INDIAN ASSOCIATION OF PHYSICS TEACHERS
NATIONAL STANDARD EXAMINATION IN PHYSICS 2015-16

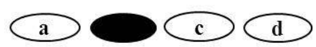
Date of Examination: 22nd November, 2015
Time: 0930 to 1130 Hrs

Q. Paper Code: P 105

Write the question paper code mentioned above on YOUR answer sheet (in the space provided), otherwise your answer sheet will NOT be assessed. Note that the same Q. P. Code appears on each page of the question paper.

Instructions to Candidates –

1. Use of mobile phones, smartphones, ipads during examination is **STRICTLY PROHIBITED**.
2. In addition to this question paper, you are given answer sheet along with Candidate's copy.
3. On the answer sheet, make all the entries carefully in the space provided **ONLY** in **BLOCK CAPITALS** as well as by properly darkening the appropriate bubbles.
   Incomplete/ incorrect/carelessly filled information may disqualify your candidature.
4. On the answer sheet, use only **BLUE or BLACK BALL POINT PEN** for making entries and filling the bubbles.
5. Question paper has two parts. In Part A1(Q. Nos 1 to 60) each question has four alternatives, out of which **only one** is correct. Choose the correct alternative and fill the appropriate bubble, as shown.

   Q. No. 22 

   In Part A2 (Q. Nos. 61 to 70) each question has four alternatives out of which **any number of alternatives** (1, 2, 3 or 4) may be correct. You have to choose ALL correct alternatives and fill the appropriate bubbles, as shown.

   Q. No. 64 

6. For **Part A1**, each correct answer gets 3 marks. A wrong one gets a penalty of 1 mark. **Part A2** full marks are 6 for each question, you get them when **ALL** correct answers are marked.
7. Any rough work should be done only in the space provided.
8. Use of **non-programmable** calculator is allowed.
9. No candidate should leave the examination hall before the completion of the examination.
10. After submitting your answerpaper, take away the Candidate's copy for your reference.

Please DO NOT make any mark other than filling the appropriate bubbles properly in the space provided on the answer sheet.
Answer sheets are evaluated using machine, hence CHANGE OF ENTRY IS NOT ALLOWED.
Scratching or overwriting may result in a wrong score.
DO NOT WRITE ON THE BACK SIDE OF THE ANSWER SHEET.

Instructions to Candidates (continued)–

Read the following instructions after submitting the answer sheet.

11. **Comments regarding this question paper, if any, may be sent by email only to iaptpune@gmail.com till 24th November, 2015.**
12. **The answers/solutions to this question paper will be available on our website – www.iapt.org.in by 2nd December, 2015.**
13. **CERTIFICATES and AWARDS –**

    Following certificates are awarded by the IAPT to students successful in NSEs

    (i)Certificates to "Centre Top 10%" students

    (ii)Merit Certificates to "Statewise Top 1%" students

    (iii)Merit Certificates and a book prize to "National Top 1%" students
14. Result sheets and the "Centre Top 10%" certificates will be dispatched to the Prof-in-charge of the centre by January, 2016.
15. List of students (with centre number and roll number only) having score above MAS will be displayed on our website (**www.iapt.org.in**) by **22nd December, 2015.** See the **Eligibility Clause** in the Student's brochure on our website.
16. Students eligible for the INO Examination on the basis of selection criteria mentioned in Student's brochure will be informed accordingly.
17. Gold medals will be awarded to TOP 35 students in the entire process.

Instructions to Candidates (continued)–

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Q.P. Code –P 105

INDIAN ASSOCIATION OF PHYSICS TEACHERS

NATIONAL STANDARD EXAMINATION IN PHYSICS 2015-16

Total Time : 120 minutes (A-1 and A-2)

A – 1

ONLY ONE OUT OF FOUR OPTIONS IS CORRECT.

N. B. – Physical constants are given at the end.

1. An expression containing certain physical quantities is (1273.43 – 51.7052 + 745)× 21. After evaluation the correct answer is

   (a) 41301.2208 (b) 4.1×10^4 (c) 41307 (d) 41000

2. A body of mass m and radius R rolling horizontally without slipping at a speed v climbs a ramp to a height $\frac{3v^2}{4g}$. The rolling body can be

   (a) a sphere (b) a circular ring (c) a spherical shell (d) a circular disc

3. A particle of mass 10 g starts from rest at t = 0 s from a point (0 m, 4 m) and gets accelerated at 0.5 m/s^2 along $x - \sqrt{3}y + 4\sqrt{3} = 0$ in XY plane. The angular momentum of the particle about the origin (in SI units) at t = 2 s is

   (a) $-0.01\sqrt{3}\,\hat{k}$ (b) $-0.02\sqrt{3}\,\hat{k}$ (c) zero (d) $-20\sqrt{3}\,\hat{k}$

4. A body released from a height H hits elastically an inclined plane at a point P. After the impact the body starts moving horizontally and hits the ground. The height at which point P should be situated so as to have the total time of travel maximum is

   (a) H (b) $2H$ (c) $\frac{H}{4}$ (d) $\frac{H}{2}$

5. A thin rod of length l in the shape of a semicircle is pivoted at one of its ends such that it is free to oscillate in its own plane. The frequency f of small oscillations of the semicircular rod is

   (a) $\frac{1}{2\pi}\sqrt{\frac{g\pi}{2l}}$ (b) $\frac{1}{2\pi}\sqrt{\frac{g\sqrt{\pi^2+4}}{2l}}$ (c) $\frac{1}{2\pi}\sqrt{\frac{g(\pi+2)}{l}}$ (d) $\frac{1}{2\pi}\sqrt{\frac{g(\pi^2+1)}{2\pi l}}$

6. Two air bubbles with radii r_1 and r_2 ($r_2 > r_1$) formed of the same liquid stick to each other to form a common interface. Therefore, the radius of curvature of the common surface is

(a) $\sqrt{r_1 r_2}$ (b) infinity (c) $\frac{r_2}{r_1}\sqrt{r_2^2 - r_1^2}$ (d) $\frac{r_1 r_2}{r_2 - r_1}$

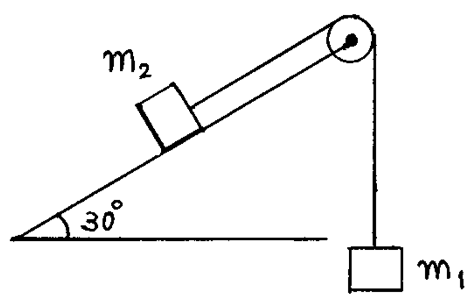
7. A particle executes a periodic motion according to the relation $x = 4\cos^2(50t)\sin(500t)$. Therefore, the motion can be considered to be the superposition of n independent simple harmonic motions, where n is

(a) 2 (b) 3 (c) 4 (d) 5

8. A car moving along a straight road at a speed of u m/s applies brakes at $t = 0$ second. The ratio of distances travelled by the car during 3rd and 8th secondis 15 : 13. The car covers a distance of 0.25 m in the last second of its travel. Therefore, the acceleration a(in m/s^2) and the speed u(in m/s) of the car are respectively

(a) −0.1, 16 (b) −0.2, 12 (c) −0.5, 20 (d) −0.1 , 16

9. Masses m_1 and m_2 are connected to a string passing over a pulley as shown. Mass m_1 starts from rest and falls through a distance d in time t. Now, by interchanging the massesthe time required for $m_2$to fall through the same distance is 2 t. Therefore, the ratio of masses $m_1 : m_2$ is



(a) $\frac{2}{3}$ (b) $\frac{3}{2}$ (c) $\frac{5}{2}$ (d) $\frac{4}{3}$

10. The graph of specific heat of water (on Y axis) against temperature (on X axis) between 0° C and 100° C

(a) is a straight line parallel to the temperature axis.
(b) is a straight line passing through a point (15° C, 1 cal/g-°C) and having a small positive slope.
(c) has a minimum between 14.5° C and 15.5° C.
(d) has a minimum at about 30° C.

11. When a light wave is incident at the interface between two media, the reflection coefficient is given by $\frac{(n-1)^2}{(n+1)^2}$ where n is the refractive index of the denser medium with respect to the rarer medium. Two stretched strings whose linear densities are 25 g/m and 9 g/m are joined together. Assuming the law of optics holds good here also, the reflection coefficient for the pulse along the strings is

(a) $\frac{9}{16}$ (b) $\frac{3}{4}$ (c) $\frac{1}{16}$ (d) $\frac{1}{9}$

12. A certain perfect gas occupying 1 litre at 80 cm of Hg suddenly expands to 1190 cc while the pressure falls to 60 cm of Hg. Therefore, the gas is

(a) polyatomic (b) diatomic (c) monatomic (d) data inadequate

13. Two thin rods of lengths l_1 and $l_2$at a certain temperature are joined to each other end to end. The composite rod is then heated through a temperature θ. The coefficients of linear expansion of the two rods are α_1 and α_2 respectively. Then, the effective coefficient of linear expansion of the composite rod is

(a) $\frac{\alpha_1+\alpha_2}{2}$ (b) $\sqrt{\alpha_1\alpha_2}$ (c) $\frac{l_1\alpha_2+l_2\alpha_1}{l_1+l_2}$ (d) $\frac{l_1\alpha_1+l_2\alpha_2}{l_1+l_2}$

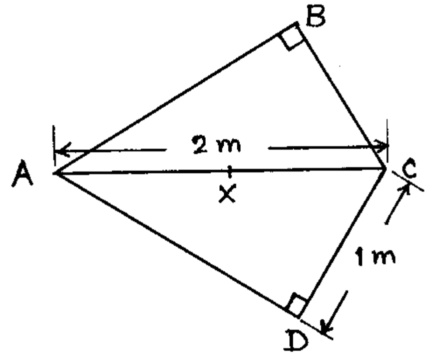
14. A yo-yo has a spool of mass m and radius R. A massless string is wound around an axle of radius b and of negligible mass. If the yo-yo released from rest has a downward acceleration of $\frac{g}{9}$, the ratio $\frac{R}{b}$ is

(a) 2 (b) 3 (c) 4 (d) 5

15. A pulley of negligible mass is suspended from a spring balance. Blocks weighing 5.0 kg and 3.0 kg are attached to the two ends of a string passing over the pulley. The reading on the spring balance will be

(a) 8.0 kg (b) 7.5 kg (c) 2.0 kg (d) 4.0 kg

16. A uniform rod (ABCDAC) is bent in the shape of a kite as shown. If a point X along AC is the centre of mass of the structure, distance AX is



(a) 1.50 m (b) 1.08 m (c) 1.00 m (d) 1.10 m

17. Two particles, each of mass m and charge q are attached at the ends of a light rod of length $2r$. The rod is rotated at a constant angular speed ω about an axis perpendicular to the rod passing through its centre. The ratio of magnetic moment of the system to its angular momentum is

(a) $\frac{q}{m}$ (b) $\frac{q}{2m}$ (c) $\frac{2q}{m}$ (d) $\frac{q}{4m}$

18. A jet of water of cross-sectional area A hits a plate normally with velocity v. The plate is moving in the direction of the jet with velocity V. Therefore, the force exerted on the plate is proportional to

(a) v (b) v^2 (c) $(v-V)$ (d) $(v-V)^2$

19. A heavy cylindrical shaft (pile) of mass M is driven vertically through a distance s into the ground by the blow of a pile-driver of mass m. The pile driver drops vertically through a distance h onto the head of the pile. The average resistance of the ground is

(a) $g\left[\frac{m^2}{M}\frac{h}{s} + 2m\right]$

(b) $g\left[\frac{m^2}{(m+M)}\frac{h}{s} + (m+M)\right]$

(c) $g\left[\frac{M^2}{m}\frac{h}{s} + (m+M)\right]$

(d) $g\left[\frac{m^2}{(m+M)}\frac{h}{s} + 2(m+M)\right]$

20. An optical fibre consists of a core (refractive index n_1) surrounded by a cladding (refractive index n_2). A ray of light enters the fibre from air at an angle θ with the fibre axis. The maximum value of θ for which the ray can propagate down the fibre is

(a) $sin^{-1}\sqrt{\frac{n_1}{n_2}}$ (b) $sin^{-1}\sqrt{\frac{n_2}{n_1}}$ (c) $sin^{-1}\sqrt{n_1^2 + n_2^2}$ (d) $sin^{-1}\sqrt{n_1^2 - n_2^2}$

21. Two coils wound on the same magnetic core have inductances L_1 and L_2. When the two coils are connected in series, the effective inductance is

    (a) $L_1 + L_2$.
    (b) certainly greater than $L_1 + L_2$.
    (c) certainly less than $L_1 + L_2$.
    (d) none of the above.

22. A particle of mass m and charge $-q$ moves along a diameter of a uniform spherical charge distribution of radius R with total charge $+Q$. The angular frequency of the periodic motion performed by the particle is

    (a) $\sqrt{\frac{2\pi}{\epsilon_0}\frac{qQ}{mR^3}}$ (b) $\sqrt{\frac{1}{2\pi\epsilon_0}\frac{qQ}{mR^3}}$ (c) $\sqrt{\frac{1}{\epsilon_0}\frac{qQ}{mr^3}}$ (d) $\sqrt{\frac{1}{4\pi\epsilon_0}\frac{qQ}{mR^3}}$

23. A spherical body of mass m_1 moving with a speed $u_1$collides elastically with a lighter spherical body of mass m_2 initially at rest. The maximum angle through which the heavier body gets deflected after collision depends upon

    (a) $m_1$and $u_1$only (b) $m_2$and u_1 only (c) m_1 and m_2 only (d) m_1, m_2 and u_1 all

24. A non-conducting spherical shell of radius R surrounds a point charge q. The electric flux through a cap of the shell of half angle θ is

    (a) $\frac{2\pi q\theta}{\epsilon_0}$. (b) $\frac{q}{2\epsilon_0}(1 - cos\theta)$. (c) $\frac{q(2\theta)}{4\pi\epsilon_0}$. (d) $\frac{q\theta}{2\pi\epsilon_0}$.

25. In a Young's double slit experiment the intensity at a point is I where the corresponding path difference is one sixth of the wavelength of light used. If I_0 denotes the maximum intensity, the ratio $\frac{I}{I_0}$ is equal to

    (a) $\frac{1}{4}$ (b)$\frac{1}{2}$ (c)$\frac{\sqrt{3}}{2}$ (d)$\frac{3}{4}$

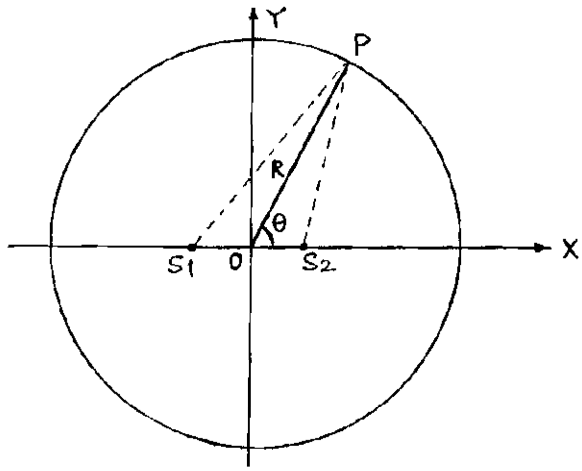
26. A charge $+q$is placed at a distance of d from a point O. A conducting body surrounds point O such that q remains outside. The electric field at O due to the induced charge is

    (a) zero
    (b) $\frac{1}{4\pi\epsilon_0}\frac{q}{d^2}$directed towards the charge q
    (c) $\frac{1}{4\pi\epsilon_0}\frac{q}{d^2}$ directed away from the charge q
    (d) data insufficient

27. A coaxial cable consists of two thin cylindrical conducting shells of radii a and$b$ ($a<b$). The inductance per unit length of the cable is

(a) $\frac{\mu_0}{2\pi}\frac{(a+b)}{a}$ (b) $\frac{\mu_0}{4\pi} ln\left(\frac{a}{b}\right)$ (c) $\frac{\mu_0}{4\pi} ln\left(\frac{b}{a}\right)$ (d) $\frac{\mu_0}{2\pi} ln\left(\frac{b}{a}\right)$

28. Two coherent sources of light S_1 and S_2, equidistant from the origin, are separated by a distance 2λ as shown. They emit light of wavelength λ. Interference is observed on a screen placed along the circle of large radius R. Point P is seen to be a point of constructive interference. Then, angle θ (other than 0^o and 90^o) is



(a) 45^o (b) 30^o (c) 60^o (d) not possible in the first quadrant

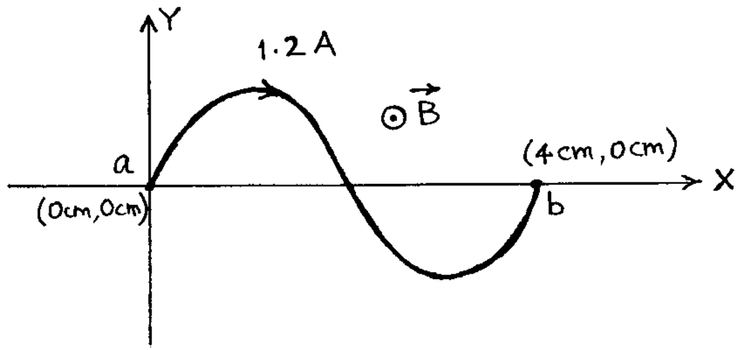
29. If a current of 2 A passing through a certain electrolyte for t minutes liberates 1 gram of oxygen, then t is about

(a) 6000 (b) 100 (c) 50 (d) 25

30. A polarized light is incident on a polaroid. Let I_0 be the intensity of light transmitted by this polaroid. Now, a very large number (say N) of polaroids is placed in a row with their axes displaced through a small angle θ successively. If the last polaroid is crossed to the first one, the intensity of light transmitted by the last polaroid is about

(a) zero (b)$\frac{I_0}{2}$ (c)I_0 (d) $\frac{I_0}{N}$

31. A wire *ab* of length 10 cm is fixed in the shape of a sinusoidal curve as shown. The wire carries a current of 1.2 A. In a uniform magnetic field $\vec{B}$ of 0.1 T, the wire experiences a force whose magnitude is



(a) 1.2×10^{-2}N. (b) 4.8×10^{-3}N. (c) zero. (d) insufficient data.

32. A charge $(-2Q)$ is distributed uniformly on a spherical balloon of radius R. Another point charge $(+Q)$ is situated at the centre of the balloon. The balloon is now inflated to twice the radius. Neglecting the elastic energy involved in the process, the change in total electric energy of the system is

(a) $\frac{-Q^2}{2\pi\epsilon_0 R}$ (b) $\frac{-Q^2}{4\pi\epsilon_0 R}$ (c) $\frac{+Q^2}{4\pi\epsilon_0 R}$ (d) zero

33. A rainbow is formed when a ray of sunlight passes through a spherical raindrop. Then the total angle through which the ray deviates is (i and r denote the angles of incidence and of refraction respectively)

(a) $2i - 4r$ (b) $\pi + 2i - 4r$ (c) $2(i - r)$ (d) $2(\pi + i - 2r)$

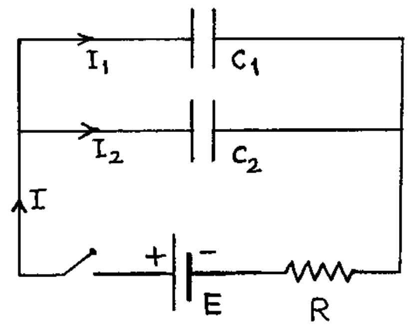
34. A series LCR circuit is connected to an ac source of frequency f and a voltage V. At this frequency, reactance of the capacitor is 350 ohm while the resistance of the circuit is 180 ohm. Current in the circuit leads the voltage by 54° and power dissipated in the circuit is 140 watt. Therefore, voltage V is

(a) 250 volt (b) 260 volt (c) 270 volt (d) 280 volt

35. A car has a rear view mirror of focal length 20 cm. A truck 2 m broad and 1.6 m in height is overtaking the car with a relative speed of 15 km/hr. At the moment when the truck is 6 m behind the car, the car driver will see the image of the truck to be moving at a speed of

(a) 0.0043 m/s (b) 0.13 m/s (c) 0.21 m/s (d) 4.17 m/s

36. In the circuit shown below the switch is closed at $t = 0$. For $0 < t < R\,(C_1 + C_2)$, the current I_1 in the capacitor C_1 in terms of total current I is



(a) $\left(\frac{C_1}{C_2}\right) I$ (b) $\left(\frac{C_2}{C_1}\right) I$ (c) $\left(\frac{C_1}{C_1+C_2}\right) I$ (d) $\left(\frac{C_2}{C_1+C_2}\right) I$

37. The earth is getting energy from the sun whose surface temperature is T_s and radius is R. Let the radius of the earth be r and the distance from the sun be d. Assume the earth and the sun both to behave as perfect black bodies and the earth is in thermal equilibrium at a constant temperature T_e. Therefore, the temperature T_s of the sun is xT_e where x is

(a) $\sqrt{\frac{2d}{R}}$ (b) $\sqrt{\frac{2R}{r}}$ (c) $\sqrt{\frac{4d}{r}}$ (d) $\frac{d}{R}$

38. Imagine an atom made up of a proton and a hypothetical particle of double the mass as that of an electron but the same charge. Apply Bohr theory to consider transitions of the hypothetical particle to the ground state. Then, the longest wavelength (in terms of Rydberg constant for hydrogen atom) is

(a) $\frac{1}{2R}$ (b) $\frac{5}{3R}$ (c) $\frac{1}{3R}$ (d) $\frac{2}{3R}$

39. The half life period of a radioactive element X is the same as the mean lifetime of another radioactive element Y. Initially both of them have the same number of atoms. Then,

(a) X and Y have the same initial decay rate.
(b) X and Y decay at the same rate always.
(c) Y will decay at larger rate than X.
(d) X will decay at larger rate than Y.

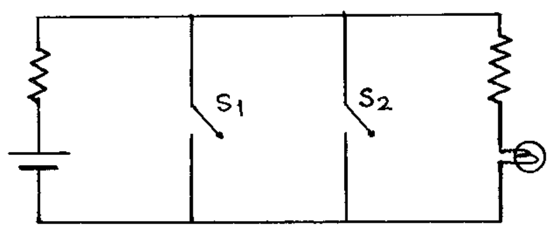
40. A sodium atom emits a photon of wavelength 590 nm and recoils with velocity v equal to

(a) 0.029 m/s (b) 0.048 m/s (c) 0.0023 m/s (d) data inadequate

41. A practical diode (p-n junction) when forward biased is equivalent to

(a) a closed switch.
(b) a cell (potential difference).
(c) a small resistance.
(d) all the above in series.

42. The circuit shown below is equivalent to



(a) OR gate (b) NOR gate (c) AND gate (d) NAND gate

43. Which one of the following statements in connection with a semiconducting material is NOT CORRECT?

(a) They have negative temperature coefficient of resistance.
(b) They have a moderate forbidden energy gap.
(c) Current is carried by electrons and holes both.
(d) Every semiconducting material is a tetravalent element.

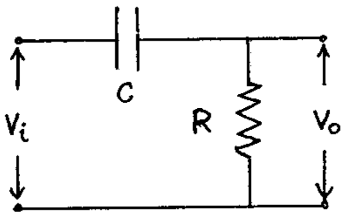
Group of Q. Nos. 44 to 51 is based on the following paragraph.

Generally light emitted from a source contains several wavelengths. Similarly the electrical voltage at the output of a sensor contains a mixture of dc and several ac components of different amplitudes and different frequencies. Filter circuits are used to pass desired frequencies and /or to eliminate undesired frequencies. The frequencies transmitted by the filter form the pass band while the frequencies eliminated by the filter form the stop band or rejection band.

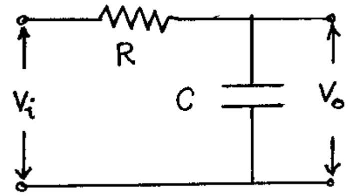
We can think of four basic types of electrical filters- a low pass filter where frequencies below a certain cutoff frequency $f_c$are passed. Similarly one can think of a high pass filter, band pass filter, band stop (or band rejection) filter. The cutoff frequency f_c is the frequency at which the output voltage falls to $\frac{1}{\sqrt{2}}$ times its maximum value.

An inductor and/or a capacitoris an essential component of a filter. Generally a resistance is included in a filter circuit to determine the time constant and hence the cutoff frequency.

44. Refer to the RC networks (1) and (2) shown below. Which of the following statements is true?



(1)



(2)

(a) Each of the two networks represents a low pass filter.
(b) Each of the two networks represents a high pass filter.
(c) Network (1) represents a low pass filter while network (2) a high pass filter.
(d) Network (1) represents a high pass filter while network (2) a low pass filter.

45. The input-output voltage relation for a certain high pass filter is given by

$$\frac{V_o}{V_i} = \frac{\omega CR}{\sqrt{1+\omega^2 C^2 R^2}}$$

The cut-off frequency(f_c) for this filter will be

(a) $\frac{1}{2\pi RC}$ (b) $\frac{\sqrt{2}}{\pi RC}$ (c) $\frac{\pi}{2RC}$ (d) $\frac{1}{RC}$

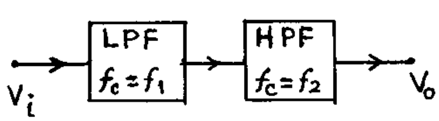
46. The input-output voltage relation for a certain filter circuit is given by

$$\frac{V_o}{V_i} = \frac{\omega\beta A}{\sqrt{(\omega_1^2-\omega^2)^2+\omega^2\beta^2}}$$

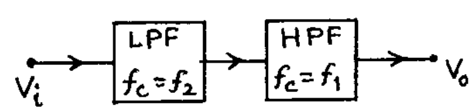
where ω is the angular frequency of the input while ω_1, A and β are constants. This relation is meant for

(a) low pass filter (b) high pass filter (c) band pass filter (d) band stop filter

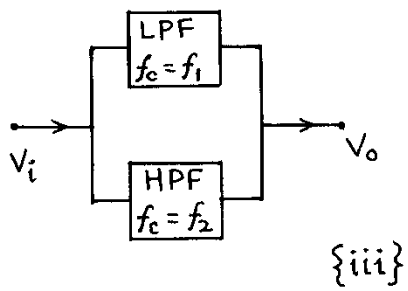
47. Refer to the following schematic diagrams of different combinations of a low pass filter (LPF) and a high pass filter (HPF). Assume $f_1 < f_2$. The combination that works as a band pass filter is

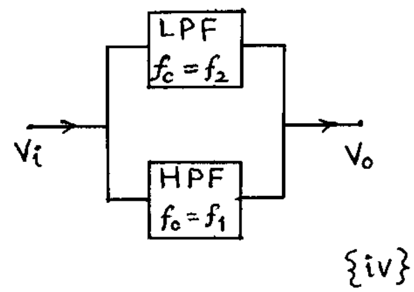


{i}



{ii}





(a) {i} (b) {ii} (c) {iii} (d){iv}

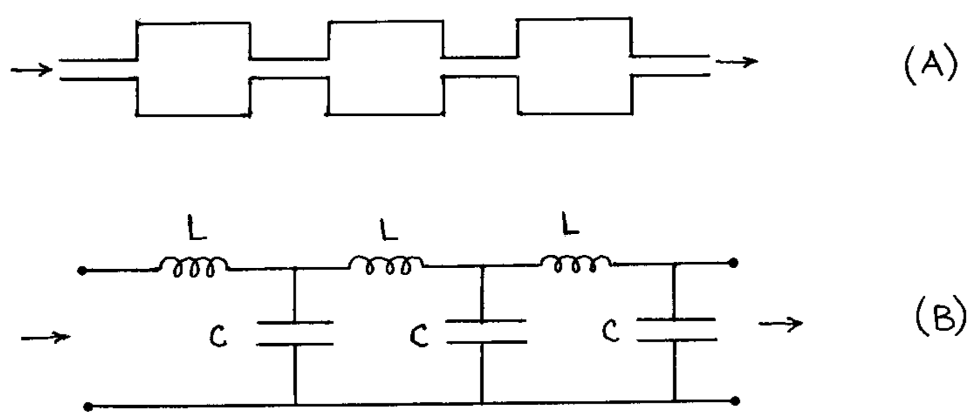
48. Refer to the schematic diagram in Q. No. (47). The combination that works as a band elimination filter is

(a) {i} (b) {ii} (c) {iii} (d) {iv}

49. An astrophysicist desires to study radiation at wavelengths higher than those for visible light coming from a certain celestial body. He must use an optical filter that is

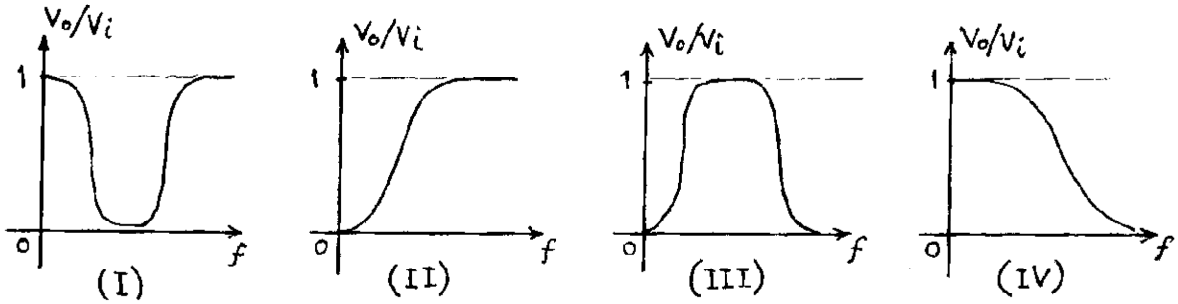
(a) high pass. (b) low pass. (c) band pas (d) band rejection

50. Figure (A) below shows an acoustical filter that consists of a set of identical cavities connected by narrow tubes and figure (B) shows its electrical analog. The acoustical filter represented by figure (A) is



(a) low pass (b) high pass (c) band pass (d) band rejection

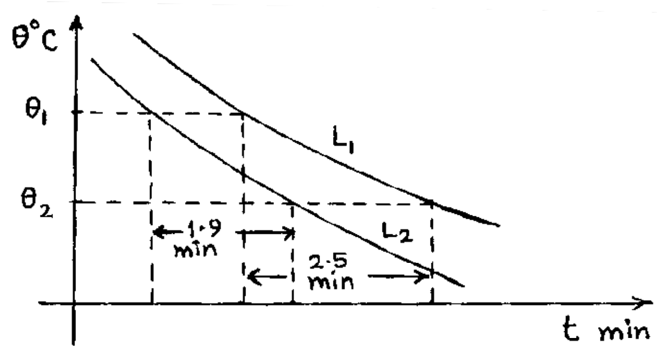
51. Graphs I, II, III and IV shown below represent the frequency response of different types of filter circuits. The correct order of these graphs corresponding to low pass, high pass, band pass and band stop filter is



(a) I, II, III, IV (b) II, IV, III, I (c) IV, II, III, I (d) IV, III, II, I

Group of Q. Nos. 52 to 60isbased on the following paragraph.

Equal volumes of two liquids (L_1 and L_2) are taken in two identical calorimeters. Both L_1 and L_2 are initially at about 80^oC. Calorimeters are corked fitted with thermometers to record the temperatures of the liquids. The temperatures are recorded every 30 s alternating between the two liquids, that is the temperatures are recorded at an interval of 1 min for any one liquid. The graphs of temperature θ (^oC) versus time t (min)for two liquids L_1 and $L_2$are as shown.



52. From the graphs it can be said that

(a) Newton's law of cooling is not valid.
(b) thespecific heat of L_2 is greater than that of L_1.
(c) the observations recorded are not consistent.
(d) none of the above statements is correct.

53. Equal volumes of the two liquids are necessary so that
(a) heat contents of the two liquids are equal.
(b) the exposed surfaces are equal.
(c) thecalculations are simplified.
(d) none of the above.

54. The nature of the outer surfaces of the calorimeters

(a) should be blackened and rough.
(b) should be silvered and rough.
(c) should be silvered and polished / shining.
(d) could be arbitrary.

55. Which of the following arrangements would be the ideal environment for the two calorimeters?

(a) A double walled box, both inner and outer space filled with water.
(b) A double walled box with water in the inner box and empty outer box.
(c) A double walled box with water in the outer box and empty inner box.
(d) In air without any box.

56. The two curves will
(a) intersect at some later time.
(b) merge after a long time.
(c) remain separate at all times.
(d) be parallel to the X axis but distinct after a long time.

57. Given: mass of L_1 = 50 g and mass of L_2 = 62.5 g. If water equivalent of calorimeters is assumed to be negligible, then $\left(\frac{s_1}{s_2}\right)$equals

(a) 1.04 (b) 0.60 (c) 0.95 (d) 1.64

58. If $\rho_1$and ρ_2 are the densities of L_1 and L_2 respectively then, identify the correct statement.

(a) $s_1>s_2$, $\rho_1>\rho_2$ (b) $s_1>s_2$, $\rho_1<\rho_2$
(c) $s_1<s_2$, $\rho_1>\rho_2$ (d) $s_1<s_2$, $\rho_1<\rho_2$

59. If the experiment is carried out with equal masses of the two liquids, then

(a) L_1 will cool faster.
(b) L_2 will cool faster.
(c) both the liquids will cool at the same rate.
(d) nothing can be said about the rates as data are insufficient.

60. The entire experiment is repeated with other two liquids having nearly the same specific heats. Then,

(a) the two curves will be coincident.
(b) the two curves will be parallel.
(c) the two curves will intersect at a point.
(d) nothing can be said about the two curves as data are insufficient.

A 2

In Q. Nos. 61 to 70 any number of options (1 or 2 or 3 or all 4) may be correct. You are to identify all of them correctly to get 6 marks. Even if one answer identified is incorrect or one correct answer is missed, you get zero marks.

61. Which of the following is / are the unit / s of magnetic field ?

    (a) tesla (b) newton / ampere-meter (c) weber / meter^2 (d) volt-second / meter^2

62. The inductance of a solenoid varies

    (a) directly as the area of cross section.
    (b) directly as the square of the number of turns.
    (c) inversely as the length of the solenoid.
    (d) directly as the volume enclosed by the solenoid.

63. Which of the following statement/s in case of a thermodynamic process is/are correct? (The symbols carry their usual meaning.)

    (a) $\Delta E_{\text{int}} = W$ indicates an adiabatic process.
    (b) $\Delta E_{\text{int}} = Q$ suggests an isochoric process.
    (c) $\Delta E_{\text{int}} = 0$ is true for a cyclic process.
    (d) $\Delta E_{\text{int}} = -W$ indicates an adiabatic process.

64. With a rise of temperature

    (a) surface tension of water decreases. (b) viscosity of water decreases.
    (c) viscosity of air decreases. (d) viscosity of air increases.

65. Which of the following statement/s is/are correct in case of a source of emf (such as a primary cell)?

    (a) Inside the cell there always exist an electrostatic field and a non-electrostatic field of equal magnitude directed opposite to it.
    (b) Potential difference is the work of an electrostatic field whereas electromotive force is the work of a non-electrostatic field.
    (c) Under certain condition current can flow from positive terminal to negative terminal within the cell.
    (d) When an external resistance is connected to the cell, the electrostatic field inside the cell decreases in magnitude compared to the non-electrostatic field.

66. Which of the following statement/s is/are correct in case of a resistance in a resistance box used in a laboratory?

(a) The resistance is prepared using tungsten or nichrome wire.
(b) The resistance is prepared using manganin wire.
(c) Half of the length of the resistance wire is wound clockwise and the remaining half anticlockwise just to accommodate the whole length in a small space.
(d) Half of the length of the resistance wire is wound clockwise and the remaining half anticlockwise to make the inductive effect zero.

67. In a certain experiment density of the material of a small metallic cylindrical tube of a given mass is to be determined. Its length is about 3 cm, outer diameter more than about 1 cm and wall thickness about 2mm; the flat base being a little thicker than 2mm. Which of the following set/s of apparatus can be used to determine the volume of the tube accurately?

(a) Water and a measuring cylinder.
(b) Water, a measuring cylinder and a micrometer screw gauge.
(c) An overflow vessel, a measuring cylinder and water.
(d) Only verniercallipers.

68. An object and a screen are separated by a distance D. A convex lens of focal length f such that $4f<D$, is moved between the object and the screen to get two sharp images. If the two positions of the lens are separated by a distance L, then

(a) L is equal to $\sqrt{D(D-4f)}$.
(b) object distance in one position is numerically equal to image distance in the other position.
(c) the ratio of sizes of the two images is $\frac{(D-L)}{(D+L)}$.
(d) the ratio of sizes of the two images is $\frac{(D-L)^2}{(D+L)^2}$.

69. A transistor (*pnp* or *npn*) can be used as

(a) an amplifier.
(b) an oscillator.
(c) a switch.
(d) a current source.

70. When photons each with energy 4.25 eV strike the surface of a metal A, the photoelectrons given out have maximum kinetic energy T_A and the corresponding de Broglie wave length isλ_A. When another metal surface B is irradiated with photons each with energy 4.70 eV, the corresponding maximum kinetic energy $T_B$is 1.50eV less thanT_A. If the de Broglie wave length λ_B of these photoelectrons is twice that of λ_A, then

(a) work function of metal A is 2.25 eV.
(b) work function of metal A is 4.20 eV.
(c) T_A = 2.0 eV.
(d) the radiation incident on metal A has a wavelength 292 nm.

-x-x-x-x-x-x-x-x-x-

Physical constants you may need…

Magnitude of charge on electron $e = 1.60 \times 10^{-19}$ C
Mass of electron $m_e = 9.10 \times 10^{-31}$ kg
Universal gravitational constant $G = 6.67 \times 10^{-11}$ Nm^2/ kg^2
Permittivity of free space $\varepsilon_0 = 8.85 \times 10^{-12}$ C^2/Nm^2
Universal gas constant R = 8.31 J/mol K
Planck constant $h = 6.62 \times 10^{-34}$Js
Stefan constant $\sigma = 5.67 \times 10^{-8}$ W/m^{2}K^4
Boltzmann constant $k = 1.38 \times 10^{-23}$ J/K
Mass of proton $m_p = 1.67 \times 10^{-27}$ kg
Faraday constant = 96,500 C/mol
Boiling point of nitrogen = 77.4 K
Boiling point of oxygen = 90.19 K
Boiling point of hydrogen =20.3 K
Boiling point of helium = 4.20 K

Rough Page

Rough Page