# Target IIT-JAM-2018

## Test Series-2

**Booklet Code: B**

## Mechanics + Oscillations, Waves & Optics

**Duration: 2:30 Hours** | **PHYSICS-PH** | **Date: 06-01-2018**

**Maximum Marks: 100**

### Read the following instructions carefully:

1 Attempt all the questions.

2. **Section-A** contains **30** Multiple Choice Questions (MCQ). Each question has 4 choices (a), (b), (c) and (d), for its answer, out of which **ONLY ONE** is correct. From **Q.1 to Q.10** carries 1 Marks and **Q.11 to Q.3**0 carries 2 Marks each.

3. **Section-B** contains **10** Multiple Select Questions(MSQ). Each question has 4 choices (a), (b), (c) and (d) for its answer, out of which **ONE or MORE than ONE** is/are correct. For each correct answer you will be awarded **2 marks.**

4. Section-**C** contains **20** Numerical Answer Type (NAT) questions. From **Q.41 to Q.50** carries **1 Mark** each and **Q.51 to Q.60** carries **2 Marks** each. For each NAT type question, the value of answer in between 0 to 9.

5. In all sections, questions not attempted will result in zero mark. In Section–A (MCQ), wrong answer will result in negative marks. For all **1 mark** questions, **1/3 marks** will be deducted for each wrong answer. For all **2 marks** questions, **2/3 marks** will be deducted for each wrong answer. In Section–B (MSQ),there is no negative and no partial marking provision. There is no negative marking in Section –C (NAT) as well.



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## Section-A : Multiple Choice Questions (MCQ)

**Q.1 to Q.10: Carry 1 Mark each.**

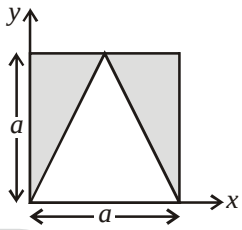
1. A particle moving under central force has mass $m$, energy $E$ and angular momentum $L$. If $r = r_0$ be turning point then speed of the particle at this point is

(a) $\sqrt{\frac{2E}{m}}$ (b) $\frac{L}{mr_0}$ (c) $\sqrt{\frac{2}{m}\left(E - \frac{L^2}{mr_0^2}\right)}$ (d) $\sqrt{\frac{2}{m}\left(E + \frac{L^2}{mr_0^2}\right)}$

2. A particle of mass $m$ moving in circular orbit under a central force $f = -Kr^3$, has angular momentum L. If radius of circular orbit is doubled then its angular momentum will become

(a) 2L (b) 4L (c) 8L (d) $2^{3/2}$ L

3. From a uniform square plate of side '$a$' a triangle is removed as shown in the figure, coordinate of center of mass of remaining portion with respect to given origin is




(a) $\frac{a}{3}, \frac{a}{3}$ (b) $\frac{a}{2}, \frac{2a}{3}$

(c) $\frac{a}{3}, \frac{2a}{3}$ (d) $\frac{a}{2}, \frac{a}{3}$

4. A body of mass $m = 10^{-2}$ kg is moving in a medium and experiences a frictional force $F = -kv^2$. Its initial speed is $v_0 = 10$ ms$^{-1}$. If, after 10 s, its energy is $\frac{1}{8}mv_0^2$, the value of $k$ will be

(a) $10^{-3}$ kgs$^{-1}$ (b) $10^{-4}$ kgm$^{-1}$ (c) $10^{-1}$ kgm$^{-1}$s$^{-1}$ (d) $10^{-3}$ kgm$^{-1}$

5. A particle of mass $m$ is given a speed $v_0$ at $t = 0$. As it moves a drag force kV acts on it, where $k$ is constant and $v$ is instantaneous speed. If $x$ and $a$ be instantaneous position and acceleration of the particle respectively, then

(a) $a = \frac{k^2 x}{m^2}$ (b) $a = -\frac{k^2 x}{m^2} - \frac{k v_0}{m}$ (c) $a = -\frac{k^2 x}{m^2} + \frac{k v_0}{m^2}$ (d) $a = \frac{k^2 x}{m^2} - \frac{k v_0}{m}$

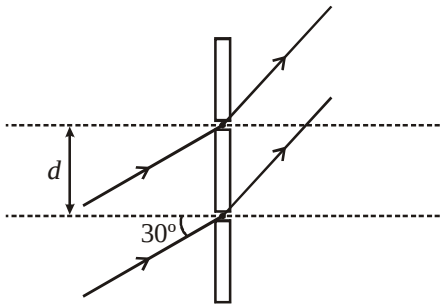
6. Suppose you observe fifteen bright fringes in the of a double-slit pattern. If you know that the separation of the slits $d = 10$ mm, you can conclude that the width of each slit is

(a) 0.63 mm (b) 1.25 mm (c) 1.68 mm (d) 1.38 mm

7. Suppose you are walking in night on a Delhi road. The headlights of an oncoming car are 1.2 m apart. What is the maximum distance from the car at which you can see the headlight as two sources of light if the diameter of the pupil of your eye is 5.0 mm and the wavelength of the light is 555 nm?

(a) 8.9 km (b) 22 km (c) 4.4 km (d) 5.4 km

8. A beam of sodium light of wavelength 589 nm is incident on a diffraction grating as shown in figure. If the second order diffraction maximum is observed at 50.25 degrees to the normal, then calculate the number of lines per cm of the grating is

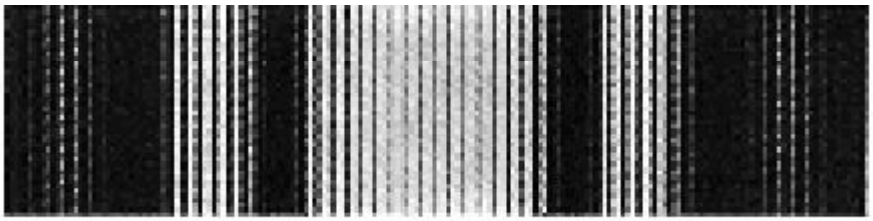



(a) $2.28 \times 10^3$ cm$^{-1}$ (b) $1.53 \times 10^5$ cm$^{-1}$ (c) $6.53 \times 10^3$ cm$^{-1}$ (d) $1.31 \times 10^5$ cm$^{-1}$

9. Light of wavelength 500 nm illuminates parallel slits and produces an interference pattern on a screen that is 1m from the slits. In terms of the initial intensity $I_0$, the light's intensity in the interference pattern at a point for which the path difference is 100 nm is

(a) 2.62 $I_0$ (b) 2.87 $I_0$ (c) 3.08 $I_0$ (d) 3.31 $I_0$

10. The fringes are the result of



(a) diffraction from a single slit.
(b) interference from a double slit in addition to diffraction from the two slits.
(c) interference from three slits.
(d) None of the above.

**Q.11 to Q.30: Carry 2 Marks each.**

11. A planet of mass *m* revolves around the sun of mass M (assumed to be at rest) in elliptical orbit of semi-major axis '*a*'. Maximum and minimum speed of planet in its orbit are $v_1$ and $v_2$ respectively. Angular momentum of planet about centre of force is

(a) $\frac{mv_1v_2a}{v_1+v_2}$ (b) $\frac{2mv_1v_2a}{v_1+v_2}$ (c) $2m(v_1+v_2)a$ (d) $2m\sqrt{v_1v_2}a$

12. Two particles of masses *m* and 2*m* are connected by light spring of spring constant K. $x_1$ and $x_2$ denote the coordinates of *m* and 2*m* respectively. If at $t=0$, $x_1=0$, $x_2=A$, then which of the following is correct

(a) $x_1=A\sin\left(\sqrt{\frac{3K}{2m}}t\right)$, $x_2=A\cos\left(\sqrt{\frac{3K}{2m}}t\right)$ (b) $|x_2-x_1|=A\cos\left(\sqrt{\frac{3K}{2m}}t\right)$

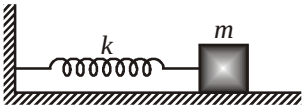
(c) $|x_2-x_1|=A\cos\left(\sqrt{\frac{K}{m}}t\right)$ (d) $|x_2-x_1|=A\cos\left(\sqrt{\frac{3K}{m}}t\right)$

13. A particle of unit mass is released at $x=1$ in one dimensional potential $V(x)=x^3-x$. Which one of the following statements is not correct

(a) Particle will come to rest at $x=0$ (b) Particle's speed is maximum at $x=\frac{1}{\sqrt{3}}$

(c) Speed of the particle at $x=\frac{1}{2}$ is $\frac{\sqrt{3}}{2}$ (d) Particle will not return to $x=1$

14. A block of mass *m* is connected to a spring of force constant *k* and placed on a rough horizontal surface as shown in the figure. Coefficient of friction between ground and block is μ. When constant force *F* is applied parallel to spring the block moves a distance '*x*' before coming to rest speed of particle at *x*/2 is




(a) $\frac{F+\mu mg}{2\sqrt{km}}$ (b) $\frac{F-\mu mg}{\sqrt{km}}$ (c) $\frac{F-\mu mg}{2\sqrt{km}}$ (d) $\frac{F-\mu mg}{4\sqrt{km}}$

15. A thin rod of mass '*m*' is suspended from one end about which it is free to rotate. It is held in horizontal position and released. Force applied by the rod on the hinge at the instant it passes through lowest position is

(a) $mg$ (b) $\frac{3mg}{2}$ (c) $\frac{5mg}{2}$ (d) $3mg$

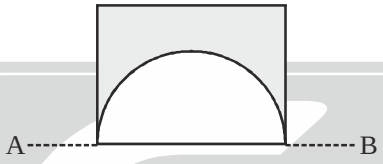
16. A particle moves on a plane in such a way that its radial and transverse speeds are always equal and transverse acceleration is zero. Force acting on the particle varies with radial distance ($r$) as

(a) $F \propto \frac{1}{r^2}$ (b) $F \propto \frac{1}{r^3}$ (c) $F \propto \frac{1}{r^4}$ (d) $F \propto r$

17. A ball is dropped on a floor from a height '*h*'. It rebounds to a height less than '*h*' after first collision and finally comes to rest after several collision. If total distance moved by the ball is *Nh* then coefficient of restitution for collision between ball and floor is

(a) $\sqrt{\frac{N-1}{N+1}}$ (b) $\sqrt{\frac{N^2-1}{N^2+1}}$ (c) $\frac{N-1}{N+1}$ (d) $\frac{N^2-1}{N^2+1}$

18. A thin uniform square plate has mass *M* and side *a*. A semi circular portion is cut from the plate as shown in the figure. Moment of inertia of the remaining portion about axis *AB* is




(a) $\frac{13ma^2}{48}$ (b) $\frac{ma^2}{3}\left[1-\frac{3\pi}{128}\right]$ (c) $\frac{29ma^2}{96}$ (d) $\frac{ma^2}{3}\left[1-\frac{3\pi}{64}\right]$

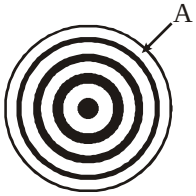
19. Consider a thin rod of length *l* undergoing small oscillation in vertical plane, when point of suspension is at distance *l*/2 from centre time period is $T_1$ and when point of suspension is at distance *l*/6 time period is $T_2$, value of $T_1/T_2$ is

(a) $\sqrt{2}$ (b) $\sqrt{3}$ (c) $1/\sqrt{2}$ (d) 1

20. A ball is placed on smooth horizontal surface. Another identical ball moving with speed $v_0$ collides with it and flies off at θ angle with direction of motion. If the two balls again collide after time *T*, value of θ is

(a) $\sin^{-1}\frac{gT}{v_0}$ (b) $\tan^{-1}\frac{gT}{v_0}$ (c) $\tan^{-1}\frac{v_0}{gT}$ (d) $\tan^{-1}\frac{gT}{2v_0}$

21. The interference pattern is from a spherical lens placed on a flat reflecting surface using a monochromatic light of wavelength λ = 550 nm. If the distance from the center to A is 0.6 mm, the radius of curvature of the lens is

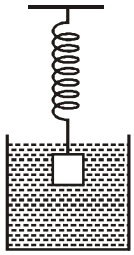


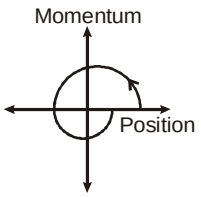

(a) 41.3 cm (b) 82.5 cm (c) 18.7 cm (d) 26.2 cm

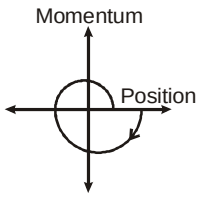
22. A block is kept on a horizontal table. The table is executing simple harmonic motion of time period *T* in the horizontal plane. The coefficient of static friction between the block and the table is μ. The maximum amplitude of the table for which the block does not slip on the surface of the table is

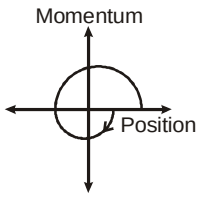
(a) $\frac{\mu gT}{2\pi}$ (b) $\frac{\mu gT^2}{2\pi^2}$ (c) $\frac{\mu gT^2}{4\pi^2}$ (d) $\mu gT^2$

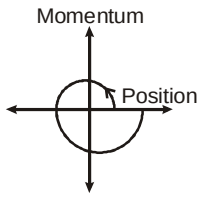
23. Consider the spring-mass system, with the mass submerged in water, as shown in the figure. The phase space diagram for one cycle of this system is



(a) 


(b) 


(c) 


(d) 


24. The amplitude of a damped oscillator decreases to 0.9 times its original magnitude in 5s. In another 10s it will decrease to $\alpha$ times its original magnitude, where $\alpha$ equals

(a) 0.7 (b) 0.81 (c) 0.729 (d) 0.6

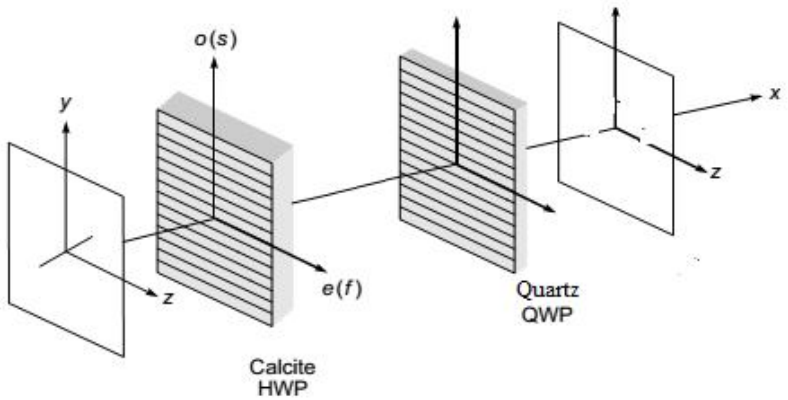
25. An ideal gas enclosed in a vertical cylindrical container supports a freely moving piston of mass M. The piston and the cylindrical have equal cross sectional area A. When the piston is in equilibrium, the volume of the gas is $V_0$ and its pressure is $P_0$. The piston is slightly displaced from the equilibrium position and released. Assuming that the system is completely isolated from its surroundings, the piston executes a simple harmonic motion with frequency

(a) $\frac{1}{2\pi}\frac{A\gamma P_0}{V_0 M}$ (b) $\frac{1}{2\pi}\frac{V_0 M P_0}{A^2\gamma}$ (c) $\frac{1}{2\pi}\sqrt{\frac{A^2\gamma P_0}{MV_0}}$ (d) $\frac{1}{2\pi}\sqrt{\frac{MV_0}{A\gamma P_0}}$

26. A pendulum made of a uniform wire of cross sectional area A has time period T. When an additional mass M is added to it bob, the time period changes to $T_M$. If the Young's modulus of the material of the wire is Y then 1/Y is equal to :
($g$ = gravitational acceleration)

(a) $\left[1-\left(\frac{T_M}{T}\right)^2\right]\frac{A}{Mg}$ (b) $\left[1-\left(\frac{T}{T_M}\right)^2\right]\frac{A}{Mg}$ (c) $\left[\left(\frac{T_M}{T}\right)^2-1\right]\frac{A}{Mg}$ (d) $\left[\left(\frac{T_M}{T}\right)^2-1\right]\frac{Mg}{A}$

27. Consider the arrangement of the two wave plate HWP (negative) and QWP (positive). Optical axis of both the plate are parallel as shown in the figure.

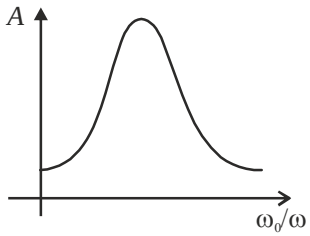



Assume a plane polarized light incident normally with vibration angle $\phi = 45^o$ with the optical axis.

(a) The final emergent light is LCP (b) The final emergent light is RCP

(c) The final emergent light is linearly polarized (d) The final emergent light is unpolarized.

28. The plot of amplitude A versus $\frac{\omega_0}{\omega}$ of a forced oscillation is shown.




The height of the curve at resonance is

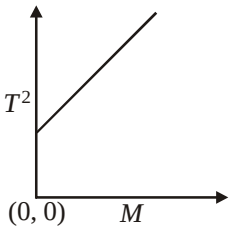
(a) $\propto k^{-1}$ (b) $\propto k^{-1}$ (c) $= \infty$ (d) $\propto b^{-1}$

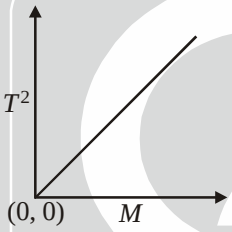
29. A point performs damped oscillations with frequency ω and amplitude $a_0 \exp(-bt)$ . The velocity amplitude of the point as a function of time t if at the initial moment $t = 0$, its displacement is equal to $a_0$ is

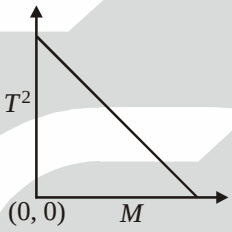
(a) $v_0 = a_0\sqrt{\omega^2 - b^2}e^{-bt}$ (b) $v_0 = a_0\sqrt{\omega^2 + b^2}e^{-bt}$

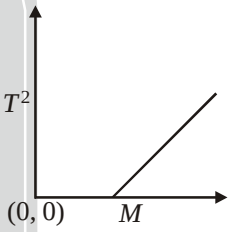
(c ) $v_0 = 2a_0\sqrt{\omega^2 + b^2}e^{-bt}$ (d ) $v_0 = 2a_0\sqrt{\omega^2 - 2b^2}e^{-bt}$

30. The spring constant *k*, of a spring of a mass $m_s$ , is determined experimentally by loading the spring with mass *M* and recording the time period *T*, for a single oscillation. If the experiment is carried out for different masses, then the graph that correctly represents the result is

(a) 


(b) 


(c) 


(d) 


## Section-B : Multiple Select Questions (MSQ)

**Q.31 to Q.40: Carry 2 Marks each.**

31. A thin rod of length '*l*' and mass '*m*' is suspended from one end. The rod is deflected by 60º from vertical position and released. If the rod rotates freely about one end and motion remains confined to vertical plane, then which of the following statement(s) is/are correct.

(a) Energy is conserved but angular momentum is not conserved

(b) Energy of the rod in terms of angle $\theta$ with downward vertical is $E = \frac{1}{6}m\ell^2\dot{\theta}^2 - \frac{mg\ell}{2}\cos\theta$

(c) Angular velocity of the rod at the lowest point is $\sqrt{\frac{3g}{\ell}}$

(d) Angular acceleration of the rod at the initial moment is $-\frac{3\sqrt{3}g}{4\ell}$

32. A particle of mass *m* is moving along the side of a square of side *a*, with a uniform speed *v* in the *xy*-plane as shown in the figure :

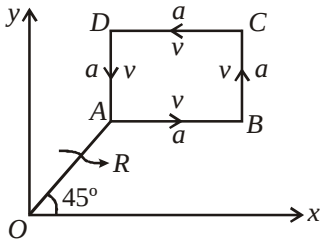
Which of the following statements is false for the angular momentum *L* about the origin ?

(a) $L = -\frac{mv}{\sqrt{2}}R\hat{k}$ , when the particle is moving from *A* to *B*.

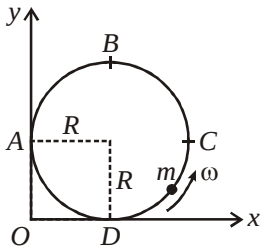
(b) $L = mv\left(\frac{R}{\sqrt{2}} + a\right)\hat{k}$, when the particle is moving from $B$ to $C$.

(c) $L = mv\left(\frac{R}{\sqrt{2}} - a\right)\hat{k}$, when the particle is moving from $C$ to $D$.

(d) $L = \frac{mv}{\sqrt{2}} R\hat{k}$, when the particle is moving from $D$ to $A$.




33. A particle is moving in circle with constant angular speed ω as shown in the figure :




Which of the following statement(s) is/are CORRECT ?

(a) At two positions torque about '$O$' is zero.

(b) Magnitude of torque about '$O$' when particle is at $A$, $B$, $C$ or $D$ is $m\omega^2 R^2$.

(c) Maximum value of torque about '$O$' is $\sqrt{2}m\omega^2 R^2$.

(d) Torque about centre of circle is zero.

34. A circular disc of radius $R$ is made to revolve about its axis with uniform angular velocity in anti-clockwise sense. An insect of mass '$m$' lying at periphery experiences net inertial forces $F_1$ and $F_2$ respectively, when it crawls anti-clockwise and clockwise respectively with constant speed with respect to the disc. Which of the following statement(s) is/are CORRECT ?

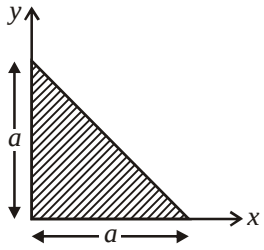
(a) Angular speed of the disc is $\sqrt{\frac{F_1 + F_2}{2mR}}$

(b) Angular speed of the disc is $\sqrt{\frac{F_1 - F_2}{2mR}}$

(c) Speed of the particle with respect to disc is $\frac{F_1 - F_2}{\sqrt{8mR(F_1 + F_2)}}$

(d) Friction force on the particle is greater when particle moves anti-clockwise.

35. A triangular plate of mass '$m$' lies of $xy$-plane as shown in the figure. Which of the following statement(s) is/are CORRECT ?




(a) Coordinate of centre of mass is $\left(\frac{a}{3}, \frac{a}{3}\right)$ (b) $I_{xx} = \frac{ma^2}{12}$

(c) $I_{xy} = -\frac{ma^2}{12}$ (d) $I_{zz} = \frac{ma^2}{6}$

36. A violet light of wavelength 400nm of intensity $I_0$ is used in a single slit diffraction experiment with slit width of 0.06 m. The distance between the screen and slit is 2m. If yellow light is replaced by the red light of wavelength 700 nm of the same intensity. Then the observed pattern will reveal

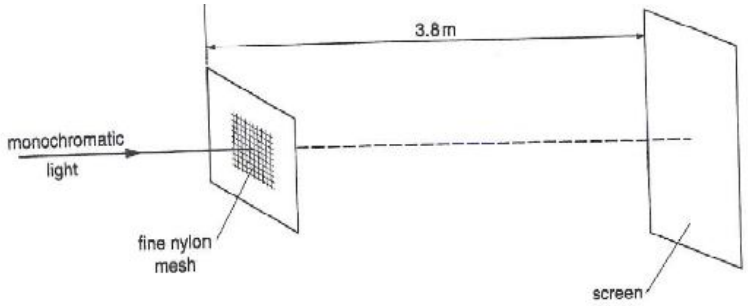
(a) That the central maxima are now broader (b) Intensity of the central maxima reduces

(c) Intensity of the central maxima remain same (d) First minima appear at higher angle

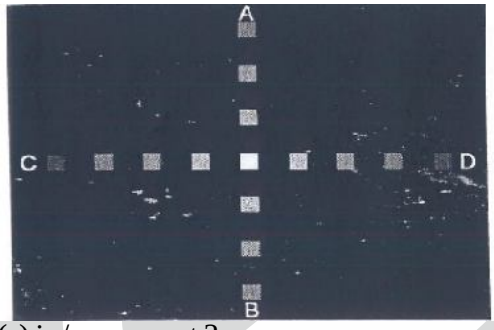
37. Velocity of sound in air is 320 m/s. A pipe closed at one end has a length of 1m. Neglecting end corrections, the air column in the pipe can resonate for sound of frequency

(a) 80 Hz (b) 240 Hz (c) 320 Hz (d) 400 Hz

38. Light from a distance source of monochromatic light of wavelength 590 nm passes through a fine nylone mesh. The light is then incident on a screen, as shown in figure.




The thread of the lylon mesh act as a diffraction grating with lines in the horizontal and in the vertical direction. part of the pattern of the spots of the light on the screen is shown in figure.




Then the following statement(s) is /are correct ?

(a) AB line of spot of the light is produced by the horizontal nylon thread.
(b) If subsequent maxima in line AB is formed at 0.8cm, then the angle between subsequen maxima is $2.1\times10^{-3}$ rad.
(c) The number of the nylone thread per mm in mesh is 3.5
(d) CD line of spot of the light is produced by the horizontal nylon thread

39. Consider the formation of Newton's rings by monochromatic light of $\lambda = 6.4\times10^{-5} cm$. Assume the point of contact to be perfect. Now slowly raise the lens vertically above the plate. Assume the radius of the convex surface to be 100 cm.

(a) At height $t_0 = 9.6\times10^{-4} cm$, there will be dark fringe at the center.
(b) When lens is moved upward by height $t_0 = 9.6\times10^{-4} cm$, 15, bright fringe collapsed to the center.
(c) When lens is moved upward by height $t_0 = 9.6\times10^{-4} cm$, 30, dark fringe collapsed to the center.
(d) Radius of the fringe expanded when we raise the lens.

40. Looking into the Michelson interferometer, we see a dark central disk surrounded by concentric light and dark rings. One mirror is 2 cm farther from the beam splitter and other is at 4 cm, also $\lambda$ = 500 nm. Which of the following statement(s) is/are CORRECT ?

(a) the order of the central disk is 80,000.
(b) the order of the 6th dark ring is 79,994.
(c) If one mirror is further moved by the distance 250 nm, the central fringe becomes bright.
(d) If one mirror is further moved by the distance 500 nm, the central fringe remain dark.

## Section-C : Numerical Answer Type (NAT)

**Q.41 to Q.50: Carry 1 Mark each.**

41. A string 3m length is resonated with a vibrator 150Hz attached to its one end. The string vibrate in three segment, the speed of the transverse wave in the string is equal to _____ (m/s).

42. A fire alarm sounds with a frequency of 912Hz. Two fire engine rush to the site in opposite direction. One travel with speed of 45 m/s and other with 30 m/s. If the speed of the sound in air be 330 m/s. The difference between the frequencies of the siren heard by the driver of the two fire engine will be _____ (Hz).

43. A thin rod of mass *m* and length *l* placed on smooth horizontal surface. It is given a horizontal impulse J at one end in direction perpendicular to length. If $v_1$ and $v_2$ be speeds to two ends of rod just after the impulse then $\frac{v_1}{v_2}(>1)$ is _____

44. A particle of unit mass moves under potential $V(x) = x^2 - 1$ joule. If particle has speed 2 m/s at $x = 1$ then its speed at $x = 0$ is _____m/s.

45. A satellite revolves around the earth with time period *T* and energy *E*. It is taken to new orbit in which its time period becomes 8*T* and energy *NE*, value of *N* is _____

46. Acceleration due to gravity at a distance $\frac{R_e}{2}$ from centre of earth is $g_1$ and at distance $2R_e$ from centre of earth is $g_2$. Assume earth to be uniform spehere of radius $R_e$. The value of $\frac{g_1}{g_2}$ is _____

47. A thin rod is made to spin about its center with angular velocity $\omega_0$ and given an upward speed $v_0$. When upward speed becomes zero, the angular speed of rod becomes $\omega$. The value of $\frac{\omega_0}{\omega}$ is _____

48. A stationary wave given by equation $\frac{d^2y}{dt^2} = 11.56 \times 10^4 \frac{d^2y}{dx^2}$ is established in $L$ = 17m long pipe filled with gas grid closed at both the ends. The fundamental frequencies is _____Hz.

49. In a young's double slit experiment $I_0$ is the maximum intensity and $\beta$ is the fringe width. If $\delta$ is the phase difference between the interfering beams at any point P at a distance *y* from the centre band, If $y = 0.25$ mm and $\beta = 1$mm, intensity at *P* is then the intensity at that point is $I = n \times I_0$ where value of *n* is _____

50. For a three narrow slit grating, the diffracted intensity at an angle $\theta$ is given by

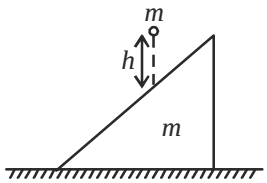
$$I = \frac{I_{max}}{9}\left(I + 4\cos\delta + 4\cos^2\delta\right) \quad \text{where, } \delta = \frac{2\pi}{\lambda} d\sin\theta$$

The intensity ratio of central maxima to secondary maxima is _____

**Q.51 to Q.60: Carry 2 Marks each.**

51. A copper rod of length 50 cm is clamped at its mid-point. The number of natural longitudinal oscillations of the rod in the frequency range from 20 to 50 kHz are .....
[Given : $y_{copper} = 130 \times 10^9$ N-m$^2$, $\rho_{copper} = 8.9 \times 10^3$ kg/m$^3$ ].

52. A ball is dropped from a height 'h' on a wedge of equal mass placed on smooth horizontal surface. The ball rebounds in horizontal direction and collision is elastic and speed of ball after collision is $N\sqrt{gh}$ . The value of *N* is _____

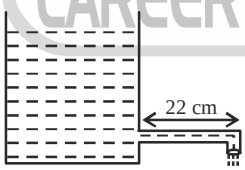



53. A circular disc of radius R is placed in vertical position on a rough horizontal surface. When horizontal force *F* is applied at centre level the disc rolls without slipping and friction force *f* acts on the disc. The value of $\frac{F}{f}$ is _____

54. Angular momentum of a particle relative to certain origin is $\vec{L} = 4\hat{i} + t^2\hat{j}$. Torque on the particle at the moment torque and angular momentum are perpendicular to each other is _____

55. When a particle of mass *m* is placed at a distance 2*L* from centre of a thin rod of mass *M* and length *L* it experiences a force $\frac{NGMm}{L^2}$. (Distance measured parallel to length of the rod). The value of *N* is _____

56. Water flows out of a big tank along a tube bent at right angle. The inside radius of the tube is 0.5 cm and length of horizontal section of the tube is 22cm. The water (density 1 gm/cc) flows at a rate 0.50 litres persecond. Torque of reaction forces of flowing water, acting on the tubes wall, relative to the point 'O' is _____N-m.




57. A machine of total mass 90 kg is supported by a spring resting on the floor and its motion is constrained to be in the vertical direction only. The system is lightly damped with a damping constant 900 Ns/m. The machine contains an eccentrically mounted shaft which, when rotating at an angular frequency p, produces a vertical force on the system of $Fp^2 \sin pt$, where F is a constant. It is found that resonance occurs at 1200 r.p.m. (revolutions per minute) and the amplitude of vibration at the resonance state is then 1 cm. Assume that the gravity has a negligible effect on the motion.

The numerical value of constant F is _____$\times \frac{1}{4\pi}$.

58. If the quality factor Q in the steady state forced vibration is defined as

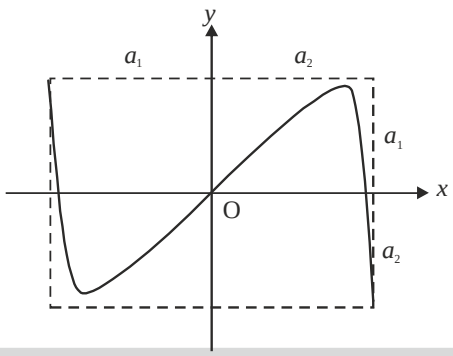
$$Q = \frac{2\pi \times Average\ energy\ stored\ per\ cycle}{Average\ energy\ dissipated\ per\ cycle}$$

The ratio of natural frequency to the driving frequency at which Quality factor is minimum is _____

59. Two vibrations of frequencies in the ratio 1 : 3 and initial phase difference ä, given by

$$x = a_1 \sin \omega t,$$
$$y = a_2 \sin(3\omega t + \delta)$$

act simultaneously on a particle at right angles to each other. The figure traced by the particle is




For phase difference $\delta = n \times \pi$, where minimum value of $n$ is _____

60. Consider a Young Double slit experiement in which both the slit is covered by the thin piece of film of referctive index 1.33 and 1.54 , and it is illuminated by the coherent light of wavlength 500 nm, the minimum thickness of the each thin film such that the central fringe is bright is $n \times 10^{-3}\ mm$. The value of $n$ is _____

***** END OF QUESTION PAPER *****

***Space for Rough Work***

**IIT-JAM PHYSICA-PH**

**TEST SERIES - 2**

**(Mechanics & Oscillations, Waves and Optics)**

**Date : 06-01-2018**

**Booklet: B**

## ANSWER KEY

### Section-A : Multiple Choice Questions (MCQ)

| | | | | |
|---|---|---|---|---|
| **1.** (b) | **2.** (c) | **3.** (b) | **4.** (b) | **5.** (d) |
| **6.** (b) | **7.** (a) | **8.** (a) | **9.** (a) | **10.** (b) |
| **11.** (b) | **12.** (b) | **13.** (d) | **14.** (b) | **15.** (c) |
| **16.** (b) | **17.** (a) | **18.** (b) | **19.** (d) | **20.** (b) |
| **21.** (c) | **22.** (c) | **23.** (b) | **24.** (c) | **25.** (c) |
| **26.** (c) | **27.** (a) | **28.** (d) | **29.** (b) | **30.** (a) |

### Section-B : Multiple Select Questions (MSQ)

| | | | |
|---|---|---|---|
| **31.** (a),(b),(d) | **32.** (**b**),(**d**) | **33.** (a),(b),(c),(d) | **34.** (a),(d) |
| **35.** (a),(b),(c),(d) | **36.** (a), (c), (d) | **37.** (a),(b),(d) | **38.** (a),(b),(c) |
| **39.** (a), (c) | **40.** (a), (b),(d) | | |

### Section-C : Numerical Answer Type (NAT)

| | | | |
|---|---|---|---|
| **41.** (300) | **42.** (40 to 42) | **43.** (2 to 2) | **44.** (2.40 to 2.50) |
| **45.** (0.25) | **46.** (2 to 2) | **47.** (1 to 1) | **48.** (10) |
| **49.** (0.5) | **50.** (9) | **51.** (4) | **52.** (1 to 1) |
| **53.** (3 to 3) | **54.** (0) | **55.** (0.25 to 0.27) | **56.** (0.65 to 0.75) |
| **57.** (0.8to 1.0) | **58.** (1 to 1) | **59.** (0) | 60. (2.2 to 2.5 ) |