron microscope, an operator changes the normal operating voltage of 100keV to a high operating voltage of 200 keV. The percentage change in spatial resolution due to such voltage change will be

1. ~10 % 2. ~20 % 3. ~30 % 4. ~40 %

72 . The bulk diffusion coefficients of metal A in B are $10^{-12} m^2/s$ and $10^{-14} m^2/s$ at 1300 K and 900 K, respectively. The activation energy for diffusion of A through grain boundaries of B considering its magnitude to be 0.45 times than that of bulk diffusion is [Given: Universal gas constant, R = 8.31 J/mol-K]:

1. 278.4 kJ/mol 2. 201.2 kJ/mol 3. 100.6 kJ/mol 4. 50.3 kJ/mol

73 . The sharpest possible crack to cause brittle fracture in a material with Poisson's ratio of 0.29 following Griffith's equation in plane strain condition should possess crack tip root radius as X times the inter-atomic spacing where X is equal to:

1. 1.00 2. 1.39 3. 2.78 4. 3.00

74 . 20 mol% of NiO is added to Fe_3O_4 to form nickel ferrite ($NiFe_2O_4$). The net spin magnetic moments (in Bohr magnetron) for Fe^{2+}, Fe^{3+} and Ni^{2+} are 4, 5 and 2, respectively. The percentage change in saturation magnetization (which is proportional to the number of Bohr magnetron per unit cell) will be closest to

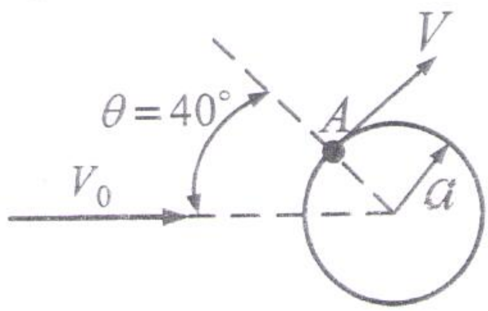
1. 40 %
2. 30 %
3. 20 %
4. 10 %

75 . An ideal plastic material exhibits yield stress of 200 MPa and catastrophic fracture occurs from the peak stress value during tensile test of a 25 mm gauge length specimen. If the tensile toughness and the resilience of the flow curve are given as 50.4 and 0.4 mJ/mm^3, respectively. The percentage elongation of the material in the plastic regime would be:

1. 25%
2. 12.5%
3. 0.25%
4. 0.125%

FLUID MECHANICS

76 . A fluid flows past a sphere with an upstream velocity of $V_0 = 40$ m/s as shown in the figure. It is found that the speed of the fluid along the front part of the sphere is $V = \frac{3}{2} V_0 sin\theta$. The streamwise and normal components of acceleration in m/s^2 at point A, if the radius of the sphere is a = 0.20 m, respectively are numerically closest to :



1. 3720 and 4430
2. 4430 and 3720
3. 8860 and 7440
4. 7440 and 8860

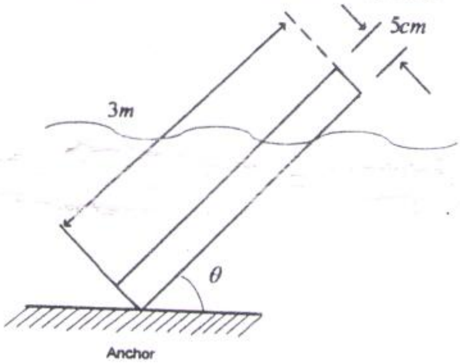
77 . The two-dimensional velocity field for an incompressible, Newtonian fluid is described as $\vec{V} = (12xy^2 - 6x^3)\hat{i} + (18x^2y - 4y^3)\hat{j}$, where $\hat{i}$ and $\hat{j}$ are the unit vectors along x and y directions respectively. Here the velocity has units of m/s; x, y being in meter. The stresses $\sigma_{xx}, \sigma_{yy}, \tau_{xy}$, at $x = 0.5$ m, $y = 1.0$ m, are given by (if pressure at this point is 6 kPa, and fluid viscosity is 1.5 Pa . s).

1. $\sigma_{xx} = -5.98$ kPa, $\sigma_{yy} = 45$ Pa, $\tau_{xy} = -6.02$ kPa
2. $\sigma_{xx} = -5.98$ kPa, $\sigma_{yy} = -6.02$ kPa, $\tau_{xy} = 45$ Pa
3. $\sigma_{xx} = 45$ Pa, $\sigma_{yy} = -6.02$ kPa, $\tau_{xy} = -5.98$ kPa
4. $\sigma_{xx} = -6.02$ kPa, $\sigma_{yy} = -5.98$ kPa, $\tau_{xy} = 45$ Pa

78 . A cylindrical open container has volume ∀ and bottom area A. The container is filled with glycerin (density ρ_g) and rests on the floor of an elevator. The elevator has an upward acceleration of a. What is the resultant force that the container exerts on the floor of the elevator during this acceleration? Neglect the weight of the container.

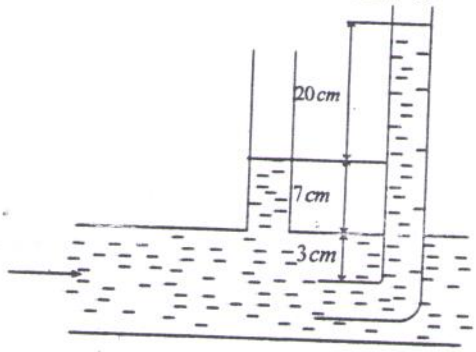
1. $\rho a \forall$ 2. $\rho(a-g)\forall$ 3. $\rho(a+g)\forall$ 4. $\rho(g-a)\forall$

79 . A plate of wood with specific gravity 0.4 is anchored to the bottom of a lake as shown in the following figure. The dimensions of the plate are 5 cm × 10 cm × 3 m, and the depth of the lake is 1 m at this location. Assume that the 10 cm dimension is perpendicular to the plane of the figure and the density of the lake water is 1000 kg/m³. The angle θ at which the plate will float is numerically closest to:



1. 15° 2. 30° 3. 60° 4. 90°

80 . A piezometer and a Pitot tube are tapped into a horizontal water pipe as shown in the following figure, to measure static and stagnation pressures. Assume the flow as steady, incompressible and irrotational. Neglect energy losses. For the indicated water column heights, the velocity of water at the centre of pipe, taking $g = 10\ \mathrm{m/s^2}$, is

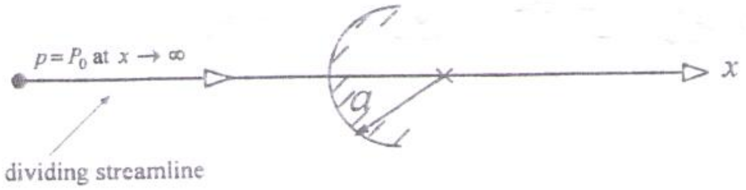


1. 1 m/s 2. 2 m/s
3. 3 m/s 4. 4 m/s

81 . A thin flat plate of dimensions of 100 cm × 200 cm is completely immersed in an oil stream with velocity 6 m/s. The density and dynamic viscosity of oil may be taken as 890 kg/m³ and 0.29 kg/m.s respectively. Assume a drag coefficient given by : $C_D = 1.328\ Re_L^{-0.5}$, where Re_L is the Reynolds number based on the plate length. The total frictional force, if the fluid stream is along the longer side of the plate, is numerically closest to

1. 4.435 N 2. 44.35 N 3. 443.5 N 4. 4435 N

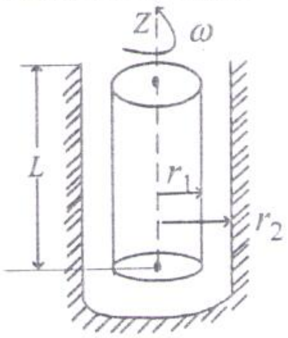
2. An incompressible fluid with density ρ flows steadily past an object shown in the figure. The fluid velocity along the horizontal dividing streamline $(-\infty \le x \le a)$ is found to be $V = V_0\left(1+\frac{a}{x}\right)$, where a is the radius of curvature of the front of the object and V_0 is the upstream velocity. If the upstream pressure is P_0, obtain the pressure distribution $p(x)$ for $-\infty \le x \le -a$, assuming inviscid flow



1. $p = P_0 - \rho a V_0^2\left(\frac{1}{x}+\frac{a}{2x^2}\right)$ 2. $p = P_0 + \rho a V_0^2\left(\frac{1}{x}+\frac{a}{x^2}\right)$

3. $p = P_0 - \rho a V_0^2\left(\frac{1}{x}+\frac{a}{x^2}\right)$ 4. $p = P_0 + \rho a V_0^2\left(\frac{1}{x}+\frac{a}{2x^2}\right)$

83. A Couette viscometer consists of fluid filled between two concentric cylinders as shown in the figure. The inner cylinder (radius r_1) rotates insides an outer cylinder of radius r_2 at uniform angular velocity ω, while the outer one is restrained by means of a torsional spring. The torque acting on the outer cylinder is measured by means of spring deflection. Assuming the flow to be steady, laminar, purely circular and independent of Z direction, expression for the dynamic viscosity in terms of the measured torque (T), angular velocity (ω) and other geometric parameters are,



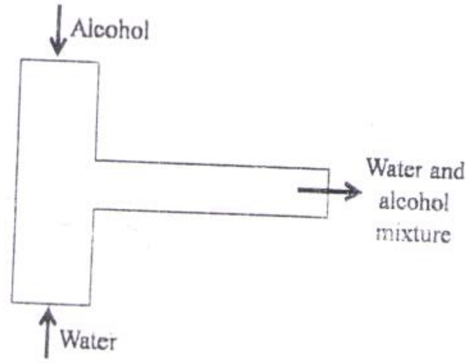
1. $\frac{T}{4\pi\omega L}\frac{1}{r_1^2}$ 2. $\frac{T}{4\pi\omega L}\frac{1}{r_2^2}$

3. $\frac{T}{4\pi\omega L}\frac{(r_2^2+r_1^2)}{r_1^2\, r_2^2}$ 4. $\frac{T}{4\pi\omega L}\frac{(r_2^2-r_1^2)}{r_1^2\, r_2^2}$

84. A rocket has an initial mass of m_0 (rocket + fuel) and $\dot{m}_e$ is the rate (constant) at which the mass of the fuel is expended. If the drag force of air on the rocket is given by kv^2 (where v is the speed of the rocket), then the differential equation governing the rocket motion is given by (assuming the expelled mass to exit from the rocket at a constant velocity u relative to the rocket)

1. $(m_0 - \dot{m}_e t)\frac{dv}{dt} + kv^2 = \dot{m}_e v - (m_0 - \dot{m}_e t)g$
2. $(m_0 - \dot{m}_e t)\frac{dv}{dt} + kv^2 = (m_0 - \dot{m}_e t)(v+u) - (m_0 - \dot{m}_e t)g$
3. $(m_0 - \dot{m}_e t)\frac{dv}{dt} - kv^2 = \dot{m}_e u - (m_0 - \dot{m}_e t)g$
4. $(m_0 - \dot{m}_e t)\frac{dv}{dt} + kv^2 = (m_0 - \dot{m}_e t)(v-u) - (m_0 - \dot{m}_e t)g$

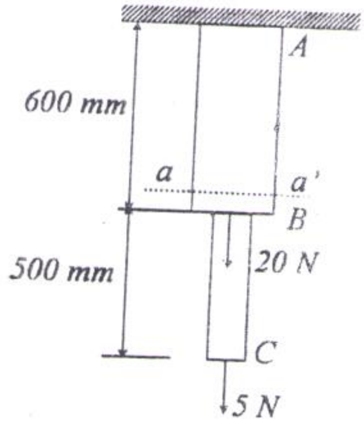
85 . Water (density =1000 kg/m^3) at 0.1 m^3/s and alcohol (specific gravity = 0.8) at 0.3 m^3/s are mixed in a T-junction as shown in the figure. Assuming all the flows to be steady and incompressible, average density of the mixture of alcohol and water, in kg/m^3, is



1. 340
2. 560
3. 680
4. 850

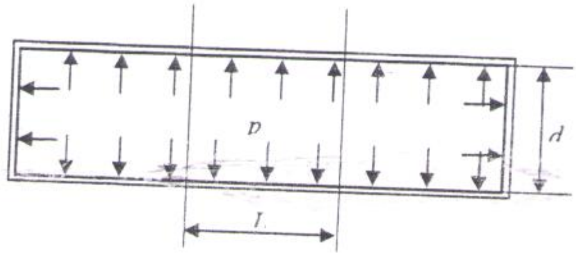
SOLID MECHANICS

86 . A stepped bar is hung from the ceiling as shown in the figure. The cross-section of $AB = 500\ mm^2$, and that of $BC = 200\ mm^2$. Assuming that the density of both the rods are the same and equal to $7500\ kg/m^3$, find the axial force at a section a-a' just above B. Take $g = 10\ m/s^2$. A downward force of $20\ N$ is acting at B and a force of $5\ N$ at C is acting upwards.



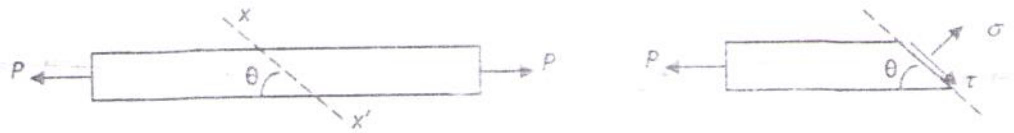
1. 32. 5 N
2. 22.5 N
3. 90 N
4. 100 N

87 . A long thin walled closed ended cylindrical vessel of thickness 't' is subjected to an internal pressure 'p' as shown. Find the strain energy stored in the central part of the cylinder of length 'L' due to pressure 'p'.



1. $\frac{3\pi p^2 d^3 L}{16Et}$
2. $\frac{3\pi p^2 d^3 L}{32Et}$
3. $\frac{5\pi p^2 d^3 L}{16Et}$
4. $\frac{5\pi p^2 d^3 L}{32Et}$

88 . A bar of cross-sectional area A is subjected to an axial load P. Let τ be the average shear stress acting on a plane oriented at an angle θ to the axis, as shown. Which one of the choices below corresponds to the variation of τ with respect to θ $(0 < \theta < \pi/2)$.



1.

θ	0	$\pi/4$	$\pi/2$
τ	0	$\frac{P}{2A}$	$\frac{P}{A}$

2.

θ	0	$\pi/4$	$\pi/2$
τ	0	$\frac{P}{4A}$	$\frac{P}{2A}$

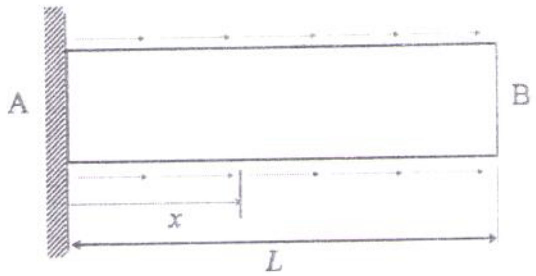
3.

θ	0	$\pi/4$	$\pi/2$
τ	0	$\frac{P}{2A}$	0

4.

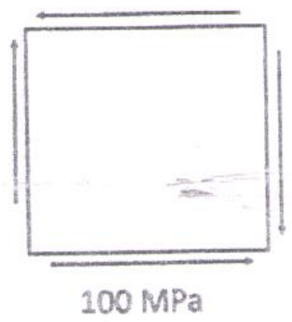
θ	0	$\pi/4$	$\pi/2$
τ	$\frac{P}{2A}$	$\frac{P}{4A}$	0

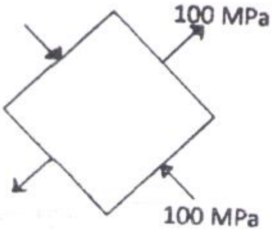
89 . A non-uniform loading on the bar causes a normal strain which can be expressed as $\varepsilon_x = kx^2$, where k is a constant. Determine the displacement of the end B of the bar.

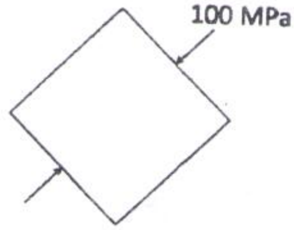


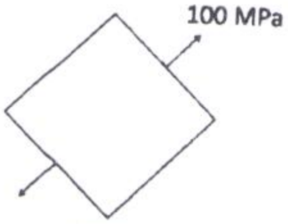
1. $\frac{KL^3}{3}$ 2. $\frac{KL^2}{3}$ 3. KL^2 4. $\frac{KL^2}{2}$

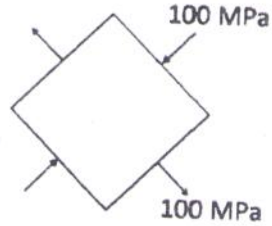
90 . Determine the equivalent state of stress on an element oriented 45° counter-clockwise from the element shown.



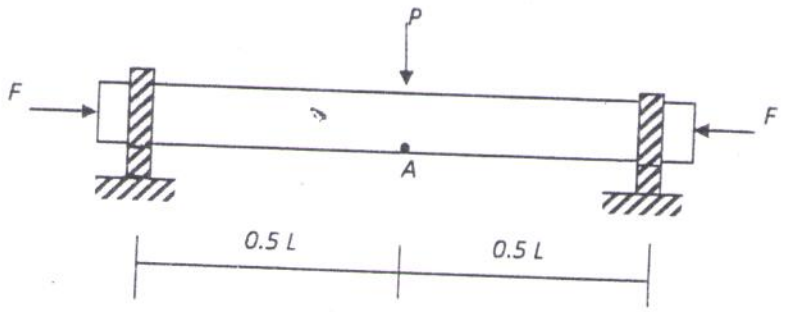
1. 

2. 

3. 

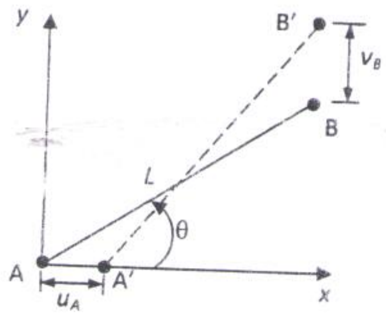
4. 

91 . A solid shaft of diameter d resting on two journal bearings is subjected to a transverse load P, at the center and an axial load F, as shown. Determine the axial stress, σ, that is developed at point A shown. The journal bearing may be assumed to support only vertical loads.



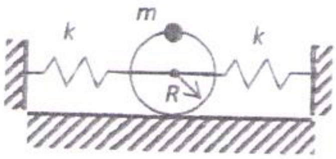
1. $\sigma = \frac{8PL}{\pi d^3} - \frac{4F}{\pi d^2}$
2. $\sigma = \frac{4PL}{\pi d^3} - \frac{8F}{\pi d^2}$
3. $\sigma = \frac{(8P-4F)}{\pi d^2}$
4. $\sigma = \frac{-8PL}{\pi d^3} - \frac{4F}{\pi d^2}$

92 . The fiber AB has length L and orientation θ. If its ends A and B undergo small displacements u_A and v_B as shown, determine the strain in the fiber.



1. $\cos\theta \frac{u_A}{L} + \sin\theta \frac{v_B}{L}$
2. $-\cos\theta \frac{u_A}{L} + \sin\theta \frac{v_B}{L}$
3. $\sin\theta \frac{u_A}{L} - \cos\theta \frac{v_B}{L}$
4. $-\sin\theta \frac{u_A}{L} - \cos\theta \frac{v_B}{L}$

93 . A disk of radius R and negligible mass is rolling without slipping on a surface as shown in the Figure. A heavy point mass m is attached to the disk at the topmost point. The center of the disk is attached to the two side walls by means of springs of stiffness k as shown. Derive the natural frequency of the system for small amplitude oscillations.



1. $\sqrt{\frac{2k}{m}-\frac{g}{R}}$ 2. $\sqrt{\frac{2k}{m}+\frac{g}{R}}$ 3. $\sqrt{\frac{k}{m}-\frac{g}{R}}$ 4. $\sqrt{\frac{k}{m}+\frac{g}{R}}$

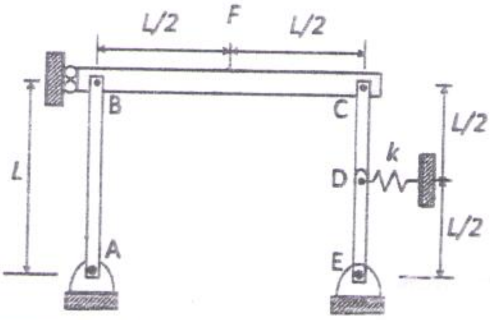
94 . The stress state at a location in an aircraft structural member is given by:

$$\begin{pmatrix} 100 & 0 & -30 \\ 0 & 0 & 0 \\ -30 & 0 & 180 \end{pmatrix} MPa$$

Choose the closest value of the yield strength of the material such that the factor of safety is about 2? Use Tresca criterion for yield.

1. 25 MPa 2. 48 MPa 3. 70 MPa 4. 15 MPa

95 . A rigid bar which is constrained to move in the vertical direction is supported by a column AB and rigid bar assembly CDE as shown in the Figure. The joint D is attached to the wall by a spring of stiffness k. Calculate the diameter d of the column AB so that both AB and assembly CDE have the same factor of safety against buckling. The elastic modulus of the column AB is E.



The moment of inertia of AB is I. Use Euler's formula for buckling.

1. $d=\left(\frac{8kL^3}{\pi^3 E}\right)^{1/4}$ 2. $d=2\left(\frac{kL^3}{\pi^2 E}\right)^{1/4}$

3. $d=\left(\frac{kL^3}{\pi^3 E}\right)^{1/4}$ 4. $d=2\left(\frac{kL^3}{\pi^3 E}\right)^{1/4}$

THERMODYNAMICS

96. In a steady flow compressor a gas is compressed from 100 kPa (gage) and 2.7 m^3/s to a final state of 300 kPa (gage) and 1.5 m^3/s. Assuming the compression process to be reversible and polytropic, the power input to the compressor (in kW) is close to: (Atmospheric pressure = 1.01 bar)

1. 59 2. 241 3. 387 4. 395

97. A house, that is losing heat at a rate of 54,000 kJ/h when the outside temperature drops to 4°C, is to be heated by electric resistance heaters. If the house is to be maintained at 25°C at all times, the second law efficiency of the heating process is

1. 93% 2. 56% 3. 14% 4. 7%

98. Liquid water enters a 25 kW pump at 100 kPa pressure at a rate of 5 kg/s. The kinetic and potential energy changes of water during the pumping process may be neglected. Density of water is 1000 kg/m^3 which may be assumed to remain constant during the process. The highest pressure (in kPa) the liquid water can have at the exit of the pump is

1. 5100 2. 510 3. 105 4. 51

99. The following saturation property data is available for the refrigerant CFC-11 (molecular mass = 137.4 kg/kmol). Using the data given and applying Clausius-Clayperon Equation, estimate the latent heat of vaporization of CFC-11 at 25oC. The universal gas constant is equal to 8.314 kJ/kmol.K.

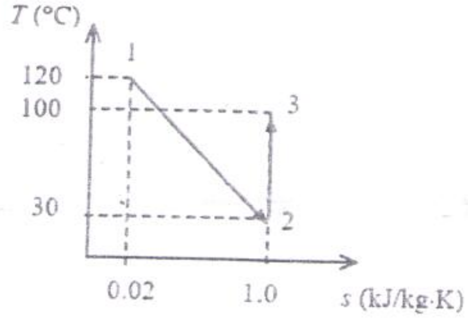
Sat. pressure (kPa)	Sat. temperature (°C)
103.8	24.5
107.4	25.5

1. 50.9 2. 101.8 3. 183.2 4. 203.2

100. In a steam boiler, 100 kg/s of liquid water at 40 bar and 40°C (enthalpy = 167 kJ/kg and entropy = 0.57 kJ/kg.K) is heated to a final temperature and pressure of 673 K and 40 bar (enthalpy = 3213 kJ/kg and entropy = 6.77 kJ/kg.K) using flue gases available at 750 K. Neglecting kinetic and potential energy changes, the entropy generation in the process (in kW/K) is close to:

1. 214 2. 406 3. 620 4. 1026

101 . The heat transfer for the reversible process 1-2-3 (as shown in the figure), in kJ/kg, is



1. 88 2. 170 3. 341 4. 682

102 . A heat pump operates on the ideal vapour-compression refrigeration cycle and uses refrigerant 134a as the working fluid. The condenser operates at 1200 kPa while the evaporator operates at 280 kPa. The specific enthalpy of the refrigerant at the exit of the compressor is 280 kJ/kg. Refrigerant properties: h_g at 280 kPa is 249.72 kJ/kg; h_f at 1200 kPa is 117.77 kJ/kg. The COP (heating) of the system is

1. 2.36 2. 3.36 3. 4.36 4. 5.36

103 . A piston-cylinder device contains 1 kg of a gas at 140 kPa and 27oC. The gas is now compressed slowly in a polytropic process following pV 1.3 = constant till the volume is reduced by half. The specific gas constant for the gas is 0.3 kJ/kgK and the constant volume specific heat is 0.7 kJ/kgK. The entropy change of the gas during the process (in kJ/K) is

1. 0.3535 2. 0.0625 3. − 0.0625 4. − 0.3535

104 . In an air-standard Otto Cycle, the working fluid air may be assumed to be an ideal gas. The compression ratio is 7. Compression begins at 0.1 MPa and 35°C. The maximum temperature in the cycle is 1100°C. Also given air properties: R_{air}= 0.287 kJ/kgK and $C_{p,air}$=1.005 kJ/kgK. The net work output (in kJ/kg) of the cycle will be

1. 131.4 2. 231.4 3. 272.7 4. 504.2

105 . In a steam power plant based on ideal, simple Rankine cycle, the turbine develops a power output of 12 MW. Assuming saturated liquid water at pump inlet (density = 993 kg/m^3), what percentage of turbine output is required for the condensate pump? The enthalpy and entropy of saturated vapour at condenser pressure are 2573 kJ/kg and 8.27 kJ/kg.K, respectively. The other relevant properties of steam at required state points are given in the table.

Location	P (bar)	h (kJ/kg)	s (kJ/kg.K)
Pump inlet	0.073	167	0.57
Boiler exit	40.00	3213	6.77

1. 0.036 2. 0.36 3. 1.36 4. 2.4

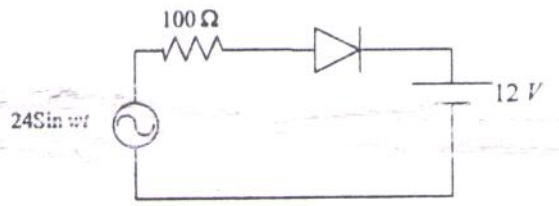
ELECTRONICS

106 . Which one of the following expressions is logically equivalent to the Boolean expression given as (A, B and C are Boolean variables):

$$(A+B)\left(\overline{\bar{A}(\bar{B}+\bar{C})}\right)+\bar{A}(B+C)$$

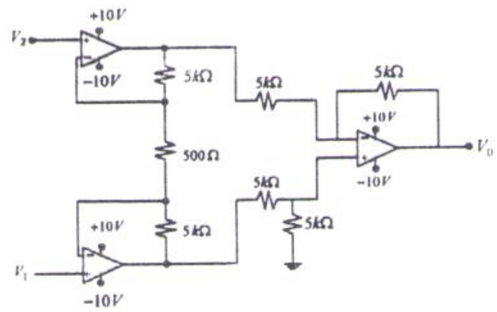
1. $A+B$ 2. $AB+C$ 3. $A+B+C$ 4. $B+AC$

107 . For the circuit shown, the cut-in voltage of the diode is 0.6 V. What will be the maximum reverse-bias diode voltage and the fraction (in %) of the cycle over which the diode conducts?



1. 24 V and 67.6 %
2. 36 V and 32.4 %
3. 12 V and 67.6 %
4. 24 V and 50 %

108 . For the circuit shown, the output voltage (V_0) is given by

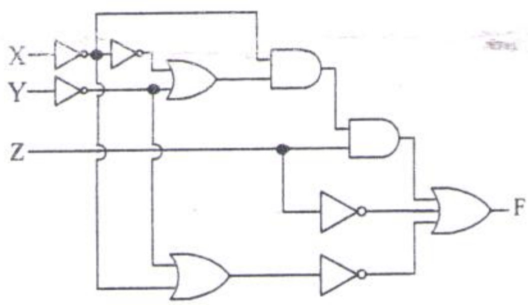


1. $21(V_1-V_2)$
2. $51(V_2-V_1)$
3. $21(V_2-V_1)$
4. $51(V_1-V_2)$

109 . A JK flip-flop has propagation delay (t_{pd}) of 13 ns. What is the largest MOD ripple counter that can be constructed using such flip-flops and can be operated upto 10 MHz?

1. $MOD-32$ 2. $MOD-64$ 3. $MOD-128$ 4. $MOD-256$

110 . For the circuit shown, the expression for F is

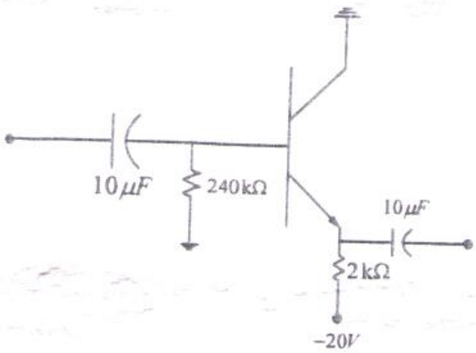


1. $\bar{X}\bar{Y}+XY+Z$
2. $\bar{X}\bar{Y}+\bar{Z}$
3. $X\bar{Y}+\bar{Y}X+Z$
4. $\bar{Z}+\bar{X}\bar{Y}+XY$

111. If u(k) and δ(k) represent the unit step and unit impulse functions, respectively, then the inverse Z-transform of $F(z) = \frac{1}{z+1}$ for k > 0 is given by

1. $(-1)^k \delta(k)$
2. $\delta(k) - (-1)^k$
3. $(-1)^k u(k)$
4. $u(k) - (-1)^k$

112. For the network shown, determine the quiescent values of V_{CE} and I_E. The following transistor parameters are assumed:
$\beta = 90$, $V_{BE(ON)} = 0.7$ V.



1. 14.6 V and 8.73 mA
2. 10.5 V and 3.85 mA
3. 16.43 V and 7.72 mA
4. 11.68 V and 4.16 mA

113. A PCM multiplexing system is designed using a 256 levels quantizer for transmission of three signals each of which is band limited to 5 kHz, 10 kHz and 5 kHz, respectively. Assuming that each signal is sampled at its Nyquist rate and 8-bits are transmitted simultaneously, the maximum bit duration is

1. 3.125 μs
2. 6.25 μs
3. 25 μs
4. 12.5 μs

114. If X(s) is the Laplace transform of the function $x(t)$, then the final value of the function is

1. $\lim_{s\to\infty} X(s)$, if all poles of X(s) lie in the right half of the s-plane.
2. $\lim_{s\to\infty} X(s)$, if all poles of X(s) lie in the left half of the s-plane.
3. $\lim_{s\to\infty} sX(s)$, if all poles of sX(s) lie in the right half of the s-plane.
4. $\lim_{s\to\infty} sX(s)$, if all poles of sX(s) lie in the left half of the s-plane.

115. An angle-modulated signal is given by
$s(t) = cos2\pi\{2 \times 10^6 t + 30\sin(150t) + 40\cos(150t)\}$.
The maximum frequency and phase deviations of $s(t)$ are

1. 10.5 kHz and 140 π radian
2. 6 kHz and 80 π radian
3. 10.5 kHz and 100 π radian
4. 7.5 kHz and 100 π radian

रफ् कार्य/ROUGH WORK