BJNP

विद्या ददाति विनयम्
Knowledge is Discipline

Learning with the Speed of Mumbai and the Tradition of Kota

Max. Marks: 200 **Date: 02.10.2022**

ABHIMANYU BATCH
PHYSICS : PART TEST
Topics: Semiconductors

1. In an unbiased p-n junction, holes diffuse from p-region to n-region, because

   (a) Free electrons in the n-region attract them

   (b) They move across the junction by the potential difference

   (c) Hole concentration in p-region is more as compared to n-region

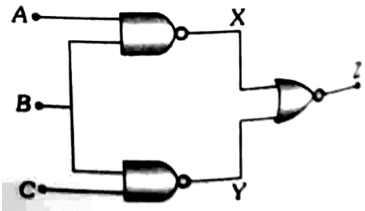
   (d) All of the above

2. A logic gate is an electronic circuit which

   (a) Makes logic decisions (b) Allows electrons flow only in one direction

   (c) Works binary algebra (d) Alternates between 0 and 1 values

3. The figure show two NAND gates followed by a NOR gate. the system is equivalent to the following logic gate



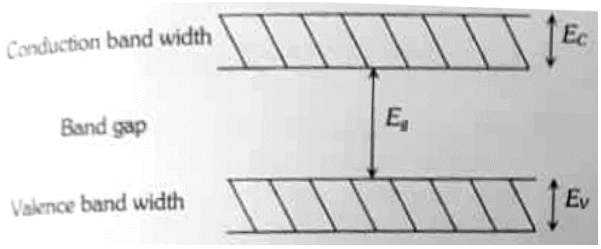
   (a) OR (b) AND (c) NAND (d) None of these

4. A researcher wants an alarm to sound when the temperature of air in his controlled research chamber rises above 40° C or falls below 20° C. The alarm can be triggered by the output of a

   (a) AND gate (b) NAND gate (c) NOT gate (d) OR gate

Space for Rough Work

5. If the lattice constant of this semiconductor is decreased, then which of the following is correct



(a) E_c and E_v increase, but E_g decrease (b) E_c and E_v decrease, but E_g increase

(c) All E_c, E_g, E_v decrease (d) All E_c, E_g, E_v increase

6. Carbon, silicon and germanium have four valence electrons each. At room temperature which one of the following statements is most appropriate

(a) The number of free conduction electrons is significant in C but small in Si and Ge

(b) The number of free conduction electrons is negligible small in all the three

(c) The number of free electrons for conduction is significant in all the three

(d) The number of free electrons for conduction is significant only in Si and Ge but small in C

7. Which impurity is doped in Si to form N-type semi-conductor

(a) Al (b) B (c) As (d) None of these

8. In a semiconductor

(a) There are no free electrons at any temperature

(b) The number of free electrons is more than that in a conductor

(c) There are no free electrons at 0 K

(d) None of these

Space for Rough Work

9. The forbidden energy band gap in conductors, semiconductor and insulators are EG_1, EG_2 and EG_2 respectively. The relation among them is

(a) $EG_1 = EG_2 = EG_3$ (b) $EG_1 < EG_2 < EG_3$ (c) $EG_1 > EG_2 > EG_3$ (d) $EG_1 < EG_2 > EG_2$

10. Energy bands in solids are a consequence of

(a) Ohm's Law (b) Pauli's exclusion principle

(c) Bohr's theory (d) Heisenberg's uncertainty principle

11. The energy band gap is maximum in

(a) Metals (b) Superconductors (c) Insulators (d) Semicondutors

12. A piece of copper and the other of germanium are cooled from the room temperature to 80 K then which of the following would be a correct statement

(a) Resistance of each increases

(b) Resistance of each decreases

(c) Resistance of copper increases while that of germanium decreases

(d) Resistance of copper decreases while that of germanium increases

13. The difference in the variation of resistance with temperature in a metal and a semiconductor arises essentially due to the difference in the

(a) Variation of scattering mechanism with temperature

(b) Crystal structure

(c) Variation of the number of charge carries with temperature

(d) Type of bond

Space for Rough Work

14. The temperature dependence of resistance of Cu and undoped Si in the temperature range 300 – 400 K, is best described by

(a) Linear increase for Cu, exponential increase for Si

(b) Linear increase for Cu, exponential decrease for Si

(c) Linear decrease for Cu, linear decrease for Si

(d) Linear increase for Cu, linear increase for Si

15. When forward bias is applied to a P-N junction, then what happens to the potential barrier V_B, and the width of charge depleted region x

(a) V_B increases, x decreases (b) V_B decreases, x increases

(c) V_B increases, x increases (d) V_B decreases, x decreases

16. In the middle of the depletion layer of a reverse-biased PN junction, the

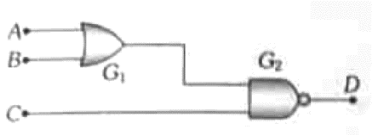
(a) Potential is zero (b) Electric field is zero

(c) Potential is maximum (d) Electric field is maximum

17. Any digital circuit can be realized by repetitive use of only

(a) NOT gates (b) OR gates (c) AND gates (d) NOR gates

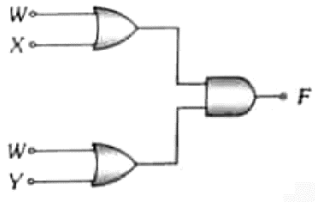
18. For the given combination of gates, if the logic states of inputs A, B, C are as follows A = B = C = 0 and A = B = 1, C = 0 then the logic states of output D are



(a) 0, 0 (b) 0, 1 (c) 1, 0 (d) 1, 1

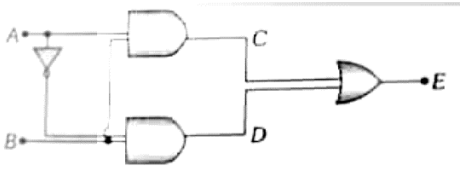
Space for Rough Work

19. The diagram of a logic circuit is given below. The output F of the circuit is represented by



(a) W . (X + Y) (b) W . (X . Y) (c) W + (X . Y) (d) W + (X + Y)

20. Truth table for the given circuit is



(a)

A	B	E
0	0	1
0	1	0
1	0	1
1	1	0

(b)

A	B	E
0	0	1
0	1	0
1	0	0
1	1	0

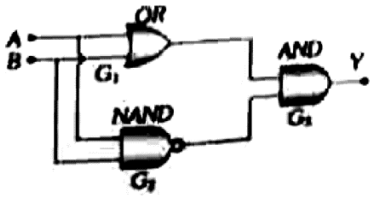
(c)

A	B	E
0	0	1
0	1	1
1	0	0
1	1	1

(d)

A	B	E
0	0	0
0	1	1
1	0	1
1	1	0

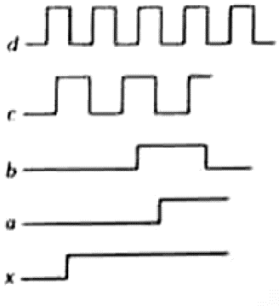
21. The following configuration of gate is equivalent to



(a) NAND (b) XOR (c) OR (d) None of these

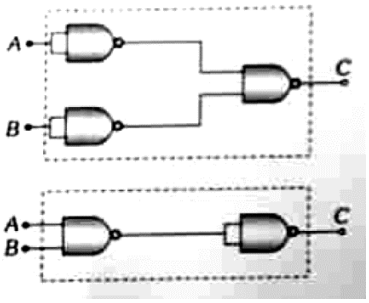
Space for Rough Work

22. If a, b, c, d are inputs to a gate and x is its output, then as per the following time graph, the gate is



(a) AND (b) OR (c) NAND (d) NOT

23. The combination of 'NAND' gates shown here under (figure) are equivalent to



(a) An OR gate and an AND gate respectively

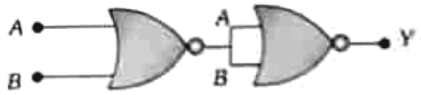
(b) An AND gate and a NOT gate respectively

(c) An AND gate and an OR gate respectively

(d) An OR gate and a None of these gate respectively

Space for Rough Work

24. Truth table for system of four NAND gates as shown in figure is



(a)

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

(b)

A	B	C
0	0	0
0	1	0
1	0	1
1	1	1

(c)

A	B	Y
0	0	1
0	1	1
1	0	0
1	1	0

(d)

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	1

25. Mobility of electrons in a semiconductor is defined as the ratio of their drift velocity to applied electric field. If for an n-type semiconductor, the density of electrons is 10^{19} m^{-3} and their mobility is 1.6 m^2 (V.s) then the resistivity of the semiconductor [since it is an n-type semiconductor contribution of holes is ignored) is close to

(a) 4 Ω m (b) 0.4 Ω m (c) 0.2 Ω m (d) 2 Ω m

Space for Rough Work

विद्या ददाति विनयम्
Knowledge is Discipline
BJNP
Learning with the Speed of Mumbai and the Tradition of Kota

Date: 02.10.2022

ABHIMANYU BATCH
MATHEMATICS : PART TEST
Topic: Differential Equation

26. The order and degree of differential equation $\sqrt{1+\frac{1}{(y')^2}} = (y'')^{3/2}$ are ….

(a) 3, 3 (b) 2, 2 (c) 3, 2 (d) 2, 3

27. The differential equation whose solution is $Ax^2 + By^2 = 1$, where A and B are arbitrary constants is of …

(a) first order and second degree (b) first order and first degree

(c) second order and first degree (d) second order and second degree

28. The order and degree of the differential equation $\frac{d^2y}{dx^2} + \left(\frac{dy}{dx}\right)^{1/3} + x^{1/4} = 0$ are respectively …

(a) 2, 3 (b) 3, 3 (c) 2, 6 (d) 2, 4

29. The order and degree of the differential equation $\sqrt{\sin x}\,(dx + dy) = \sqrt{\cos x}\,(dx - dy)$ is ….

(a) 1, 2 (b) 2, 2 (c) 1, 1 (d) 2, 1

30. If p and q are the order and degree of the differential equation $y\frac{dy}{dx} + x^3\left(\frac{d^2y}{dx^2}\right) + xy = \cos x$, then ….

(a) $p < q$ (b) $p = q$

(c) $p > q$ (d) p exist and q does not exist

Space for Rough Work

31. The differential equation for

$y = a\cos(x + b) - ce^{(d-x)} + e\sin x$

where, a, b, c, d, e are arbitrary constants is ….

(a) $y_4 - y_2 + y = 0$ (b) $y_3 + y_2 + y_1 + y = 0$ (c) $y_5 + y = 0$ (d) $y_3 - y_2 + y_1 - y = 0$

32. The differential equation of the family of circles passing through the points (a, 0) and (–a, 0) is ….

(a) $(x^2 - y^2 - a^2)\frac{dy}{dx} - 2xy = 0$ (b) $(x^2 + y^2 - a^2)\frac{dy}{dx} - 2xy = 0$

(c) $(x^2 - y^2 - a^2)\frac{dy}{dx} + 2xy = 0$ (d) $(x^2 + y^2 + a^2)\frac{dy}{dx} + 2xy = 0$

33. If the differential equation of the equation $y = Ae^{2x} + Be^{-x/2}$ is $ay_2 + by_1 + cy = 0$, then the value of a + b + c = …

(a) 3 (b) 8 (c) 2 (d) –2

34. The sum of order and degree of the differential equation of $x^2 + y^2 - 2ay = 0$ is ….

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

35. From the differential equation of

$y = (A + Bx)e^{3x}$

where, A and B are arbitrary constants

(a) $y_2 - 6y_1 - 9y = 0$ (b) $y_2 + 6y_1 + 9y = 0$ (c) $y_1 + 6y_1 - 9y = 0$ (d) $y_2 - 6y_1 + 9y = 0$

36. Which of the following is second ordered differential equation ….

(a) $y'^2 + x = y^2$ (b) $y'y'' + y = \sin x$ (c) $y''' + y'' = 0$ (d) $y' = y$

Space for Rough Work

37. The differential equation of the curve

$$y = ax\cos\left(\frac{1}{x} + b\right)$$

where a, b are parameters is …..

(a) $x^2y_2 + y = 0$ (b) $x^4y_2 + y = 0$ (c) $xy_2 - y = 0$ (d) $x^4y_2 - y = 0$

38. The differential equation of the family of circles having their centres on the line x = 5 and touching the Y-axis is ..

(a) $(x^2 + 10x)y_1^2 + (x - 5)^2 = 0$ (b) $(x^2 - 10x)y_1^2 + (x + 5)^2 = 0$

(c) $(x^2 + 10x)y_1^2 + (x + 5)^2 = 0$ (d) $(x^2 - 10x)y_1^2 + (x - 5)^2 = 0$

39. The differential equation of the family of parabiolas having vertex at the origin and the Y-axis as the axis of symmetry is $Axy_1 + By = 0$, then the value of A + B = ….

(a) –1 (b) 1 (c) 0 (d) 2

40. The differential equation of family of parabolas with focus at the origin and the axis along X-axis is $yy_1^2 = Axy_1 + By$, then the value of A + B = ….

(a) 1 (b) –1 (c) 2 (d) Both (a) and (b)

41. If the particular solution of

$$\frac{dy}{dx}\tan y = \sin(x + y) + \sin(x - y)$$

is sec y + 2 cos x = A, where x = 0 and $y = \frac{\pi}{3}$, then the value of A is ….

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

42. The particular solution of $\frac{dy}{dx} = \left(\frac{y}{x}\right)^{1/3}$ if x = y = 1 is ….

(a) $x^{2/3} + y^{2/3} = 1$ (b) $x^{2/3} + y^{2/3} = 0$ (c) $y^{2/3} - x^{2/3} = 0$ (d) $y^{2/3} - x^{2/3} = 2$

Space for Rough Work

43. The particular solution of $\frac{dy}{dx} = 2^{y-x}$ is …. if $y(n) = n,\ n \in W$.

(a) $\frac{1}{2^x} + \frac{1}{2^y} = 0$ (b) $2^{-x} = 2^{-y}$ (c) $2^x = 2^{-y}$ (d) $2^{-x} = 2^y$

44. The number of arbitrary constants in the general solutions of order n and n + 1 are respectively ….

(a) n – 1, n (b) n, n + 1 (c) n + 1, n + 2 (d) n + 1, n

45. The number of arbitrary constants in the particular solution of a differential equation of third order is ….

(a) 3 (b) 2 (c) 1 (d) 0

46. The slope at any point of a curve y = f(x) is given by $\frac{dy}{dx} = 3x^2$ and it passes through (–1, 1). Then the equation of the curve is ….

(a) $y = x^3 + 2$ (b) $y = 3x^2 + 4$ (c) $y = 3x^3 + 4$ (d) $y = x^3 + 5$

47. A curve such that $\frac{dy}{dx} = \sqrt{\frac{y}{x+1}}$ and the point (3, 9) lies on the curve, then equation of curve is …

(a) $\sqrt{y} = \sqrt{x+1} + 1$ (b) $\sqrt{y} = \sqrt{x+1} - 1$ (c) $\sqrt{x+1} = \sqrt{y} + 2$ (d) $\sqrt{y} = \sqrt{x+1} + 2$

48. The solution of differential equation

x dy – y dx = 0 is ….

(a) parabola whose vertex at origin (b) circle whose centre at origin

(c) a rectangular hyperbola (d) straight line passing through origin

Space for Rough Work

49. The particular solution of

$$\frac{dy}{dx} = \sin(x + y) + \cos(x + y)$$

is …. if $x = y = \pi$.

(a) $\tan\left(\frac{x + y}{2}\right) = x + c$

(b) $\log\left|\tan\left(\frac{x + y}{2}\right)\right| = c$

(c) $\tan\left(\frac{x - y}{2}\right) = x + c$

(d) $\log\left|1 + \tan\left(\frac{x + y}{2}\right)\right| = x - \pi$

50. The solution of the equation

$$\frac{dy}{dx} = \tan^2(x + y)$$ is ….

(a) $2(y - x) + \sin 2(x + y) = c$

(b) $y - x + \sin(x + y) = c$

(c) $2(y + x) + \sin 2(x + y) = c$

(d) $2(y - x) + \sin(x + y) = c$

Space for Rough Work

विद्या ददाति विनयम्
Knowledge is Discipline
BJNP
Learning with the Speed of Mumbai and the Tradition of Kota

Max. Marks: 200 **Date: 02.10.2022**

ABHIMANYU BATCH
PHYSICS : PART TEST ANSWER KEY
Topics: Semiconductors

1.	(c)	2.	(a)	3.	(b)	4.	(d)	5.	(b)
6.	(a)	7.	(a)	8.	(b)	9.	(c)	10.	(d)
11.	(b)	12.	(a)	13.	(a)	14.	(c)	15.	(d)
16.	(c)	17.	(d)	18.	(d)	19.	(c)	20.	(c)
21.	(b)	22.	(b)	23.	(a)	24.	(a)	25.	(b)

Date: 02.10.2022

ABHIMANYU BATCH
MATHEMATICS : PART TEST ANSWER KEY
Topic: Differential Equation

26.	(d)	27.	(c)	28.	(a)	29.	(c)	30.	(c)
31.	(b)	32.	(a)	33.	(a)	34.	(b)	35.	(d)
36.	(b)	37.	(b)	38.	(d)	39.	(a)	40.	(d)
41.	(d)	42.	(c)	43.	(b)	44.	(b)	45.	(d)
46.	(a)	47.	(a)	48.	(d)	49.	(d)	50.	(a)