

NARAYANA'S SENSATIONAL SUCCESS ACROSS INDIA

7 Students Secured 100 Percentile in All India JEE Main-2020

BELOW 10
21
RANKS
All Cat

BELOW 100
113
RANKS
All Cat



ADMISSIONS OPEN (2020-21)

OUR REGULAR CLASSROOM PROGRAMME

One Year Classroom Program
JEE/NEET-2021
(for students moving from XI to XII)

Two Year Classroom Program
JEE/NEET-2022
(for students moving from X to XI)

Three Year Integrated Classroom Program
JEE/NEET-2023
(for students moving from IX to X)

Four Year Integrated Classroom Program
JEE/NEET-2024
(for students moving from VIII to IX)

FOUNDATION PROGRAMMES
For NTSE, NSEJS, JSTSE,
Olympiads & School/Board Exams
(for students moving to
Class VI, VII, VIII, IX & X)

APEX BATCH
Two years school Integrated
Classroom Program - 2022
For JEE Main & Advance / NEET (for XI Studying Students)
Course Feature - Complete Coverage of CBSE - Regular Classes - Weekly Test & Regular Analysis - Lab Facility
- Motivation & Counseling - Competitive Exam Prep - Ample time for self study

Online Classes for IIT/NEET/Foundation/Olympiads

- Access Recording of Past Classes on n-Learn App
- Online Parent Teacher Meeting
- Personalized Extra Classes & Live Doubt Solving
- Hybrid/Customized Classroom model
- Video Solution of Weekly/Fortnightly Test
- Printed Study Material will be sent by us
- n-Learn App
- Counselling Motivational sessions
- Affordable Fee
- Doubt Classes / Practice Classes
- Provision to Convert from online to regular classroom programme
- Once Classes resume by just paying nominal fee

Online Test

- Micro & Macro Analysis
- Relative performance (All India Ranking)
- Question wise Analysis
- Unlimited Practice Test
- Grand Test

NARAYANA

Digital
Classes
STUDY ONLINE FROM HOME

For Class
7th to 12th +



JEE-MAIN-2021

MARCH ATTEMPT

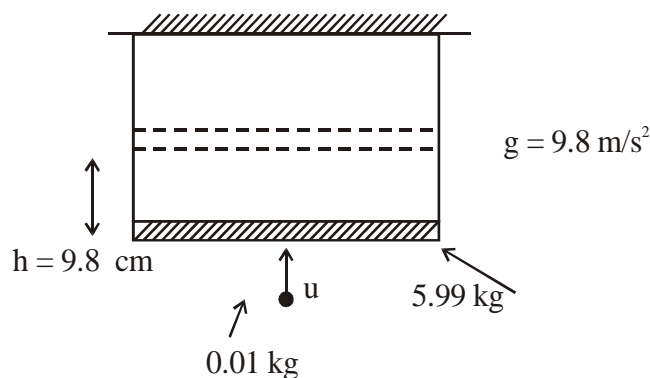
16.03.21_SHIFT - II

PHYSICS

JEE-MAIN 2021 (16 MARCH ATTEMPT) SHIFT-2

PHYSICS

1. A bullet of mass 0.01 kg collides with a stick hanging with string and sticks to it as shown in figure. Stick rises to 9.8 cm. If gravitational acceleration is 9.8 m/s^2 . Find initial velocity of bullet (in m/s).



- (1) $490\sqrt{2} \text{ m/s}$ (2) $588\sqrt{2} \text{ m/s}$ (3) $294\sqrt{2} \text{ m/s}$ (4) $98\sqrt{2} \text{ m/s}$

Ans. (2)

Sol. $P_i = 0.01 \times u + 0 = P_f = 6 \times v$

$$v = \frac{0.01u}{6}$$

using energy conservation

$$\frac{1}{2} \times 6 \times \left(\frac{u}{600} \right)^2 = 6 \times 9.8 \times 9.8 \times 10^{-2}$$

$$u = 6 \times 98 \times \sqrt{2} = 588\sqrt{2} \text{ m/s}$$

2. A particle of mass 2kg is placed at rest at origin. A force $\vec{F} = 2\hat{i} + 3\hat{j} + 5\hat{k}$ is acting on particle. At $t = 4\text{sec}$ the position vector of particle is found to be $8\hat{i} + b\hat{j} + 20\hat{k}$. Find b.

- (1) 12 (2) -6 (3) 2 (4) 10

Ans. (1)

Sol. $\vec{a} = \frac{\vec{F}}{m} = \frac{2\hat{i} + 3\hat{j} + 5\hat{k}}{2}$

$$\vec{r}_f - \vec{r}_i = \vec{u}t + \frac{1}{2}\vec{a}t^2$$

$$(x\hat{i} + y\hat{j} + z\hat{k}) - (0\hat{i} + 0\hat{j} + 0\hat{k}) = \frac{1}{2} \times \left(\frac{2\hat{i} + 3\hat{j} + 5\hat{k}}{2} \right) (4)^2$$

$$x\hat{i} + y\hat{j} + z\hat{k} = 8\hat{i} + 12\hat{j} + 20\hat{k}$$

3. Heat produced in a resistance if 1.5A current is passed through it is 500J in 20 sec. If the current is 3A, the heat produced in the same resistor in the same duration will be :

(1) 500 J (2) 1000 J (3) 1500 J (4) 2000 J

Ans. (4)

Sol. $I^2RT = H$

$$\frac{H_1}{H_2} = \left(\frac{I_1}{I_2} \right)^2$$

$$\Rightarrow H_2 = 500 \times \left(\frac{3}{1.5} \right)^2 = 2000 \text{ J}$$

4. Half life for a radioactive sample is 20 min. Find the time interval in between decaying from 33% to 66 % occurs:

(1) 40 min. (2) 60 min (3) 20 min (4) 10 min

Ans. (3)

Sol. $T_{1/2} = 20 \text{ min} \quad \Rightarrow \frac{\ln 2}{\lambda} = 20 \text{ min}$

$$\Rightarrow \lambda = \frac{\ln 2}{20(\text{min})}$$

$$\because N_t = N_0 e^{-\lambda t}$$

$$\frac{N_t}{N_0} = e^{-\lambda t_1} \quad \Rightarrow 0.67 = e^{-\lambda t_1}$$

$$\Rightarrow \ln(0.67) = -\lambda t_1$$

$$\Rightarrow \ln\left(\frac{100}{67}\right) = \lambda t_1 \Rightarrow t_1 = \frac{\ln\left(\frac{100}{67}\right) \times 20(\text{min})}{(\ln 2)}$$

Similarly $t_2 = \frac{\ln\left(\frac{100}{34}\right) \times 20(\text{min})}{\ln(2)}$

$$t_2 - t_1 = 19.57 \text{ min} \approx 20 \text{ min.}$$

5. In the line of sight communication maximum separation between two antennas is 45 km. Find the height of each antenna assuming they are of same height and radius of earth is 6400 km.

(1) 20.65 m (2) 39.55 m (3) 18.45 m (4) 64.39 m

Ans. (2)

Sol. $D = 2\sqrt{2Rh}$

$$H = \frac{D^2}{8R} = \frac{45^2}{8 \times 6400} \text{ km} = 39.55 \text{ m}$$

6. If the energy required to dissemble particles of earth upto infinite distance is $\frac{xGM_e^2}{5R_e}$

Where M_e = Mass of earth

R_e = Radius of earth

Evaluate x

Ans. 3

Sol. $E = U_f - U_i$

$$E = 0 - \left(\frac{3}{5} \frac{GM_e^2}{R_e} \right) = \frac{3}{5} \frac{GM_e^2}{R_e}$$

So $x = 3$

7. If electron and proton are accelerated by same potential difference 100 V, then find the ratio of their de-Broglie wavelength

$$M_e = 9.1 \times 10^{-31} \text{ kg}$$

$$M_p = 1.6825 \times 10^{-27} \text{ kg}$$

(1) 43

(2) $\frac{1}{43}$

(3) $\frac{40}{1}$

(4) $\frac{1}{40}$

Ans. (1)

Sol. $\lambda_e = \frac{12.27}{\sqrt{V}} \text{ Å}$ $\frac{\lambda_e}{\lambda_p} = \frac{12.27}{0.286} = 43$

$$\lambda_p = \frac{0.286}{\sqrt{V}} \text{ Å}$$

8. Find the magnitude of torque produced by a force $\vec{F} = 4\hat{i} + 3\hat{j} + \hat{k}$ about point (2,3,5).

Ans. 22.44

Sol. $|\vec{\tau}| = |\vec{r} \times \vec{F}|$

$$|\vec{\tau}| = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & 3 & 5 \\ 4 & 3 & 1 \end{vmatrix}$$

$$|\vec{\tau}| = \hat{i}(3-15) - \hat{j}(2-20) + \hat{k}(6-12)$$

$$|\vec{\tau}| = -12\hat{i} + 18\hat{j} - 6\hat{k}$$

$$|\vec{r}| = \sqrt{(-12)^2 + (18)^2 + (-6)^2} = \sqrt{504}$$

$$= 22.44$$

9. A particle moves with a velocity depends on time as

$$\vec{v} = 0.5t^2 \hat{i} + 3t\hat{j} + 9\hat{k}$$

Find the position vector at $t = 2$ sec.

(1) $\tan^{-1}\left(\frac{2}{3}\right)$ with x-axis

(2) $\tan^{-1}(3)$ with y-axis

(2) $\tan^{-1}\left(\frac{1}{3}\right)$ with x-axis

(3) $\tan^{-1}\left(\frac{3}{5}\right)$ with y-axis

Ans. (2)

Sol. $\frac{dx}{dt} = 0.5t^2 \hat{i} + 3t\hat{j} + 9\hat{k}$

$$x = \int_0^2 0.5t^2 \hat{i} dt + \int_0^2 3t \hat{j} dt + \int_0^2 9\hat{k} dt$$

$$x = 0.5 \times \frac{8}{3} \hat{i} + 6\hat{j} + 18\hat{k}$$

Dot product of x with unit vector of y -direction gives angle $\tan^{-1}(3)$ with y -axis

10. In carnot engine temperature of source is 127°C with efficiency 60%. Find out temperature of sink ($^\circ\text{C}$).

(1) 143

(2) -105

(3) -113

(4) 113

Ans. (3)

Sol. $\eta = \left(1 - \frac{T_2}{T_1}\right) = 0.6 = 1 - \frac{T_2}{400}$

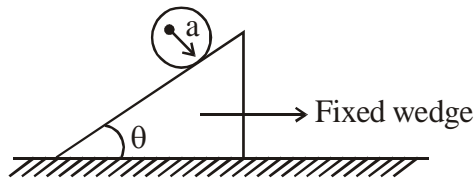
$$\frac{T_2}{400} = 0.4$$

$$T_2 = 160\text{K}$$

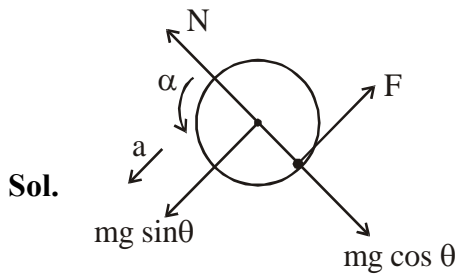
$$T_2 = 160 - 273$$

$$T_2 = -113^\circ\text{C}$$

11. A disc having radius "a" is rising on an inclined plane as shown in figure. If the acceleration of disc is $\frac{2}{b}g\sin\theta$, then find the value of "b" ?



Ans. 3



$$mg \sin \theta - f = ma_{cm} \quad (1)$$

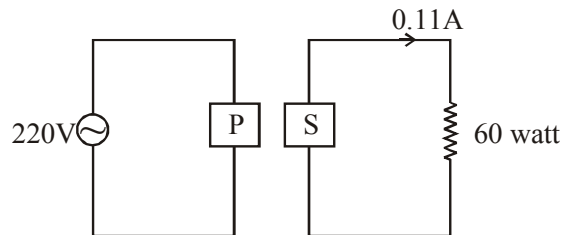
$$f \cdot a = \frac{ma^2}{2} \cdot \alpha \quad (3)$$

$$a_{cm} = \alpha a \quad (4)$$

on solving

$$a_{cm} = \frac{2}{3}g\sin\theta \quad \Rightarrow b = 3$$

12. In a transformer primary voltage is 220V and secondary current is 0.11A with output power 60W.



(1) Transformer is step up.

(2) Transformer is step down

(3) Transformer is auxiliary

(4) None of these

Ans. (1)

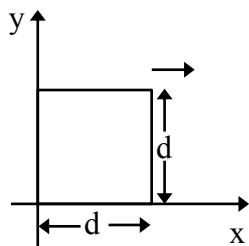
Sol. $P_s = V_s \times I_s$

$$60 = V_s \times 0.11$$

$$V_s = \frac{60}{0.11} = \frac{6000}{11}, V_p = 220 \text{ volt}$$

$V_s > V_p$ so it is step up transformer

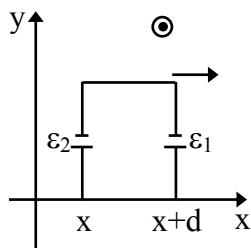
13. A conducting square loop of side length 'd' with its edges parallel to x-axis and y-axis move with velocity $v_0 \hat{i}$ in a region having magnetic field $\vec{B} = \frac{B_0 x}{a} \hat{k}$. Find the induced emf.



- (1) $\frac{Bd^2 v_0}{2a}$ (2) $\frac{Bd^2 v_0}{a}$ (3) $\frac{Bd^2 v_0^2}{2a}$ (4) $\frac{Bd^2 v_0^2}{a}$

Ans. (2)

Sol.



$$\epsilon_1 = \frac{B_0(x+d)}{a} v_0 d$$

$$\epsilon_2 = \frac{B_0 x}{a} v_0 d$$

$$\epsilon_{\text{net}} = \epsilon_1 - \epsilon_2 = \frac{B_0 v_0 d^2}{a}$$

14. Statement-1 \rightarrow A cyclist can move on a horizontal road with speed 7 km/hr in a circle of radius 2 m and coefficient of static friction is 0.2.

Statement-2 \rightarrow maximum speed with which a cyclist can move in a circle on same banked road having inclination of 45° is 18.5 km/hr.

- (1) Statement-1 is true, statement 2 is false
 (2) Statement-1 is true, statement 2 is true
 (3) Statement-1 is false, statement 2 is true
 (4) Statement-1 is false, statement 2 is false

Ans. (2)

Sol. On a horizontal ground,

$$v_{\max} = \sqrt{\mu Rg} = \sqrt{0.2 \times 2 \times 9.8} = 1.97 \text{ m/s}$$

$$1.97 \times \frac{18}{5}$$

$$= 7.12 \text{ km/hr} = 7.2 \text{ km/hr}$$

Statement-2

$$v_{\max} = \sqrt{gr \left(\frac{\tan \theta + \mu}{1 - \mu \tan \theta} \right)} = \sqrt{2 \times 9.8 \times \frac{1.2}{0.8}} = 19.5 \text{ km/hr}$$

$$v_{\min} = \sqrt{rg \left(\frac{\tan \theta - \mu}{1 + \mu \tan \theta} \right)} = \sqrt{2 \times 9.8 \times \frac{0.8}{1.2}} = 13.01 \text{ km/hr}$$

- 15.** A swimmer can swim with speed 12 m/s in still water. Speed of river is 6 m/s. Find the angle at which he should swim with downstream so that he reaches directly opposite point on the other side

- (1) 90° (2) 150° (3) 60° (4) 120°

Ans. (4)

Sol. $\cos \theta = \frac{6}{12} = \frac{1}{2}$

$$\theta = 60^\circ$$

- 16.** In a damped oscillation, damping constant is 20 gm/sec and mass of an object is 500 gm. Find out time when amplitude of oscillation becomes half.

- (1) 34.6 sec. (2) 44.6 sec. (3) 65.1 sec. (4) 55.6 sec.

Ans. (1)

Sol. $A = A_0 e^{-\frac{bt}{2m}}$

$$\frac{bt}{2m} = \ln 2 = 0.693$$

$$t = \frac{2m}{b} \times 0.693$$

$$t = 2 \times \frac{500}{20} \times 0.693$$

$$t = 50 \times 0.693 = 34.6 \text{ sec.}$$

17. Radioactive substance A has half life 54 min and B has half life 18 min. Initially both have same number of nuclei. Find time (min) when A will become 16 times of B.

Ans. 108

Sol. $N_A = N_0$ and $N_B = N_0$ initially

$$N_B = \frac{N_A}{16}$$

$$N_0 e^{-\lambda_2 t} = \frac{N_0}{16} e^{-\lambda_1 t}$$

$$16 = e^{-\lambda_1 t + \lambda_2 t}$$

$$2^4 = e^{(-\lambda_1 + \lambda_2)t}$$

$$\left(\frac{\ln 2}{18} - \frac{\ln 2}{54} \right) t = 4 \ln 2$$

$$T = 27 \times 4 = 108 \text{ min}$$

18. 1.5 miligram of gold (molar mass 198 gram/mole) is undergoing radioactive decay having half life of 2.7 days. Find initial activity of substance.

(1) 366 curie (2) 466 curie (3) 536 curie (4) 636 curie

Ans. (1)

Sol. Initial activity = $A_0 = \lambda N_0$.

$$= \frac{\ln 2}{T_{1/2}} \times \frac{1.5 \times 10^{-3}}{198} \times 6.023 \times 10^{23}$$

$$= \frac{\ln 2}{2.7 \times 3600 \times 24} \times \frac{1.5 \times 10^{-3}}{198} \times \frac{6.023 \times 10^{23}}{3.7 \times 10^{10}} \text{ Ci}$$

$$= 366 \text{ Ci}$$

19. Heat produced per second is 10 m J through a resistor if current 2 mA passes by it. Find its resistance.

Ans. 2500

Sol. $H = i^2 R t$

$$10 \times 10^{-3} = 4 \times 10^{-6} R$$

$$\therefore 10 \times \frac{10^3}{4} = R$$

$$\therefore R = 2500 \Omega$$

20. If converging lens is placed in the same medium, from which lens is made. If Radius of curvature is R_1 and R_2 then focal length of lens will be inside it.

- (1) Infinite (2) Zero (3) 1 (4) $\frac{R_1 R_2}{R_1 - R_2}$

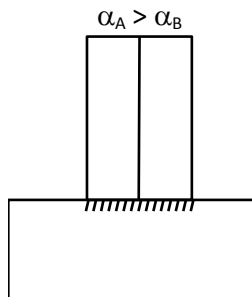
Ans. (1)

Sol. $\frac{1}{f} = \left[\frac{n_2}{n_1} - 1 \right] \left[\frac{1}{R_1} - \frac{1}{R_2} \right]$

$$\frac{1}{f} = 0$$

$f = \text{infinite.}$

21. A thin bimetallic strip is rigidly attached on its bottom surface as shown. Coefficient of linear expansion of strip A is more than strip B. If temperature of system is decreased, find correct option among the following.



- (1) Bends towards left (2) Bends towards right
(3) Neither bends nor shrinks (4) Shrinks but does not bends

Ans. (1)

22. A charge q is moved in magnetic field by distance dl . Find the work done by magnetic field.

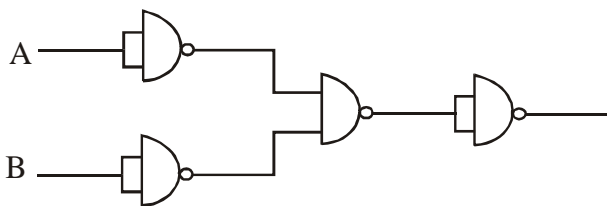
- (1) zero (2) infinity (3) 1 (4) -1

Ans. (1)

Sol. $\vec{F} = q\vec{V} \times \vec{B}$

$$P = \vec{F} \cdot \vec{V} = 0 \quad \Rightarrow \quad W = 0$$

23.



identify the given logic gater

(1) NAND

(2) NOR

(3) OR

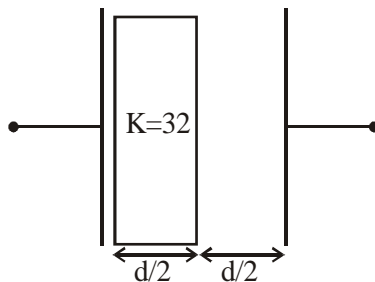
(4) AND

Ans. (2)

Sol. $Y = \overline{\overline{A} \cdot \overline{B}} = \overline{A} \cdot \overline{B}$

So given logic gates circuit is a Nor gate

24. A parallel plate capacitor has area of plates 2m^2 and distance between plates 1m . It is half filled with dielectric of dielectric constant $K = 3.2$ as shown in figure. Its capacitance is _____ ϵ_0 .



Ans. 3.04

Sol. $C_1 = \frac{K\epsilon_0 A}{d/2}; C_2 = \frac{\epsilon_0 A}{d/2}$

$$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} = \frac{d}{2K\epsilon_0 A} + \frac{d}{2\epsilon_0 A}$$

$$\frac{1}{C} = \frac{d}{2\epsilon_0 A} \left(\frac{K+1}{K} \right)$$

$$C = \frac{2\epsilon_0 AK}{d(K+1)} = \frac{2 \times 2 \times 3.2}{1 \times 4.2} \epsilon_0 = 3.04 \epsilon_0$$

25. In a vessel containing an ideal gas the pressure is $1.1 \times 10^5 \text{ pa}$, temperature is 27°c & diameter of molecules is 0.8 nm . Find the mean free path of the molecules if Boltzman constant is 1.38×10^{-23} .
- (1) 13.2 nm (2) 132 nm (3) 32 nm (4) 1.32 nm

Ans. (1)

Sol. $\lambda_{\text{mean}} = \frac{1}{\sqrt{2}\pi d^2 \left(\frac{N}{V}\right)}$ & $PV = NK_B T$

$$\therefore \lambda_{\text{mean}} = \frac{K_B T}{\sqrt{2}\pi d^2 p}$$

$$= \frac{1.38 \times 10^{-23} \times 300}{\sqrt{2} \times 3.14 \times 0.64 \times 10^{-18} \times 1.1 \times 10^5}$$

$$= 132 \times 10^{-10} \text{ m}$$

$$= 132 \text{ \AA}$$

$$13.2 \text{ nm}$$

26. Coming Soon

27. Coming Soon

28. Coming Soon

29. Coming Soon

30. Coming Soon