

# FINAL JEE-MAIN EXAMINATION – JULY, 2022

(Held On Monday 25<sup>th</sup> July, 2022)

TIME : 3 : 00 PM to 6 : 00 PM

## PHYSICS

### SECTION-A

1. In AM modulation, a signal is modulated on a carrier wave such that maximum and minimum amplitude are found to be 6V and 2V respectively. The modulation index is

(A) 100% (B) 80%  
(C) 60% (D) 50%

Official Ans. by NTA (D)

Allen Ans. (D)

2. The electric current in a circular coil of 2 turns produces a magnetic induction  $B_1$  at its centre. The coil is unwound and is rewound into a circular coil of 5 turns and the same current produces a magnetic induction  $B_2$  at its centre.

The ratio of  $\frac{B_2}{B_1}$  is :

(A)  $\frac{5}{2}$  (B)  $\frac{25}{4}$   
(C)  $\frac{5}{4}$  (D)  $\frac{25}{2}$

Official Ans. by NTA (B)

Allen Ans. (B)

3. A drop of liquid of density  $\rho$  is floating half immersed in a liquid of density  $\sigma$  and surface tension  $7.5 \times 10^{-4} \text{ Ncm}^{-1}$ . The radius of drop in cm will be : (Take :  $g = 10 \text{ m/s}^2$ )

(A)  $\frac{15}{\sqrt{2\rho - \sigma}}$  (B)  $\frac{15}{\sqrt{\rho - \sigma}}$   
(C)  $\frac{3}{2\sqrt{\rho - \sigma}}$  (D)  $\frac{3}{20\sqrt{2\rho - \sigma}}$

Official Ans. by NTA (A)

Allen Ans. (A)

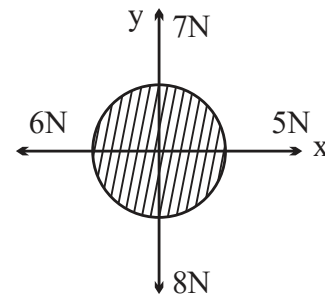
## TEST PAPER WITH ANSWER

4. Two billiard balls of mass 0.05 kg each moving in opposite directions with  $10 \text{ ms}^{-1}$  collide and rebound with the same speed. If the time duration of contact is  $t = 0.005 \text{ s}$ , then what is the force exerted on the ball due to each other?  
(A) 100 N (B) 200 N  
(C) 300 N (D) 400 N

Official Ans. by NTA (B)

Allen Ans. (B)

5. For a free body diagram shown in the figure, the four forces are applied in the 'x' and 'y' directions. What additional force must be applied and at what angle with positive x-axis so that the net acceleration of body is zero?



(A)  $\sqrt{2} \text{ N}$ ,  $45^\circ$  (B)  $\sqrt{2} \text{ N}$ ,  $135^\circ$   
(C)  $\frac{2}{\sqrt{3}} \text{ N}$ ,  $30^\circ$  (D)  $2 \text{ N}$ ,  $45^\circ$

Official Ans. by NTA (A)

Allen Ans. (A)

6. Capacitance of an isolated conducting sphere of radius  $R_1$  becomes  $n$  times when it is enclosed by a concentric conducting sphere of radius  $R_2$  connected to earth. The ratio of

their radii  $\left(\frac{R_2}{R_1}\right)$  is:

(A)  $\frac{n}{n-1}$  (B)  $\frac{2n}{2n+1}$   
(C)  $\frac{n+1}{n}$  (D)  $\frac{2n+1}{n}$

Official Ans. by NTA (A)

Allen Ans. (A)

7. The ratio of wavelengths of proton and deuteron accelerated by potential  $V_p$  and  $V_d$  is  $1:\sqrt{2}$ . Then, the ratio of  $V_p$  to  $V_d$  will be

(A) 1 : 1 (B)  $\sqrt{2}:1$   
(C) 2 : 1 (D) 4 : 1

**Official Ans. by NTA (D)**

**Allen Ans. (D)**

8. For an object placed at a distance 2.4 m from a lens, a sharp focused image is observed on a screen placed at a distance 12 cm from the lens. A glass plate of refractive index 1.5 and thickness 1 cm is introduced between lens and screen such that the glass plate plane faces parallel to the screen. By what distance should the object be shifted so that a sharp focused image is observed again on the screen?

(A) 0.8 m (B) 3.2 m  
(C) 1.2 m (D) 5.6 m

**Official Ans. by NTA (B)**

**Allen Ans. (B)**

9. Light wave traveling in air along x-direction is given by  $E_y = 540 \sin \pi \times 10^4(x - ct)$   $\text{Vm}^{-1}$ . Then, the peak value of magnetic field of wave will be (Given  $c = 3 \times 10^8 \text{ ms}^{-1}$ )

(A)  $18 \times 10^{-7} \text{ T}$  (B)  $54 \times 10^{-7} \text{ T}$   
(C)  $54 \times 10^{-8} \text{ T}$  (D)  $18 \times 10^{-8} \text{ T}$

**Official Ans. by NTA (A)**

**Allen Ans. (A)**

10. When you walk through a metal detector carrying a metal object in your pocket, it raises an alarm. This phenomenon works on

(A) Electromagnetic induction  
(B) Resonance in ac circuits  
(C) Mutual induction in ac circuits  
(D) interference of electromagnetic waves

**Official Ans. by NTA (B)**

**Allen Ans. (B)**

11. An electron with energy 0.1 keV moves at right angle to the earth's magnetic field of  $1 \times 10^{-4} \text{ Wbm}^{-2}$ . The frequency of revolution of the electron will be

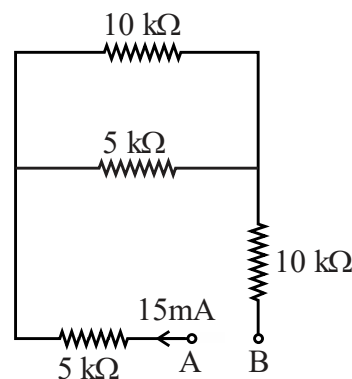
(Take mass of electron =  $9.0 \times 10^{-31} \text{ kg}$ )

(A)  $1.6 \times 10^5 \text{ Hz}$  (B)  $5.6 \times 10^5 \text{ Hz}$   
(C)  $2.8 \times 10^6 \text{ Hz}$  (D)  $1.8 \times 10^6 \text{ Hz}$

**Official Ans. by NTA (C)**

**Allen Ans. (C)**

12. A current of 15 mA flows in the circuit as shown in figure. The value of potential difference between the points A and B will be



(A) 50V (B) 75V  
(C) 150V (D) 275V

**Official Ans. by NTA (D)**

**Allen Ans. (D)**

13. The length of a seconds pendulum at a height  $h = 2R$  from earth surface will be:

(Given:  $R$ =Radius of earth and acceleration due to gravity at the surface of earth  $g = \pi^2 \text{ m/s}^{-2}$ )

(A)  $\frac{2}{9} \text{ m}$  (B)  $\frac{4}{9} \text{ m}$   
(C)  $\frac{8}{9} \text{ m}$  (D)  $\frac{1}{9} \text{ m}$

**Official Ans. by NTA (D)**

**Allen Ans. (D)**

14. Sound travels in a mixture of two moles of helium and  $n$  moles of hydrogen. If rms speed of gas molecules in the mixture is  $\sqrt{2}$  times the speed of sound, then the value of  $n$  will be  
(A) 1 (B) 2  
(C) 3 (D) 4

**Official Ans. by NTA (B)**

**Allen Ans. (B)**

15. Let  $\eta_1$  is the efficiency of an engine at  $T_1 = 447^\circ\text{C}$  and  $T_2 = 147^\circ\text{C}$  while  $\eta_2$  is the efficiency at  $T_1 = 947^\circ\text{C}$  and  $T_2 = 47^\circ\text{C}$ . The ratio  $\frac{\eta_1}{\eta_2}$  will be :

- (A) 0.41 (B) 0.56  
(C) 0.73 (D) 0.70

**Official Ans. by NTA (B)**

**Allen Ans. (B)**

16. An object is taken to a height above the surface of earth at a distance  $\frac{5}{4}R$  from the centre of the earth. Where radius of earth,  $R = 6400$  km. The percentage decrease in the weight of the object will be  
(A) 36% (B) 50%  
(C) 64% (D) 25%

**Official Ans. by NTA (A)**

**Allen Ans. (A)**

17. A bag of sand of mass 9.8 kg is suspended by a rope. A bullet of 200 g travelling with speed  $10\text{ ms}^{-1}$  gets embedded in it, then loss of kinetic energy will be  
(A) 4.9 J (B) 9.8 J  
(C) 14.7 (D) 19.6 J

**Official Ans. by NTA (B)**

**Allen Ans. (B)**

18. A ball is projected from the ground with a speed  $15\text{ ms}^{-1}$  at an angle  $\theta$  with horizontal so that its range and maximum height are equal, then  $\tan \theta$  will be equal to

- (A)  $\frac{1}{4}$  (B)  $\frac{1}{2}$   
(C) 2 (D) 4

**Official Ans. by NTA (D)**

**Allen Ans. (D)**

19. The maximum error in the measurement of resistance, current and time for which current flows in an electrical circuit are 1%, 2% and 3% respectively. The maximum percentage error in the detection of the dissipated heat will be:

- (A) 2 (B) 4  
(C) 6 (D) 8

**Official Ans. by NTA (D)**

**Allen Ans. (D)**

20. Hydrogen atom from excited state comes to the ground by emitting a photon of wavelength  $\lambda$ . The value of principal quantum number 'n' of the excited state will be :  
(R : Rydberg constant)

- (A)  $\sqrt{\frac{\lambda R}{\lambda - 1}}$  (B)  $\sqrt{\frac{\lambda R}{\lambda R - 1}}$   
(C)  $\sqrt{\frac{\lambda}{\lambda R - 1}}$  (D)  $\sqrt{\frac{\lambda R^2}{\lambda R - 1}}$

**Official Ans. by NTA (B)**

**Allen Ans. (B)**

### SECTION-B

1. A particle is moving in a straight line such that its velocity is increasing at  $5\text{ ms}^{-1}$  per meter. The acceleration of the particle is \_\_\_\_\_  $\text{ms}^{-2}$  at a point where its velocity is  $20\text{ ms}^{-1}$ .

**Official Ans. by NTA (100)**

**Allen Ans. (100)**

2. Three identical spheres each of mass  $M$  are placed at the corners of a right angled triangle with mutually perpendicular sides equal to 3 m each. Taking point of intersection of mutually perpendicular sides as origin, the magnitude of position vector of centre of mass of the system will be  $\sqrt{x} m$ . The value of  $x$  is

**Official Ans. by NTA (2)**

**Allen Ans. (2)**

3. A block of ice of mass 120 g at temperature  $0^\circ\text{C}$  is put in 300 gm of water at  $25^\circ\text{C}$ . The xg of ice melts as the temperature of the water reaches  $0^\circ\text{C}$ . The value of x is

[Use: Specific heat capacity of water =  $4200 \text{ J kg}^{-1} \text{ K}^{-1}$ , Latent heat of ice =  $3.5 \times 10^5 \text{ J kg}^{-1}$ ]

**Official Ans. by NTA (90)**

**Allen Ans. (90)**

4.  $\frac{x}{x+4}$  is the ratio of energies of photons produced due to transition of an electron of hydrogen atom from its

(i) third permitted energy level to the second level and

(ii) the highest permitted energy level to the second permitted level.

The value of x will be

**Official Ans. by NTA (5)**

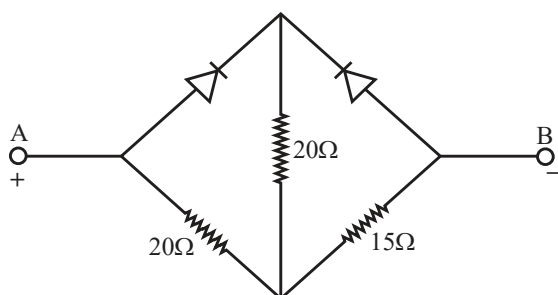
**Allen Ans. (5)**

5. In a potentiometer arrangement, a cell of emf 1.20 V gives a balance point at 36 cm length of wire. This cell is now replaced by another cell of emf 1.80 V. The difference in balancing length of potentiometer wire in above conditions will be \_\_\_\_\_ cm.

**Official Ans. by NTA (18)**

**Allen Ans. (18)**

6. Two ideal diodes are connected in the network as shown in figure. The equivalent resistance between A and B is \_\_\_\_\_  $\Omega$ .



**Official Ans. by NTA (25)**

**Allen Ans. (25)**

7. Two waves executing simple harmonic motion travelling in the same direction with same amplitude and frequency are superimposed. The resultant amplitude is equal to the  $\sqrt{3}$  times of amplitude of individual motions.

The phase difference between the two motions is \_\_\_\_\_ (degree)

**Official Ans. by NTA (60)**

**Allen Ans. (60)**

8. Two parallel plate capacitors of capacity C and 3C are connected in parallel combination and charged to a potential difference 18V. The battery is then disconnected and the space between the plates of the capacitor of capacity C is completely filled with a material of dielectric constant 9. The final potential difference across the combination of capacitors will be \_\_\_\_\_ V

**Official Ans. by NTA (6)**

**Allen Ans. (6)**

9. A convex lens of focal length 20 cm is placed in front of convex mirror with principal axis coinciding each other. The distance between the lens and mirror is 10 cm. A point object is placed on principal axis at a distance of 60 cm from the convex lens. The image formed by combination coincides the object itself. The focal length of the convex mirror is \_\_\_\_\_ cm.

**Official Ans. by NTA (10)**

**Allen Ans. (10)**

10. Magnetic flux (in weber) in a closed circuit of resistance  $20 \Omega$  varies with time t(s) as  $\phi = 8t^2 - 9t + 5$ . The magnitude of the induced current at  $t = 0.25 \text{ s}$  will be \_\_\_\_\_ mA

**Official Ans. by NTA (250)**

**Allen Ans. (250)**