

# FINAL JEE–MAIN EXAMINATION – JUNE, 2022

(Held On Saturday 25<sup>th</sup> June, 2022)

TIME : 9 : 00 AM to 12 : 00 PM

## PHYSICS

### SECTION-A

1. If  $Z = \frac{A^2 B^3}{C^4}$ , then the relative error in Z will be :

(A)  $\frac{\Delta A}{A} + \frac{\Delta B}{B} + \frac{\Delta C}{C}$   
 (B)  $\frac{2\Delta A}{A} + \frac{3\Delta B}{B} - \frac{4\Delta C}{C}$   
 (C)  $\frac{2\Delta A}{A} + \frac{3\Delta B}{B} + \frac{4\Delta C}{C}$   
 (D)  $\frac{\Delta A}{A} + \frac{\Delta B}{B} - \frac{\Delta C}{C}$

Official Ans. by NTA (C)

Allen Ans. (C)

2.  $\vec{A}$  is a vector quantity such that  $|\vec{A}| =$  non-zero constant. Which of the following expressions is true for  $\vec{A}$  ?

(A)  $\vec{A} \cdot \vec{A} = 0$  (B)  $\vec{A} \times \vec{A} < 0$   
 (C)  $\vec{A} \times \vec{A} = 0$  (D)  $\vec{A} \times \vec{A} > 0$

Official Ans. by NTA (C)

Allen Ans. (C)

3. Which of the following relations is true for two unit vectors  $\hat{A}$  and  $\hat{B}$  making an angle  $\theta$  to each other?

(A)  $|\hat{A} + \hat{B}| = |\hat{A} - \hat{B}| \tan \frac{\theta}{2}$   
 (B)  $|\hat{A} - \hat{B}| = |\hat{A} + \hat{B}| \tan \frac{\theta}{2}$   
 (C)  $|\hat{A} + \hat{B}| = |\hat{A} - \hat{B}| \cos \frac{\theta}{2}$   
 (D)  $|\hat{A} - \hat{B}| = |\hat{A} + \hat{B}| \cos \frac{\theta}{2}$

Official Ans. by NTA (B)

Allen Ans. (B)

## TEST PAPER WITH ANSWER

4. If force  $\vec{F} = 3\hat{i} + 4\hat{j} - 2\hat{k}$  acts on a particle having position vector  $2\hat{i} + \hat{j} + 2\hat{k}$  then, the torque about the origin will be :-

(A)  $3\hat{i} + 4\hat{j} - 2\hat{k}$   
 (B)  $-10\hat{i} + 10\hat{j} + 5\hat{k}$   
 (C)  $10\hat{i} + 5\hat{j} - 10\hat{k}$   
 (D)  $10\hat{i} + \hat{j} - 5\hat{k}$

Official Ans. by NTA (B)

Allen Ans. (B)

5. The height of any point P above the surface of earth is equal to diameter of earth. The value of acceleration due to gravity at point P will be : (Given g = acceleration due to gravity at the surface of earth)

(A) g/2 (B) g/4  
 (C) g/3 (D) g/9

Official Ans. by NTA (D)

Allen Ans. (D)

6. The terminal velocity ( $v_t$ ) of the spherical rain drop depends on the radius (r) of the spherical rain drop as:-

(A)  $r^{1/2}$  (B) r  
 (C)  $r^2$  (D)  $r^3$

Official Ans. by NTA (C)

Allen Ans. (C)

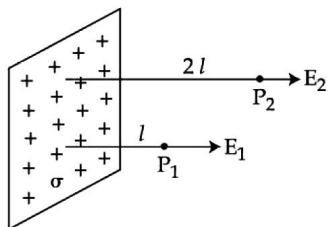
7. The relation between root mean square speed ( $v_{rms}$ ) and most probable speed ( $v_p$ ) for the molar mass M of oxygen gas molecule at the temperature of 300 K will be :-

(A)  $v_{rms} = \sqrt{\frac{2}{3}} v_p$  (B)  $v_{rms} = \sqrt{\frac{3}{2}} v_p$   
 (C)  $v_{rms} = v_p$  (D)  $v_{rms} = \sqrt{\frac{1}{3}} v_p$

Official Ans. by NTA (B)

Allen Ans. (B)

8. In the figure, a very large plane sheet of positive charge is shown.  $P_1$  and  $P_2$  are two points at distance  $l$  and  $2l$  from the charge distribution. If  $\sigma$  is the surface charge density, then the magnitude of electric fields  $E_1$  and  $E_2$  at  $P_1$  and  $P_2$  respectively are :



- (A)  $E_1 = \sigma / \epsilon_0$ ,  $E_2 = \sigma / 2\epsilon_0$   
 (B)  $E_1 = 2\sigma / \epsilon_0$ ,  $E_2 = \sigma / \epsilon_0$   
 (C)  $E_1 = E_2 = \sigma / 2\epsilon_0$   
 (D)  $E_1 = E_2 = \sigma / \epsilon_0$

Official Ans. by NTA (C)

Allen Ans. (C)

9. Match List-I with List-II

List-I	List-II
(A) AC generator	(I) Detects the presence of current in the circuit
(B) Galvanometer	(II) Converts mechanical energy into electrical energy
(C) Transformer	(III) Works on the principle of resonance in AC circuit
(D) Metal detector	(IV) Changes an alternating voltage for smaller or greater value

Choose the **correct answer** from the options given below :-

- (A) (A)–(II), B–(I), (C)–(IV), (D)–(III)  
 (B) (A)–(II), B–(I), (C)–(III), (D)–(IV)  
 (C) (A)–(III), B–(IV), (C)–(II), (D)–(I)  
 (D) (A)–(III), B–(I), (C)–(II), (D)–(IV)

Official Ans. by NTA (A)

Allen Ans. (A)

10. A long straight wire with a circular cross-section having radius  $R$ , is carrying a steady current  $I$ . The current  $I$  is uniformly distributed across this cross-section. Then the variation of magnetic field due to current  $I$  with distance  $r$  ( $r < R$ ) from its centre will be :-

- (A)  $B \propto r^2$  (B)  $B \propto r$   
 (C)  $B \propto \frac{1}{r^2}$  (D)  $B \propto \frac{1}{r}$

Official Ans. by NTA (B)

Allen Ans. (B)

11. If wattless current flows in the AC circuit, then the circuit is

- (A) Purely Resistive circuit  
 (B) Purely Inductive circuit  
 (C) LCR series circuit  
 (D) RC series circuit only

Official Ans. by NTA (B)

Allen Ans. (B)

12. The electric field in an electromagnetic wave is given by  $E = 56.5 \sin \omega(t - x/c) \text{ NC}^{-1}$ . Find the intensity of the wave if it is propagating along  $x$ -axis in the free space. (Given  $\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$ )

- (A)  $5.65 \text{ Wm}^{-2}$  (B)  $4.24 \text{ Wm}^{-2}$   
 (C)  $1.9 \times 10^{-7} \text{ Wm}^{-2}$  (D)  $56.5 \text{ Wm}^{-2}$

Official Ans. by NTA (B)

Allen Ans. (B)

13. The two light beams having intensities  $I$  and  $9I$  interfere to produce a fringe pattern on a screen. The phase difference between the

beams is  $\frac{\pi}{2}$  at point P and  $\pi$  at point Q. Then

the difference between the resultant intensities at P and Q will be :

- (A)  $2I$  (B)  $6I$   
 (C)  $5I$  (D)  $7I$

Official Ans. by NTA (B)

Allen Ans. (B)

14. A light wave travelling linearly in a medium of dielectric constant 4, incident on the horizontal interface separating medium with air. The angle of incidence for which the total intensity of incident wave will be reflected back into the same medium will be (Given : relative permeability of medium  $\mu_r = 1$ )
- (A)  $10^\circ$  (B)  $20^\circ$   
 (C)  $30^\circ$  (D)  $60^\circ$

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

**Allen Ans. (D)**

15. Given below are two statements :-
- Statement I :** Davisson-Germer experiment establishes the wave nature of electrons.
- Statement II :** If electrons have wave nature, they can interfere and show diffraction.
- In the light of the above statements choose the **correct answer** from the options given below:-
- (A) Both **Statement I** and **Statement II** are true  
 (B) Both **Statement I** and **Statement II** are false  
 (C) **Statement I** is true but **Statement II** is false  
 (D) **Statement I** is false but **Statement II** is true

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

**Allen Ans. (A)**

16. The ratio for the speed of the electron in the 3<sup>rd</sup> orbit of  $\text{He}^+$  to the speed of the electron in the 3<sup>rd</sup> orbit of hydrogen atom will be :-
- (A) 1 : 1 (B) 1 : 2  
 (C) 4 : 1 (D) 2 : 1

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

**Allen Ans. (D)**

17. The photodiode is used to detect the optical signals. These diodes are preferably operated in reverse biased mode because.
- (A) fractional change in majority carriers produce higher forward bias current  
 (B) fractional change in majority carriers produce higher reverse bias current  
 (C) fractional change in minority carriers produce higher forward bias current  
 (D) fractional change in minority carriers produce higher reverse bias current

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

**Allen Ans. (D)**

18. A signal of 100 THz frequency can be transmitted with maximum efficiency by :
- (A) Coaxial cable  
 (B) Optical fibre  
 (C) Twisted pair of copper wires  
 (D) Water

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

**Allen Ans. (B)**

19. The difference of speed of light in the two media A and B ( $v_A - v_B$ ) is  $2.6 \times 10^7$  m/s. If the refractive index of medium B is 1.47, then the ratio of refractive index of medium B to medium A is : (Given : speed of light in vacuum  $c = 3 \times 10^8 \text{ ms}^{-1}$ )
- (A) 1.303 (B) 1.318  
 (C) 1.13 (D) 0.12

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

**Allen Ans. (C)**

20. A teacher in his physics laboratory allotted an experiment to determine the resistance (G) of a galvanometer. Students took the observations for  $\frac{1}{3}$  deflection in the galvanometer. Which of the below is **true** for measuring value of G?
- (A)  $\frac{1}{3}$  deflection method cannot be used for determining the resistance of the galvanometer.  
 (B)  $\frac{1}{3}$  deflection method can be used and in this case the G equals to twice the value of shunt resistance(s).  
 (C)  $\frac{1}{3}$  deflection method can be used and in this case, the G equals to three times the value of shunt resistance(s)  
 (D)  $\frac{1}{3}$  deflection method can be used and in this case the G value equals to the shunt resistance(s).

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

**Allen Ans. (B)**

**SECTION-B**

1. A uniform chain of 6 m length is placed on a table such that a part of its length is hanging over the edge of the table. The system is at rest. The co-efficient of static friction between the chain and the surface of the table is 0.5, the maximum length of the chain hanging from the table is \_\_\_\_\_ m.

**Official Ans. by NTA 2**

**Allen Ans. 2**

2. A 0.5 kg block moving at a speed of  $12 \text{ ms}^{-1}$  compresses a spring through a distance 30 cm when its speed is halved. The spring constant of the spring will be \_\_\_\_\_  $\text{Nm}^{-1}$ .

**Official Ans. by NTA 600**

**Allen Ans. 600**

3. The velocity of upper layer of water in a river is  $36 \text{ kmh}^{-1}$ . Shearing stress between horizontal layers of water is  $10^{-3} \text{ Nm}^{-2}$ . Depth of the river is \_\_\_\_\_ m. (Co-efficiency of viscosity of water is  $10^{-2} \text{ Pa.s}$ )

**Official Ans. by NTA 100**

**Allen Ans. 100**

4. A steam engine intakes 50g of steam at  $100^\circ\text{C}$  per minute and cools it down to  $20^\circ\text{C}$ . If latent heat of vaporization of steam is  $540 \text{ cal g}^{-1}$ , then the heat rejected by the steam engine per minute is \_\_\_\_\_  $\times 10^3 \text{ cal}$ .

**Official Ans. by NTA 31**

**Allen Ans. 31**

5. The first overtone frequency of an open organ pipe is equal to the fundamental frequency of a closed organ pipe. If the length of the closed organ pipe is 20 cm. The length of the open organ pipe is \_\_\_\_\_ cm.

**Official Ans. by NTA 80**

**Allen Ans. 80**

6. The equivalent capacitance between points A and B in below shown figure will be \_\_\_\_\_  $\mu\text{F}$ .



**Official Ans. by NTA 6**

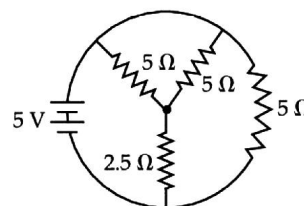
**Allen Ans. 6**

7. A resistor develops 300 J of thermal energy in 15s, when a current of 2A is passed through it. If the current increases to 3A, the energy developed in 10s is \_\_\_\_\_ J.

**Official Ans. by NTA 450**

**Allen Ans. 450**

8. The total current supplied to the circuit as shown in figure by the 5V battery is \_\_\_\_\_ A



**Official Ans. by NTA 2**

**Allen Ans. 2**

9. The current in a coil of self inductance 2.0 H is increasing according to  $I = 2\sin(t^2)\text{A}$ . The amount of energy spent during the period when current changes from 0 to 2A is \_\_\_\_\_ J.

**Official Ans. by NTA 4**

**Allen Ans. 4**

10. A force on an object of mass 100g is  $(10\hat{i} + 5\hat{j}) \text{ N}$ . The position of that object at  $t = 2\text{s}$  is  $(a\hat{i} + b\hat{j}) \text{ m}$  after starting from rest. The value of  $\frac{a}{b}$  will be \_\_\_\_\_

**Official Ans. by NTA 2**

**Allen Ans. 2**