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

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

JEE-MAIN-2021

FEBRUARY ATTEMPT

26.02.21_SHIFT-I

PHYSICS

1. Work done by force is $W = \alpha^2\beta e^{-\frac{\beta x^2}{KT}}$, where x-distance, K = Boltzmann's constant and T is temperature. The dimension of α is

a) $\alpha = M^1L^2T^{-1}$ *b) $M^0L^1T^0$ c) $M^0L^1T^{-2}$ d) $M^2L^1T^{-2}$

sol: $\frac{\beta x^2}{KT}$ is dimension less so $KT = \beta x^2 \Rightarrow M^1L^2T^{-2} = \beta L^2$

$\beta = M^1T^{-2}$

$w = \alpha^2 \times \beta$

$M^1L^2T^{-2} = \alpha^2 \times M^1T^{-2}$

$\alpha = L$

2. Statement-1: Resolving power of electron microscope is greater than optical microscope.

Statement-2: de-Broglie wave length of electron is very less than visible light.

a) Statement (1) is correct, statement (2) is correct but not correct explanation.

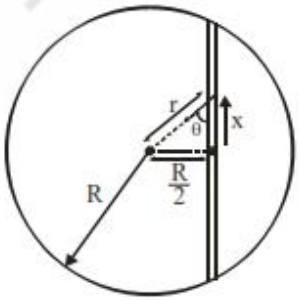
*b) Statement (1) is correct, statement (2) is correct and it is correct explanation.

c) Statement (1) is correct, statement (2) is wrong.

d) Statement (1) is wrong and statement (2) is also wrong.

Sol: The wave length of wave associated with e^{-1} is less that of visible light. Therefore the resolving power of an electron microscope is higher than that of an optical microscope.

3. A tunnel is dug along the chord at a distance $\frac{R}{2}$ from centre of earth as shown. If particle is released in tunnel, find its time period?



a) $2\pi\sqrt{\frac{R}{2g}}$ *b) $2\pi\sqrt{\frac{R}{g}}$ c) $\pi\sqrt{\frac{R}{2g}}$ d) $4\pi\sqrt{\frac{R}{g}}$

sol: If displaced from equilibrium position.

$$F_{\text{res towards equilibrium}} = \left(\frac{GMmr}{R^3}\right)\cos\theta$$

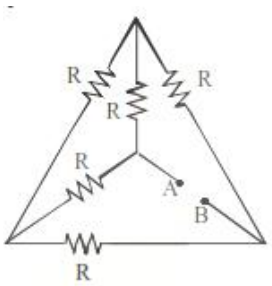
$$= \frac{GMmr}{R^3}.\frac{x}{r}$$

$$= \left(\frac{GMmr}{R^3}\right)x$$

$$= \left(\frac{gm}{R}\right)x$$

$$\therefore\ T = 2\pi\sqrt{\frac{m}{\frac{mg}{R}}} = 2\pi\sqrt{\frac{R}{g}}$$

4. Find out equivalent resistance between AB.



a) 3R b) $\frac{R}{2}$ c) 2R *d) R

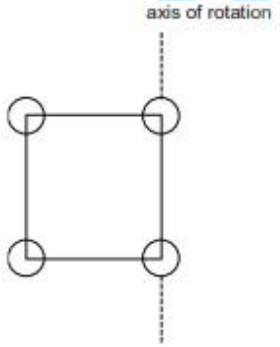
sol: It is balanced wheat stone bridge so

$R_{AB} = R$

5. Four identical solid spheres of mass m and radius a are placed on four corner of square of side b. find out moment of inertia about any one side.

*a) $\frac{8}{5}ma^2 + 2mb^2$ b) $\frac{8}{3}ma^2 + 2mb^2$ c) $\frac{5}{3}ma^2 + mb^2$ d) $\frac{8}{5}ma^2 + mb^2$

Sol:



$$I = 2 \times \frac{2}{5}ma^2 + 2\left[\frac{2}{5}ma^2 + mb^2\right]$$

$$I = \frac{4}{5}ma^2 + \frac{4}{5}ma^2 + 2mb^2$$

$$= \frac{8}{5}ma^2 + 2mb^2$$

6. A sphere and ring are separated by $\sqrt{8}R$ distance. Find force between them?

a) $\frac{GMm}{R^2}\left(\frac{2}{27}\right)$ b) $\frac{GMm}{R^2}\left(\frac{\sqrt{8}}{3}\right)$ *c)n $\frac{GMm}{R^2}\left(\frac{\sqrt{8}}{27}\right)$ d) $\frac{GMm}{R^2}\left(\frac{\sqrt{6}}{27}\right)$

sol: $F=\frac{GMm\sqrt{8}R}{(R^2+8R^2)^{3/2}}$

$=\frac{GMm}{R^2}\times\frac{\sqrt{8}}{27}$

7. In a spherical mirror height of an object is 100 cm and height of an image is 25 cm and their orientations are same then

a) image real, convex mirror b) images real, concave mirror

c) image virtual, concave mirror *d) image virtual, convex mirror

sol: same orientation so image is virtual. It is combination or real object and virtual image using it is possible only from convex mirror.

8. In YDSE experiment separations between plane of slits and screen is 1 m. separation between slits is 2 mm. the wavelength of light is 500 nm. The wavelength of light is 500 nm. The fringe width is

*a) 0.25 mm b) 0.2 mm c) 0.30 mm d) 0.40 mm

Sol: $\beta=\frac{\lambda D}{d}=\frac{500\times10^{-9}\times1}{2\times20^{-3}}$

$=2.5\times10^{-4}=0.25\text{ mm}$

9. In a gas LED separation between valance band and conduction band is 1.9 eV. Then the light emitted is:

a) 1024 nm, Red b) 1024 nm, Orange

*c) 654 nm, Orange d) 654 nm, Red

Sol: $\gamma=\frac{1242}{1.9}\text{nm}=654\,\text{nm, orange}.$

10. A particle is moving in circle with uniform speed under the action of central force F which is inversely proportional to radius as $F \propto \frac{1}{r^3}$. Period of revolution is proportional to.

a) $T \propto \frac{1}{r^2}$ *b) $T \propto r^2$ c) $T \propto r$ d) $T \propto \frac{1}{r}$

sol: $F = \frac{C}{r^3} = m\omega^2 r$

$\therefore \omega^2 \propto \frac{1}{r^4}$

$\therefore \omega \propto \frac{1}{r^2}$

$\therefore T \propto r^2$

11. Large numbers of small drops of radius r combine and form bigger drop of radius R. if mechanical equivalent of heat is J. Then heat released per unit volume. If surface tension is T.

*a) $\frac{3T}{J}\left(\frac{1}{r}-\frac{1}{R}\right)$ b) $\frac{3T}{J}\left(\frac{1}{r^2}-\frac{1}{R^2}\right)$ c) $\frac{T}{J}\left(\frac{1}{r^2}-\frac{1}{R^2}\right)$ d) $\frac{T}{J}\left(\frac{1}{r}-\frac{1}{R}\right)$

Sol: $n\frac{4}{3}\pi r^3 - \frac{4}{3}\pi R^3$

$\left(n^{1/3}\right)r = R$

Δu loss

= T (change in surface area)

$= T(n4\pi r^2 - 4\pi R^2)$

$= T4\pi(nr^2 - R^2)$

$$\Delta U = 4\pi T\left[\left(\frac{R}{r}\right)^3 r^2 - R^2\right]$$

$$\Delta U = 4\pi T\frac{\left[\frac{R^3}{r} - R^2\right]}{J}$$

$$\frac{\Delta U}{V} = \frac{4\pi T\left[\frac{R^3}{r} - R^2\right]}{J \times \frac{4}{3}\pi R^3} = \frac{3T}{J}\left[\frac{1}{r} - \frac{1}{R}\right]$$

12. The current flowing in a wire is given as $I = I_1 \sin\omega t + I_2 \cos\omega t$. Find the rms value of current?

*a) $\frac{\left(I_1^2 + I_2^2\right)^{1/2}}{\sqrt{2}}$ b) $\frac{\left(I_1^2 + I_2^2\right)^{1/2}}{2}$ c) $\frac{\left(I_1^2 - I_2^2\right)^{1/2}}{\sqrt{2}}$ d) $\frac{\left(I_1^2 - I_2^2\right)^{1/2}}{2}$

Sol: $I = \sqrt{I_1^2 + I_2^2 + 2I_1I_2\cos 90°}$

$I_0 = \sqrt{I_1^2 + I^2}$

$$I_{rms} = \frac{I_0}{\sqrt{2}}$$

$$= \sqrt{\frac{I_1^2 + I_2^2}{2}}$$

13. A planet is revolving about sun in an elliptical orbit. Choose the correct option based on the statements given below.

(i) Areal velocity is constant.

(ii) Areal velocity is proportional to velocity.

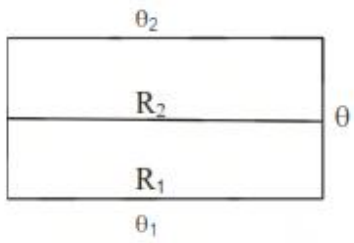
(iii) When planet is nearest to sun it's speed is maximum.

(iv) Planet will move with constant speed.

(v) Areal velocity is inversely proportional to velocity.

*a) (i) is correct b) (ii) is correct c) (iv) is correct d) (v) is correct

14. Two rod of thermal resistance R_1 and R_2 are connected as shown. Temp θ_1 and θ_2 are given. Find common temp θ of two connecting rod.



a) $\frac{\theta_1 R_2 - \theta_2 R_1}{R_1 + R_2}$ b) $\frac{R_1\theta_1 - R_2\theta_2}{R_1 + R_2}$ c) $\frac{\theta_1 R_2 - \theta_2 R_1}{R_1 - R_2}$ *d) $\frac{\theta_1 R_2 + \theta_2 R_1}{R_1 - R_2}$

sol; $\frac{\theta_2 - \theta}{R_2} = \frac{\theta - \theta_1}{R_1}$

$\theta_2 R_1 - \theta R_1 = \theta R_2 - \theta_1 R_2$

$\theta[R_1 + R_2] = \theta_1 R_2 + \theta_2 R_1$

$\theta = \frac{\theta_1 R_2 + \theta_2 R_1}{R_1 + R_2}$

15. If λ_1 represents wavelength of 3rd line of Lyman series and λ_2 represents, wave length of 1st line of paschen series in hydrogen spectrum. Find the ratio of $\frac{\lambda_1}{\lambda_2}$.

*a) $\frac{7}{135}$ b) $\frac{5}{133}$ c) $\frac{6}{135}$ d) $\frac{9}{135}$

Sol: $\frac{1}{\lambda_1} = R\left[1 - \frac{1}{(4)^2}\right]$, Lyman,

$\frac{1}{\lambda_2} = R\left[\frac{1}{9} - \frac{1}{(4)^2}\right]$, Parchen

$$\frac{\lambda_1}{\lambda_2} = \frac{\left(\frac{1}{9} - \frac{1}{16}\right)}{\left(1 - \frac{1}{16}\right)} = \frac{\frac{7}{9\times16}}{\frac{15}{16}}$$

$$\frac{\lambda_1}{\lambda_2} = \frac{7}{9\times15} = \frac{7}{135}$$

16. Object of mass M (M >> m) moving with velocity u collides with the object of mass m, which is at rest consider following statements.

Statement (1) : After collision maximum velocity of object of mass m will be 2u

Statement (2) : In elastic collision kinetic energy and momentum both tare conserved.

a) Statement (1) is correct, statement (2) is correct but not correct explanation.

*b) Statement (1) is correct, statement (2) is correct and it is correct explanation.

c) Statement (1) is correct, statement (2) is wrong.

d) Statement (1) is wrong and , statement (2) is also wrong.

17. A uniform line charge of length l and change Q is given as shown in figure. Find out electric field at point O (symmetrically arranged)

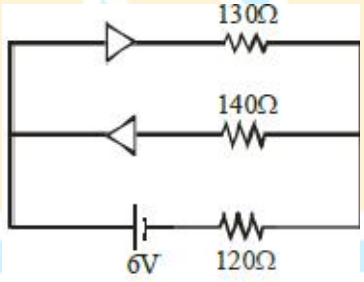
*a) $\frac{Q}{2\sqrt{3}\pi\varepsilon_0 l^2}$ b) $\frac{Q}{\sqrt{3}\pi\varepsilon_0 l^2}$ c) $\frac{Q}{2\sqrt{2}\pi\varepsilon_0 l^2}$ d) $\frac{Q}{\sqrt{2}\pi\varepsilon_0 l^2}$

sol: $E = \frac{K\lambda}{r}(\sin\theta_1 + \sin\theta_2)$

$\theta_1 + \theta_2 = 30^0, r = \frac{\sqrt{3}l}{2}, \lambda = \frac{Q}{l}$

$$E = \frac{1}{4\pi\varepsilon_0}\frac{\frac{Q}{l}\left(\frac{1}{2}+\frac{1}{2}\right)}{\frac{\sqrt{3}l}{2}} = \frac{Q}{2\sqrt{3}\pi\varepsilon_0 l^2}$$

18. Two diodes are shown in figure in forward biasing resistance of diodes is 50Ω and in reverse biasing it is infinite. Find the current flowing through 120Ω ?



*a) 20 mA b) 25 mA c) 32 mA d) 16 mA

sol; $i = \frac{6}{300} = \frac{1}{50}A$

$= \frac{1000}{50}mA$

= 20 mA

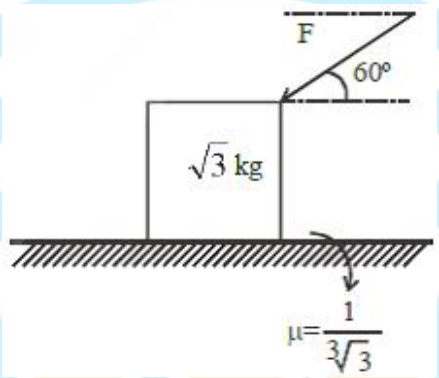
19. A 2kg object is placed on a frictionless surface (In x-y plane). If force acting on the object is $\vec{F} = 20\hat{i} + 10\hat{j}\,N$. Find out displacement along x-axis in first 10 sec.

*a) 500 m b) 300 m c) 400 m d) 200 m

Sol: $a_x = \frac{20}{2} = 10\,m/s^2$

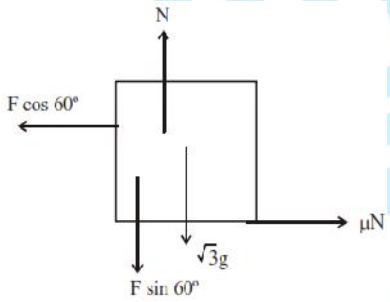
$x = 0 + \frac{1}{2} \times 10 \times 10^2 = 5000\,m$

20. If limiting value of force for block just to slide is 3x then write the value of x.



Ans: 3

Sol:



$F\cos 60^0 = \mu\left(\sqrt{3}g + F\sin 60^0\right)$

$\therefore \frac{F}{2} = \mu\left(\sqrt{3}g + \frac{\sqrt{3}F}{2}\right)$

$\therefore \frac{F}{2} = \frac{\sqrt{3}g}{3\sqrt{3}} + \frac{F}{6}$

$$\therefore \frac{F}{3}=\frac{\sqrt{3}g}{3\sqrt{3}}$$

$$\therefore F=g=10$$

$$3x=10$$

$$x=\frac{10}{3}=3.33$$

21. In a series L-C-R circuit, At resonance quality factor is 100. Now value of self inductance L is doubled and resistance is decreases two fold then find new value of quality factor.

Ans: 283

sol: $$Q=\frac{x_L}{R}=\frac{wL}{R}=\frac{1}{\sqrt{LC}}\times\frac{L}{R}=\frac{\sqrt{L}}{R\sqrt{C}}$$

$$Q^1=\frac{\sqrt{2L}.2}{\sqrt{C}R}=2\sqrt{2}Q$$

$$Q^1=2\sqrt{2}(100)=282.2=283$$

22. There are two capacitor C_1 and C_2 if $C_2>C_1$ when they are connected in parallel the equivalent capacitance is $\frac{15}{4}$ times the equivalent capacitance when connected in series. Find C_2/C_1 ?

Ans: Bonus

sol; $$C_1+C_2=\frac{15}{4}\left(\frac{C_1C_2}{C_1+C_2}\right)$$

$$4(C_1+C_2)^2=15C_1C_2$$

$$4C_1^2+4C_2^2-17C_1C_2=0$$

$$4+4\left(\frac{C_2}{C_1}\right)^2-7\frac{C_2}{C_1}=0$$

$$4\left(\frac{C_2}{C_1}\right)^2 - 7\frac{C_2}{C_1} + 4 = 0$$

$\frac{C_2}{C_1}$ has not real value

$\frac{C_2}{C_1} = \text{Imagianry}$

23. The maximum and minimum amplitude of modulated wave is 16 V and 8 V respectively. The modulation index is $x \times 10^{-2}$. Find value of x.

Ans: 33

sol; $u = \frac{A_{max} - A_{min}}{A_{max} - A_{min}}$

$= \frac{16-8}{16+8} = \frac{8}{24} = \frac{1}{3}$

$= 0.33 = 33 \times 10^{-2}$

x = 33

24. A 1000 W bulb has optical efficiency 1.2 %. Find the amplitude (V/m) of electric field at distance 2m from bulb ?

Ans: 13

sol: $I = \frac{1}{2}(\varepsilon_0 c)E_0^2 = \frac{\text{Power}}{4\pi(2)^2}$

$\therefore \frac{1}{2} \times (4\pi\varepsilon_0) c E_0^2 = \frac{1000 \times 1.2}{4} \times \frac{1}{100}$

$\therefore \frac{1}{2} \times \frac{3 \times 10^8}{9 \times 10^9} \times E_0^2 = 3$

$\therefore E_0^2 = 180$

25. Displacement equation of string wave is given by y =A $\sin(x+30t)$. Mass per unit length of wire is 0.325 gm/cm. Find tension (in N) in string.

Ans: 29 N

sol: $V=\frac{\omega}{K}=30\,m/s$

$V=\sqrt{\frac{T}{\mu}}$

$T=v^2\times u=\frac{(30)^2(0.325)\times10^{-3}}{10^{-2}}$

$=900\times3.25\times10^{-2}$

$T=29.25\,N$

26. 20 coulomb charge flows through 15 volt battery in a certain interval. Find work done (in J) by the battery ?

Ans: 300

sol: $\omega=QV$

$=15\times20=300\,Joule$

27. A non-conducting container is divided into two parts of volume 4.5. Litre and 5.5 Litre, pressure 2 atmosphere and 3 atmosphere, number of moles 3 and 4. If partition valve is opened then find out common pressure (in atmosphere) (In both parts ideal gases are identical)

Ans: 2.55

sol: using energy conservation

$\frac{f}{2}\times2\times4.5+\frac{f}{2}3\times5.5=\frac{f}{2}\times P\times10$

$2\times\frac{9}{2}+3\times\frac{11}{2}=P\times10$

$\frac{18}{2}+\frac{33}{2}=P\times10$

$$P = \frac{51}{20}$$

P = 2.55 atmosphere

28. When a man holding spring balance in stationary lift then it's reading is 60 kg. Now if lift starts descends with constant acceleration 1.8 m/s^2 then what is the new reading of spring balancing in newton. (Take g = 10 m/s^2)

Ans: 492

sol; $mg - T = ma$

$T = m(g - a)$

$= 60[10 - 1.8]$

$= 60 \times 8.2$

$= 492\ N$