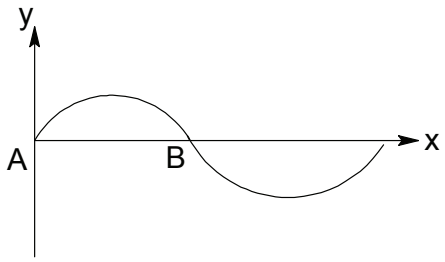
PHYSICS **Max. Marks: 60**

SECTION – I
(MULTIPLE CORRECT ANSWER TYPE)

This section contains 6 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which **ONE OR MORE than ONE** option can be correct.

Marking scheme: +4 for all correct options & +1 partial marks, 0 if not attempted and -2 in all wrong cases.

1. The tension in a stretched string fixed at both ends is changed by 2%, the fundamental frequency is found to get changed by 15Hz. Select the correct statement(s):



A) Wavelength of the string of fundamental frequency does not change
B) Velocity of propagation of wave changes by 2%
C) Velocity of propagation of wave changes by 1%
D) Original frequency is 1500 Hz

2. In an experiment of resonance tube, first resonance occurs at $l = 10cm$ from the open end of the tube. End correction of the tube is 1.0cm and the frequency of tuning fork is 700Hz.
A) Velocity of sound is 308m/s
B) Next resonance will occur at l = 32cm
C) Next resonance will occur at l = 33cm
D) Radius of resonance tube is 1.67cm

3. An observer A is moving directly towards a stationary sound source while another observer B is moving away from the source with the same velocity. Which of the following statements are correct?
A) Average of frequencies recorded by A and B is equal to natural frequency of the source
B) Wavelength of wave received by A is less than that of wave received by B.
C) Wavelength of waves received by two observers will be same
D) Both the observers will observe the wave traveling with same speed

4. The energy of a particle executing simple harmonic motion is given by $E = Ax^2 + Bv^2$ where x is the displacement from mean position x = 0 and v is the velocity of the particle at x then choose the correct statement(s)

A) Amplitude of SHM is $\sqrt{\frac{2E}{A}}$

B) Maximum velocity of the particle during SHM is $\sqrt{\frac{E}{B}}$

C) Time period of motion is $2\pi\sqrt{\frac{B}{A}}$

D) Displacement of the particle is proportional to the velocity of the particle

5. A horizontal plank has a rectangular block placed on it. The plank starts oscillating vertically and simple harmonically with an amplitude of 40 cm. The block just loses contact with the plank when the latter is momentarily at rest. Then
(Take $g = 10\ m/s^2$)

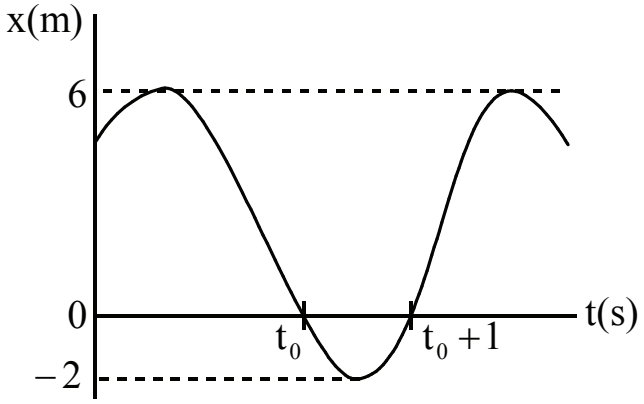
A) The period of oscillation is $(2\pi/5)$

B) The block weighs double its weight, when the plank is at the other position of momentary rest

C) The block weighs 0.5 times its weight on the plank halfway up from mean position

D) The block weighs 1.5 times its weight on the plank halfway down from mean position

6. A particle executes SHM about a point other than x = 0 as shown in the graph.



Choose the **CORRECT** option(s) :

A) Amplitude is equal to 4 m

B) Equilibrium position is at x = 0

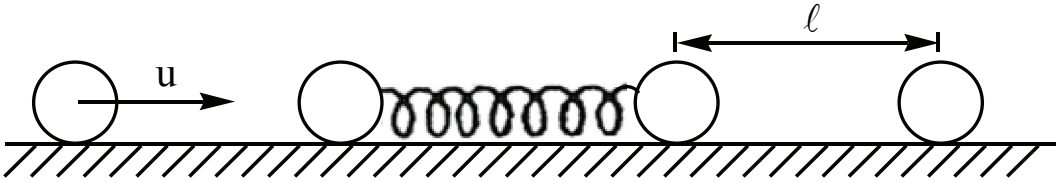
C) Equilibrium position is at x = 2 m

D) Angular frequency $=\frac{2\pi}{3}$

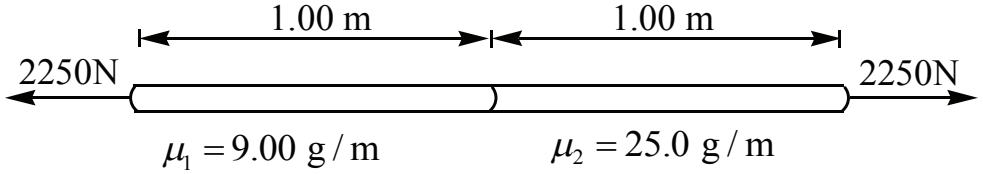
SECTION-II
(NUMERICAL VALUE TYPE)

This section contains 8 questions. Each question is numerical value. For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to second decimal place.
(e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30).
Marking scheme: +3 for correct answer , 0 if not attempted and 0 in all other cases.

7. Two identical metal balls connected at the ends of a light spring of force constant k form a dumbbell like structure. The dumbbell rests on a frictionless horizontal floor and third identical ball is placed at distance ℓ from the right ball of the dumbbell. All the three balls are in a line. A fourth identical ball moving with velocity u collides with left ball of the dumbbell. If all collisions are elastic and rightmost ball aquries a velocity u. The minimum value of ℓ is $\pi u\sqrt{\frac{m}{xk}}$. Find x.



8. A wire is made by welding together two metals having different densities. Figure shows a 2.00 m long section of wire centered on the junction, but the wire extends much farther in both direction. The wire is placed under 2250 N tension, then a 1500 Hz wave with an amplitude of 3.00 mm is sent down the wire. How many wavelengths (complete cycles) of the wave are in this 2.00 m long section of the wire ?



9. A particle performs SHM under the action of a force F_1 With frequency 3 Hz. If force is changed to F_2 frequency of oscillation changes to 4 Hz. If both forces act simultaneously in the same direction on the particle then find new frequency of oscillation (in Hz).

10. In Fig. (i) and (ii) Point charges at O and O' are $+Q_0$ each and charges of bobs are +Q and + 2Q respectively. Both simple pendulum are of equal lengths and bobs are of equal mass, isolated from each other and performing oscillations for very small angular displacements. If T_1 and T_2 are time period of oscillations of (i) and (ii) respectively then find $\frac{T_2}{T_1}$

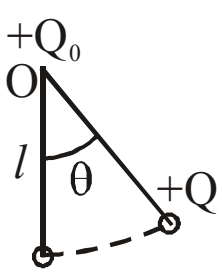


Fig. (i)

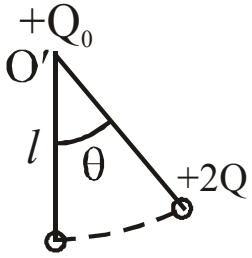
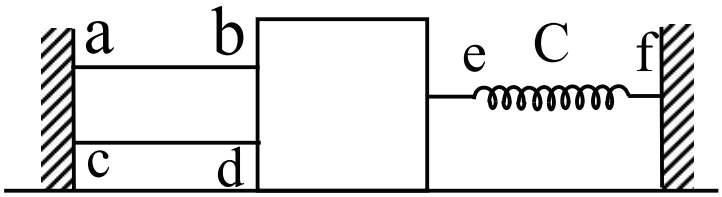


Fig. (ii)

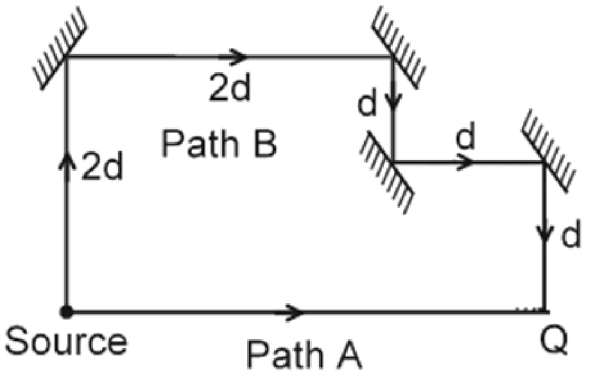
11. A block of mass m placed on a smooth horizontal surface is connected by two elastic strings ab and cd of equal length ℓ, Young's Modulus Y & 2Y, area of cross section A & A/2 respectively and a spring of force constant C. Both the strings and spring are in unstretched condition, if the time period of small oscillation of the block along the horizontal surface is $2\pi\left[\sqrt{\frac{m}{x_1 C}}+\sqrt{\frac{m\ell}{x_2 YA+x_3 C\ell}}\right]$. Find $x_1+x_3-x_2$.



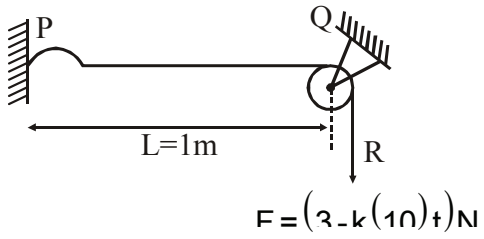
12. Two pulses travelling on the same string are describes by the function y_1 and y_2 generated from points A and B is in meter respectively $y_1=\frac{2}{(x-2t)^2+1}$,

$y_2 = \frac{-2}{(x+4t)^2+2}$, where x (in metre) and t (in sec) are in the distance between A & B is 1.5m. The position where these two pulses will meet from A is. (Shape of the pulse does not change) is $x \times 10^{-1}\ m$. Find x

13. A sound source emits two sinusoidal sound waves, both of wavelength λ, along paths A and B as shown in figure. The sound travelling along path B is reflected from four rigid surfaces as shown and then interferes at point Q, producing minimum intensity at that point. The minimum value of d in terms of λ is $\frac{\lambda}{N}$, find the value of N:



14. As shown in figure string PQR is stretched by force F = (3 –10 kt) N, where k is a constant and t is time in second. At time t = 0, a pulse is generated at the end P of the string. Find the value of k (in N/s), if the value of force become zero as the pulse reaches at point Q. (Assume linear mass density is constant and having value 0.3 g/cm)



SECTION – III

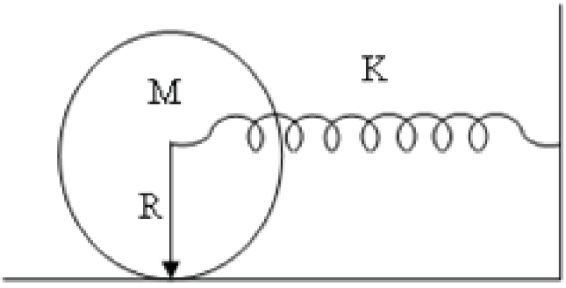
(COMPREHENSIN TYPE)

This section contains 2 Paragraphs. Based on each paragraph, there are 2 questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** option can be correct.

Marking scheme: +3 for correct answer, 0 if not attempted and -1 in all other cases.

Paragraph for Question Nos. 15 to 16

A circular disc of mass M and radius R is connected to spring and placed on rough surface. The friction is sufficient for pure rolling. When the disc is slightly displaced and released, it executes simple harmonic motion.



15. Let μ be the coefficient of friction between the disc and ground, the amplitude A of oscillations for which no slipping occurs is

A) $0 < A < \frac{4\mu Mg}{K}$

B) $A > \frac{3\mu Mg}{K}$

C) amplitude A must be less than $\frac{\mu M g}{K}$

D) $0 < A < \frac{3\mu M g}{K}$

16. The time period of oscillations of the disc

A) depends on its radius

B) depends on amplitude

C) depends on its mass

D) depends only on spring constant of spring

Paragraph for Question Nos. 17 to 18

The displacement of a sound wave in the medium is given by the equation $y_1 = A\cos(ax + bt)$, where A, a, b are positive constants. The wave is reflected by an obstacle situated at x = 0. The intensity of reflected wave is 0.64 times that of incident wave. Then find

17. The wavelength and the frequency of the incident wave are

A) $\lambda = \frac{\pi}{a}, n = \frac{b}{2\pi}$ B) $\lambda = \frac{2\pi}{a}, n = \frac{b}{2\pi}$

C) $\lambda = \frac{2\pi}{a}, n = \frac{b}{\pi}$ D) $\lambda = \frac{\pi}{a}, n = \frac{b}{\pi}$

18. In the resultant wave formed after reflection, the maximum and minimum values of particle speeds in medium are

A) $V_{max} = 1.8\,Ab,\ V_{min} = 0.2\,Ab$

B) $V_{max} = 1.6\,Ab,\ V_{min} = 0.1\,Ab$

C) $V_{max} = 1.4\,Ab,\ V_{min} = 0.1\,Ab$

D) $V_{max} = 1.2\,Ab,\ V_{min} = 0.2\,Ab$

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A right Choice for the Real Aspirant

ICON Central Office , Madhapur – Hyderabad

Sec: Sr.Super60 & All | PTA-03(Paper-1) | Date: 28-03-2020

Time: 09.00Am to 12.00 | 2018_P1 | Max.Marks:180

KEY SHEET

PHYSICS

1	ACD	2	ABD	3	AC	4	BC	5	ABCD
6	ACD	7	8	8	8	9	5	10	1
11	0	12	5	13	8	14	2	15	D
16	C	17	B	18	A				

CHEMISTRY

19	ABC	20	ABCD	21	ABCD	22	ABC	23	BCD
24	ABCD	25	5.00	26	4.00	27	8.00	28	0.50
29	0.20	30	132.00	31	4.00	32	2.00	33	B
34	C	35	C	36	A				

MATHS

37	ABC	38	BC	39	ABCD	40	ABCD	41	ABD
42	BCD	43	2	44	6	45	7	46	8
47	3	48	6	49	0	50	3	51	A
52	C	53	A	54	C				

SOLUTIONS

PHYSICS

1. Wavelength depends on length which is fixed. Therefore wavelength does not change.
Further $v = \sqrt{T/m}$ or $v \propto T^{1/2}$.

$\therefore$ % change in $v = \frac{1}{2}$ $(\%\, change\, in\, T)$

$= \frac{1}{2}(2) = 1\%$.

i.e, Speed and hence frequency will change by 1 %.
Change in frequency is 15 Hz which is 1 % of 1500 Hz.
Therefore, original frequency should be 1500 Hz.

2. $\frac{\lambda}{4} = L_1 + e$ for first resonance

$\frac{3\lambda}{4} = L_2 + e$ for second resonance

$v = f\lambda$ and $e = 0.6r$

3. Let velocity of each observer be u a shown in figure.

Then frequency received by A will be

$$n_1 = n_o\left(\frac{v+u}{v}\right)$$

where n_o is natural frequency of the source and v is sound propagation velocity. The frequency received by B will be

$$n_2 = n_o\left(\frac{v-u}{v}\right)$$

Since $(n_1 + n_2)/2 = n_o$, therefore, (a) is correct.

4. Total energy in an SHM is $E = \frac{1}{2}m\omega^2x^2 + \frac{1}{2}mv^2 = \frac{1}{2}m\omega^2a^2$

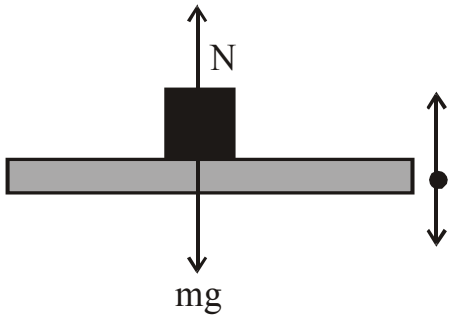
Comparing, $\frac{1}{2}m\omega^2 = A$ and $\frac{1}{2}m = B$

$E = \frac{1}{2}m\omega^2a^2 \Rightarrow E = Aa^2 \Rightarrow$ Amplitude, $a = \sqrt{\frac{E}{A}}$

$\omega = \sqrt{\frac{A}{B}} \Rightarrow v_{max} = a\omega = \sqrt{\frac{A}{B}} \times \sqrt{\frac{E}{A}} = \sqrt{\frac{E}{B}}$

Time period, $T = \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{B}{A}}$

5.



$mg - N = ma$

or $mg - 0 = m\omega^2 A$

$\therefore \quad \omega = \sqrt{\frac{g}{A}} = \sqrt{\frac{10}{0.40}} = 5 \text{ rad/s}$

$T = \frac{2\pi}{\omega} = \frac{2\pi}{5} s$

$a_{max} = \omega^2 A = 25 \times 0.4 = 10 \text{ m/s}^2 = g$

At $y = \frac{a}{2}$ above mean position, $f = \frac{g}{2}$ downwards or, apparent weight of the block will be $\frac{mg}{2}$.

At $y = \frac{a}{2}$ below mean position, $f = \frac{g}{2}$ upwards or apparent weight of the block will be $\frac{3mg}{2}$.

6. Equilibrium position will be midway between – 2 and 6 m i.e., 2 m and amplitude $= 6 - 2 = 4 \text{ m}$

7. $\ell = \frac{\pi u}{2}\sqrt{\frac{m}{2k}}$

After collision at the left end, the motion of the dumbbell can be conceived as superposition of translation of mass center of the dumbbell and oscillations about the mass center. For minimum value of ℓ, the right ball of the dumbbell must collide with the right most ball at the end of the first half period of the oscillations.

8. $v_1 = \sqrt{\frac{T_1}{\mu_1}} = \sqrt{\frac{2250 \times 10^3}{900}} = 5 \times 100 = 500 \text{ m/s}$

$v_2 = \sqrt{\frac{T_2}{\mu_2}} = \sqrt{\frac{2250 \times 10^3}{25}} = 3 \times 100 = 300 \text{ m/s}$

$\lambda_1 = \frac{v_1}{f} \qquad \lambda_2 = \frac{v_2}{f}$

$\lambda_1 = \frac{1}{3} m$

$\lambda_2 = \frac{1}{5} m$

$\therefore$ Net wavelength $= 3 + 5 = 8$

9. $F_1 = -m\omega_1^2 x, \quad F_2 = -m\omega_2^2 x$

$F = F_1 + F_2 = m\left(\omega_1^2 + \omega_2^2\right)(-x)$

$\omega^2 = \omega_1^2 + \omega_2^2$

$n^2 = n_1^2 + n_2^2$

$n = \sqrt{3^2 + 4^2} = 5 \text{ Hz}.$

10. There is no torque by electric forces about points of suspension O and O'.

11. Conceptual

12. y_1 is travelling along positive x direction

y_2 is travelling along negative x direction.

Speed of wave y_1 is = 2 m/s

Speed of wave y_2 is $= -4\,m/s$

Suppose they meet at a distance x from A

$\frac{x}{2}=\frac{1.5-x}{4}\Rightarrow 4x=3-2x$

$6x=3$

$x=0.5\,m$ from A.

13. Path difference = Path B – Path A

= 7d – 3d = 4d

[Note that there is no phase change in reflections from mirror in case of sound]

For being out of phase :

$\Delta x = 4d = \frac{\lambda}{2};\frac{3\lambda}{2};\ldots\ldots\ldots\ldots$

For minimum d, $4d = \frac{\lambda}{2} \Rightarrow d = \frac{\lambda}{8}$

14. $v=\sqrt{\frac{3-(10K)t}{3\times10^{-2}}}=\frac{dx}{dt}$

$\int_0^L dx=\frac{10}{\sqrt{3}}\int_0^t\sqrt{3-10kt}\cdot dt$

15 & 16.

$F-f=ma$

$fR=\frac{mR^2\alpha}{2}$

$f=\frac{ma}{2}$

$F=\frac{3ma}{2}$

$F=3f$

$f=\frac{F}{3}$

$f=\frac{Kx}{3}$

$X=A\cos\omega t$

$f=\frac{KA}{3}\cos\omega t$

$\mu mg=\frac{KA}{3}$

$A=\frac{3\mu mg}{K}$

$\therefore\ O<A>\frac{3\mu mg}{K}$; for no slipping

$a=\frac{-2F}{3m}=\frac{-2Kx}{3m}$

$T=2\pi\sqrt{\frac{3m}{2K}}\quad W_f=0$

17. The equation of incident wave $y_1 = A\cos(ax + bt)$ (1)
The standard equation for a travelling wave is
$y = A\cos(kx + \omega t)$ (2)
Where k is propagation constant and ω is angular velocity.
Comparison of equation (1) and (2) yields, k = a, and ω = b.
$\therefore \quad \lambda = 2\pi/k = 2\pi/a$ and $x = \omega/2\pi = b/2\pi$

18. The resultant wave formed will have maximum amplitude A + 0.8A =1.8A
and minimum amplitude A – 0.8A = 0.2A
$\therefore \ V_{max} = 1.8\ A \times \omega = 1.8Ab$
$V_{min} = 0.2Ab$

CHEMISTRY

19. ABC

Sol- Acid-Base reactions are favoured from strong to weak direction. Order of acidic strength is $CH_3COOH > CH_3 - OH > CH_3 - C \equiv CH > NH_3$

20. ABCD

Sol- Methyl Ketones are formed from terminal alkynes.

is obtained from either $CH - CH_2 - C \equiv C - CH_2 - CH_3$ give only one product

21. ABCD

Sol- (A) Cyclic bromonium intermediate is decomposed by internal nucleophite $(-OH)$.
(C) Occurs through more stable carbocation intermediate
(D) Carbocation is stabilized by attack of internal nucleophile $(-OH)$

22. ABC

Sol- CsCl is like bcc

23. BCD

Sol- $Z > 1 \Rightarrow V_{real} > V_{ideal}$ so forces of repulsion are dominant.

24. ABCD

Sol- (A) is correct because packing efficiency of fcc and ccp is 74%
(B) is correct because in crystals with very high coordination number cation and anion missing from the original position
(C) is correct because in number of atoms in fcc unit cell is 4
(D) is correct because fcc structure has 8 tetrahedral void and 4 atoms hence number of tetrahedral voids per sphere is $\frac{8}{4} = 2$

25. 5.00

Sol- A) HBr D) $Hg(OAC)_2 / H_2O, NaBH_4 / OH^-$ E) $aq.H_2SO_4$
F) H_2 / Ni I) $NBS / h\upsilon$

26. 4.00