KEAM Physics

Sample Paper – 5

Duration: 150 Minutes **Maximum Marks: 480**

Instructions

- This paper contains **120 Multiple Choice Questions** (Single Correct Answer), modelled on **Paper I (Physics)** of the **KEAM** (Kerala Engineering Architecture Medical) entrance examination.
- Each question has **five options** (A, B, C, D, E); only **one** option is correct.
- Each correct answer carries $+4$ **marks**. Each incorrect answer carries -0.5 **marks**. Unattempted questions carry **0 marks**.
- If more than one option is marked, the response is treated as incorrect and attracts -0.5 marks.
- Personal calculators, log tables, mobile phones, and other electronic gadgets are **strictly prohibited**. Rough work must be done only in the space provided in the question booklet.
- Syllabus: **Class XI & XII Physics** (Kerala State Board / NCERT) — Mechanics, Thermodynamics, Waves, Electrostatics, Current Electricity, Magnetism, Optics, Modern Physics, Semiconductors.

Q1. A body of mass $m = (2.0 \pm 0.1)$ kg moves with speed $v = (10.0 \pm 0.2)$ m/s. The percentage error in its kinetic energy $KE = \frac{1}{2}mv^2$ is:

(A) 5%

(B) 7%

(C) 9%

(D) 12%

(E) 14%

Q2. The volume of a cylinder is $V = \pi r^2 h$. If $r = (5.0 \pm 0.1)$ cm and $h = (10.0 \pm 0.2)$ cm, the percentage error in V is:

(A) 2%

(B) 4%

(C) 5%

(D) 6%

(E) 8%

Q3. A particle starts from rest and accelerates uniformly at 4 m/s^2. Using the formula for distance covered in the nth second, $s_n = u + a\left(n - \frac{1}{2}\right)$, the distance covered **in the 5th second** is:

(A) 16 m

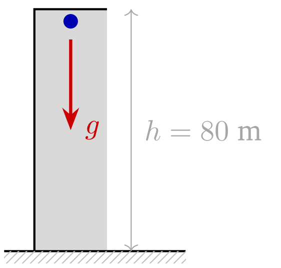
(B) 18 m

(C) 20 m

(D) 22 m

(E) 10 m

Q4. A stone is dropped from rest from a height of 80 m. Taking $g = 10$ m/s^2, the time taken to reach the ground is:



(A) 4 s

(B) 6 s

(C) 8 s

(D) 2 s

(E) 5 s

Q5. A projectile is launched with the same speed at angles 30° and 60° to the horizontal. The ratio of the maximum heights H_{30}/H_{60} is:

(A) $1 : 2$

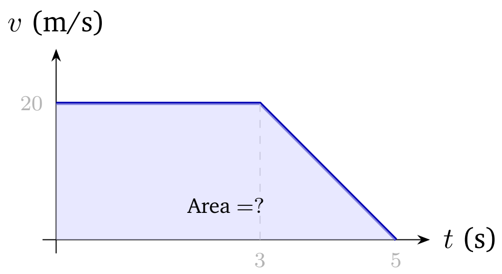
(B) $2 : 1$

(C) $3 : 1$

(D) $1 : 1$

(E) $1 : 3$

Q6. A particle moves with constant velocity 20 m/s for 3 s, then decelerates uniformly to rest in 2 s, as shown in the velocity-time graph. The total displacement is:



(A) 60 m

(B) 70 m

(C) 80 m

(D) 90 m

(E) 100 m

Q7. Train A travels at 60 km/h and Train B travels at 90 km/h **toward each other** on the same track. The relative velocity of approach is:

(A) 30 km/h

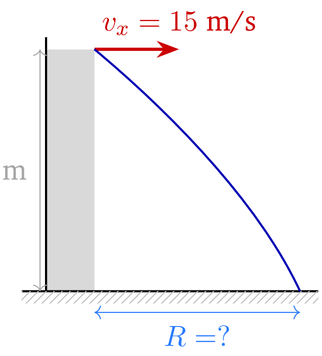
(B) 60 km/h

(C) 90 km/h

(D) 150 km/h

(E) 120 km/h

Q8. A ball is thrown horizontally with speed 15 m/s from the top of a cliff 80 m high. Taking $g = 10$ m/s^2, the horizontal distance from the base of the cliff where the ball hits the ground is:



(A) 45 m

(B) 60 m

(C) 75 m

(D) 90 m

(E) 30 m

Q9. A car travels 40 km due east and then 30 km due north, completing the journey in 2 h. The average **speed** for the entire journey is:

(A) 35 km/h

(B) 25 km/h

(C) 50 km/h

(D) 20 km/h

(E) 40 km/h

Q10. A particle moves along the x-axis with position $x = 2t^2 + 3t + 1$ (metres, t in seconds). The average velocity between $t = 1$ s and $t = 3$ s is:

(A) 9 m/s

(B) 7 m/s

(C) 13 m/s

(D) 5 m/s

(E) 11 m/s

Q11. A box rests on a table. Which of the following represents a **correct** Newton's third law action-reaction pair?

(A) Weight of the box (downward) and normal force of the table on the box (upward)

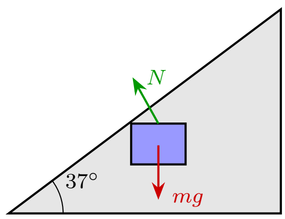
(B) Weight of the box and weight of the table

(C) Force of the box on the table (downward contact force) and force of the table on the box (normal force upward)

(D) Tension in a rope attached to the box and the weight of the box

(E) Friction on the box from the table and the weight of the box

Q12. A block begins to slide down an inclined surface when the angle of inclination is 37° ($\sin 37^\circ = 0.6$, $\cos 37^\circ = 0.8$), as shown. The coefficient of static friction μ_s between the block and the incline is:



(A) 0.60

(B) 0.50

(C) 0.80

(D) 0.75

(E) 1.00

Q13. Three blocks A (2 kg), B (3 kg), and C (5 kg) are placed in contact on a **frictionless** surface and pushed by a horizontal force $F = 20$ N applied on block A. The contact force between blocks B and C is:

(A) 4 N

(B) 10 N

(C) 14 N

(D) 16 N

(E) 6 N

Q14. A shell of mass 10 kg, initially at rest, explodes into two pieces of masses 2 kg and 8 kg. If the 2 kg piece flies off at 60 m/s, the speed of the 8 kg piece is:

(A) 15 m/s

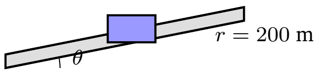
(B) 20 m/s

(C) 30 m/s

(D) 7.5 m/s

(E) 10 m/s

Q15. A curved road of radius 200 m is banked so that a vehicle can navigate it without friction at a certain speed. If $g = 10$ m/s^2 and the ideal speed for no friction is 20 m/s, then $\tan\theta$ (where θ is the banking angle) equals:



(A) 0.1

(B) 0.5

(C) 0.4

(D) 0.25

(E) 0.2

Q16. A spring with spring constant $k = 400$ N/m is compressed by 5 cm. The magnitude of the restoring force exerted by the spring is:

(A) 40 N

(B) 10 N

(C) 20 N

(D) 8 N

(E) 80 N

Q17. A block of mass 5 kg rests on a rough incline at 37° ($\sin 37^\circ = 0.6$, $\cos 37^\circ = 0.8$) with coefficient of static friction $\mu_s = 0.3$. The minimum force (parallel to the incline, directed up) needed to just start moving the block **up** the incline is ($g = 10$ m/s^2):

(A) 30 N

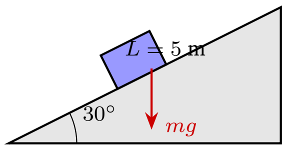
(B) 12 N

(C) 36 N

(D) 42 N

(E) 48 N

Q18. A block of mass 4 kg slides down a smooth incline of length 5 m inclined at 30° to the horizontal. The work done by gravity on the block is ($g = 10$ m/s^2):



(A) 50 J

(B) 100 J

(C) 150 J

(D) 200 J

(E) 80 J

Q19. A particle moves under the influence of a conservative force $F = (4 - 2x)$ N (where x is in metres). Using $F = -\dfrac{dU}{dx}$, the potential energy function $U(x)$ (with $U(0) = 0$) is:

(A) $U = x^2 - 4x$ J

(B) $U = 4x - x^2$ J

(C) $U = 2x - 4$ J

(D) $U = 4 - 2x$ J

(E) $U = 2x^2 - 4x$ J

Q20. Object 1 has mass $2m$ and speed $v/2$. Object 2 has mass m and speed v. The ratio of their kinetic energies $KE_1 : KE_2$ is:

(A) $2 : 1$

(B) $1 : 4$

(C) $4 : 1$

(D) $1 : 1$

(E) $1 : 2$

Q21. A car of mass 1500 kg moves at constant speed 20 m/s against a frictional force of 750 N. The power delivered by the engine is:

(A) 7.5 kW

(B) 10 kW

(C) 15 kW

(D) 20 kW

(E) 30 kW

Q22. A ball of mass 2 kg moving at 6 m/s collides and sticks perfectly to a stationary ball of mass 4 kg. The speed after collision and the kinetic energy lost are:

(A) 1 m/s; 36 J

(B) 3 m/s; 18 J

(C) 2 m/s; 12 J

(D) 2 m/s; 24 J

(E) 4 m/s; 24 J

Q23. A spring with spring constant $k = 500$ N/m is compressed by $x = 0.1$ m. The elastic potential energy stored in the spring is:

(A) 5.0 J

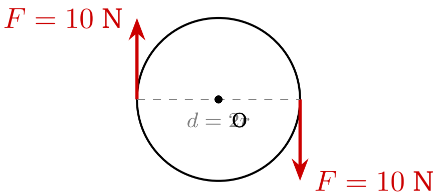
(B) 2.5 J

(C) 1.25 J

(D) 50 J

(E) 0.5 J

Q24. Two equal and opposite forces of magnitude $F = 10$ N are applied at opposite ends of a diameter of a disc of radius $r = 0.5$ m, forming a couple, as shown. The torque of the couple is:



(A) 10 N·m

(B) 5 N·m

(C) 20 N·m

(D) 2.5 N·m

(E) 15 N·m

Q25. A net torque of 50 N·m is applied to a disc having moment of inertia $I = 25$ kg·m^2. The angular acceleration produced is:

(A) 5 rad/s^2

(B) 50 rad/s^2

(C) 0.5 rad/s^2

(D) 25 rad/s^2

(E) 2 rad/s^2

Q26. A thin-walled hollow cylinder (like a ring) of mass M and radius R has its moment of inertia about its **central axis** equal to:

(A) $\frac{1}{2}MR^2$
(B) $\frac{1}{4}MR^2$
(C) MR^2
(D) $\frac{2}{3}MR^2$
(E) $2MR^2$

Q27. A star of radius R_0 rotates with period T_0. It undergoes a supernova collapse reducing its radius to $R_0/5$. Assuming angular momentum is conserved, the new period of rotation is:

(A) $T_0/5$

(B) $T_0/10$

(C) $T_0/50$

(D) $T_0/25$

(E) $5T_0$

Q28. A disc rotates **counterclockwise** when viewed from above. According to the right-hand rule, the direction of the angular momentum vector $\vec{L}$ is:

(A) Radially outward from the axis

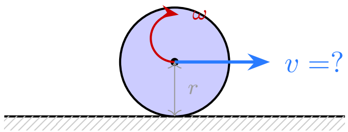
(B) Vertically upward (same direction as viewing)

(C) Vertically downward

(D) Tangentially in the direction of rotation

(E) Horizontally in the plane of the disc

Q29. A solid cylinder of radius $r = 0.5$ m rolls without slipping on a flat surface. If its angular velocity is $\omega = 4$ rad/s, the translational speed of its centre is:



(A) 2 m/s

(B) 4 m/s

(C) 8 m/s

(D) 1 m/s

(E) 0.5 m/s

Q30. A flywheel has moment of inertia $I = 4$ kg·m^2 and rotates at angular speed $\omega = 10$ rad/s. Its rotational kinetic energy is:

(A) 400 J

(B) 100 J

(C) 40 J

(D) 800 J

(E) 200 J

Q31. Kepler's second law states that a planet sweeps out **equal areas in equal times** as it orbits the Sun. This law is a direct consequence of conservation of:

(A) Linear momentum

(B) Kinetic energy

(C) Angular momentum

(D) Total mechanical energy

(E) Gravitational potential energy

Q32. At a depth $d = R/4$ below Earth's surface (where R is Earth's radius), the acceleration due to gravity g' is:

(A) $g/4$

(B) $g/2$

(C) g

(D) $3g/4$

(E) $7g/8$

Q33. A satellite orbits Earth at orbital radius r_0 with period T_0. Another satellite orbits at radius $4r_0$. By Kepler's third law ($T^2 \propto r^3$), the period of the second satellite is:

(A) $4T_0$

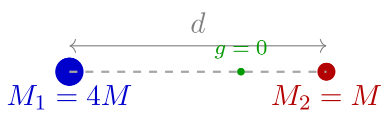
(B) $8T_0$

(C) $2T_0$

(D) $16T_0$

(E) $64T_0$

Q34. Two point masses $M_1 = 4M$ and $M_2 = M$ are separated by distance d. At what distance from M_1 (along the line joining them) is the net gravitational field equal to **zero**?



(A) $\dfrac{2d}{3}$ from M_1

(B) $\dfrac{d}{3}$ from M_1

(C) $\dfrac{d}{2}$ from M_1

(D) $\dfrac{3d}{4}$ from M_1

(E) $\dfrac{d}{4}$ from M_1

Q35. A metal cube of volume $V_0 = 0.001\ \text{m}^3$ is subjected to a pressure increase $\Delta P = 2 \times 10^8$ Pa, causing a volume decrease $\Delta V = 2 \times 10^{-6}\ \text{m}^3$. The bulk modulus of the metal is:

(A) 10^8 Pa

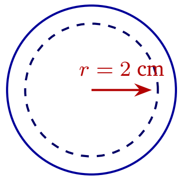
(B) 10^9 Pa

(C) 10^{10} Pa

(D) 2×10^{10} Pa

(E) 10^{11} Pa

Q36. A soap bubble of radius $r = 2$ cm has surface tension $T = 0.04$ N/m. A soap bubble has **two** free surfaces, so the excess pressure inside is $\Delta P = 4T/r$. The excess pressure inside the bubble is:



$\Delta P = 4T/r = ?$

(A) 4 Pa

(B) 2 Pa

(C) 8 Pa

(D) 16 Pa

(E) 1 Pa

Q37. A spherical ball of radius $r = 1$ cm $= 0.01$ m, density $\rho = 1700$ kg/m^3 falls through a liquid of density $\sigma = 800$ kg/m^3 and viscosity $\eta = 1$ Pa·s. Taking $g = 10$ m/s^2, the terminal velocity is:

$$v_T = \frac{2r^2(\rho - \sigma)g}{9\eta}$$

(A) 0.02 m/s

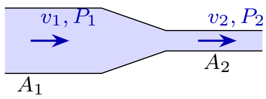
(B) 2.0 m/s

(C) 0.1 m/s

(D) 0.2 m/s

(E) 1.0 m/s

Q38. In a horizontal venturimeter, a fluid flows from a wider section (area A_1) to a narrower throat (area $A_2 < A_1$), as shown. By Bernoulli's principle, the pressure at the throat compared to the pressure at the wider section is:



(A) Higher than at the wider section

(B) Lower than at the wider section

(C) Equal to the pressure at the wider section

(D) Zero

(E) Equal to atmospheric pressure

Q39. In the stress-strain graph of a ductile material, which of the following is true **beyond the elastic limit**?

(A) The wire does not return to its original length when the load is removed (permanent deformation occurs)

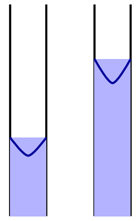
(B) The wire breaks immediately at the elastic limit

(C) Stress remains proportional to strain (Hooke's law still holds)

(D) The material becomes more brittle

(E) Young's modulus of the material increases

Q40. A liquid rises to height $h_1 = 2$ cm in a capillary tube when the contact angle is 60° ($\cos 60^\circ = 0.5$). Using the same tube, liquid, and surface tension, but with contact angle 0° ($\cos 0^\circ = 1$), the new height of rise h_2 is:



$\theta = 60^\circ$, $h_1 \theta = 20^\circ$ cm, $h_2 = ?$

(A) 1 cm

(B) 2 cm

(C) 3 cm

(D) 6 cm

(E) 4 cm

Q41. For a **monatomic** ideal gas, the molar heat capacities C_V, C_P and the ratio $\gamma = C_P/C_V$ are respectively:

(A) $R,\ 2R,\ 2$

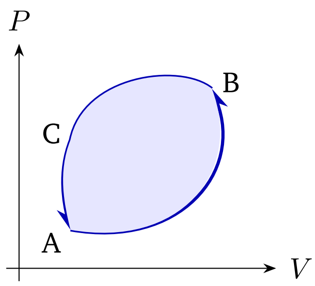
(B) $\frac{5}{2}R,\ \frac{7}{2}R,\ \frac{7}{5}$

(C) $\frac{3}{2}R,\ \frac{5}{2}R,\ \frac{5}{3}$

(D) $R,\ \frac{3}{2}R,\ \frac{3}{2}$

(E) $\frac{7}{2}R,\ \frac{9}{2}R,\ \frac{9}{7}$

Q42. A gas undergoes a cyclic process $A \to B \to C \to A$ shown on the P-V diagram below. The net work done **by the gas** in one complete cycle equals:



(A) Zero, because energy is conserved in a cycle

(B) Sum of work done in each individual process

(C) Change in internal energy over the cycle

(D) Area enclosed by the loop on the P-V diagram

(E) Heat supplied minus heat rejected

Q43. A refrigerator removes 600 J of heat from the cold reservoir and the compressor performs 200 J of work per cycle. The coefficient of performance (COP) β of the refrigerator is:

(A) 0.33

(B) 3.0

(C) 2.0

(D) 4.0

(E) 1.5

Q44. Two moles of an ideal gas are heated **isobarically** from 300 K to 400 K. Taking $R = 8.3$ J/(mol·K), the work done **by the gas** is:

(A) 1660 J

(B) 830 J

(C) 3320 J

(D) 2494 J

(E) 4986 J

Q45. For an ideal gas at temperature T, three characteristic molecular speeds are defined: most probable speed v_{mp}, mean speed $\bar{v}$, and root mean square speed v_{rms}. The correct order is:

(A) $v_{rms} < \bar{v} < v_{mp}$

(B) $v_{mp} < v_{rms} < \bar{v}$

(C) $\bar{v} < v_{mp} < v_{rms}$

(D) $v_{rms} < v_{mp} < \bar{v}$

(E) $v_{mp} < \bar{v} < v_{rms}$

Q46. According to kinetic theory, for a gas with n molecules per unit volume, each of mass m and mean square speed $\langle v^2 \rangle$, the pressure P is given by:

(A) $P = nm\langle v^2 \rangle$

(B) $P = nm\sqrt{\langle v^2 \rangle}$

(C) $P = \frac{1}{3}nm\langle v^2 \rangle$

(D) $P = \frac{2}{3}nm\langle v^2 \rangle$

(E) $P = \frac{1}{6}nm\langle v^2 \rangle$

Q47. A metal rod of length $L = 1$ m, cross-sectional area $A = 4$ cm^2 $= 4 \times 10^{-4}$ m^2, and thermal conductivity $K = 200$ W/(m·K) has its ends maintained at $100°$C and $20°$C. The steady-state rate of heat flow is:

(A) 64 W

(B) 0.64 W

(C) 3.2 W

(D) 6.4 W

(E) 12.8 W

Q48. The mean free path λ of a gas molecule INCREASES when:

(A) Pressure is increased at constant temperature

(B) Temperature is increased at constant pressure

(C) Volume is decreased at constant temperature

(D) Molecular diameter is increased

(E) Number density is increased

Q49. For one mole of an ideal gas, applying the first law to isobaric and isochoric processes shows that:

(A) $C_P - C_V = R$

(B) $C_P - C_V = 2R$

(C) $C_P - C_V = R/2$

(D) $C_P - C_V = \gamma R$

(E) $C_P - C_V = R/(\gamma - 1)$

Q50. In Maxwell's molecular speed distribution curve, the peak of the distribution (the most densely populated speed) corresponds to which speed?

(A) Root mean square speed v_{rms}

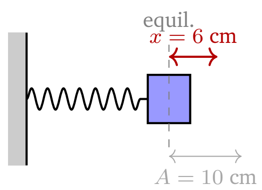
(B) Mean speed $\bar{v}$

(C) Average speed (same as mean)

(D) Maximum possible speed

(E) Most probable speed v_{mp}

Q51. A particle executes simple harmonic motion with amplitude $A = 10$ cm and angular frequency $\omega = 4$ rad/s. The speed of the particle when the displacement is $x = 6$ cm is:



(A) 40 cm/s

(B) 24 cm/s

(C) 32 cm/s

(D) 16 cm/s

(E) 8 cm/s

Q52. A uniform rod of length L is pivoted at one end and oscillates as a compound pendulum. Its moment of inertia about the pivot is $I = ML^2/3$

and the centre of mass is at $L/2$ from the pivot. The equivalent simple pendulum length L_{eff} (where $T = 2\pi\sqrt{L_{eff}/g}$) is:

(A) $L/2$

(B) $L/3$

(C) L

(D) $2L/3$

(E) $3L/4$

Q53. Two springs of spring constants $k_1 = 3$ N/m and $k_2 = 6$ N/m are connected in **series** to a block of mass $m = 1$ kg. The time period of oscillation is:

(A) π s

(B) $\pi\sqrt{2}$ s

(C) 2π s

(D) $\pi/\sqrt{2}$ s

(E) $2\pi/\sqrt{2}$ s

Q54. In a lightly damped forced oscillation system with natural frequency ω_0, the amplitude of oscillation is **maximum** when the driving angular frequency ω_d is approximately equal to:

(A) The natural frequency ω_0

(B) Twice the natural frequency $2\omega_0$

(C) Half the natural frequency $\omega_0/2$

(D) Any frequency greater than ω_0

(E) Zero frequency

Q55. In SHM with amplitude A, the kinetic energy equals the potential energy at displacement x equal to:

(A) $x = 0$ (mean position)

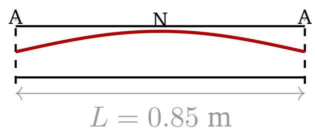
(B) $x = A$ (extreme position)

(C) $x = A/2$

(D) $x = A/4$

(E) $x = A/\sqrt{2}$

Q56. An open organ pipe (open at both ends) of length $L = 0.85$ m resonates in its fundamental mode. Taking the speed of sound $v = 340$ m/s, the fundamental frequency is:



(A) 100 Hz

(B) 400 Hz

(C) 200 Hz

(D) 50 Hz

(E) 340 Hz

Q57. A travelling wave is described by $y = 0.5\sin(4x - 8t)$ metres, where x is in metres and t in seconds. The wavelength and wave speed are respectively:

(A) $\lambda = 2\pi$ m, $\quad v = 4$ m/s

(B) $\lambda = \pi$ m, $\quad v = 2$ m/s

(C) $\lambda = \pi/2$ m, $\quad v = 4$ m/s

(D) $\lambda = \pi/2$ m, $\quad v = 2$ m/s

(E) $\lambda = 4$ m, $\quad v = 8$ m/s

Q58. Newton assumed sound propagation in air is **isothermal** and obtained $v = \sqrt{P/\rho}$. Laplace corrected this by noting the process is actually **adiabatic**. The correct formula (Laplace) for speed of sound in a gas is:

(A) $v = \sqrt{P/\rho}$

(B) $v = \sqrt{\gamma P/\rho}$

(C) $v = \sqrt{\gamma\rho/P}$

(D) $v = \gamma\sqrt{P/\rho}$

(E) $v = \sqrt{P/\gamma\rho}$

Q59. An observer moves toward a **stationary** source of sound (frequency $f_0 = 500$ Hz) at speed $v_0 = 20$ m/s. The speed of sound is $v = 340$ m/s. The apparent frequency heard by the observer is:

(A) $\frac{500 \times 360}{340}$ Hz (≈ 529 Hz)

(B) $\frac{500 \times 340}{360}$ Hz (≈ 472 Hz)

(C) $\frac{500 \times 320}{340}$ Hz (≈ 471 Hz)

(D) $\frac{500 \times 340}{320}$ Hz (≈ 531 Hz)

(E) $\frac{500 \times 340}{300}$ Hz (≈ 567 Hz)

Q60. A sound wave has intensity $I = 10^{-4}$ W/m^2. Taking the reference intensity $I_0 = 10^{-12}$ W/m^2, the intensity level in decibels ($\beta = 10\log_{10}(I/I_0)$) is:

(A) 40 dB

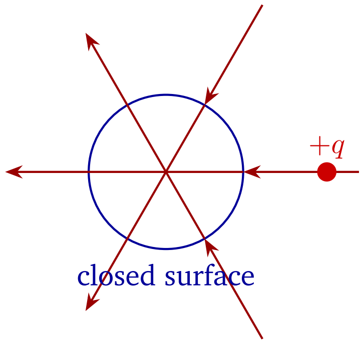
(B) 120 dB

(C) 60 dB

(D) 100 dB

(E) 80 dB

Q61. A point charge q is placed **outside** a closed spherical surface, as shown. By Gauss's law, the total electric flux through the sphere is:



(A) q/ε_0

(B) $q/(4\pi\varepsilon_0 R^2)$

(C) Zero

(D) $q/(2\varepsilon_0)$

(E) $-q/\varepsilon_0$

Q62. Two point charges $q_1 = +2\ \mu$C and $q_2 = -3\ \mu$C are separated by a distance $r = 30$ cm. Taking $k = 9 \times 10^9$ N·m^2/C^2, the electric potential energy of the system is:

(A) $+0.18$ J

(B) -0.54 J

(C) $+0.54$ J

(D) -0.18 J

(E) 0 J

Q63. The electric potential at a point P due to a charge Q is $V = 90$ V. The work done in bringing a test charge $q_0 = 0.2$ C from infinity to point P is:

(A) 90 J

(B) 18 J

(C) 450 J

(D) 0 J

(E) 9 J

Q64. Three capacitors $C_1 = 4\ \mu\text{F}$, $C_2 = 6\ \mu\text{F}$, and $C_3 = 2\ \mu\text{F}$ are connected in **parallel**. The equivalent capacitance is:

(A) $12\ \mu\text{F}$

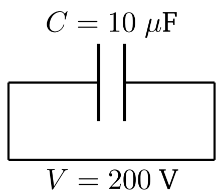
(B) $0.92\ \mu\text{F}$

(C) $6\ \mu\text{F}$

(D) $8\ \mu\text{F}$

(E) $24\ \mu\text{F}$

Q65. A capacitor of capacitance $C = 10\ \mu\text{F}$ is charged to a potential difference $V = 200$ V. The energy stored in the capacitor is:



(A) 0.04 J

(B) 2.0 J

(C) 0.4 J

(D) 4.0 J

(E) 0.2 J

Q66. A parallel plate capacitor has plates of area A carrying surface charge density σ. Which of the following correctly gives the electrostatic force per unit area on each plate?

(A) $\sigma^2 A/\varepsilon_0$

(B) $\sigma A^2/(2\varepsilon_0)$

(C) $\sigma^2/(2\varepsilon_0)$

(D) $\sigma^2/(4\varepsilon_0)$

(E) $\varepsilon_0\sigma^2$

Q67. A neutral conducting sphere has a spherical cavity. A charge $+q$ is placed **inside** the cavity (not touching the walls). The charge induced on the **outer surface** of the conductor is:

(A) $-q$

(B) Zero

(C) $+2q$

(D) $+q$

(E) $-2q$

Q68. An electric dipole with dipole moment $p = 2 \times 10^{-29}$ C·m is placed in a uniform electric field $E = 5 \times 10^5$ N/C at an angle $\theta = 60^\circ$ to the field. The potential energy of the dipole is:

(A) $+5 \times 10^{-24}$ J

(B) -5×10^{-24} J

(C) -10^{-23} J

(D) $+10^{-23}$ J

(E) Zero

Q69. The Van de Graaff generator can accumulate very large charges on its hollow dome because:

(A) Charge deposited on the inner surface of the hollow conductor moves to the outer surface, allowing unlimited accumulation

(B) Charge is stored inside the conductor

(C) The electric field inside the dome is very large

(D) Electromagnetic induction continuously generates charge

(E) Charge does not leak from sharp pointed conductors

Q70. In an electric field diagram, the region where field lines are most **densely packed** corresponds to:

(A) Lowest potential

(B) Highest potential

(C) Zero field

(D) Lowest field intensity

(E) Highest field intensity

Q71. A battery of EMF 12 V and internal resistance $r = 2\ \Omega$ is connected to a variable external resistor R. Maximum power is delivered to R when:

(A) $R = 0$

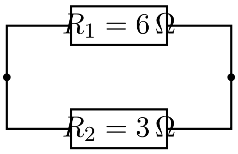
(B) $R \to \infty$

(C) $R = 2\ \Omega$

(D) $R = 4\ \Omega$

(E) $R = 1\ \Omega$

Q72. Two resistors $R_1 = 6\ \Omega$ and $R_2 = 3\ \Omega$ are connected in **parallel**. The equivalent resistance is:



(A) $9\ \Omega$

(B) $4\ \Omega$

(C) $3\ \Omega$

(D) $2\ \Omega$

(E) $18\ \Omega$

Q73. Two cells with $\varepsilon_1 = 3$ V, $r_1 = 1\ \Omega$ and $\varepsilon_2 = 2$ V, $r_2 = 2\ \Omega$ are connected in parallel. The equivalent EMF is:

(A) 5 V

(B) $8/3$ V

(C) 2.5 V

(D) 3 V

(E) 2 V

Q74. A current of 3 A flows through a resistor of $5\ \Omega$ for 2 min. The heat generated in the resistor is:

(A) 5400 J

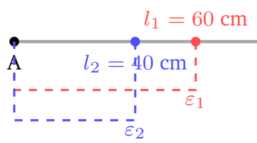
(B) 1800 J

(C) 270 J

(D) 900 J

(E) 3600 J

Q75. In a potentiometer experiment, the balancing length for cell 1 is $l_1 = 60$ cm and for cell 2 is $l_2 = 40$ cm for the same primary current. The ratio $\varepsilon_1 : \varepsilon_2$ of their EMFs is:



(A) $1 : 1$

(B) $2 : 3$

(C) $4 : 6$

(D) $1 : 2$

(E) $3 : 2$

Q76. In a meter bridge, a known resistance $P = 30\ \Omega$ is placed in the left gap. The bridge balances at 60 cm from the left end. The unknown resistance Q in the right gap is:

(A) $45\ \Omega$

(B) $25\ \Omega$

(C) $20\ \Omega$

(D) $30\ \Omega$

(E) $10\ \Omega$

Q77. A copper wire has resistance $R_0 = 5\ \Omega$ at $0°$C. Taking the temperature coefficient of resistance $\alpha = 4 \times 10^{-3}\ °\text{C}^{-1}$, the resistance at $100°$C is:

(A) $5.4\ \Omega$

(B) $6.0\ \Omega$

(C) $5.02\ \Omega$

(D) $7.0\ \Omega$

(E) $9.0\ \Omega$

Q78. A carbon resistor has colour bands Yellow (4), Violet (7), Red (multiplier $\times 100$), Gold ($\pm 5\%$). The resistance of this resistor is:

(A) $47\ \Omega\ \pm 5\%$

(B) 4.7 k$\Omega\ \pm 5\%$

(C) 47 k$\Omega\ \pm 5\%$

(D) $470\ \Omega\ \pm 5\%$

(E) 0.47 k$\Omega\ \pm 5\%$

Q79. An electric heater rated at 1500 W is used for 2 h. The electrical energy consumed, expressed in kilowatt-hours (kWh), is:

(A) 3 kWh

(B) 1.5 kWh

(C) 6 kWh

(D) 0.75 kWh

(E) 9 kWh

Q80. An RC circuit with $R = 1$ MΩ and $C = 5$ μF is connected to an EMF $\varepsilon = 10$ V. In the **steady state**, the charge on the capacitor is:

(A) 5 μC

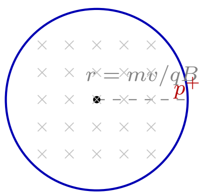
(B) 500 μC

(C) 10 μC

(D) 100 μC

(E) 50 μC

Q81. A proton (mass $m_p = 1.67 \times 10^{-27}$ kg, charge $e = 1.6 \times 10^{-19}$ C) moves with speed $v = 2 \times 10^6$ m/s perpendicular to a magnetic field $B = 0.1$ T. The radius of its circular orbit is:



(A) 0.10 m

(B) 0.15 m

(C) 0.21 m

(D) 0.42 m

(E) 1.05 m

Q82. In a velocity selector, a particle is in equilibrium when the electric force equals the magnetic force: $qE = qvB$. If $E = 2 \times 10^4$ V/m and $B = 0.04$ T, the selected speed is:

(A) 8×10^5 m/s

(B) 2×10^5 m/s

(C) 10^6 m/s

(D) 5×10^5 m/s

(E) 10^5 m/s

Q83. A bar magnet with magnetic moment $M = 0.4$ A·m^2 is placed in a uniform field $B = 0.5$ T at angle $\theta = 30^\circ$. The torque acting on the magnet is:

(A) 0.20 N·m

(B) 0.10 N·m

(C) 0.05 N·m

(D) 0.40 N·m

(E) 0.02 N·m

Q84. At a location, the angle of dip is $\delta = 30^\circ$ and the horizontal component of Earth's magnetic field is $B_H = 0.3$ T. The total magnetic field B at that location is ($B_H = B\cos\delta$):

(A) $0.2\sqrt{3}$ T

(B) $0.3\sqrt{3}$ T

(C) 0.6 T

(D) 0.15 T

(E) $0.1\sqrt{3}$ T

Q85. In the B-H hysteresis loop of a ferromagnetic material, the area enclosed by the loop represents:

(A) Retentivity of the material

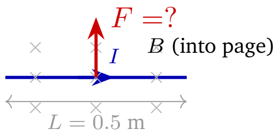
(B) Coercive force

(C) Magnetic susceptibility

(D) Magnetic permeability

(E) Energy dissipated per cycle per unit volume

Q86. A straight current-carrying wire of length $L = 0.5$ m carries current $I = 4$ A in a uniform magnetic field $B = 0.3$ T directed perpendicular to the wire. The force on the wire is:



(A) 1.2 N

(B) 0.3 N

(C) 0.6 N

(D) 2.4 N

(E) 0.15 N

Q87. Which of the following **correctly** distinguishes ferromagnetic from paramagnetic materials?

(A) Both are strongly attracted by magnets

(B) Paramagnetic materials show stronger magnetization than ferromagnetics

(C) Ferromagnetic materials have zero magnetic susceptibility

(D) Ferromagnetic materials have very high relative permeability and form magnetic domains; paramagnetic materials have small positive susceptibility and no domains

(E) Ferromagnetic materials are repelled by magnetic fields

Q88. In a tangent galvanometer, a current I produces deflection $\theta = 45°$. When the current is doubled to $2I$, the new deflection θ' satisfies $\tan\theta' = 2\tan\theta$. The value of θ' is:

(A) $90°$

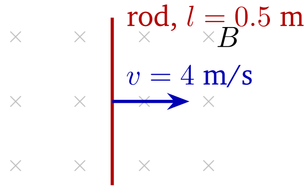
(B) $\arctan(2) \approx 63.4°$

(C) $60°$

(D) $30°$

(E) $45°$

Q89. A conducting rod of length $l = 0.5$ m moves with velocity $v = 4$ m/s perpendicular to a uniform magnetic field $B = 0.3$ T, as shown. The induced EMF is:



(A) 0.6 V

(B) 0.3 V

(C) 1.2 V

(D) 0.15 V

(E) 2.4 V

Q90. A DC motor is connected to a supply voltage of $V = 200$ V. The armature resistance is $R_a = 2\ \Omega$ and the motor draws a current of $I = 10$ A at full load. The back EMF generated by the motor is:

(A) 200 V

(B) 20 V

(C) 220 V

(D) 100 V

(E) 180 V

Q91. An ideal transformer (100% efficiency) has primary voltage $V_1 = 220$ V, primary current $I_1 = 2$ A, and secondary voltage $V_2 = 11$ V. The secondary current I_2 is:

(A) 2 A

(B) 22 A

(C) 40 A

(D) 4 A

(E) 20 A

Q92. In a series RL circuit with $L = 0.2$ H and $R = 4\ \Omega$, connected to a DC source, the current grows as $I = I_0(1 - e^{-t/\tau})$. The time constant τ is:

(A) 0.8 s

(B) 0.8 Ω

(C) 5 s

(D) 0.05 s

(E) 20 s

Q93. A series RLC circuit has $R = 30\ \Omega$, inductive reactance $X_L = 70\ \Omega$, and capacitive reactance $X_C = 30\ \Omega$. The impedance of the circuit is:

(A) 40 Ω

(B) 50 Ω

(C) 100 Ω

(D) 70 Ω

(E) 30 Ω

Q94. A series LC circuit has $L = 0.1$ H and $C = 100\ \mu$F $= 10^{-4}$ F. The resonant frequency $f_0 = \omega_0/(2\pi)$ is approximately:

(A) ≈ 50 Hz

(B) 100 Hz

(C) 25 Hz

(D) 200 Hz

(E) 10 Hz

Q95. In an AC circuit, the RMS voltage is $V_{rms} = 200$ V, the RMS current is $I_{rms} = 5$ A, and the power factor is $\cos\phi = 0.8$. The average power consumed is:

(A) 1000 W

(B) 200 W

(C) 500 W

(D) 400 W

(E) 800 W

Q96. An inductor of self-inductance $L = 0.5$ H is connected to an AC supply of frequency $f = 50$ Hz. The inductive reactance $X_L = \omega L = 2\pi f L$ is:

(A) $25\ \Omega$

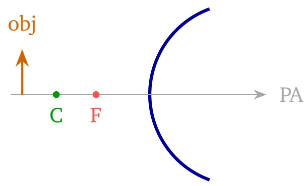
(B) $50\ \Omega$

(C) $50\pi\ \Omega$

(D) $100\pi\ \Omega$

(E) $\pi/50\ \Omega$

Q97. A concave mirror has focal length $f = 20$ cm. An object is placed 60 cm in front of it. Using the mirror formula ($1/v + 1/u = 1/f$, with sign convention $u < 0$, $f < 0$ for concave), the image distance and lateral magnification are:



(A) $v = -60$ cm, $\quad m = -1$

(B) $v = +30$ cm, $\quad m = +1/2$

(C) $v = -20$ cm, $\quad m = -1/3$

(D) $v = -30$ cm, $\quad m = -1/2$

(E) $v = +60$ cm, $\quad m = +1$

Q98. Light travels in air ($n_1 = 1$) and strikes a convex glass surface ($n_2 = 1.5$, $R = +10$ cm) with the object at $u = -20$ cm. Using $\dfrac{n_1}{u} + \dfrac{n_2}{v} = \dfrac{n_2 - n_1}{R}$, the image distance v is:

(A) 10 cm

(B) 15 cm

(C) 20 cm

(D) 25 cm

(E) 30 cm

Q99. A convex lens has a focal length of 25 cm. Its power in diopters is:

(A) $+4$ D

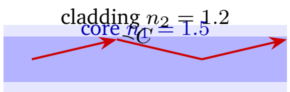
(B) $+2$ D

(C) -4 D

(D) $+0.25$ D

(E) -2 D

Q100. An optical fiber has core refractive index $n_1 = 1.5$ and cladding refractive index $n_2 = 1.2$. Total internal reflection occurs for angles of incidence inside the core exceeding the critical angle C, where $\sin C = n_2/n_1$. The critical angle C is:



(A) $30°$

(B) $37°$

(C) $45°$

(D) $60°$

(E) $\arcsin(0.8) \approx 53°$

Q101. A compound microscope has an objective of focal length $f_o = 1$ cm and an eyepiece of focal length $f_e = 5$ cm. The image formed by the objective is at 14 cm from the objective (tube length $L = 14$ cm). The total magnification for least distance of distinct vision $D = 25$ cm is:

$$M = \frac{L}{f_o}\left(1 + \frac{D}{f_e}\right)$$

(A) 14

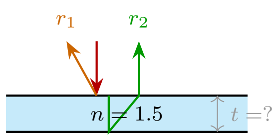
(B) 30

(C) 84

(D) 42

(E) 6

Q102. Light of wavelength $\lambda = 600$ nm is incident normally on a soap film of refractive index $n = 1.5$. For constructive interference (with one phase reversal at the upper surface), the minimum thickness t satisfying $2nt = \lambda/2$ is:



(A) 600 nm

(B) 400 nm

(C) 200 nm

(D) 100 nm

(E) 50 nm

Q103. Light is incident from air on a glass surface with refractive index $n = \sqrt{3}$. At Brewster's angle θ_B ($\tan\theta_B = n$), the angle of refraction θ_r inside the glass is:

(A) 60°

(B) 30°

(C) 45°

(D) 90°

(E) 15°

Q104. A diffraction grating has 500 lines/mm, so the grating spacing is $d = 2000$ nm. For light of wavelength $\lambda = 600$ nm, the angle θ of the **first-order** diffraction maximum is:

(A) $\arcsin(0.3) \approx 17.5^\circ$

(B) 30°

(C) 45°

(D) $\arcsin(0.6) \approx 36.9^\circ$

(E) 60°

Q105. For two light sources to produce a **sustained (stable)** interference pattern, the **necessary** condition is that the sources must be:

(A) Of equal intensity

(B) Of the same polarization

(C) Of equal amplitude

(D) Very close together

(E) Coherent (constant phase difference and same frequency)

Q106. In a photoelectric effect experiment, stopping potential V_0 is measured for different frequencies ν of incident light. The graph of V_0 vs ν is a straight line. The **slope** of this line equals:

(A) Work function ϕ

(B) Threshold frequency ν_0

(C) h/e (Planck's constant divided by electron charge)

(D) $e\phi$

(E) e/h

Q107. A metal has work function $\phi = 2.0$ eV. Light of frequency $\nu = 8 \times 10^{14}$ Hz is incident on it. Using $h = 4.14 \times 10^{-15}$ eV·s, the stopping potential V_0 is:

(A) 2.0 V

(B) 3.3 V

(C) 0.7 V

(D) 1.3 V

(E) 5.3 V

Q108. A proton (mass $m_p = 1.67 \times 10^{-27}$ kg) is accelerated from rest through a potential difference of $V = 100$ V. The de Broglie wavelength $\lambda = h/\sqrt{2m_peV}$ (taking $h = 6.63 \times 10^{-34}$ J·s, $e = 1.6 \times 10^{-19}$ C) is approximately:

(A) 9.1×10^{-11} m

(B) 9.1×10^{-13} m

(C) 9.1×10^{-10} m

(D) 9.1×10^{-15} m

(E) 1.4×10^{-10} m

Q109. Heisenberg's uncertainty principle states that the simultaneous uncertainties in position Δx and momentum Δp of a particle satisfy:

(A) $\Delta x \cdot \Delta p \geq \frac{\hbar}{2}$

(B) $\Delta x \cdot \Delta p \geq \hbar$

(C) $\Delta x \cdot \Delta p \leq \frac{\hbar}{2}$

(D) $\Delta x \cdot \Delta p = \hbar$

(E) $\Delta x \cdot \Delta p \geq h$

Q110. In the Bohr model, the radius of the nth orbit of hydrogen is $r_n = n^2 a_0$, where $a_0 = 0.529$ Å is the Bohr radius. The radius of the **third orbit** ($n = 3$) of hydrogen is:

(A) a_0

(B) $4a_0$

(C) $16a_0$

(D) $2a_0$

(E) $9a_0$

Q111. The Paschen series of the hydrogen spectrum arises from transitions to the $n = 3$ level. The **first line** of the Paschen series corresponds to the electronic transition:

(A) $n = 2 \rightarrow n = 1$

(B) $n = 3 \rightarrow n = 2$

(C) $n = 4 \rightarrow n = 3$

(D) $n = 5 \rightarrow n = 3$

(E) $n = 4 \rightarrow n = 2$

Q112. Two nuclei have mass numbers $A_1 = 8$ and $A_2 = 64$. Using $R = R_0A^{1/3}$, the ratio of their nuclear radii $R_1 : R_2$ is:

(A) $1 : 4$

(B) $1 : 8$

(C) $2 : 1$

(D) $1 : 2$

(E) $1 : 3$

Q113. The **mass defect** of a nucleus is defined as the difference between:

(A) Mass of the nucleus and the mass of its electrons

(B) Sum of the masses of all constituent (free) nucleons and the actual mass of the nucleus

(C) Mass of protons and mass of neutrons inside the nucleus

(D) Atomic mass number and the actual mass of the nucleus (in kg)

(E) Mass of the nucleus and the mass of the atom

Q114. In a **pure (intrinsic)** semiconductor at room temperature, which of the following is always true?

(A) The number of free electrons equals the number of holes

(B) Only electrons act as charge carriers

(C) Only holes act as charge carriers

(D) There are no free charge carriers

(E) Electron concentration exceeds hole concentration

Q115. When a p-n junction diode is **reverse biased**, the width of the depletion region:

(A) Decreases

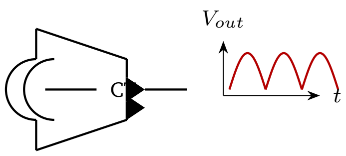
(B) Remains unchanged

(C) Becomes zero

(D) Oscillates

(E) Increases

Q116. A full-wave rectifier (using two diodes and a centre-tap transformer) is connected to a 50 Hz AC supply. The output is shown schematically below. The **ripple frequency** of the rectified output is:



(A) 25 Hz

(B) 50 Hz

(C) 100 Hz

(D) 150 Hz

(E) 200 Hz

Q117. Frequency Modulation (FM) is preferred over Amplitude Modulation (AM) in high-fidelity audio broadcasting primarily because:

(A) FM signals travel farther distances

(B) FM requires less bandwidth than AM

(C) FM is cheaper and simpler to implement

(D) FM is far less susceptible to noise and electrical interference (noise affects amplitude, not frequency)

(E) FM can transmit at higher power levels

Q118. Which layer of the Earth's atmosphere is responsible for **reflecting short radio waves (sky waves)** back to Earth for long-distance communication?

(A) Troposphere

(B) Ionosphere

(C) Stratosphere

(D) Mesosphere

(E) Exosphere

Q119. The critical frequency f_c of the ionosphere (above which radio waves are not reflected) is given by $f_c = 9\sqrt{N_{\max}}$ Hz, where $N_{\max}$ is the maximum electron density per m^3. If $N_{\max} = 10^{12}$ m^{-3}, the critical frequency is:

(A) 9 MHz

(B) 81 MHz

(C) 3 MHz

(D) 18 MHz

(E) 90 MHz

Q120. According to the Nyquist sampling theorem, a signal with a maximum frequency component of $f_{max} = 4$ kHz can be completely reconstructed if the minimum sampling rate f_s satisfies $f_s \geq 2f_{max}$. The minimum sampling rate is:

(A) 4 kHz

(B) 2 kHz

(C) 1 kHz

(D) 6 kHz

(E) 8 kHz

Detailed Solutions

Q1. Answer: (C)

Q2. Answer: (D)

Q3. Answer: (B)

Q4. Answer: (A)

Q5. Answer: (E)

Q6. Answer: (C)

Q7. Answer: (D)

Q8. Answer: (B)

Q9. Answer: (A)

Q10. Answer: (E)

Q11. Answer: (C)

Q12. Answer: (D)

Q13. Answer: (B)

Q14. Answer: (A)

Q15. Answer: (E)

Q16. $\boxed{\text{Answer: (C)}}$

Q17. $\boxed{\text{Answer: (D)}}$

Q18. $\boxed{\text{Answer: (B)}}$

Q19. $\boxed{\text{Answer: (A)}}$

Q20. $\boxed{\text{Answer: (E)}}$

Q21. $\boxed{\text{Answer: (C)}}$

Q22. $\boxed{\text{Answer: (D)}}$

Q23. $\boxed{\text{Answer: (B)}}$

Q24. $\boxed{\text{Answer: (A)}}$

Q25. $\boxed{\text{Answer: (E)}}$

Q26. $\boxed{\text{Answer: (C)}}$

Q27. $\boxed{\text{Answer: (D)}}$

Q28. $\boxed{\text{Answer: (B)}}$

Q29. $\boxed{\text{Answer: (A)}}$

Q30. $\boxed{\text{Answer: (E)}}$

Q31. $\boxed{\text{Answer: (C)}}$

Q32. $\boxed{\text{Answer: (D)}}$

Q33. $\boxed{\text{Answer: (B)}}$

Q34. $\boxed{\text{Answer: (A)}}$

Q35. $\boxed{\text{Answer: (E)}}$

Q36. $\boxed{\text{Answer: (C)}}$

Q37. $\boxed{\text{Answer: (D)}}$

Q38. $\boxed{\text{Answer: (B)}}$

Q39. $\boxed{\text{Answer: (A)}}$

Q40. $\boxed{\text{Answer: (E)}}$

Q41. $\boxed{\text{Answer: (C)}}$

Q42. $\boxed{\text{Answer: (D)}}$

Q43. $\boxed{\text{Answer: (B)}}$

Q44. $\boxed{\text{Answer: (A)}}$

Q45. $\boxed{\text{Answer: (E)}}$

Q46. $\boxed{\text{Answer: (C)}}$

Q47. $\boxed{\text{Answer: (D)}}$

Q48. $\boxed{\text{Answer: (B)}}$

Q49. $\boxed{\text{Answer: (A)}}$

Q50. $\boxed{\text{Answer: (E)}}$

Q51. $\boxed{\text{Answer: (C)}}$

Q52. $\boxed{\text{Answer: (D)}}$

Q53. $\boxed{\text{Answer: (B)}}$

Q54. $\boxed{\text{Answer: (A)}}$

Q55. $\boxed{\text{Answer: (E)}}$

Q56. $\boxed{\text{Answer: (C)}}$

Q57. $\boxed{\text{Answer: (D)}}$

Q58. $\boxed{\text{Answer: (B)}}$

Q59. $\boxed{\text{Answer: (A)}}$

Q60. $\boxed{\text{Answer: (E)}}$

Q61. $\boxed{\text{Answer: (C)}}$

Q62. $\boxed{\text{Answer: (D)}}$

Q63. $\boxed{\text{Answer: (B)}}$

Q64. Answer: (A)

Q65. Answer: (E)

Q66. Answer: (C)

Q67. Answer: (D)

Q68. Answer: (B)

Q69. Answer: (A)

Q70. Answer: (E)

Q71. Answer: (C)

Q72. Answer: (D)

Q73. Answer: (B)

Q74. Answer: (A)

Q75. Answer: (E)

Q76. Answer: (C)

Q77. Answer: (D)

Q78. Answer: (B)

Q79. Answer: (A)

Q80. Answer: (E)

Q81. Answer: (C)

Q82. Answer: (D)

Q83. Answer: (B)

Q84. Answer: (A)

Q85. Answer: (E)

Q86. Answer: (C)

Q87. Answer: (D)

Q88. Answer: (B)

Q89. Answer: (A)

Q90. Answer: (E)

Q91. Answer: (C)

Q92. Answer: (D)

Q93. Answer: (B)

Q94. Answer: (A)

Q95. Answer: (E)

Q96. $\boxed{\text{Answer: (C)}}$

Q97. $\boxed{\text{Answer: (D)}}$

Q98. $\boxed{\text{Answer: (B)}}$

Q99. $\boxed{\text{Answer: (A)}}$

Q100. $\boxed{\text{Answer: (E)}}$

Q101. $\boxed{\text{Answer: (C)}}$

Q102. $\boxed{\text{Answer: (D)}}$

Q103. $\boxed{\text{Answer: (B)}}$

Q104. $\boxed{\text{Answer: (A)}}$

Q105. $\boxed{\text{Answer: (E)}}$

Q106. $\boxed{\text{Answer: (C)}}$

Q107. $\boxed{\text{Answer: (D)}}$

Q108. $\boxed{\text{Answer: (B)}}$

Q109. $\boxed{\text{Answer: (A)}}$

Q110. $\boxed{\text{Answer: (E)}}$

Q111. $\boxed{\text{Answer: (C)}}$

Q112. $\boxed{\text{Answer: (D)}}$

Q113. $\boxed{\text{Answer: (B)}}$

Q114. $\boxed{\text{Answer: (A)}}$

Q115. $\boxed{\text{Answer: (E)}}$

Q116. $\boxed{\text{Answer: (C)}}$

Q117. $\boxed{\text{Answer: (D)}}$

Q118. $\boxed{\text{Answer: (B)}}$

Q119. $\boxed{\text{Answer: (A)}}$

Q120. $\boxed{\text{Answer: (E)}}$

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	C	2	D	3	B	4	A	5	E
6	C	7	D	8	B	9	A	10	E
11	C	12	D	13	B	14	A	15	E
16	C	17	D	18	B	19	A	20	E
21	C	22	D	23	B	24	A	25	E
26	C	27	D	28	B	29	A	30	E
31	C	32	D	33	B	34	A	35	E
36	C	37	D	38	B	39	A	40	E
41	C	42	D	43	B	44	A	45	E
46	C	47	D	48	B	49	A	50	E
51	C	52	D	53	B	54	A	55	E
56	C	57	D	58	B	59	A	60	E
61	C	62	D	63	B	64	A	65	E
66	C	67	D	68	B	69	A	70	E
71	C	72	D	73	B	74	A	75	E
76	C	77	D	78	B	79	A	80	E
81	C	82	D	83	B	84	A	85	E
86	C	87	D	88	B	89	A	90	E
91	C	92	D	93	B	94	A	95	E
96	C	97	D	98	B	99	A	100	E
101	C	102	D	103	B	104	A	105	E
106	C	107	D	108	B	109	A	110	E
111	C	112	D	113	B	114	A	115	E
116	C	117	D	118	B	119	A	120	E