42 YEARS OF EXCELLENCE

NARAYANA EDUCATIONAL INSTITUTIONS

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

M LIKHITH REDDY	SHIVA KRISHNA	TANUJA	SWAYAM CHUBE	HARSHVARDAHAN AGARWAL	YESHASH CHANDRA	PARTH DWIVEDI
HT No. TL0305724	HT No. TL01330751	HT No. TL01327005	HT No. MR16303069	HT No. HR09300789	HT No. TL02305081	Appl. No. 200310166791
100 PERCENTILE	100 PERCENTILE	100 PERCENTILE	100 PERCENTILE	100 PERCENTILE	100 PERCENTILE	100 PERCENTILE

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 • Competetive Exam Prep. • Ample time for self stuty

❑ 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-Lean 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 +

TOLL FREE : 1800 102 3344 | Visit us at : www.narayanagroup.com

NARAYANA
EDUCATIONAL INSTITUTIONS

42 YEARS OF EXCELLENCE

SRAMAYEVA JAYATHE

THE NARAYANA GROUP

JEE-MAIN-2021

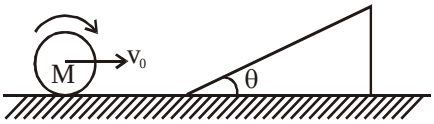
FEBRUARY ATTEMPT

25.02.2021_SHIFT-II

PHYSICS

PHYSICS

1. A solid sphere as shown is rolling without slipping. Find maximum length travelled on an inclined plane?



(1) $\frac{7v^2}{10g\sin\theta}$ (2) $\frac{10v^2}{7g\sin\theta}$ (3) $\frac{5v^2}{7g\sin\theta}$ (4) $\frac{7v^2}{5g\sin\theta}$

Ans. (1)

Sol. $Mg(\ell \sin\theta) = \frac{1}{2}MV_0^2 + \frac{1}{2}\times\frac{2}{5}MV_0^2$

$\therefore Mg\ell\sin\theta = \frac{7}{10}MV^2 \quad \therefore \ell = \frac{7v^2}{10g\sin\theta}$

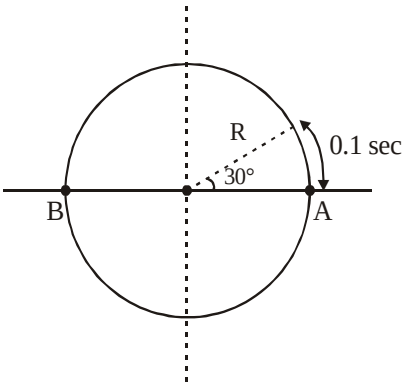
2. In an amplitude modulated wave, message wave frequency f_m and carrier wave frequency f_c. Find out wavelength of amplitude modulated wave.

(1) $\frac{c}{f_c}$ (2) $\frac{c}{f_m}$ (3) $\frac{c}{f_c + f_m}$ (4) $\frac{c}{f_c - f_m}$

Ans. (1)

Sol. Using theory $\lambda = \frac{c}{f_c}$

3. A unit mass particle is moving in a circle of radius R such that its projection on diameter executes SHM. In 0.1 sec interval, particle undergoes angular displacement of 30°. Find force acting on particle at position B. If it starts from A. (R = 0.36m)



(1) 9.7 (2) 0.1 (3) 100 (4) 53.2

Ans. (1)

Sol. Particle is in uniform circular motion.

$$\therefore \quad \omega = \frac{\frac{\pi}{6}}{0.1} = \frac{10\pi}{6} = \frac{5\pi}{3}$$

$$\therefore \quad F = m\omega^2 R = 1 \times \frac{25\pi^2}{9} \times 0.36 = \pi^2$$

4. Sun light is diffracted through a circular aperture of diameter 0.1μm. If diameter is slightly increased then

(1) Size of circular fringe will increase, intensity decrease.

(2) Size of circular fringe will decrease, intensity increase.

(3) Size of circular fringe will increase, intensity increase.

(4) Size of circular fringe will decrease, intensity decrease.

Ans. **(2)**

Sol. $\sin\theta = \frac{1.22\lambda}{D} \Rightarrow$ If D is increased $\Rightarrow$ sin θ decreased

$\therefore$ size of circular fringe will decrease

Intensity will increase.

5. Proton and electron are moving along circular path with same speed. Find out ratio of debroglie wavelength that is $\frac{\lambda_e}{\lambda_p}$. If $m_p = 1836\ m_e$.

(1) 1836 (2) 1837 (3) $\frac{1}{1836}$ (4) $\frac{1}{1837}$

Ans. (1)

Sol. $\lambda = \frac{h}{mv}$

$$\frac{\lambda_e}{\lambda_p} = \frac{m_p}{m_e} = 1836$$

6. Find out dimension of $\frac{1}{4\pi\varepsilon_0}\frac{e^2}{hc}$ where e : electronic charge, ε_0 = permittivity of free space, h : plank constant, c : speed of light

(1) $M^1L^1T^{-2}C^2$ (2) $M^2L^2T^{-3}C^2$ (3) $M^1L^1T^{-2}C^2$ (4) Dimension less

Ans. (4)

Sol. $\frac{1}{4\pi\varepsilon_0}\frac{e^2}{hc} = \frac{Ke^2 \times \lambda^2}{\lambda^2 \times hc} = \frac{F \times \lambda}{E} = \frac{E}{E}$ **:** dimension less

7. In a given AC series circuit containing elements R, L and C & source voltage = 220v, it is known that if L alone is removed or if C alone is removed, phase difference between current & voltage remains 45°. Find i_{RMS} ? (R = 110 Ω)

(1) 2A (2) 2.5A (3) 1A (4) 1.5A

Ans. (1)

Sol. Since ϕ remains same,

circuit is in resonance.

$$\therefore i_{RMS} = \frac{V_{RMS}}{Z} = \frac{220}{110} = \boxed{2A}$$

8. **Statement-1 :** Rotational KE of a gas molecule follows Maxwell's speed distribution curve.

Statement-2 : Rotational KE & translational KE of a diatomic gas molecule is same.

(1) 1-true 2-false (2) 1-false 2-true

(3) 1-false 2-false (4) 1-true 2-true

Ans. **(3)**

Sol. Maxwell's Boltzmann distribution curve is always drawn for no. of molecules (N) vs velocity of molecules. so statement-1 is false.

$$\text{T.K.E. of diatomic molecule} = \frac{3}{2}KT$$

$$\text{R.K.E. of diatomic molecule} = \frac{2}{2}KT$$

Statement-2 is false.

9. If an electron of a hydrogen atom jumps from n = 2 to n = 1 then find the wavelength of released photon.

(1) 121.5 nm (2) 123.15 nm (3) 125.15 nm (4) 128.15 nm

Ans. (1)

Sol. $13.6 \times \left(1-\frac{1}{4}\right) = \frac{1240}{\lambda(nm)}$

$$\lambda = \frac{4\times1240}{13.6\times3}\text{nm} = 121.5 \text{ nm}$$

10. In photoelectric effect of a certain metal the stopping potential is 0.71 V if the wavelength of incident radiation is 491 nm. Now the stopping potential comes out to be 1.43 V if the wavelength of incident radiation is:

(1) 390 nm (2) 382 nm (3) 275 nm (4) 392 nm

Ans. (2)

Sol. $\frac{hc}{\lambda} = \phi + eV_s.$

$\frac{1240}{491} = \phi + 0.71$

$\frac{1240}{\lambda} = \phi + 1.43$

$1240\left(\frac{1}{\lambda} - \frac{1}{491}\right) = 0.72$

$\lambda = 382$ nm

11. Two particles having mass $M_1 = 4$ gm, $M_2 = 16$ gm. If kinetic energy of both the particle is equal then ratio of their momentum is n : 2 then n is:

(1) 2 (2) 1/2 (3) 4 (4) 1/4

Ans. **(2)**

Sol. $K_1 = \frac{P_1^2}{2m_1}$ & $K_2 = \frac{P_2^2}{2m_2}$

$\therefore \frac{K_1}{K_2} = \left(\frac{P_1}{P_2}\right)^2 \times \left(\frac{M_2}{M_1}\right)$

$\therefore \left(\frac{P_1}{P_2}\right)^2 = \frac{M_2}{M_1} \quad \Rightarrow \frac{P_1}{P_2} = \sqrt{\frac{M_2}{M_1}} = \frac{1}{2}.$

12. An electron enters in a capacitor making an angle α with one plane having kinetic energy K_1 and comes out with kinetic energy K_2 making an angle β with other plane. Find ratio of K_1 and K_2

(1) $\frac{\cos^2\beta}{\cos^2\alpha}$ (2) $\frac{\cos^2\alpha}{\cos^2\beta}$ (3) $\frac{\sin^2\alpha}{\sin^2\beta}$ (4) $\frac{\sin^2\beta}{\sin^2\alpha}$

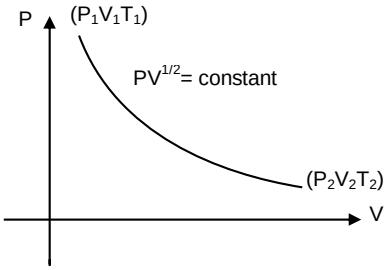
Ans. **(1)**

Sol. $v_1 \cos\alpha = v_2 \cos\beta$

$v_1^2 \cos^2\alpha = v_2^2 \cos^2\beta$

$\frac{K_1}{K_2} = \frac{\cos^2\beta}{\cos^2\alpha}$

13. A gas follows $PV^{1/2}$ = constant as shown. If $V_2 = 2V_1$, find $\frac{T_2}{T_1}$?



(1) $\frac{1}{\sqrt{2}}$ (2) $\sqrt{2}$ (3) $\sqrt{3}$ (4) $\frac{1}{\sqrt{3}}$

Ans. (2)

Sol. $PV^{1/2} = C$

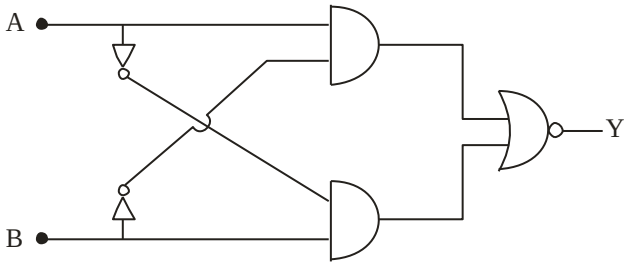
$\therefore TV^{-1/2} = C$

$\therefore \frac{T_1}{\sqrt{V_1}} = \frac{T_2}{\sqrt{V_2}}$

$\therefore \left(\frac{T_2}{T_1}\right)^2 = \frac{V_2}{V_1} = 2$

$\therefore \frac{T_2}{T_1} = \sqrt{2}$

14. For given logic gates circuit, which truth table is right.



(1)

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

(2)

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

(3)

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

(4)

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

Ans. (1)

Sol. $Y = \overline{A\bar{B} + \bar{A}B}$

$Y = \overline{A\bar{B}} \cdot \overline{\bar{A}B}$

$Y = (\bar{A} + B) \cdot (A + \bar{B})$

$Y = \bar{A} \cdot A + \bar{A}\,\bar{B} + A \cdot B + B\bar{B}$

$Y = AB + \bar{A}\,\bar{B}$

15. Match the column I and column II.

Column I	**Column II**
(A) Transformer	(P) AC to DC
(B) Rectifier	(Q) Step up – Step down
(C) Filter	(R) Ripple is removed
(D) Stabiliser	(S) For any input, output would be same

(1) A→Q B→P C→R D→S

(2) A→Q B→P C→S D→R

(3) A→P B→Q C→R D→S

(4) A→P B→Q C→S D→R

Ans. (1)

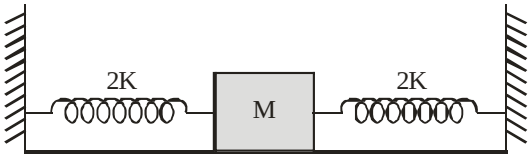
Sol. Transformer → Step up – Step down

Rectifier → AC to DC

Filter → Ripple is removed

Stabiliser → For any input, output would be same

16. Find time period of oscillation of mass M, assume surface to be smooth.



(1) $2\pi\sqrt{\frac{M}{K}}$ (2) $2\pi\sqrt{\frac{M}{4K}}$ (3) $2\pi\sqrt{\frac{2M}{K}}$ (4) $2\pi\sqrt{\frac{3M}{2K}}$

Ans. (2)

Sol. $K_{eff} = 2K + 2K = 4K$

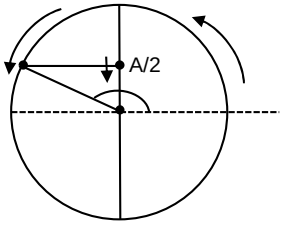
$\therefore \quad T = 2\pi\sqrt{\frac{M}{4K}}$

17. **A** particle starts performing SHM on a smooth horizontal plane and it is released from $x = \frac{A}{2}$ & it's moving in –ve x-direction then ϕ = ?

(1) $\frac{\pi}{6}$ (2) $\frac{5\pi}{6}$ (3) $\frac{2\pi}{3}$ (4) $\frac{\pi}{3}$

Ans. (2)

Sol.



$\phi = \frac{\pi}{2} + \frac{\pi}{3}$

$\phi = \frac{5\pi}{6}$

18. For an extrinsic semiconductor if doping concentration is increases then.

(1) For N type and P-type fermi level will increase if $T > T_f$ (T=temp of semi-conductor, T_f = fermi Temp.)

(2) For N type fermi level will increase and for P type fermi level will decrease.

(3) For N-type fermi level will decrease and for P-type fermi level will increase.

(4) For N-type fermi level will decrease and for P-type fermi level will decrease.

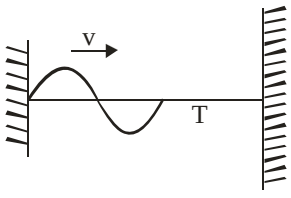
Ans. 2

Sol. The variation of the fermi level obeys two conditions.

→ The mass action law

→ The neutrality equation.

19. If tension is increased by 4% in vibrating string, find % change in speed of wave?



Tension = T

Ans. **2**

Sol. $v = \sqrt{\frac{T}{\mu}}$

$$\therefore \quad \ell nv = \frac{1}{2}\ell nT - \frac{1}{2}\ell n\mu$$

$$\%\frac{dv}{v} = \%\frac{1}{2}\frac{dT}{T}$$

$$\therefore \quad \%\frac{dv}{v} = \frac{1}{2}\times 4 = 2\%$$

20. If $\vec{p}\times\vec{g} = \vec{g}\times\vec{p}$ and angle between $\vec{p}$ & $\vec{g}$ is θ where $\theta \in (0, 360°)$ then value of θ is:

Ans. 180°

Sol. $\vec{p}\times\vec{g} = \vec{g}\times\vec{p}$ only if $\vec{p} = 0$ or $\vec{g} = 0$ or angle between them is 0° or 180°.

$\therefore \theta = 180°$

21. A satellite is projected from surface of earth so that it can attain 10R height from surface of earth. Its speed at surface of earth is $v = V_{escape}\, x\sqrt{\frac{x}{11}}$ find x.

Ans. 10

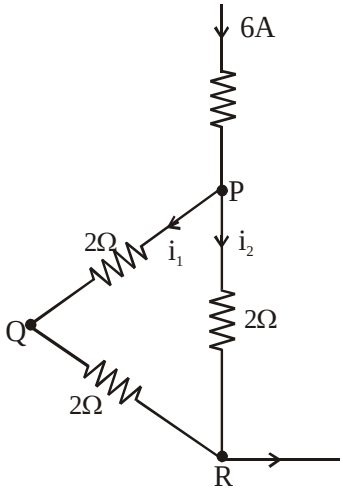
Sol. $$-\frac{GMm}{R} + \frac{1}{2}mv^2 = -\frac{GMm}{11R}$$

$$\frac{1}{2}mv^2 = \frac{10GMm}{11R}$$

$$v = V_{escape}\, x\sqrt{\frac{10}{11}}$$

$x = 10$

22.



Find $i_1 = ?$

Ans. **2 A**

23. For Carnot engine $\frac{W}{Q_{in}}=\frac{1}{4}$. If sink temperature is decreased by 52°C then $\frac{W}{Q_{in}}=\frac{1}{2}$. Find out source temperature in °C.

Ans. **208 °C**

Sol. $\frac{W}{Q_{in}}=\frac{1}{4}=1-\frac{T_2}{T_1}$

$\frac{T_2}{T_1}=\frac{3}{4}$ ...(i)

$\frac{W}{Q_{in}}=\frac{1}{2}=1-\frac{(T_2-52°)}{T_1}$

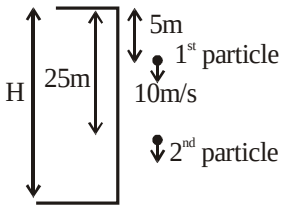
$\frac{T_1}{2}=T_2-\frac{3}{4}T_1+52°$

$T_1=208\ °C$

24. A particle is dropped from the top of a tower. When it has travelled a distance of 5m, another particle is dropped from a distance of 25m below the top of tower. If both of them reach the bottom of tower simultaneously, then find the height of tower.

Ans. **45 m**

Sol. At the instant 2nd particle is dropped 1st particle is moving at 10 m/s & has moved for time 1s.



Time for particles to meet, $\Delta t=\frac{S_{rel}}{V_{rel}}=\frac{20}{10}=2s$

$\therefore$ Time taken by first particle to reach ground = 3s

$H=\frac{1}{2}g(3)^2=45m$

25. For a x-ray if it's wavelength is 10A° & mass of a particle having same energy and same wavelength as x-ray is $\frac{xh}{3}$ where h is plank's constant then value of x is:

Ans. **5**

Sol. $\frac{hc}{\lambda}=\frac{1}{2}mv^2$

$$\frac{hc}{\lambda} = \frac{m^2v^2}{2m}$$

$$\frac{hc}{\lambda} = \frac{h^2}{\lambda^2(2m)}$$

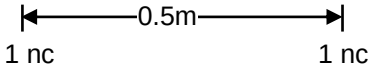
$$m = \frac{h}{2c\lambda} = \frac{h}{2(3\times10^{8})(10\times10^{-10})}$$

$$m = \frac{5h}{3}$$

26. Two conducting charge particles of negligible volume whose charges are 2.1 nc and –0.1 nc respectively are brought in contact and then separated by 0.5 m. If force of interaction between them is $x \times (10^{-9})N$ then x is :-

Ans. 36

Sol.



$$F = \frac{K(1\times10^{-9})(1\times10^{-9})}{(0.5)^2} = 36 \times 10^{-9}N$$

$$x = 36$$

27. Coming soon.

Ans.

Sol.

28. Coming soon.

Ans.

Sol.

29. Coming soon.

Ans.

Sol.

30. Coming soon.

Ans.

Sol.