TEST SERIES CSIR-NET/JRF DEC. 2018

BOOKLET SERIES B

Paper Code 05

Test Type: TEST SERIES

PHYSICAL SCIENCES

Duration: 02:00 Hours

Date: 23-11-2018

Maximum Marks: 100

Read the following instructions carefully:

* Single Paper Test is divided into **TWO** Parts.

Part - A: This part shall carry **10** questions. Each question shall be of **2 marks.**

Part - B: This part shall contain **40** questions. Each question shall be of **2 marks**.

* Darken the appropriate bubbles with HB pencil/Ball Pen to write your answer.

* There will be negative marking @25% for each wrong answer.

* The candidates shall be allowed to carry the Question Paper Booklet after completion of the exam.

* For rough work, blank sheet is attached at the end of test booklet.

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PART-A : GENERAL APTITUDE

1. In a race of class seven student's annual sports meet Amit beats Bryan by 20 m. Bryan beats Christine by 10m. By how many metres Amit beats Christine?
(a) 20 m (b) 25 m (c) 28 m (d) 30 m

2. Rakesh turned to his north-west direction and walked for 3 km. He again turned 90º clockwise and moved 3 km more. Then he again turned 90º clockwise and moved 3 km more. Now, in which direction is he from the original point?
(a) South-west (b) South-east (c) East (d) North

3. In a meeting of 20 persons each shakes hand with every other once and only once. What is the total number of hand shakes?
(a) 380 (b) 190 (c) 300 (d) 360

4. What is the unit digit of $(4289)^{4289}$?
(a) 1 (b) 6 (c) 7 (d) 9

5. In a row of school children, Henry is 16^{th} from the left and Sami is 8^{th} from the right. If they interchange their positions, then Henry becomes 33^{rd} from the left. What is the total number of students in the row?
(a) 42 (b) 40 (c) 38 (d) 44

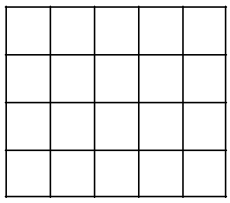
6. Pointing to the photograph of a man, Leela said, "His brother's father is the only son of my Grandmother" How is Leela related to the man in the photograph?
(a) Sister (b) Mother (c) Aunty (d) Daughter

7. If a right angled triangle having base of 3 cm and height of 4 cm is rotated 360º by its base. What is the total volume covered by this procedure?
(a) 16π cm^3 (b) 24π cm^3 (c) 12π cm^3 (d) 18π cm^3

8. Below is given few statements. Based on these statements find out which one of the given option is *correct*?
Statements:
(i) Some A are B (ii) All B are C (iii) All C are D
Conclusions:
(1) All C are A (2) All B are D (3) No B are D
(a) 1 and 2 are correct (b) only 2 is correct
(c) 1 and 3 are correct (d) 2 and 3 are correct

9. If in a certain code 'BOX' is coded as 'CLY', so in the same code what should be the code for 'RAT'?
(a) SIU (b) GZI (c) SZI (d) TIZ

10. What are the total numbers of squares in the given figure?

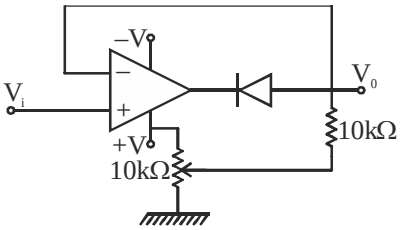


(a) 40 (b) 100 (c) 150 (d) 80

PART-B : ELECTRONICS AND CLASSICAL MECHANICS

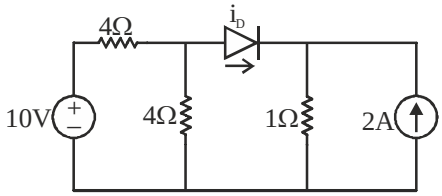
11. Consider the following circuit. How does the above circuit work?

(a) As a logarithmic amplifier
(b) As a negative clipper
(c) As a positive clipper
(d) As a half-wave rectifier

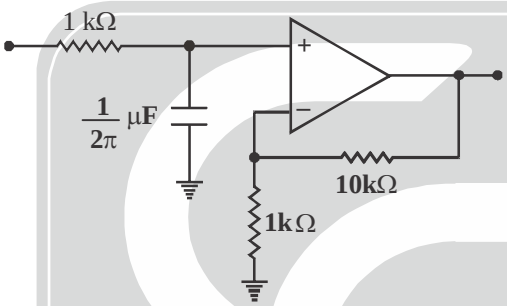


12. In the circuit of figure the current i_D through the ideal diode (zero cut in voltage and forward resistance) equals

(a) 0 A
(b) 4 A
(c) 1 A
(d) None of the above

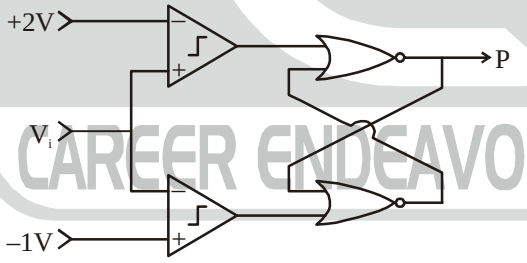


13. For an ideal op-amp circuit given below, the dc gain and the cut off frequency, respectively are



(a) 1 and 1 kHz (b) 1 and 100 Hz (c) 11 and 1 kHz (d) 11 and 100 Hz

14. Choose the correct statements relating to the circuit of figure



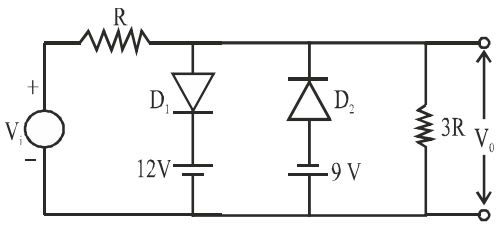
(a) For $V_i = -2v$, P = 0
(b) For $V_i = +3v$, P = 0
(c) For $V_i = 0v$, P = 0 always
(d) For $V_i = 0v$, P can be either 0 or 1

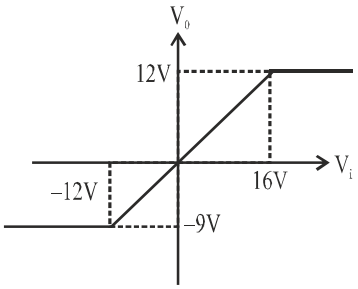
15. The minimized expression for the k-map of given below is

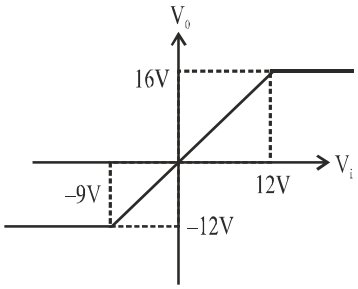
CD \ AB	00	01	11	10
00		1	×	
01			×	
11	1	1	×	×
10	1		×	×

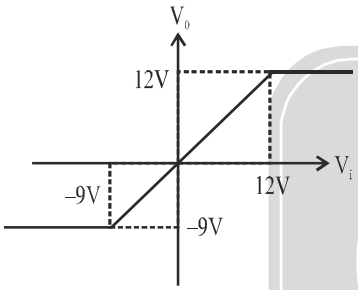
(a) $\bar{A}B\bar{C}\bar{D} + \bar{A}CD + \bar{A}BC\bar{D}$
(b) $\bar{A}B\bar{C}\bar{D} + \bar{A}CD + \bar{A}BC$
(c) $B\bar{C}\bar{D} + CD + \bar{A}\bar{B}C$
(d) $B\bar{C}\bar{D} + CD + \bar{B}C$

16. For the clipper circuit shown in fig, the transfer characteristic is



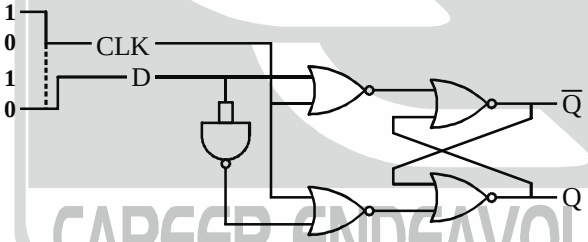
(a)


(b)


(c)


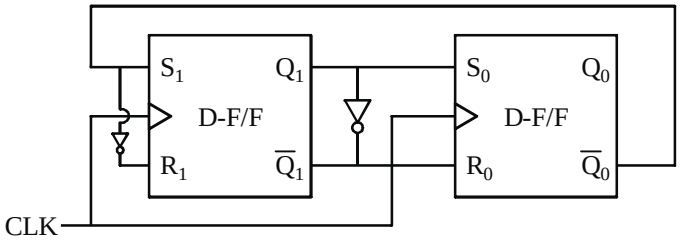
(d) None of these

17. For the circuit shown below. D has a transition from 0 to 1 after clock changes from 1 to 0. Assume gate delays to be negligible



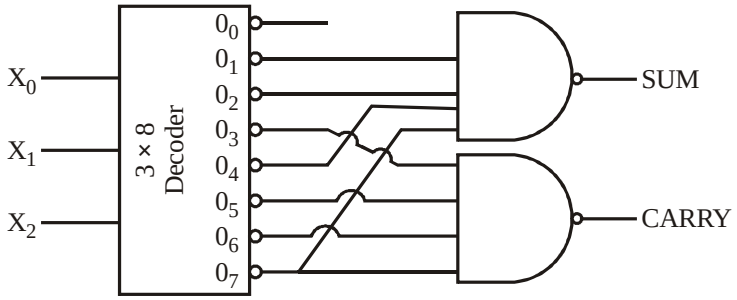
Which of the following statements is TRUE ?
(a) Q goes to 1 at the CLK transition and stays at 1.
(b) Q goes to 0 at the CLK transition and stays at 0.
(c) Q goes to 1 at the CLK transition and goes to 0 when D goes to 1.
(d) Q goes to 0 at the CLK transition and goes to 1 when 0 goes to 1.

18. Determine the value of following counter after 729 pulses, initial value is given as 11



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

19. A full adder with 3 inputs as $X_0X_1X_2$ is designed using a 3 × 8 decoder as shown in figure. Then,



(a) $SUM = \Sigma(1,2,4,7),\ CARRY = \Sigma(3,5,6,7)$

(b) $SUM = \Sigma(3,5,6,7),\ CARRY = \Sigma(1,2,4,7)$

(c) $SUM = \Sigma(0,3,5,6),\ CARRY = \Sigma(1,2,4,7)$

(d) None of the above

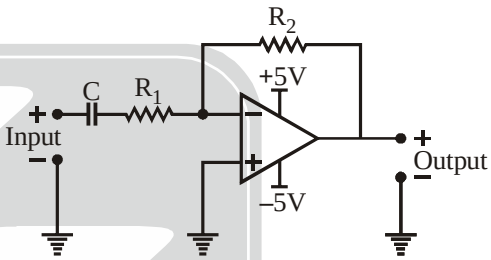
20. The circuit shown is a

(a) Low pass filter with $f_{3dB} = \dfrac{1}{(R_1 + R_2)C}$ rad/s

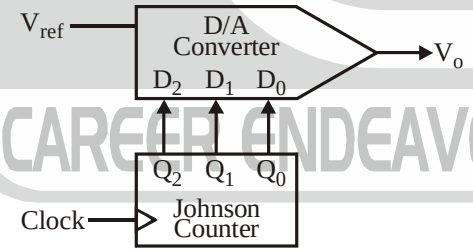
(b) High pass filter with $f_{3dB} = \dfrac{1}{R_1C}$ rad/s

(c) Low pass filter with $f_{3dB} = \dfrac{1}{R_1C}$ rad/s

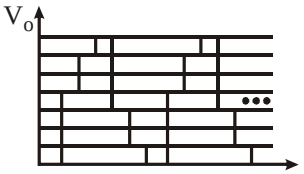
(d) High pass filter with $f_{3dB} = \dfrac{1}{(R_1 + R_2)C}$ rad/s

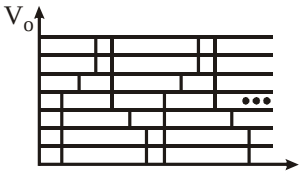


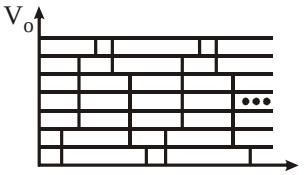
21. The output of a 3-stage Johnson (twisted ring) counter is fed to digital-to-analog (D/A) converter as shown in the figure below.

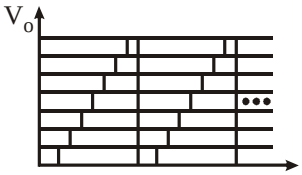


Assume all the states of the counter to be unset initially. The waveform which represents the D/A converter output V_o is

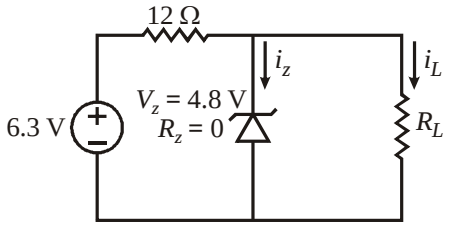
(a)


(b)


(c)


(d)


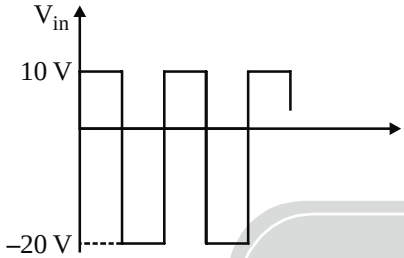
22. In the voltage regulator circuit shown below the Zener diode current is to be limited to the range $\mathbf{5 \le i_L \le 100}$ mA.

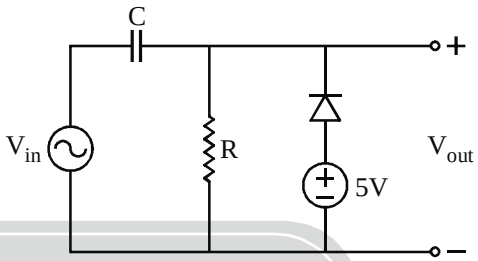


The range of possible load current is

(a) $5 \le i_L \le 130$ mA (b) $25 \le i_L \le 120$ mA (c) $10 \le i_L \le 110$ mA (d) None of these

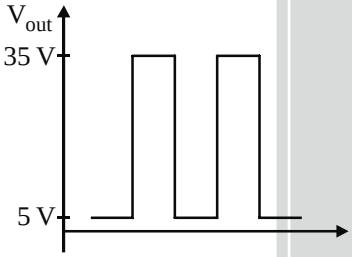
23. V_i the input wave given to the following circuit. Which of the following graph represents output waveform V_o.



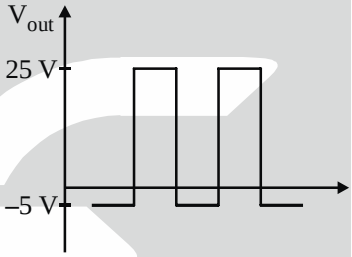


Assume the time constant RC is large and diode is ideal.

(a)

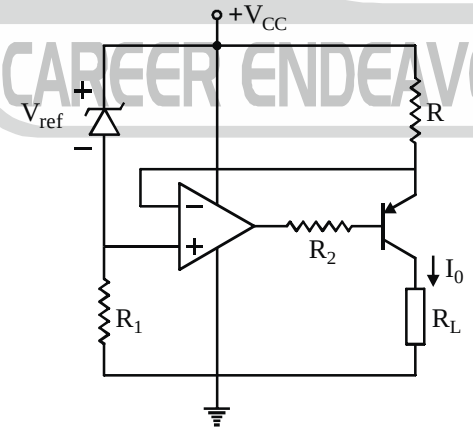


(b)



(c) Both (a) and (b) (d) None of these

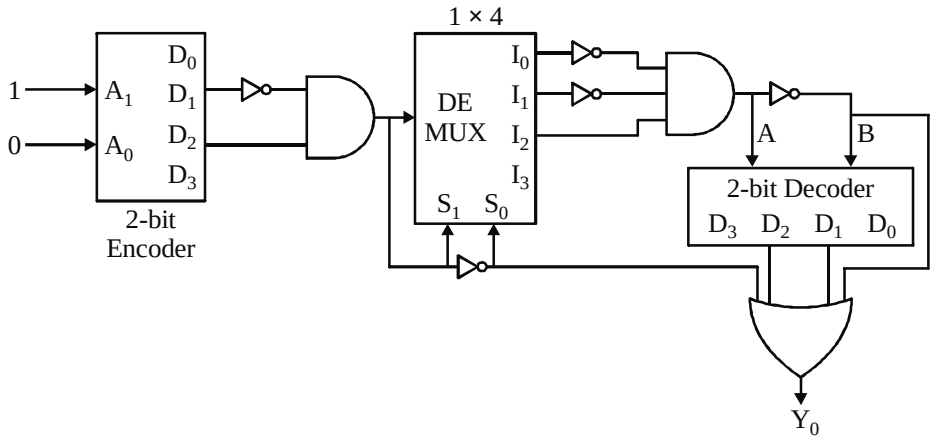
24. Consider the constant current source shown in the figure below. Let β represent the current gain of the transistor.



The load current I_0 through R_L is

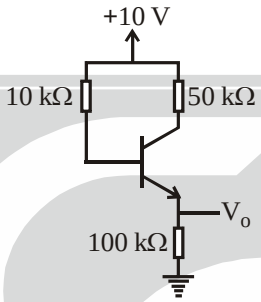
(a) $I_0 = \left(\frac{\beta+1}{\beta}\right)\frac{V_{ref}}{R}$ (b) $I_0 = \left(\frac{\beta}{\beta+1}\right)\frac{V_{ref}}{R}$ (c) $I_0 = \left(\frac{\beta+1}{\beta}\right)\frac{V_{ref}}{2R}$ (d) $I_0 = \left(\frac{\beta}{\beta+1}\right)\frac{V_{ref}}{2R}$

25. Which of the following is the output Y_0 ?



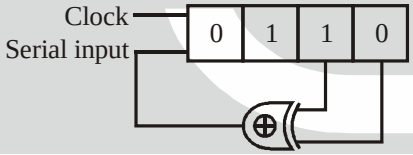
(a) A (b) $A\bar{B}$ (c) 1 (d) 0

26. The transistor circuit shown uses a silicon transistor with $V_{BE} = 0.7\,V$, $I_C \approx I_E$ and a dc current gain of 100. The value of V_0 is



(a) 8.3 V (b) 9.3 V (c) 6.3 V (d) 7.23 V

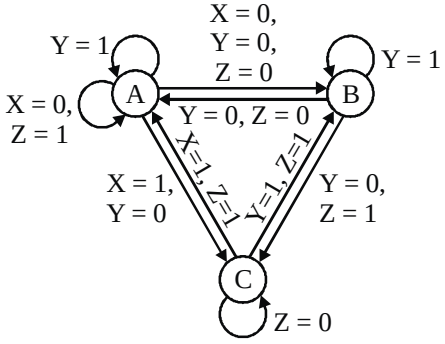
27. The initial contents of the 4-bit serial-in-parallel-out, right-shift, Shift Register shown in figure, is 0110. After three clock pulses are applied, the contents of the Shift Refister will be



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

28. A pulse train with a frequency of 10 MHz is counted using a modulo 1024 ripple counter built with J-K flip-flops. For proper operation of the counter, the maximum permissible propagation delay per flip-flop stage is
(a) 100 nsec (b) 50 nsec (c) 25 nsec (d) 10 nsec

29. The state transition diagram for a finite state machine with states A, B and C and binary inputs X, Y and Z is shown in the figure.



Which one of the following statements is ***correct***?

(a) Transitions from state A are ambiguously defined.
(b) Transitions from state B are ambiguously defined.
(c) Transitions from state C are ambiguously defined.
(d) All of the state transitions are defined unambiguously.

30. A 2-bit binary multiplier can be implemented using

(a) 2 input AND gates only
(b) Six 2-input AND gates and two XOR gates
(c) Two 2-input NORs and one XNOR gate
(d) XOR gates and shifts registers.

31. Lagrangian of a system is $L = \frac{1}{2}m(\dot{x}^2 + \dot{y}^2 + \dot{z}^2) - \frac{1}{2}k(x^2 + y^2 + z^2)$. If a uniform electric field is applied in z-direction then which of the following remains conserved.

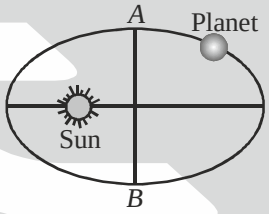
(a) L_x (b) L_y (c) L_z (d) All L_x, L_y, L_z

Here L_x, L_y, L_z are Cartesian components of angular momentum.

32. Time evolution of a dynamical system is given as $\frac{dx}{dt} = 4x - x^3$. Which of the following statements is correct

(a) $x = 0$ is stable fixed point and $x = \pm 2$ are unstable fixed points
(b) $x = 0$ is unstable fixed point and $x = \pm 2$ are stable fixed points
(c) $x = 0$, 2 are unstable fixed point and $x = -2$ is stable fixed points
(d) $x = 0$, 2 are stable fixed point and $x = -2$ is unstable fixed points

33. A planet revolves around the Sun in an elliptical orbit of eccentricity 'e'. If T_1 and T_2 be time taken by planet in going from one extreme of minor axis to the other extreme (i.e. from A to B) through perigee and apogee respectively then value of T_1/T_2 is



(a) $\frac{1-e}{1+e}$ (b) $\frac{1+e}{1-e}$

(c) $\frac{\pi - e}{\pi + e}$ (d) 1

34. A planet p_1 revolves around a star S_1 (mass M) in an elliptical orbit of semi-major axis 'a' with time of revolution T_1. Another planet p_2 revolves around another star S_2 (mass $32M$) in an elliptical orbit of semi-major axis '$2a$' time of revolution T_2. Value of T_2/T_1 is

(a) $2\sqrt{2}$ (b) 2 (c) $\frac{1}{2}$ (d) 1

35. A source of light is moving with speed $\frac{c}{2}$ towards an observer who is also moving towards the source with speed $\frac{c}{2}$. Both the velocities are with respect to lab. If the source emits light of frequency ν_0 then frequency measured by the observer will be

(a) ν_0 (b) $\frac{\sqrt{3}\nu_0}{2}$ (c) $\sqrt{3}\nu_0$ (d) $3\nu_0$

36. A binary system of star consists of two stars of masses m and $3m$ revolving about their common centre of mass under their own mutual gravitational attraction. Ratio of angular momentum of first to the second is

(a) $\frac{1}{3}$ (b) 3 (c) 1 (d) 9

37. A glass slab having refractive index 2 is moving with velocity $\frac{c}{2}\hat{i}$ with respect to lab. A light beam is travelling inside the slab in y-direction. What is speed of light beam as measured in lab frame?

(a) $\frac{\sqrt{7}}{4}c$ (b) $\frac{c}{\sqrt{2}}$ (c) $\frac{\sqrt{2}\,c}{3}$ (d) $\frac{c}{2\sqrt{2}}$

38. A particle of rest mass m_0 moves with constant speed $\frac{c}{2}$ at angle 60° to $+x$ axis with respect to lab frame.

What is energy of particle in a frame which is moving with velocity $\frac{c}{2}$ in $+x$ direction.

(a) $2m_0c^2$ (b) $\frac{\sqrt{3}\,m_0c^2}{2}$ (c) $\frac{3m_0c^2}{2}$ (d) $\frac{7\,m_0c^2}{6}$

39. Hamiltonian of a system is $H=\frac{p_x^2}{2m}e^{-\alpha t}+\frac{1}{2}kx^2e^{\alpha t}+\beta x p_x$ corresponding Lagrangian is

(a) $\left(\frac{1}{2}m\dot{x}^2-\frac{1}{2}kx^2\right)e^{-\alpha t}-\beta x\dot{x}$ (b) $\left[\frac{1}{2}m(\dot{x}-\beta x)^2-\frac{1}{2}kx^2\right]e^{-\alpha t}$

(c) $\left[\frac{1}{2}m(\dot{x}-\beta x)^2-\frac{1}{2}kx^2\right]e^{\alpha t}$ (d) $\frac{1}{2}m\dot{x}^2e^{-\alpha t}-\frac{1}{2}kx^2e^{\alpha t}-\beta x\dot{x}$

40. Generating function for a canonical transformation is $F_1=-\frac{q^2}{P}$. The other generating function $F_2(p,P)$ for this canonical transformation is

(a) $\frac{p^2P}{2}$ (b) $\frac{-p^2P}{2}$ (c) $\frac{-p^2P}{4}$ (d) $\frac{p^2P}{4}$

41. For canonical transformation $q, p \to Q, P$ such that $p=\sin Q,\ q=-P\operatorname{cosec} Q$ generating function $F(q,Q)$ is

(a) $q\cos Q$ (b) $q\sin Q$ (c) $-q\sin Q$ (d) $-q\cos Q$

42. A particle of unit mass moves in one dimensional potential $V(x)=x^2-x$. If area of phase space orbit is π then its energy is

(a) $\frac{1}{2}$ (b) 2 (c) $\frac{1}{\sqrt{2}}$ (d) $\frac{1}{4}$

43. A particle moves in one dimensional potential $V(x) = V_0[\delta(x+a) + \delta(x-a)]$ where V_0 is positive constant. Shape of phase space trajectory of the particle is

(a) parabola (b) rectangle (c) circle (d) ellipse

44. A particle is moving in one dimensional potential $V(x) = kx^6$. If amplitude is doubled then time period of its motion will become

(a) $\frac{1}{2}$ times (b) 2 times (c) $\frac{1}{4}$ times (d) 4 times

45. Lagrangian of a particle moving in *x*-*y* plane is $L = \frac{1}{2}m(\dot{x}^2 + \dot{y}^2) - \frac{1}{2}m\omega^2(x^2 + y^2)$. Which of the following path is not possible

(a) straight line (b) circle (c) ellipse (d) parabola

46. A ball of unit mass is dropped from some height with zero initial velocity. In addition to gravity a drag force $-kv$ also acts on it. Distance travelled in 2 second is approximately (take k = 1kg/sec, g = 10m/s^2)

(a) 5 meter (b) 11 meter (c) 21 meter (d) 2.5 meter

47. Hamiltonian of a system is $H = \frac{(p_x - \alpha x)^2}{2m} + \frac{1}{2}m\omega^2 x^2$. If at $t = 0$, $x = A$, $\dot{x} = v_0$ then $x(t)$ is given

(a) $A\cos\omega t + \frac{v_0}{\omega}\sin\omega t$ (b) $A\cos\omega t + \frac{v_0}{\omega}(t - \cos\omega t)$

(c) $A\cos\omega t + \frac{v_0}{\omega}(t + \cos\omega t)$ (d) $A(1 - \sin\omega t) + \frac{v_0}{\omega}\sin\omega t$

48. Hamiltonian of a system is $H = \frac{(p_x - \alpha y)^2 + (p_y + \alpha x)^2}{2m} + \beta z^2$. If L_z be *z*-component of angular momentum then value of Poisson bracket $\{L_z, H\}$ is

(a) $\frac{p_x^2 + p_y^2}{m}$ (b) $\frac{\alpha^2(x^2 + y^2)}{m}$ (c) $\frac{\alpha(yp_x - xp_y)}{m}$ (d) 0

49. A thin rod of mass m and length l has linear mass density proportional to distance from one end. Moment of inertia of the rod about an axis passing through center and perpendicular to length is

(a) $\frac{ml^2}{12}$ (b) $\frac{ml^2}{4}$ (c) $\frac{ml^2}{3}$ (d) $\frac{ml^2}{24}$

50. Lagrangian of a system is $L = \frac{1}{2}m(\dot{x}^2 + \dot{y}^2 + \dot{z}^2) - K(2x + 3y - z)$. Which of the following is not constant of motion.

(a) $3p_x - 2p_y$ (b) $3p_x + p_z$ (c) $2p_x + p_z$ (d) $p_y + 3p_z$

space for rough work

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Physical Sciences (CSIR-NET/JRF)

Test Series- (B)

Date: 23-11-2018

ANSWER KEY

PART-A

1. (c)	2. (b)	3. (b)	4. (d)	5. (b)	6. (a)	7. (a)
8. (b)	9. (b)	10. (a)				

PART-B

11. (b)	12. (c)	13. (c)	14. (c)	15. (d)	16. (a)	17. (b)
18. (a)	19. (a)	20. (b)	21. (a)	22. (b)	23. (a)	24. (a)
25. (c)	26. (b)	27. (c)	28. (a)	29. (c)	30. (b)	31. (c)
32. (b)	33. (c)	34. (c)	35. (d)	36. (c)	37. (a)	38. (c)
39. (c)	40. (d)	41. (b)	42. (d)	43. (b)	44. (c)	45. (d)
46. (b)	47. (a)	48. (d)	49. (a)	50. (b)		