Jharkhand Polytechnic Physics

Sample Paper – 8

Duration: 50 Minutes **Maximum Marks: 50**

Instructions

- This paper contains **50** Multiple Choice Questions (Single Correct Answer), modelled on the Physics section of the **Jharkhand Polytechnic (PECE)** entrance examination conducted by JCECEB.
- Each correct answer carries **+1 mark**. There is **a negative marking of 0.25 mark** for every wrong answer. Unattempted questions carry **no penalty**.
- Only **one** option is correct. Choose carefully.
- This is an offline OMR based test. Darken the correct bubble fully with a blue or black ball pen.
- Take $\mathbf{g = 10\ m/s^2}$ wherever required, unless stated otherwise.
- Use of mobile phones, calculators, or electronic gadgets is strictly prohibited.

Q1. The SI unit of linear momentum is the:

(A) newton (N)

(B) joule (J)

(C) kilogram metre per second (kg m/s)

(D) watt (W)

Q2. Identify the derived physical quantity from the list below:

(A) Force

(B) Length

(C) Time

(D) Mass

Q3. A train moves with a speed of 54 km/h. Its speed in metre per second is:

(A) 20 m/s

(B) 10 m/s

(C) 27 m/s

(D) 15 m/s

Q4. Which pair of physical quantities is measured in the same SI unit?

(A) Force and momentum

(B) Work and energy

(C) Power and energy

(D) Pressure and force

Q5. A car starting from rest reaches a velocity of 10 m/s after travelling a distance of 25 m. Its uniform acceleration is:

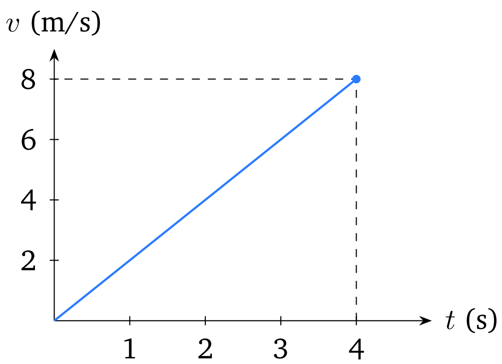
(A) 2 m/s^2

(B) 4 m/s^2

(C) 5 m/s^2

(D) 0.4 m/s^2

Q6. The velocity–time graph of a body is the straight line shown below, rising from rest to 8 m/s in 4 s. The displacement of the body in this time (area under the graph) is:



(A) 32 m

(B) 12 m

(C) 16 m

(D) 2 m

Q7. Among the following bodies, the one having the greatest inertia is a:

(A) cricket ball

(B) loaded truck

(C) bicycle

(D) football

Q8. A force acts on a body of mass 10 kg and produces an acceleration of 2 m/s^2. The magnitude of the force is:

(A) 5 N

(B) 12 N

(C) 8 N

(D) 20 N

Q9. A jet engine moves the aircraft forward by pushing exhaust gases backward. This is a direct application of:

(A) Newton's third law of motion

(B) Newton's first law of motion

(C) the law of conservation of energy

(D) the principle of moments

Q10. A body of mass 4 kg moves with a velocity of 5 m/s. Its linear momentum is:

(A) 9 kg m/s

(B) 20 kg m/s

(C) 1.25 kg m/s

(D) 0.8 kg m/s

Q11. When the velocity of a body decreases steadily with time, its acceleration is said to be:

(A) zero

(B) uniform and positive

(C) directed along the motion

(D) negative (retardation)

Q12. A constant force of 11 N moves a body through a distance of 4 m in the direction of the force. The work done is:

(A) 15 J

(B) 7 J

(C) 44 J

(D) 2.75 J

Q13. The kinetic energy of a body of mass 2 kg moving with a speed of 6 m/s is:

(A) 36 J

(B) 6 J

(C) 12 J

(D) 72 J

Q14. A body of mass 4 kg is lifted to a height of 5 m. The gravitational potential energy gained is:

(A) 20 J

(B) 40 J

(C) 100 J

(D) 200 J

Q15. An engine does 300 J of work in 20 seconds. Its power is:

(A) 6000 W

(B) 15 W

(C) 320 W

(D) 0.067 W

Q16. If the speed of a moving body is doubled, its kinetic energy becomes:

(A) doubled

(B) halved

(C) four times the original

(D) unchanged

Q17. The weight of a body of mass 9 kg on the surface of the Earth is:

(A) 90 N

(B) 9 N

(C) 0.9 N

(D) 900 N

Q18. If the distance between two bodies is increased to three times its original value, the gravitational force of attraction between them becomes:

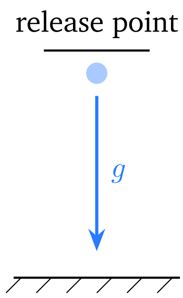
(A) three times

(B) nine times

(C) one-third

(D) one-ninth

Q19. A stone is dropped from rest and falls freely for 4 seconds, as shown. Its velocity at that instant is (take $g = 10$ m/s^2):



(A) 10 m/s

(B) 20 m/s

(C) 40 m/s

(D) 80 m/s

Q20. An astronaut inside an orbiting space station feels weightless because:

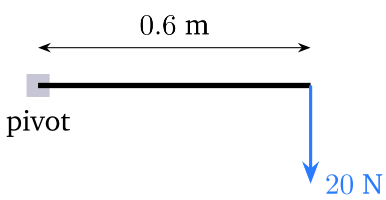
(A) there is no gravity at that height in space

(B) the astronaut and the station are both in continuous free fall around the Earth

(C) the mass of the astronaut becomes zero in space

(D) there is no air present in space

Q21. A force of 20 N is applied at a perpendicular distance of 0.6 m from the pivot, as shown. The moment (turning effect) of the force about the pivot is:



(A) 20 N m

(B) 33.3 N m

(C) 0.03 N m

(D) 12 N m

Q22. A spanner with a long handle is preferred over one with a short handle for loosening a tight nut because a longer arm:

(A) produces a larger turning moment for the same applied force

(B) reduces the total weight of the spanner

(C) increases the applied force on its own

(D) decreases the moment of the force about the nut

Q23. Which one of the following is an example of simple harmonic motion?

(A) a car moving on a straight level road

(B) the Earth revolving around the Sun

(C) the to-and-fro vibration of a mass attached to a spring

(D) a stone falling freely under gravity

Q24. The length of a simple pendulum is made four times its original value. Its time period becomes:

(A) four times the original

(B) two times the original

(C) half of the original

(D) unchanged

Q25. A temperature of $98.6\,^{\circ}\mathrm{F}$ expressed on the Celsius scale is:

(A) $37\,^{\circ}\mathrm{C}$

(B) $66.6\,^{\circ}\mathrm{C}$

(C) $32\,^{\circ}\mathrm{C}$

(D) $72\,^{\circ}\mathrm{C}$

Q26. How much heat is required to raise the temperature of 2 kg of water by $5\,^{\circ}\mathrm{C}$? (Specific heat of water $= 4200\ \mathrm{J\,kg^{-1}\,^{\circ}C^{-1}}$)

(A) 4200 J

(B) 8400 J

(C) 21000 J

(D) 42000 J

Q27. When water is heated in a pan, the hot water rises while the cooler water sinks, setting up currents. This mode of heat transfer is called:

(A) conduction

(B) convection

(C) radiation

(D) reflection

Q28. White clothes are preferred during summer because a white surface:

(A) absorbs most of the heat radiation falling on it

(B) is a very good conductor of heat

(C) reflects most of the heat radiation falling on it

(D) produces cool air around the body

Q29. The heat required to change 1 kg of water at $100\,^{\circ}\mathrm{C}$ into steam at $100\,^{\circ}\mathrm{C}$ is called the latent heat of:

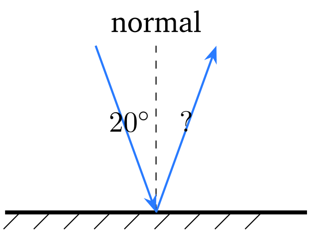
(A) vaporization

(B) fusion

(C) sublimation

(D) condensation

Q30. A ray of light strikes a plane mirror making an angle of incidence of 20° with the normal, as shown. The angle of reflection is:



(A) 70°

(B) 20°

(C) 40°

(D) 0°

Q31. An erect image 2 cm tall is formed of an object 4 cm tall placed before a mirror. The magnification produced is:

(A) 2

(B) 8

(C) 1

(D) 0.5

Q32. The radius of curvature of a spherical mirror is 40 cm. Its focal length is:

(A) 80 cm

(B) 40 cm

(C) 20 cm

(D) 10 cm

Q33. When a ray of light travels from a rarer medium into an optically denser medium, its speed:

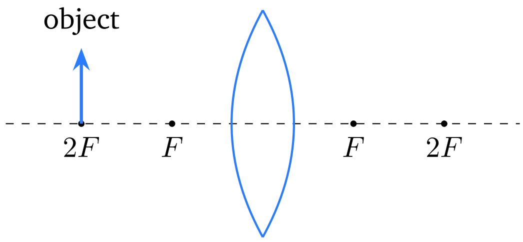
(A) decreases

(B) increases

(C) remains the same

(D) becomes zero

Q34. An object is placed at twice the focal length $(2F)$ in front of a convex lens, as shown. The image formed is:



(A) virtual, erect and magnified

(B) real, inverted and of the same size

(C) real, inverted and highly magnified

(D) formed exactly at the focus

Q35. A concave (diverging) lens, for any position of a real object, always forms an image that is:

(A) real, inverted and magnified

(B) real, inverted and diminished

(C) virtual, erect and magnified

(D) virtual, erect and diminished

Q36. The eye defect in which an elderly person cannot see both near and distant objects clearly because of the weakening of the eye muscles is called:

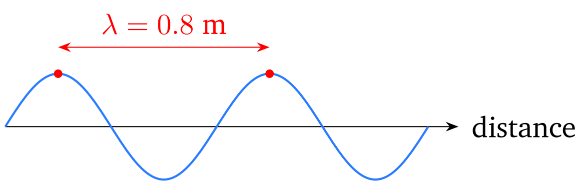
(A) myopia

(B) hypermetropia

(C) presbyopia

(D) astigmatism

Q37. A sound wave has a frequency of 425 Hz and a wavelength of 0.8 m, as represented below. The speed of the wave is:



(A) 340 m/s

(B) 531 m/s

(C) 0.0019 m/s

(D) 425.8 m/s

Q38. Sound waves are best described as:

(A) transverse electromagnetic waves

(B) transverse mechanical waves

(C) longitudinal electromagnetic waves

(D) longitudinal mechanical waves

Q39. A megaphone (speaking tube) makes a person's voice louder in a particular direction mainly by using:

(A) refraction of sound

(B) repeated reflection of sound

(C) absorption of sound

(D) dispersion of sound

Q40. The audible range of frequencies for a normal human ear is approximately:

(A) 0 Hz to 20 Hz

(B) 20 kHz to 200 kHz

(C) 20 Hz to 20,000 Hz

(D) above 20,000 Hz only

Q41. A potential difference of 20 V drives a current of 4 A through a resistor. The resistance of the resistor is:

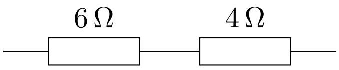
(A) $80\,\Omega$

(B) $5\,\Omega$

(C) $0.2\,\Omega$

(D) $16\,\Omega$

Q42. Two resistors of $6\,\Omega$ and $4\,\Omega$ are connected in series, as shown. Their equivalent resistance is:



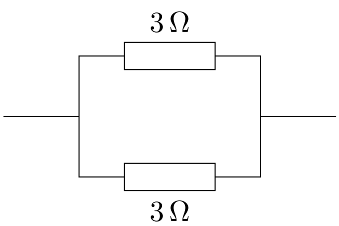
(A) $2.4\,\Omega$

(B) $24\,\Omega$

(C) $2\,\Omega$

(D) $10\,\Omega$

Q43. Two resistors, each of $3\,\Omega$, are connected in parallel, as shown. Their equivalent resistance is:



(A) $1.5\,\Omega$

(B) $6\,\Omega$

(C) $3\,\Omega$

(D) $9\,\Omega$

Q44. An electrical device operates at 110 V and draws a current of 2 A. The power consumed by it is:

(A) 55 W

(B) 110 W

(C) 220 W

(D) 440 W

Q45. Connecting too many high-power appliances to a single socket, so that the circuit draws a very large current, is called:

(A) short-circuiting

(B) earthing

(C) a parallel fault

(D) overloading

Q46. The SI unit of electrical resistivity is the:

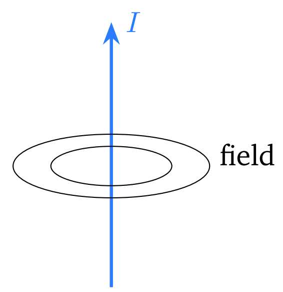
(A) ohm metre (Ω·m)

(B) ohm (Ω)

(C) ohm per metre (Ω/m)

(D) volt per ampere (V/A)

Q47. A straight vertical wire carries a current in the upward direction, as shown. By the right-hand thumb rule, the magnetic field lines around the wire, seen from above, are:



(A) clockwise concentric circles

(B) anticlockwise concentric circles

(C) straight lines parallel to the wire

(D) radial lines pointing outward

Q48. Electromagnets are used in cranes at scrap yards mainly because they can:

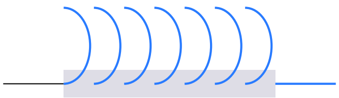
(A) melt the iron scrap quickly

(B) weld the iron pieces together

(C) lift and release heavy iron objects by switching the current on and off

(D) measure the weight of the scrap

Q49. A current-carrying coil (solenoid) wound on a soft-iron core, shown below, acts as a:



soft-iron core

(A) strong electromagnet

(B) simple resistor

(C) capacitor

(D) permanent magnet that cannot be switched off

Q50. In an electric motor, a current-carrying coil placed in a magnetic field experiences a:

(A) gain in electric charge

(B) turning force (torque) that makes it rotate

(C) rise in its own resistance

(D) complete loss of its current

Detailed Solutions

Q1.

Solution

Concept — Linear momentum: Momentum is the product of mass and velocity, $p = mv$. Its unit is built from the units of mass and velocity.

Step 1 — Build the unit: Unit of momentum $=$ (unit of mass) $\times$ (unit of velocity) $=$ kg $\times$ m/s.

Step 2 — Write it: This gives kilogram metre per second, written as kg m/s.

Why other options are wrong:

- Newton is the unit of force.
- Joule is the unit of work or energy.
- Watt is the unit of power.

Final Answer: The SI unit of momentum is kg m/s $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q1

Q2.

Solution

Concept — Fundamental and derived quantities: The seven fundamental quantities (length, mass, time, current, temperature, amount of substance, luminous intensity) cannot be broken down further. Quantities formed by combining them are called derived quantities.

Step 1 — Test each option: Length, time and mass are themselves fundamental quantities.

Step 2 — Identify the derived quantity: Force $=$ mass $\times$ acceleration, so force is built from base quantities and is therefore derived.

Why other options are wrong:

- Length is a fundamental quantity.
- Time is a fundamental quantity.
- Mass is a fundamental quantity.

Final Answer: Force is the derived quantity $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q2

Q3.

Solution

Concept — Unit conversion: To change km/h into m/s, multiply by $\frac{5}{18}$.

Step 1 — Write the conversion factor: 1 km/h $= \frac{5}{18}$ m/s.

Step 2 — Substitute the value: Speed $= 54 \times \frac{5}{18}$ m/s.

Step 3 — Simplify: $54 \div 18 = 3$, then $3 \times 5 = 15$. So speed $= 15$ m/s.

Why other options are wrong:

- 20 and 27 come from using a wrong factor.
- 10 divides by an extra factor.

Final Answer: 54 km/h $= 15$ m/s $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q3

Q4.

Solution

Concept — Same units: Two quantities share a unit only when they describe the same kind of physical effect. Work is energy transferred, so work and energy are the same kind of quantity.

Step 1 — Check work and energy: Both work and energy are measured in joule (J), since doing work changes the energy of a body.

Step 2 — Confirm: 1 J of work always corresponds to 1 J of energy, so the units match exactly.

Why other options are wrong:

- Force (N) and momentum (kg m/s) have different units.
- Power (W) and energy (J) are different.
- Pressure (Pa) and force (N) are different.

Final Answer: Work and energy share the unit joule $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q4

Q5.

Solution

Concept — Equation of motion: For uniform acceleration without time, $v^2 = u^2 + 2as$.

Step 1 — List the data: $u = 0$ (starts from rest), $v = 10$ m/s, $s = 25$ m.

Step 2 — Substitute: $10^2 = 0^2 + 2 \times a \times 25$.

Step 3 — Simplify: $100 = 50a$.

Step 4 — Solve: $a = \frac{100}{50} = 2$ m/s^2.

Why other options are wrong:

- 4 and 5 use a wrong distance or formula.
- 0.4 divides the wrong way.

Final Answer: Acceleration $= 2$ m/s$^2 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q5

Q6.

Solution

Concept — Area under a v–t graph: The area under a velocity–time graph gives the displacement. For a straight line from the origin, the area is a triangle.

Step 1 — Read the graph: The velocity rises from 0 to 8 m/s over a time of 4 s.

Step 2 — Use the triangle area: Displacement $= \frac{1}{2} \times$ base $\times$ height $= \frac{1}{2} \times 4 \times 8$.

Step 3 — Compute: $\frac{1}{2} \times 4 \times 8 = 16$ m.

Why other options are wrong:

- 32 forgets the factor $\frac{1}{2}$.
- 12 and 2 misread the base or height.

Final Answer: Displacement $= 16$ m $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q6

Q7.

Solution

Concept — Inertia and mass: Inertia is the tendency of a body to resist a change in its state of rest or motion. The greater the mass, the greater the inertia.

Step 1 — Compare the masses: Among a cricket ball, a loaded truck, a bicycle and a football, the loaded truck has by far the largest mass.

Step 2 — Conclude: The body with the largest mass has the greatest inertia, so the loaded truck wins.

Why other options are wrong:

- A cricket ball, a bicycle and a football all have much smaller masses.
- Smaller mass means it is easier to change their motion (less inertia).

Final Answer: The loaded truck has the greatest inertia $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q7

Q8.

Solution

Concept — Newton's second law: Force equals mass times acceleration, $F = ma$.

Step 1 — List the data: $m = 10$ kg, $a = 2$ m/s^2.

Step 2 — Substitute: $F = 10 \times 2$.

Step 3 — Compute: $F = 20$ N.

Why other options are wrong:

- 5 divides mass by acceleration.
- 12 adds mass and acceleration.
- 8 subtracts the values.

Final Answer: Force $= 20$ N $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q8

Q9.

Solution

Concept — Newton's third law: To every action there is an equal and opposite reaction, and the two forces act on different bodies.

Step 1 — Apply to the jet: The engine pushes the exhaust gases backward (action), and the gases push the engine, and hence the aircraft, forward (reaction).

Step 2 — Conclude: This backward push on the gases and forward push on the aircraft form an action–reaction pair.

Why other options are wrong:

- The first law deals with inertia, not the forward thrust.
- Conservation of energy does not by itself explain the direction of motion.
- The principle of moments deals with turning effects.

Final Answer: Jet thrust is an example of Newton's third law $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q9

Q10.

Solution

Concept — Linear momentum: Momentum $p = mv$, the product of mass and velocity.

Step 1 — List the data: $m = 4$ kg, $v = 5$ m/s.

Step 2 — Substitute: $p = 4 \times 5$.

Step 3 — Compute: $p = 20$ kg m/s.

Why other options are wrong:

- 9 adds mass and velocity.
- 1.25 divides velocity by mass.
- 0.8 divides mass by velocity.

Final Answer: Momentum $= 20$ kg m/s $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q10

Q11.

Solution

Concept — Sign of acceleration: Acceleration is the rate of change of velocity. If velocity decreases with time, the change in velocity is negative.

Step 1 — Look at the velocity: A steadily decreasing velocity means Δv is negative over time.

Step 2 — Name it: A negative acceleration that slows a body down is called retardation (or deceleration).

Why other options are wrong:

- Zero acceleration would keep the velocity constant.
- A positive acceleration would increase the velocity.
- Acceleration along the motion would speed the body up, not slow it.

Final Answer: Decreasing velocity means negative acceleration (retardation) $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q11

Q12.

Solution

Concept — Work done: When a force acts along the direction of motion, work $W = F \times s$.

Step 1 — List the data: $F = 11$ N, $s = 4$ m.

Step 2 — Substitute: $W = 11 \times 4$.

Step 3 — Compute: $W = 44$ J.

Why other options are wrong:

- 15 adds force and distance.
- 7 subtracts the values.
- 2.75 divides force by distance.

Final Answer: Work done $= 44$ J $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q12

Q13.

Solution

Concept — Kinetic energy: The kinetic energy of a moving body is $KE = \frac{1}{2}mv^2$.

Step 1 — List the data: $m = 2$ kg, $v = 6$ m/s.

Step 2 — Square the velocity: $v^2 = 6^2 = 36$.

Step 3 — Substitute and compute: $KE = \frac{1}{2} \times 2 \times 36 = 36$ J.

Why other options are wrong:

- 6 uses v instead of v^2.
- 12 uses a wrong factor.
- 72 forgets the factor $\frac{1}{2}$.

Final Answer: Kinetic energy $= 36$ J $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q13

Q14.

Solution

Concept — Gravitational potential energy: The energy gained on raising a body is $PE = mgh$.

Step 1 — List the data: $m = 4$ kg, $g = 10$ m/s^2, $h = 5$ m.

Step 2 — Substitute: $PE = 4 \times 10 \times 5$.

Step 3 — Compute: $PE = 200$ J.

Why other options are wrong:

- 20 and 40 leave out a factor.
- 100 uses a wrong height or mass.

Final Answer: Potential energy $= 200$ J $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q14

Q15.

Solution

Concept — Power: Power is the rate of doing work, $P = \dfrac{W}{t}$.

Step 1 — List the data: $W = 300$ J, $t = 20$ s.

Step 2 — Substitute: $P = \dfrac{300}{20}$.

Step 3 — Compute: $P = 15$ W.

Why other options are wrong:

- 6000 multiplies instead of dividing.
- 320 adds the values.
- 0.067 inverts the ratio.

Final Answer: Power $= 15$ W $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q15

Q16.

Solution

Concept — Kinetic energy and speed: Since $KE = \frac{1}{2}mv^2$, the kinetic energy depends on the square of the speed.

Step 1 — Take the new speed: If the speed is doubled, the new speed is $2v$.

Step 2 — Substitute: New $KE = \frac{1}{2}m(2v)^2 = \frac{1}{2}m \times 4v^2$.

Step 3 — Compare: This is $4 \times \frac{1}{2}mv^2$, that is four times the original kinetic energy.

Why other options are wrong:

- Doubling would be true only if KE depended on v, not v^2.
- Halving and unchanged contradict the formula.

Final Answer: Kinetic energy becomes four times the original $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q16

Q17.

Solution

Concept — Weight: The weight of a body is the gravitational force on it, $W = mg$.

Step 1 — List the data: $m = 9$ kg, $g = 10$ m/s^2.

Step 2 — Substitute: $W = 9 \times 10$.

Step 3 — Compute: $W = 90$ N.

Why other options are wrong:

- 9 N is only the mass value, not the force.
- 0.9 N divides instead of multiplying.
- 900 N multiplies by an extra factor of ten.

Final Answer: Weight $= 90$ N $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q17

Q18.

Solution

Concept — Inverse-square law: By Newton's law of gravitation, $F = G\dfrac{m_1 m_2}{r^2}$, so force is inversely proportional to the square of the distance.

Step 1 — Change the distance: The new distance is $3r$, where r is the original distance.

Step 2 — Substitute: New force $\propto \dfrac{1}{(3r)^2} = \dfrac{1}{9r^2}$.

Step 3 — Compare: This is $\dfrac{1}{9}$ of the original force.

Why other options are wrong:

- Force does not increase with distance, so 3 times and 9 times are wrong.
- One-third would apply only if force varied as $1/r$, not $1/r^2$.

Final Answer: The force becomes one-ninth $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q18

Q19.

Solution

Concept — Free fall: For a body dropped from rest, the velocity gained is $v = gt$ (since $u = 0$).

Step 1 — List the data: $u = 0$, $g = 10$ m/s^2, $t = 4$ s.

Step 2 — Substitute: $v = 10 \times 4$.

Step 3 — Compute: $v = 40$ m/s.

Why other options are wrong:

- 10 uses only g without the time.
- 20 uses half the time.
- 80 multiplies by an extra factor of two.

Final Answer: Velocity after 4 s = 40 m/s $\Rightarrow \boxed{\text{C}}$

$\boxed{\textbf{Answer: (C)}}$ Go Back to Q19

Q20.

Solution

Concept — Weightlessness in orbit: A body feels weightless when it is in free fall, because there is no supporting (normal) force acting on it.

Step 1 — Describe the orbit: An orbiting station and the astronaut inside it are both falling towards the Earth all the time, but their forward motion keeps them in a curved path.

Step 2 — Conclude: Since both fall together at the same rate, the floor does not press on the astronaut, so the astronaut feels weightless.

Why other options are wrong:

- Gravity is still present at that height; it is what holds the station in orbit.
- The astronaut's mass does not change.
- Absence of air does not cause weightlessness.

Final Answer: Weightlessness is due to continuous free fall $\Rightarrow \boxed{\text{B}}$

$\boxed{\textbf{Answer: (B)}}$ Go Back to Q20

Q21.

Solution

Concept — Moment of a force: The moment (turning effect) about a pivot is force times the perpendicular distance, moment $= F \times d$.

Step 1 — List the data: $F = 20$ N, $d = 0.6$ m.

Step 2 — Substitute: Moment $= 20 \times 0.6$.

Step 3 — Compute: Moment $= 12$ N m.

Why other options are wrong:

- 20 N m ignores the distance.
- 33.3 N m divides force by distance.
- 0.03 N m divides distance by force.

Final Answer: Moment of the force $= 12$ N m $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q21

Q22.

Solution

Concept — Moment depends on arm length: Moment $=$ force $\times$ perpendicular distance. For the same force, a longer distance gives a larger moment.

Step 1 — Compare the arms: A long handle increases the distance d between the applied force and the nut.

Step 2 — Conclude: With a larger d, the same force produces a greater turning moment, so the nut is loosened more easily.

Why other options are wrong:

- A longer handle does not reduce the weight in a useful way.
- The handle length does not increase the force on its own.
- It increases the moment, it does not decrease it.

Final Answer: A longer arm gives a larger moment for the same force $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q22

Q23.

Solution

Concept — Simple harmonic motion: SHM is a to-and-fro motion about a fixed mean position in which the restoring force is directed towards that mean position.

Step 1 — Test the spring: A mass attached to a spring, when pulled and released, oscillates back and forth about its mean position, with a restoring force pulling it back.

Step 2 — Conclude: This back-and-forth vibration of the spring-mass is a clear example of SHM.

Why other options are wrong:

- A car on a straight road moves in one direction, not to and fro.
- The Earth around the Sun is circular (periodic) motion, not SHM about a mean line.
- A freely falling stone is not oscillatory.

Final Answer: The vibrating spring-mass is the SHM example $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q23

Q24.

Solution

Concept — Pendulum time period: The time period of a simple pendulum is $T = 2\pi\sqrt{\dfrac{L}{g}}$, so $T \propto \sqrt{L}$.

Step 1 — Change the length: The new length is $4L$.

Step 2 — Substitute the proportionality: New $T \propto \sqrt{4L} = \sqrt{4} \times \sqrt{L} = 2\sqrt{L}$.

Step 3 — Compare: The new time period is 2 times the original.

Why other options are wrong:

- Four times would be true only if $T \propto L$ directly.
- Half and unchanged contradict the formula.

Final Answer: The time period becomes two times the original $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q24

Q25.

Solution

Concept — Temperature conversion: To change Fahrenheit to Celsius, use $C = \frac{5}{9}(F - 32)$.

Step 1 — Subtract 32: $F - 32 = 98.6 - 32 = 66.6$.

Step 2 — Multiply by $\frac{5}{9}$: $C = \frac{5}{9} \times 66.6$.

Step 3 — Compute: $66.6 \div 9 = 7.4$, then $7.4 \times 5 = 37$. So $C = 37\,°\text{C}$.

Why other options are wrong:

- 66.6 skips the multiplication step.
- 32 and 72 use the formula incorrectly.

Final Answer: $98.6\,°\text{F} = 37\,°\text{C} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q25

Q26.

Solution

Concept — Heat supplied: The heat needed to change temperature is $Q = mc\Delta T$.

Step 1 — List the data: $m = 2$ kg, $c = 4200\ \text{J}\,\text{kg}^{-1}\,°\text{C}^{-1}$, $\Delta T = 5\,°\text{C}$.

Step 2 — Substitute: $Q = 2 \times 4200 \times 5$.

Step 3 — Multiply step by step: $2 \times 4200 = 8400$, then $8400 \times 5 = 42000$.

Step 4 — State the result: $Q = 42000$ J.

Why other options are wrong:

- 4200 and 8400 leave out one of the factors.
- 21000 uses half the mass.

Final Answer: Heat required $= 42000$ J $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q26

Q27.

Solution

Concept — Convection: In liquids and gases, heat is carried by the actual movement of the heated material itself. This bulk movement is called convection.

Step 1 — Describe the motion: When water is heated at the bottom, the warm water expands, becomes lighter and rises, while cooler water sinks to take its place.

Step 2 — Name the process: This circulating flow of hot and cold water sets up convection currents.

Why other options are wrong:

- Conduction transfers heat without bulk movement (mainly in solids).
- Radiation needs no medium and does not involve currents.
- Reflection is not a mode of heat transfer.

Final Answer: The currents are due to convection $\Rightarrow \boxed{\text{B}}$

$\boxed{\textbf{Answer: (B)}}$ **Go Back to Q27**

Q28.

Solution

Concept — Radiation and colour: A white surface is a poor absorber and a good reflector of heat radiation, while a dark surface absorbs more.

Step 1 — Think about white clothes: White clothes reflect most of the heat radiation that falls on them.

Step 2 — Conclude: Because less heat is absorbed, the body stays cooler, so white clothes are comfortable in summer.

Why other options are wrong:

- Absorbing most of the radiation would make the wearer hotter (that is what dark clothes do).
- Cloth is not chosen for its conduction here.
- White cloth does not produce cool air.

Final Answer: White clothes reflect most of the heat radiation $\Rightarrow \boxed{\text{C}}$

$\boxed{\textbf{Answer: (C)}}$ **Go Back to Q28**

Q29.

Solution

Concept — Latent heat: The heat absorbed or released during a change of state at constant temperature is the latent heat. The change from liquid to gas is called vaporization.

Step 1 — Identify the change of state: Water at $100\,^\circ\mathrm{C}$ turning into steam at $100\,^\circ\mathrm{C}$ is a change from liquid to vapour.

Step 2 — Name the latent heat: The heat needed for this change is the latent heat of vaporization.

Why other options are wrong:

- Fusion is the melting of a solid into a liquid.
- Sublimation is solid directly to gas.
- Condensation is gas turning back into liquid.

Final Answer: It is the latent heat of vaporization $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q29

Q30.

Solution

Concept — Law of reflection: The angle of incidence equals the angle of reflection, both measured from the normal to the mirror.

Step 1 — Read the angle: The angle of incidence is given as 20° from the normal.

Step 2 — Apply the law: Angle of reflection $=$ angle of incidence $= 20^\circ$.

Why other options are wrong:

- 70° is measured from the mirror surface, not from the normal.
- 40° doubles the angle.
- 0° would need the ray along the normal.

Final Answer: Angle of reflection $= 20^\circ \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q30

Q31.

Solution

Concept — Magnification: The magnification of a mirror is the ratio of the image height to the object height, $m = \frac{h'}{h}$.

Step 1 — List the data: Image height $h' = 2$ cm, object height $h = 4$ cm.

Step 2 — Substitute: $m = \frac{2}{4}$.

Step 3 — Compute: $m = 0.5$.

Why other options are wrong:

- 2 inverts the ratio (object over image).
- 8 multiplies the two heights.
- 1 would mean the image and object are the same size.

Final Answer: Magnification $= 0.5 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q31

Q32.

Solution

Concept — Mirror relation: For a spherical mirror, the focal length is half the radius of curvature, $f = \frac{R}{2}$.

Step 1 — List the data: $R = 40$ cm.

Step 2 — Substitute: $f = \frac{40}{2}$.

Step 3 — Compute: $f = 20$ cm.

Why other options are wrong:

- 80 doubles instead of halving.
- 40 keeps R unchanged.
- 10 divides by four.

Final Answer: Focal length $= 20$ cm $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q32

Q33.

Solution

Concept — Refraction and optical density: Light travels fastest in a rarer medium and slows down in a denser medium. The denser the medium, the smaller the speed of light in it.

Step 1 — Compare the media: Going from a rarer medium to a denser medium means entering a region where light moves more slowly.

Step 2 — Conclude: Therefore the speed of the light decreases.

Why other options are wrong:

- Speed would increase only going from denser to rarer.
- The speed does change at the boundary, so it does not stay the same.
- Light does not stop; it merely slows down.

Final Answer: The speed of light decreases in the denser medium $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q33

Q34.

Solution

Concept — Convex lens image at 2F: For a convex lens, when the object is placed at twice the focal length ($2F$), the image forms at $2F$ on the other side.

Step 1 — Locate the object: The object is exactly at $2F$ in front of the lens.

Step 2 — Describe the image: The image is real, inverted and of the same size as the object, formed at $2F$ on the far side.

Why other options are wrong:

- A virtual erect magnified image forms only when the object is inside the focus.
- A highly magnified real image forms when the object is between F and $2F$.
- The image at the focus forms only for an object at infinity.

Final Answer: The image is real, inverted and of the same size $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q34

Q35.

Solution

Concept — Concave (diverging) lens: A concave lens spreads out the light rays. The refracted rays appear to come from a point on the same side as the object.

Step 1 — Trace the rays: For any position of a real object, the diverging rays seem to start from a point between the object and the lens.

Step 2 — Describe the image: The image is always virtual, erect and diminished (smaller than the object).

Why other options are wrong:

- A concave lens never forms a real image of a real object.
- It never magnifies the image.

Final Answer: The image is always virtual, erect and diminished $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q35

Q36.

Solution

Concept — Eye defects: Presbyopia is an age-related defect in which the eye muscles weaken and the lens loses flexibility, so the person cannot focus on both near and distant objects.

Step 1 — Match the symptoms: Difficulty in seeing both near and far objects in old age, due to weakening of the eye muscles, describes presbyopia.

Step 2 — Note the correction: It is usually corrected with bifocal lenses.

Why other options are wrong:

- Myopia is difficulty seeing distant objects only.
- Hypermetropia is difficulty seeing near objects only.
- Astigmatism is caused by an irregular curvature of the cornea.

Final Answer: The defect is presbyopia $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q36

Q37.

Solution

Concept — Wave speed: The speed of a wave is the product of frequency and wavelength, $v = f\lambda$.

Step 1 — List the data: $f = 425$ Hz, $\lambda = 0.8$ m.

Step 2 — Substitute: $v = 425 \times 0.8$.

Step 3 — Compute: $v = 340$ m/s.

Why other options are wrong:

- 531 divides frequency by wavelength.
- 0.0019 divides wavelength by frequency.
- 425.8 adds the two values.

Final Answer: Speed of the wave $= 340$ m/s $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q37

Q38.

Solution

Concept — Nature of sound: Sound needs a material medium to travel and moves as compressions and rarefactions along the direction of travel.

Step 1 — Direction of vibration: The particles of the medium vibrate back and forth along the direction in which the sound moves, so sound is a longitudinal wave.

Step 2 — Need for a medium: Since it requires a medium (it cannot travel through vacuum), it is a mechanical wave.

Why other options are wrong:

- Sound is not transverse; the vibration is along the travel direction.
- Sound is not electromagnetic; it cannot travel through vacuum.

Final Answer: Sound is a longitudinal mechanical wave $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q38

Q39.

Solution

Concept — Reflection of sound: Sound can bounce off surfaces. A megaphone uses repeated reflections inside its cone to send the sound in one direction.

Step 1 — Trace the sound: Inside the cone of a megaphone, the sound waves reflect again and again off the walls.

Step 2 — Conclude: These repeated reflections direct the sound forward, making the voice louder in that direction.

Why other options are wrong:

- Refraction is bending of sound, not the main effect here.
- Absorption would reduce the loudness.
- Dispersion is not what a megaphone uses.

Final Answer: A megaphone works by repeated reflection of sound $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q39

Q40.

Solution

Concept — Audible range: A normal human ear can hear sounds whose frequency lies between about 20 Hz and $20{,}000$ Hz.

Step 1 — Lower limit: Sounds below 20 Hz (infrasonic) cannot be heard.

Step 2 — Upper limit: Sounds above $20{,}000$ Hz (ultrasonic) also cannot be heard. So the audible range is 20 Hz to $20{,}000$ Hz.

Why other options are wrong:

- 0 Hz to 20 Hz is the infrasonic range.
- 20 kHz to 200 kHz and above $20{,}000$ Hz are ultrasonic.

Final Answer: The audible range is 20 Hz to $20{,}000$ Hz $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q40

Q41.

Solution

Concept — Ohm's law: The potential difference, current and resistance are related by $V = IR$, so $R = \dfrac{V}{I}$.

Step 1 — List the data: $V = 20$ V, $I = 4$ A.

Step 2 — Substitute: $R = \dfrac{20}{4}$.

Step 3 — Compute: $R = 5\,\Omega$.

Why other options are wrong:

- 80 multiplies V and I.
- 0.2 inverts the ratio.
- 16 subtracts the values.

Final Answer: Resistance $= 5\,\Omega \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q41

Q42.

Solution

Concept — Resistors in series: In a series combination, the equivalent resistance is the sum of the individual resistances, $R = R_1 + R_2$.

Step 1 — List the data: $R_1 = 6\,\Omega$, $R_2 = 4\,\Omega$.

Step 2 — Add: $R = 6 + 4$.

Step 3 — Compute: $R = 10\,\Omega$.

Why other options are wrong:

- 2.4 is the parallel value of these resistors.
- 24 multiplies the resistances.
- 2 subtracts them.

Final Answer: Equivalent series resistance $= 10\,\Omega \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q42

Q43.

Solution

Concept — Equal resistors in parallel: For two equal resistors R in parallel, the equivalent resistance is $\frac{R}{2}$.

Step 1 — Apply the rule: Each resistor is $3\,\Omega$, so $R_{\text{eq}} = \frac{3}{2}$.

Step 2 — Compute: $R_{\text{eq}} = 1.5\,\Omega$.

Step 3 — Check: The parallel value is always less than the smallest resistor, and $1.5\,\Omega < 3\,\Omega$, which is consistent.

Why other options are wrong:

- 6 is the series value.
- 3 keeps one resistor only.
- 9 multiplies the resistances.

Final Answer: Equivalent parallel resistance $= 1.5\,\Omega \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q43

Q44.

Solution

Concept — Electric power: Electric power is the product of voltage and current, $P = VI$.

Step 1 — List the data: $V = 110$ V, $I = 2$ A.

Step 2 — Substitute: $P = 110 \times 2$.

Step 3 — Compute: $P = 220$ W.

Why other options are wrong:

- 55 divides voltage by current.
- 110 ignores the current.
- 440 multiplies by an extra factor of two.

Final Answer: Power consumed $= 220$ W $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q44

Q45.

Solution

Concept — Overloading: Overloading occurs when many appliances are run from one socket, so the total current drawn becomes much larger than the wiring is meant to carry.

Step 1 — Identify the cause: Plugging in too many high-power appliances together increases the total current in the circuit.

Step 2 — Name it: Drawing this excessive current is called overloading, and it can overheat the wires.

Why other options are wrong:

- Short-circuiting is the direct contact of the live and neutral wires, not just adding appliances.
- Earthing is a safety connection to the ground.
- "Parallel fault" is not the standard term for this.

Final Answer: Drawing too large a current this way is overloading $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q45

Q46.

Solution

Concept — Resistivity: Resistance is related to resistivity by $R = \rho \dfrac{l}{A}$, so $\rho = \dfrac{RA}{l}$. Its unit follows from this relation.

Step 1 — Build the unit: ρ has the unit $\dfrac{\Omega \times \text{m}^2}{\text{m}} = \Omega \times \text{m}$.

Step 2 — Write it: So the SI unit of resistivity is the ohm metre ($\Omega{\cdot}\text{m}$).

Why other options are wrong:

- Ohm (Ω) is the unit of resistance, not resistivity.
- Ohm per metre is dimensionally wrong.
- Volt per ampere is the same as the ohm (resistance).

Final Answer: The SI unit of resistivity is the ohm metre $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q46

Q47.

Solution

Concept — Right-hand thumb rule: If the thumb of the right hand points along the direction of the current, the curled fingers show the direction of the magnetic field lines, which are concentric circles around the wire.

Step 1 — Point the thumb up: The current is upward, so point the right thumb upward.

Step 2 — Curl the fingers: Seen from above (looking down the current), the fingers curl anticlockwise, so the circular field lines run anticlockwise.

Why other options are wrong:

- Clockwise would correspond to a downward current.
- The field lines are circles, not straight lines parallel to the wire.
- The field lines are not radial.

Final Answer: The field forms anticlockwise concentric circles $\Rightarrow \boxed{\text{B}}$

$\boxed{\textbf{Answer: (B)}}$ Go Back to Q47

Q48.

Solution

Concept — Electromagnet: An electromagnet is a magnet only while current flows; switching the current off removes its magnetism.

Step 1 — Lift the load: When the current is switched on, the crane's electromagnet becomes strongly magnetic and lifts heavy iron objects.

Step 2 — Release the load: When the current is switched off, the magnetism disappears and the iron is dropped at the new place.

Why other options are wrong:

- An electromagnet does not melt or weld the scrap.
- It is used to move the scrap, not to weigh it.

Final Answer: A crane electromagnet lifts and releases iron by switching the current $\Rightarrow \boxed{\text{C}}$

$\boxed{\textbf{Answer: (C)}}$ Go Back to Q48

Q49.

Solution

Concept — Solenoid with iron core: A current-carrying solenoid behaves like a magnet. Winding it on a soft-iron core greatly increases the strength of this magnet.

Step 1 — Field of the coil: The current in the coil produces a magnetic field similar to that of a bar magnet.

Step 2 — Effect of the core: The soft-iron core becomes strongly magnetised, so the combination acts as a strong electromagnet (which can be switched on and off).

Why other options are wrong:

- A resistor and a capacitor are not magnets.
- It is not a permanent magnet, because soft iron loses its magnetism when the current stops.

Final Answer: A coil on a soft-iron core acts as a strong electromagnet $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q49

Q50.

Solution

Concept — Working of an electric motor: When a current-carrying coil is placed in a magnetic field, the field exerts a force on its current-carrying sides. The two sides feel forces in opposite directions, producing a turning effect (torque).

Step 1 — Identify the cause: The magnetic field acts on the current in the coil (the magnetic effect of current).

Step 2 — State the result: The opposite forces on the two arms of the coil rotate it, so the coil experiences a turning force.

Why other options are wrong:

- The coil does not gain electric charge.
- Its resistance does not rise because of the field.
- The current keeps flowing; it is not lost.

Final Answer: The coil experiences a turning force (torque) $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q50

Answer Key

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