

MHT-CET Physics Sample Paper-10

Duration: 45 Minutes

Maximum Marks: 50

Instructions

- This paper contains a total of **50** Multiple Choice Questions.
- Each correct answer carries **+1 marks**.
- No negative marking for incorrect questions.
- Use of mobile phones, smartwatches, or any electronic gadgets is strictly prohibited.
- No marks will be deducted for questions that are left unattempted.

Q1. A flywheel has moment of inertia 0.5 kg m^2 and rotates at 20 rad s^{-1} . If a constant retarding torque of 2 N m acts on it, the time taken to stop is:

- (A) 2 s
- (B) 5 s
- (C) 10 s
- (D) 20 s

Q2. A ring and a solid disc have the same mass and radius. The ratio of their moments of inertia about their central axes is:

- (A) 1 : 1
- (B) 1 : 2
- (C) 2 : 1
- (D) 4 : 1

Q3. A particle moves in a circle of radius 2 m with angular speed 3 rad s^{-1} . Its centripetal acceleration is:

- (A) 6 m s^{-2}
- (B) 12 m s^{-2}



- (C) 18 m s^{-2}
- (D) 36 m s^{-2}

Q4. A uniform rod of length L is rotated about an axis through its centre and perpendicular to its length. Its moment of inertia is:

- (A) $\frac{1}{3}ML^2$
- (B) $\frac{1}{12}ML^2$
- (C) ML^2
- (D) $\frac{1}{2}ML^2$

Q5. A simple pendulum has time period 2 s. If it is taken to a place where g becomes one-fourth, its new time period is:

- (A) 1 s
- (B) 2 s
- (C) 4 s
- (D) 8 s

Q6. A wave is represented by $y = 5 \sin(100t - 2x)$ in SI units. The wave speed is:

- (A) 25 m s^{-1}
- (B) 50 m s^{-1}
- (C) 100 m s^{-1}
- (D) 200 m s^{-1}

Q7. In SHM, displacement is half of amplitude. If amplitude is A , the speed of the particle is:

- (A) ωA
- (B) $\frac{\sqrt{3}}{2}\omega A$
- (C) $\frac{1}{2}\omega A$
- (D) $\frac{1}{4}\omega A$



- Q8.** The fundamental frequency of a closed organ pipe of length L is:
- (A) $\frac{v}{2L}$
 - (B) $\frac{v}{4L}$
 - (C) $\frac{2v}{L}$
 - (D) $\frac{v}{L}$
- Q9.** The electric field due to a point charge at distance r is E . At distance $3r$, the field becomes:
- (A) $E/3$
 - (B) $E/6$
 - (C) $E/9$
 - (D) $9E$
- Q10.** Two equal charges repel each other with force F at separation r . If each charge is doubled and separation is also doubled, the new force is:
- (A) F
 - (B) $2F$
 - (C) $4F$
 - (D) $F/2$
- Q11.** A capacitor of capacitance $4 \mu\text{F}$ is charged to 100 V . The charge on it is:
- (A) $100 \mu\text{C}$
 - (B) $200 \mu\text{C}$
 - (C) $400 \mu\text{C}$
 - (D) $800 \mu\text{C}$
- Q12.** The work done in moving a charge 2 C through a potential difference of 5 V is:
- (A) 2.5 J
 - (B) 5 J



(C) 10 J

(D) 25 J

Q13. A conductor carries current 0.5 A. Number of electrons crossing a section per second is approximately: ($e = 1.6 \times 10^{-19}$ C)

(A) 3.125×10^{18}

(B) 1.6×10^{18}

(C) 8×10^{18}

(D) 3.125×10^{19}

Q14. A 12Ω resistor is connected across a 6 V battery. Current through it is:

(A) 0.25 A

(B) 0.5 A

(C) 2 A

(D) 72 A

Q15. A wire of resistance R is cut into two equal halves and the halves are connected in parallel. The equivalent resistance is:

(A) $R/4$

(B) $R/2$

(C) R

(D) $2R$

Q16. A bulb is rated 60 W, 120 V. Its resistance is:

(A) 120Ω

(B) 240Ω

(C) 360Ω

(D) 480Ω



- Q17.** A charged particle enters a magnetic field parallel to the field direction. The magnetic force on it is:
- (A) Maximum
 - (B) Zero
 - (C) Half of maximum
 - (D) Depends only on charge
- Q18.** A wire of length 0.5 m carries current 4 A perpendicular to a magnetic field of 0.2 T. Force on the wire is:
- (A) 0.2 N
 - (B) 0.4 N
 - (C) 2 N
 - (D) 4 N
- Q19.** The SI unit of magnetic flux is:
- (A) tesla
 - (B) weber
 - (C) henry
 - (D) gauss
- Q20.** The magnetic field inside a long solenoid is directly proportional to:
- (A) Current only
 - (B) Number of turns per unit length only
 - (C) Both current and turns per unit length
 - (D) Area of solenoid only
- Q21.** An inductor of inductance 2 H carries current changing at 3 A s^{-1} . Induced emf is:
- (A) 1.5 V



- (B) 3 V
- (C) 6 V
- (D) 12 V

Q22. In a pure capacitor connected to AC supply, current:

- (A) lags voltage by 90°
- (B) leads voltage by 90°
- (C) is in phase with voltage
- (D) is zero always

Q23. At resonance in a series LCR circuit, the power factor is:

- (A) 0
- (B) $1/2$
- (C) 1
- (D) infinite

Q24. A concave mirror of focal length 20 cm forms an image of an object placed at 40 cm. The image is formed at:

- (A) 20 cm
- (B) 40 cm
- (C) 60 cm
- (D) infinity

Q25. A convex lens forms a real image at 30 cm when object is at 15 cm. The magnification is:

- (A) +2
- (B) -2
- (C) $+1/2$
- (D) $-1/2$



- Q26.** The refractive index of a medium is 1.5. Speed of light in the medium is: ($c = 3 \times 10^8 \text{ m s}^{-1}$)
- (A) $1.5 \times 10^8 \text{ m s}^{-1}$
 - (B) $2 \times 10^8 \text{ m s}^{-1}$
 - (C) $3 \times 10^8 \text{ m s}^{-1}$
 - (D) $4.5 \times 10^8 \text{ m s}^{-1}$
- Q27.** In Young's double slit experiment, fringe width is 1 mm. If screen distance is doubled, new fringe width is:
- (A) 0.5 mm
 - (B) 1 mm
 - (C) 2 mm
 - (D) 4 mm
- Q28.** A lens has power -5 D . Its focal length is:
- (A) +20 cm
 - (B) -20 cm
 - (C) +5 cm
 - (D) -5 cm
- Q29.** An ideal gas expands isothermally. Its internal energy:
- (A) increases
 - (B) decreases
 - (C) remains constant
 - (D) becomes zero
- Q30.** At what temperature will rms speed of gas molecules become double its value at 300 K?
- (A) 600 K



- (B) 900 K
- (C) 1200 K
- (D) 150 K

Q31. A system absorbs 200 J heat and does 80 J work. Change in internal energy is:

- (A) 120 J
- (B) 200 J
- (C) 280 J
- (D) 80 J

Q32. The stopping potential for photoelectrons is 2 V. Maximum kinetic energy of photoelectrons is:

- (A) 1 eV
- (B) 2 eV
- (C) 4 eV
- (D) 0.5 eV

Q33. The wavelength of radiation emitted when electron in hydrogen jumps from $n = 3$ to $n = 2$ belongs to:

- (A) Lyman series
- (B) Balmer series
- (C) Paschen series
- (D) Brackett series

Q34. An alpha particle emission from a nucleus decreases mass number by:

- (A) 1
- (B) 2
- (C) 4
- (D) 0



- Q35.** If the frequency of incident light is below threshold frequency, photoelectric emission:
- (A) occurs after delay
 - (B) does not occur
 - (C) occurs with low current
 - (D) occurs with high kinetic energy
- Q36.** The rest mass energy of an electron is approximately:
- (A) 0.511 MeV
 - (B) 1.022 MeV
 - (C) 13.6 eV
 - (D) 931 MeV
- Q37.** A body moving with velocity 10 m s^{-1} is uniformly retarded and stops in 5 s. Its retardation is:
- (A) 1 m s^{-2}
 - (B) 2 m s^{-2}
 - (C) 5 m s^{-2}
 - (D) 10 m s^{-2}
- Q38.** A block of mass 5 kg is pulled with force 20 N on a frictionless surface. Acceleration is:
- (A) 2 m s^{-2}
 - (B) 4 m s^{-2}
 - (C) 5 m s^{-2}
 - (D) 10 m s^{-2}
- Q39.** A projectile is fired horizontally from a height. Its horizontal velocity during motion:



- (A) increases
- (B) decreases
- (C) remains constant
- (D) becomes zero

Q40. A force of 10 N displaces a body by 5 m in the direction of force. Work done is:

- (A) 2 J
- (B) 15 J
- (C) 50 J
- (D) 100 J

Q41. A spring of constant 200 N m^{-1} is stretched by 0.1 m. Energy stored is:

- (A) 0.5 J
- (B) 1 J
- (C) 2 J
- (D) 10 J

Q42. Escape velocity from Earth is v_e . Escape velocity from a planet having same mass as Earth but radius twice that of Earth is:

- (A) v_e
- (B) $v_e/\sqrt{2}$
- (C) $\sqrt{2}v_e$
- (D) $2v_e$

Q43. The gravitational potential energy of two masses separated by distance r is proportional to:

- (A) r
- (B) $1/r$
- (C) r^2



(D) $1/r^2$

Q44. The stress produced in a wire by force F over cross-sectional area A is:

(A) FA

(B) F/A

(C) A/F

(D) F^2/A

Q45. Surface tension has the same dimension as:

(A) force

(B) energy

(C) energy per unit area

(D) pressure

Q46. The dimensional formula of pressure is:

(A) MLT^{-2}

(B) $ML^{-1}T^{-2}$

(C) ML^2T^{-2}

(D) $M^0L^0T^0$

Q47. The number of significant figures in 0.00450 is:

(A) 2

(B) 3

(C) 4

(D) 5

Q48. In a forward biased p-n junction diode, the depletion layer width:

(A) increases

(B) decreases



- (C) remains unchanged
- (D) becomes infinite

Q49. The majority charge carriers in an n-type semiconductor are:

- (A) holes
- (B) electrons
- (C) protons
- (D) neutrons

Q50. In AM transmission, carrier frequency is 800 kHz and modulating frequency is 5 kHz. Upper sideband frequency is:

- (A) 795 kHz
- (B) 800 kHz
- (C) 805 kHz
- (D) 810 kHz



Detailed Solutions

Q1.

Solution

Concept:

Rotational dynamics with retarding torque.

Solution:

Step 1: Use $\tau = I\alpha$ to find angular retardation.

Step 2: $\alpha = \tau/I = 2/0.5 = 4 \text{ rad s}^{-2}$.

Step 3: Initial angular speed is 20 rad s^{-1} and final angular speed is zero.

Step 4: Using $\omega = \omega_0 - \alpha t$, $0 = 20 - 4t$, so $t = 5 \text{ s}$.

Exam Insight:

Retarding torque questions are solved exactly like linear retardation problems.

Final Answer:

5 s

Answer: (B)

Q2.

Solution

Concept:

Standard moments of inertia.

Solution:

Step 1: Moment of inertia of a ring about its central axis is $I_r = MR^2$.

Step 2: Moment of inertia of a solid disc about its central axis is $I_d = \frac{1}{2}MR^2$.

Step 3: The ratio is $I_r : I_d = MR^2 : \frac{1}{2}MR^2$.

Step 4: Hence $I_r : I_d = 2 : 1$.

Exam Insight:

Remember ring has more mass away from centre, so its moment of inertia is larger.

Final Answer:

2 : 1

Answer: (C)



Q3.

Solution**Concept:**

Centripetal acceleration in angular form.

Solution:

Step 1: For circular motion, centripetal acceleration is $a_c = \omega^2 r$.

Step 2: Here $\omega = 3 \text{ rad s}^{-1}$ and $r = 2 \text{ m}$.

Step 3: So $a_c = 3^2 \times 2 = 18 \text{ m s}^{-2}$.

Step 4: The acceleration is directed towards the centre of the circular path.

Exam Insight:

Use v^2/r if speed is given and $\omega^2 r$ if angular speed is given.

Final Answer:

$$18 \text{ m s}^{-2}$$

Answer: (C)

Q4.

Solution**Concept:**

Moment of inertia of a rod about central perpendicular axis.

Solution:

Step 1: For a uniform rod, the standard moment of inertia about its centre is $I = \frac{1}{12} ML^2$.

Step 2: If the axis were through one end, the moment of inertia would be $\frac{1}{3} ML^2$.

Step 3: The question specifically says through centre and perpendicular to length.

Step 4: Therefore the correct expression is $\frac{1}{12} ML^2$.

Exam Insight:

Do not confuse rod about centre with rod about end.

Final Answer:

$$\frac{1}{12} ML^2$$

Answer: (B)



Q5.

Solution**Concept:**

Effect of gravity on pendulum time period.

Solution:

Step 1: Time period of simple pendulum is $T = 2\pi\sqrt{l/g}$.

Step 2: For same length, $T \propto 1/\sqrt{g}$.

Step 3: If $g' = g/4$, then $T' = T\sqrt{g/g'} = T\sqrt{4} = 2T$.

Step 4: Given $T = 2$ s, new time period is 4 s.

Exam Insight:

Pendulum time period increases when effective gravity decreases.

Final Answer:

4 s

Answer: (C)

Q6.

Solution**Concept:**

Wave equation and wave speed.

Solution:

Step 1: Compare $y = 5 \sin(100t - 2x)$ with $y = A \sin(\omega t - kx)$.

Step 2: Here angular frequency $\omega = 100 \text{ rad s}^{-1}$ and wave number $k = 2 \text{ m}^{-1}$.

Step 3: Wave speed is $v = \omega/k$.

Step 4: Therefore $v = 100/2 = 50 \text{ m s}^{-1}$.

Exam Insight:

In a travelling wave, coefficient of t is ω and coefficient of x is k .

Final Answer:

50 m s⁻¹

Answer: (B)



Q7.

Solution**Concept:**

Velocity in SHM at a given displacement.

Solution:

Step 1: Speed in SHM is $v = \omega\sqrt{A^2 - x^2}$.

Step 2: Given displacement $x = A/2$.

Step 3: So $v = \omega\sqrt{A^2 - A^2/4} = \omega\sqrt{3A^2/4}$.

Step 4: Thus $v = \frac{\sqrt{3}}{2}\omega A$.

Exam Insight:

Maximum speed is at mean position; speed decreases as displacement increases.

Final Answer:

$$\frac{\sqrt{3}}{2}\omega A$$

Answer: (B)

Q8.

Solution**Concept:**

Fundamental frequency of a closed organ pipe.

Solution:

Step 1: A closed organ pipe has one end closed and one end open.

Step 2: In fundamental mode, length of pipe equals one-fourth of wavelength: $L = \lambda/4$.

Step 3: Hence $\lambda = 4L$.

Step 4: Frequency is $f = v/\lambda = v/(4L)$.

Exam Insight:

Closed pipe fundamental has quarter-wave pattern.

Final Answer:

$$\frac{v}{4L}$$

Answer: (B)

Q9.

Solution**Concept:**

Inverse-square law for electric field.

Solution:

Step 1: Electric field due to point charge is $E = kq/r^2$.

Step 2: Thus electric field is inversely proportional to square of distance.

Step 3: At distance $3r$, field is $E' = kq/(3r)^2 = kq/(9r^2)$.

Step 4: So $E' = E/9$.

Exam Insight:

Electric field follows $1/r^2$, potential follows $1/r$.

Final Answer:

$$E/9$$

Answer: (C)

Q10.

Solution**Concept:**

Coulomb's law proportionality.

Solution:

Step 1: Coulomb force is $F = kq_1q_2/r^2$.

Step 2: If each charge is doubled, product of charges becomes four times.

Step 3: If separation is doubled, r^2 becomes four times.

Step 4: The two effects cancel, so new force remains F .

Exam Insight:

Handle charge and distance changes separately in Coulomb law questions.

Final Answer:

$$F$$

Answer: (A)



Q11.

Solution**Concept:**

Charge stored in a capacitor.

Solution:

Step 1: Charge on a capacitor is $Q = CV$.

Step 2: Given $C = 4 \mu\text{F}$ and $V = 100 \text{ V}$.

Step 3: So $Q = 4 \times 100 = 400 \mu\text{C}$.

Step 4: Since capacitance is in microfarad, charge naturally comes in microcoulomb.

Exam Insight:

For quick CET calculation, $\mu\text{F} \times \text{V} = \mu\text{C}$.

Final Answer:

$$400 \mu\text{C}$$

Answer: (C)

Q12.

Solution**Concept:**

Relation between work, charge and potential difference.

Solution:

Step 1: Potential difference is work done per unit charge, $V = W/q$.

Step 2: Therefore $W = qV$.

Step 3: Given $q = 2 \text{ C}$ and $V = 5 \text{ V}$.

Step 4: So $W = 2 \times 5 = 10 \text{ J}$.

Exam Insight:

Volt means joule per coulomb.

Final Answer:

$$10 \text{ J}$$

Answer: (C)



Q13.

Solution**Concept:**

Current as flow of electrons.

Solution:

Step 1: Current is charge flowing per second: $I = Q/t$.

Step 2: In one second, charge crossing the section is $Q = 0.5 \text{ C}$.

Step 3: Number of electrons is $n = Q/e = 0.5/(1.6 \times 10^{-19})$.

Step 4: This gives $n = 3.125 \times 10^{18}$ electrons.

Exam Insight:

Number of electrons is charge divided by electronic charge.

Final Answer:

$$3.125 \times 10^{18}$$

Answer: (A)

Q14.

Solution**Concept:**

Ohm's law.

Solution:

Step 1: Ohm's law states $V = IR$.

Step 2: Current is $I = V/R$.

Step 3: Substitute $V = 6 \text{ V}$ and $R = 12 \Omega$.

Step 4: So $I = 6/12 = 0.5 \text{ A}$.

Exam Insight:

Current decreases when resistance increases for fixed voltage.

Final Answer:

$$0.5 \text{ A}$$

Answer: (B)



Q15.

Solution**Concept:**

Resistance change after cutting and parallel combination.

Solution:

Step 1: When a wire is cut into two equal halves, length of each half becomes half.

Step 2: Resistance is proportional to length, so resistance of each half is $R/2$.

Step 3: Two equal resistances $R/2$ connected in parallel give equivalent resistance $(R/2)/2$.

Step 4: Hence equivalent resistance is $R/4$.

Exam Insight:

Cutting a wire reduces resistance; putting parts in parallel reduces it further.

Final Answer:

$$R/4$$

Answer: (A)

Q16.

Solution**Concept:**

Power rating and resistance.

Solution:

Step 1: For an electrical appliance, $P = V^2/R$.

Step 2: Rearrange to get $R = V^2/P$.

Step 3: Substitute $V = 120$ V and $P = 60$ W.

Step 4: So $R = 120^2/60 = 14400/60 = 240 \Omega$.

Exam Insight:

For rated appliances, use $P = V^2/R$ when voltage and power are given.

Final Answer:

$$240 \Omega$$

Answer: (B)



Q17.

Solution**Concept:**

Magnetic force depends on angle between velocity and magnetic field.

Solution:

Step 1: Magnetic force is $F = qvB \sin \theta$.

Step 2: If velocity is parallel to magnetic field, $\theta = 0^\circ$.

Step 3: Since $\sin 0^\circ = 0$, magnetic force is zero.

Step 4: The particle continues moving in a straight line if no other force acts.

Exam Insight:

Magnetic force needs a perpendicular velocity component.

Final Answer:

0

Answer: (B)

Q18.

Solution**Concept:**

Force on a current carrying conductor.

Solution:

Step 1: Force on current carrying conductor is $F = BIl \sin \theta$.

Step 2: The wire is perpendicular to field, so $\theta = 90^\circ$ and $\sin \theta = 1$.

Step 3: Substitute $B = 0.2 \text{ T}$, $I = 4 \text{ A}$, $l = 0.5 \text{ m}$.

Step 4: $F = 0.2 \times 4 \times 0.5 = 0.4 \text{ N}$.

Exam Insight:

When conductor is perpendicular to field, magnetic force is maximum.

Final Answer:

0.4 N

Answer: (B)



Q19.

Solution**Concept:**

Unit of magnetic flux.

Solution:

Step 1: Magnetic flux is $\Phi = BA \cos \theta$.

Step 2: SI unit of magnetic field B is tesla and area is square metre.

Step 3: Therefore unit of flux is tesla metre squared.

Step 4: This derived unit is called weber.

Exam Insight:

Tesla is unit of magnetic field; weber is unit of magnetic flux.

Final Answer:

weber

Answer: (B)

Q20.

Solution**Concept:**

Magnetic field inside a long solenoid.

Solution:

Step 1: For a long solenoid, magnetic field is $B = \mu_0 n I$.

Step 2: Here n is number of turns per unit length and I is current.

Step 3: So B is directly proportional to both n and I .

Step 4: Area of solenoid is not present in this ideal formula.

Exam Insight:

Solenoid field increases by increasing current or turns density.

Final Answer:

Both current and turns per unit length

Answer: (C)



Q21.

Solution**Concept:**

Self-induced emf in an inductor.

Solution:

Step 1: Self-induced emf magnitude is $e = L \frac{dI}{dt}$.

Step 2: Given $L = 2 \text{ H}$ and $dI/dt = 3 \text{ A s}^{-1}$.

Step 3: So $e = 2 \times 3 = 6 \text{ V}$.

Step 4: Direction of induced emf opposes change in current according to Lenz's law.

Exam Insight:

Inductor opposes change in current, not steady current.

Final Answer:

6 V

Answer: (C)

Q22.

Solution**Concept:**

Phase relation in capacitive AC circuit.

Solution:

Step 1: In a purely capacitive AC circuit, charge and voltage are related by $q = CV$.

Step 2: Current is rate of change of charge, so it reaches maximum before voltage.

Step 3: Therefore current leads voltage by 90° .

Step 4: In pure inductor, current lags voltage by 90° , which is the opposite case.

Exam Insight:

Remember CIVIL: in Capacitor, I leads V; in Inductor, V leads I.

Final Answer:

Current leads voltage by 90°

Answer: (B)



Q23.

Solution**Concept:**

Power factor at resonance.

Solution:

Step 1: In a series LCR circuit, resonance occurs when $X_L = X_C$.

Step 2: Net reactance becomes zero, so impedance is purely resistive.

Step 3: Phase difference between voltage and current becomes zero.

Step 4: Power factor is $\cos \phi = \cos 0^\circ = 1$.

Exam Insight:

At resonance, series LCR circuit behaves like a pure resistor.

Final Answer:

1

Answer: (C)

Q24.

Solution**Concept:**

Mirror formula and centre of curvature case.

Solution:

Step 1: For concave mirror, centre of curvature is at $2f = 40$ cm.

Step 2: An object placed at centre of curvature forms its image at centre of curvature.

Step 3: Thus image distance is also 40 cm from the mirror.

Step 4: The image is real, inverted and same size.

Exam Insight:

For concave mirror, object at $2f$ gives image at $2f$.

Final Answer:

40 cm

Answer: (B)



Q25.

Solution**Concept:**

Magnification by a lens.

Solution:

Step 1: For a lens, magnification is $m = v/u$ using sign convention or magnitude ratio with sign.

Step 2: Real image formed by a convex lens is inverted, so magnification is negative.

Step 3: Magnitude of magnification is image distance/object distance = $30/15 = 2$.

Step 4: Hence magnification is -2 .

Exam Insight:

Real image by convex lens is inverted, so magnification is negative.

Final Answer:

$$\boxed{-2}$$

Answer: (B)

Q26.

Solution**Concept:**

Refractive index and speed of light.

Solution:

Step 1: Refractive index is defined as $n = c/v$.

Step 2: Therefore speed in medium is $v = c/n$.

Step 3: Substitute $c = 3 \times 10^8 \text{ m s}^{-1}$ and $n = 1.5$.

Step 4: $v = 3 \times 10^8 / 1.5 = 2 \times 10^8 \text{ m s}^{-1}$.

Exam Insight:

Light travels slower in a medium with refractive index greater than 1.

Final Answer:

$$\boxed{2 \times 10^8 \text{ m s}^{-1}}$$

Answer: (B)



Q27.

Solution**Concept:**

Fringe width dependence on screen distance.

Solution:

Step 1: Fringe width in YDSE is $\beta = \lambda D/d$.

Step 2: If wavelength and slit separation remain constant, $\beta \propto D$.

Step 3: Doubling screen distance doubles fringe width.

Step 4: So new fringe width is 2 mm.

Exam Insight:

YDSE fringe width is directly proportional to screen distance.

Final Answer:

2 mm

Answer: (C)

Q28.

Solution**Concept:**

Power and focal length of lens.

Solution:

Step 1: Power is $P = 1/f$ with f in metre.

Step 2: Given $P = -5$ D.

Step 3: So $f = 1/P = 1/(-5) = -0.2$ m.

Step 4: Converting to centimetre, $f = -20$ cm.

Exam Insight:

Negative power means diverging lens.

Final Answer:

-20 cm

Answer: (B)



Q29.

Solution**Concept:**

Internal energy of ideal gas in isothermal process.

Solution:

Step 1: For an ideal gas, internal energy depends only on temperature.

Step 2: In an isothermal process, temperature remains constant.

Step 3: Therefore change in internal energy is zero.

Step 4: Hence internal energy remains constant during isothermal expansion.

Exam Insight:

Isothermal ideal gas: $\Delta U = 0$.

Final Answer:

remains constant

Answer: (C)

Q30.

Solution**Concept:**

Temperature dependence of rms speed.

Solution:

Step 1: RMS speed is $v_{rms} = \sqrt{3RT/M}$.

Step 2: For same gas, $v_{rms} \propto \sqrt{T}$.

Step 3: To double rms speed, temperature must become four times.

Step 4: Thus $T' = 4 \times 300 = 1200$ K.

Exam Insight:

Speed doubles when temperature becomes four times in kelvin.

Final Answer:

1200 K

Answer: (C)



Q31.

Solution**Concept:**

First law of thermodynamics.

Solution:

Step 1: According to first law, $Q = \Delta U + W$.

Step 2: Here heat absorbed $Q = 200$ J and work done by system $W = 80$ J.

Step 3: So $\Delta U = Q - W = 200 - 80 = 120$ J.

Step 4: Internal energy increases by 120 J.

Exam Insight:

Use sign carefully: work done by system reduces internal energy gain.

Final Answer:

120 J

Answer: (A)

Q32.

Solution**Concept:**

Stopping potential and photoelectric kinetic energy.

Solution:

Step 1: Maximum kinetic energy of photoelectrons is $K_{max} = eV_s$.

Step 2: When stopping potential is measured in volts, kinetic energy in electron-volt has same numerical value.

Step 3: Given $V_s = 2$ V.

Step 4: Therefore $K_{max} = 2$ eV.

Exam Insight:

Stopping potential in volt directly gives maximum KE in eV.

Final Answer:

2 eV

Answer: (B)



Q33.

Solution**Concept:**

Hydrogen spectral series.

Solution:

Step 1: Spectral series are identified by the final orbit.

Step 2: Lyman series has final orbit $n = 1$.

Step 3: Balmer series has final orbit $n = 2$.

Step 4: Since the transition is from $n = 3$ to $n = 2$, it belongs to Balmer series.

Exam Insight:

Hydrogen transition ending at $n = 2$ is Balmer series.

Final Answer:

Balmer series

Answer: (B)

Q34.

Solution**Concept:**

Alpha decay.

Solution:

Step 1: An alpha particle is a helium nucleus ${}^4_2\text{He}$.

Step 2: When a nucleus emits an alpha particle, it loses two protons and two neutrons.

Step 3: Therefore mass number decreases by 4.

Step 4: Atomic number decreases by 2.

Exam Insight:

Alpha decay: $A - 4, Z - 2$.

Final Answer:

4

Answer: (C)



Q35.

Solution**Concept:**

Threshold frequency in photoelectric effect.

Solution:

Step 1: Photoelectric emission requires each photon to have energy at least equal to work function.

Step 2: Photon energy is $E = hf$.

Step 3: If frequency is below threshold frequency, photon energy is less than work function.

Step 4: Hence electrons cannot be emitted, whatever the intensity.

Exam Insight:

Below threshold frequency, increasing intensity cannot cause photoemission.

Final Answer:

does not occur

Answer: (B)

Q36.

Solution**Concept:**

Rest mass energy of electron.

Solution:

Step 1: The rest mass energy is given by $E = mc^2$.

Step 2: For electron, this standard value is approximately 0.511 MeV.

Step 3: The value 1.022 MeV is energy equivalent of electron-positron pair.

Step 4: 931 MeV corresponds to one atomic mass unit.

Exam Insight:

Memorise: electron rest energy is 0.511 MeV.

Final Answer:

0.511 MeV

Answer: (A)



Q37.

Solution**Concept:**

Uniform retardation.

Solution:

Step 1: Use $v = u + at$.

Step 2: Initial velocity $u = 10 \text{ m s}^{-1}$ and final velocity $v = 0$.

Step 3: Substitute: $0 = 10 + a(5)$.

Step 4: So $a = -2 \text{ m s}^{-2}$ and retardation is 2 m s^{-2} .

Exam Insight:

Retardation is magnitude of negative acceleration.

Final Answer:

$$2 \text{ m s}^{-2}$$

Answer: (B)

Q38.

Solution**Concept:**

Newton's second law on frictionless surface.

Solution:

Step 1: On a frictionless surface, net horizontal force equals applied force.

Step 2: Use $F = ma$.

Step 3: Substitute $F = 20 \text{ N}$ and $m = 5 \text{ kg}$.

Step 4: Therefore $a = 20/5 = 4 \text{ m s}^{-2}$.

Exam Insight:

Frictionless means no opposing friction force.

Final Answer:

$$4 \text{ m s}^{-2}$$

Answer: (B)



Q39.

Solution**Concept:**

Horizontal motion of projectile.

Solution:

Step 1: In projectile motion without air resistance, acceleration acts only vertically downward.

Step 2: There is no horizontal acceleration.

Step 3: Hence horizontal component of velocity remains unchanged.

Step 4: Vertical velocity changes due to gravity, but horizontal velocity stays constant.

Exam Insight:

Projectile motion separates into independent horizontal and vertical components.

Final Answer:

remains constant

Answer: (C)

Q40.

Solution**Concept:**

Work done by constant force.

Solution:

Step 1: Work done is $W = Fs \cos \theta$.

Step 2: Force and displacement are in same direction, so $\theta = 0^\circ$ and $\cos 0^\circ = 1$.

Step 3: Substitute $F = 10 \text{ N}$ and $s = 5 \text{ m}$.

Step 4: Thus $W = 10 \times 5 = 50 \text{ J}$.

Exam Insight:

Work is maximum when force and displacement are in same direction.

Final Answer:

50 J

Answer: (C)



Q41.

Solution**Concept:**

Elastic potential energy of a spring.

Solution:

Step 1: Energy stored in a spring is $U = \frac{1}{2}kx^2$.

Step 2: Given $k = 200 \text{ N m}^{-1}$ and $x = 0.1 \text{ m}$.

Step 3: $U = \frac{1}{2} \times 200 \times (0.1)^2 = 100 \times 0.01 = 1 \text{ J}$.

Step 4: The square of extension is important.

Exam Insight:

Spring energy depends on square of extension.

Final Answer:

$$1 \text{ J}$$

Answer: (B)

Q42.

Solution**Concept:**

Escape velocity dependence on mass and radius.

Solution:

Step 1: Escape velocity is $v_e = \sqrt{2GM/R}$.

Step 2: For the new planet, mass is same but radius is $2R$.

Step 3: So $v'_e = \sqrt{2GM/(2R)} = \sqrt{GM/R}$.

Step 4: Compared with Earth's $v_e = \sqrt{2GM/R}$, $v'_e = v_e/\sqrt{2}$.

Exam Insight:

Escape velocity decreases when radius increases for same mass.

Final Answer:

$$\frac{v_e}{\sqrt{2}}$$

Answer: (B)



Q43.

Solution**Concept:**

Gravitational potential energy.

Solution:

Step 1: Gravitational potential energy of two masses is $U = -\frac{GMm}{r}$.

Step 2: Its magnitude is proportional to $1/r$.

Step 3: The negative sign shows attractive nature of gravity.

Step 4: Force varies as $1/r^2$, but potential energy varies as $1/r$.

Exam Insight:

Do not confuse gravitational force with gravitational potential energy.

Final Answer:

$$1/r$$

Answer: (B)

Q44.

Solution**Concept:**

Mechanical stress.

Solution:

Step 1: Stress is defined as restoring force per unit area.

Step 2: If force F is applied normally over area A , stress is F/A .

Step 3: SI unit is newton per square metre or pascal.

Step 4: Stress is not force multiplied by area.

Exam Insight:

Stress = force per area; strain = change in length per original length.

Final Answer:

$$F/A$$

Answer: (B)



Q45.

Solution**Concept:**

Dimensions of surface tension.

Solution:

Step 1: Surface tension can be defined as force per unit length.

Step 2: It can also be interpreted as surface energy per unit area.

Step 3: Dimension of force per length is $[MLT^{-2}]/[L] = MT^{-2}$.

Step 4: Energy per area also gives $[ML^2T^{-2}]/[L^2] = MT^{-2}$.

Exam Insight:

Surface tension = force/length = energy/area.

Final Answer:

energy per unit area

Answer: (C)

Q46.

Solution**Concept:**

Dimensional formula of pressure.

Solution:

Step 1: Pressure is force per unit area.

Step 2: Dimension of force is MLT^{-2} .

Step 3: Dimension of area is L^2 .

Step 4: So pressure has dimension $MLT^{-2}/L^2 = ML^{-1}T^{-2}$.

Exam Insight:

Pressure and stress have the same dimensions.

Final Answer:

$ML^{-1}T^{-2}$

Answer: (B)



Q47.

Solution**Concept:**

Significant figures.

Solution:

Step 1: Leading zeros before a non-zero digit are not significant.

Step 2: In 0.00450, digits 4, 5, and the final 0 after decimal are significant.

Step 3: Therefore the number has three significant figures.

Step 4: The final zero is significant because it indicates measured precision.

Exam Insight:

Trailing zeros after decimal point are significant.

Final Answer:

3

Answer: (B)

Q48.

Solution**Concept:**

Forward biasing of p-n junction.

Solution:

Step 1: Forward bias means p-side is connected to positive terminal and n-side to negative terminal.

Step 2: The applied voltage opposes the built-in potential barrier.

Step 3: This allows majority carriers to cross the junction more easily.

Step 4: Hence depletion layer width decreases.

Exam Insight:

Forward bias reduces barrier; reverse bias increases barrier.

Final Answer:

decreases

Answer: (B)



Q49.

Solution**Concept:**

n-type semiconductor.

Solution:

Step 1: n-type semiconductor is formed by doping a pure semiconductor with pentavalent impurity.

Step 2: Pentavalent atoms donate extra electrons.

Step 3: These electrons become majority charge carriers.

Step 4: Holes are minority carriers in n-type semiconductor.

Exam Insight:

n-type means negative charge carriers are majority.

Final Answer:

electrons

Answer: (B)

Q50.

Solution**Concept:**

Sideband frequencies in amplitude modulation.

Solution:

Step 1: In amplitude modulation, upper sideband frequency is $f_c + f_m$.

Step 2: Given carrier frequency $f_c = 800$ kHz.

Step 3: Modulating frequency $f_m = 5$ kHz.

Step 4: Thus upper sideband frequency is $800 + 5 = 805$ kHz.

Exam Insight:

AM produces sidebands at $f_c - f_m$ and $f_c + f_m$.

Final Answer:

805 kHz

Answer: (C)



Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	B	2	C	3	C	4	B	5	C
6	B	7	B	8	B	9	C	10	A
11	C	12	C	13	A	14	B	15	A
16	B	17	B	18	B	19	B	20	C
21	C	22	B	23	C	24	B	25	B
26	B	27	C	28	B	29	C	30	C
31	A	32	B	33	B	34	C	35	B
36	A	37	B	38	B	39	C	40	C
41	B	42	B	43	B	44	B	45	C
46	B	47	B	48	B	49	B	50	C

