Jharkhand Polytechnic Physics

Sample Paper – 6

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 electrical resistance is the:

(A) ampere

(B) ohm

(C) volt

(D) watt

Q2. Which of the following is a derived physical quantity (not a base quantity)?

(A) Length

(B) Time

(C) Temperature

(D) Momentum

Q3. A train moves with a speed of 108 km/h. Its speed in metre per second is:

(A) 30 m/s

(B) 36 m/s

(C) 54 m/s

(D) 25 m/s

Q4. The least count of an ordinary metre scale (graduated in millimetres) is:

(A) 0.1 mm

(B) 0.01 mm

(C) 1 mm

(D) 1 cm

Q5. A body moving with an initial velocity of 2 m/s accelerates uniformly at 2 m/s^2 for 2 seconds. The distance covered by it is:

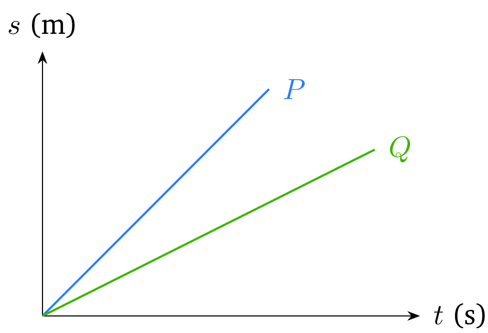
(A) 4 m

(B) 12 m

(C) 8 m

(D) 16 m

Q6. The distance–time graphs of two bodies P and Q moving along a straight road are shown below. Which statement is correct?



(A) P moves faster than Q, since its graph is steeper

(B) Q moves faster than P

(C) both move with exactly the same speed

(D) both bodies are at rest

Q7. An athlete runs some distance before taking a long jump. This is mainly because:

(A) running reduces his weight

(B) the inertia of motion gained while running helps him jump farther

(C) it reduces the air resistance acting on him

(D) it increases the force of gravity on him

Q8. A force acts on a body of mass 5 kg and produces an acceleration of 2 m/s^2. The magnitude of the force is:

(A) 2.5 N

(B) 7 N

(C) 25 N

(D) 10 N

Q9. When the air is suddenly released from an inflated balloon, the balloon shoots forward. This is an example of:

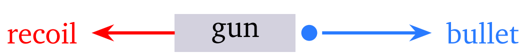
(A) Newton's third law of motion

(B) Newton's first law of motion

(C) the law of conservation of energy

(D) Archimedes' principle

Q10. A bullet is fired from a gun and the gun recoils backward, as shown. The total momentum of the gun-and-bullet system just after firing is:



(A) greater than its value before firing

(B) equal to its value before firing (which was zero)

(C) less than its value before firing but not zero

(D) exactly doubled after firing

Q11. A car speeds up uniformly from rest to 30 m/s in 6 seconds. Its acceleration is:

(A) 6 m/s^2

(B) 180 m/s^2

(C) 5 m/s^2

(D) 0.2 m/s^2

Q12. A constant force of 9 N moves a body through a distance of 5 m in the direction of the force. The work done is:

(A) 1.8 J

(B) 14 J

(C) 90 J

(D) 45 J

Q13. The kinetic energy of a body of mass 4 kg moving with a speed of 3 m/s is:

(A) 18 J

(B) 36 J

(C) 6 J

(D) 12 J

Q14. A body of mass 5 kg is lifted to a height of 8 m. The gravitational potential energy gained by it is:

(A) 40 J

(B) 400 J

(C) 200 J

(D) 13 J

Q15. A pump does 1000 J of work in 25 seconds. The power of the pump is:

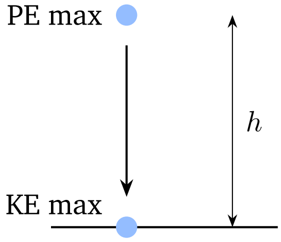
(A) 25000 W

(B) 1025 W

(C) 40 W

(D) 0.025 W

Q16. A ball falls freely from a height, as shown. During the fall (ignoring air resistance), its potential energy:



(A) increases while the kinetic energy also increases

(B) remains constant while the kinetic energy increases

(C) increases and is fully converted into heat

(D) decreases and is converted into an equal amount of kinetic energy

Q17. The weight of an object of mass 15 kg on the surface of the Earth is:

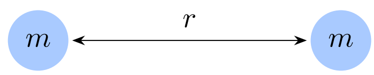
(A) 150 N

(B) 15 N

(C) 1.5 N

(D) 300 N

Q18. Two bodies attract each other gravitationally with a force F when separated by a distance r, as shown. If the distance between them is doubled, the force becomes:



(A) double ($2F$)

(B) half ($F/2$)

(C) one-fourth ($F/4$)

(D) four times ($4F$)

Q19. A stone is dropped from rest and falls freely for 5 seconds. Its velocity at that instant is (take $g = 10$ m/s^2):

(A) 25 m/s

(B) 50 m/s

(C) 5 m/s

(D) 100 m/s

Q20. In the absence of air resistance, a heavy stone and a light feather are dropped together from the same height. They will:

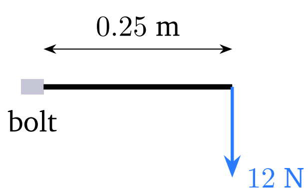
(A) the stone reaches the ground first

(B) the feather reaches the ground first

(C) neither of them reaches the ground

(D) both reach the ground at the same time

Q21. A force of 12 N is applied at the end of a spanner at a perpendicular distance of 0.25 m from the bolt, as shown. The moment (turning effect) of the force about the bolt is:



(A) 3 N m

(B) $48\ \mathrm{N\,m}$

(C) $0.02\ \mathrm{N\,m}$

(D) $6\ \mathrm{N\,m}$

Q22. A uniform beam is pivoted at its centre. It will remain in balance when the:

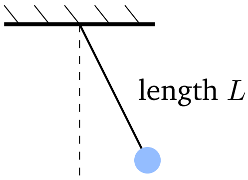
(A) beam is made of the same material throughout

(B) anticlockwise moment about the pivot equals the clockwise moment

(C) beam is very long

(D) pivot is placed at one end of the beam

Q23. For the simple pendulum shown, its time period will *increase* if we:



(A) decrease its length

(B) use a heavier bob

(C) increase its length

(D) decrease its amplitude

Q24. Simple harmonic motion is best described as a:

(A) motion in a circle at constant speed

(B) motion in a straight line with constant acceleration

(C) completely random motion of particles

(D) periodic to-and-fro motion about a fixed (mean) position

Q25. A pleasant room temperature is $20\,°\mathrm{C}$. Its value on the Fahrenheit scale is:

(A) $36\,^{\circ}\mathrm{F}$

(B) $68\,^{\circ}\mathrm{F}$

(C) $52\,^{\circ}\mathrm{F}$

(D) $93\,^{\circ}\mathrm{F}$

Q26. How much heat is required to raise the temperature of 0.5 kg of copper by $10\,^{\circ}\mathrm{C}$? (Specific heat of copper $= 400\,\mathrm{J\,kg^{-1}\,^{\circ}C^{-1}}$)

(A) 2000 J

(B) 200 J

(C) 4000 J

(D) 800 J

Q27. A metal spoon kept in a cup of hot tea slowly becomes hot at its outer end. The mode of heat transfer involved is:

(A) convection

(B) radiation

(C) advection

(D) conduction

Q28. Water is used as a coolant in the radiators of cars and machines mainly because it has a:

(A) very low boiling point

(B) very low density

(C) very high specific heat capacity

(D) very high refractive index

Q29. The fixed temperature at which a solid changes into a liquid is called its:

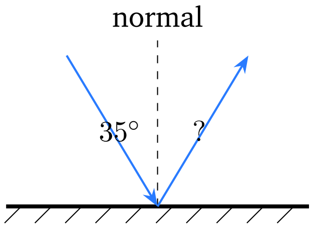
(A) boiling point

(B) melting point

(C) dew point

(D) latent point

Q30. A ray of light strikes a plane mirror making an angle of incidence of $35°$ with the normal, as shown. The angle of reflection is:



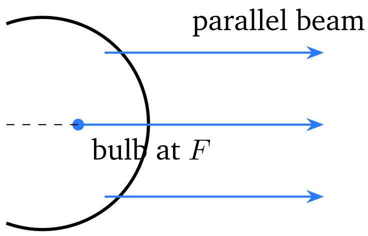
(A) $35°$

(B) $55°$

(C) $70°$

(D) $0°$

Q31. In a torch and a vehicle headlight, the bulb is placed at the focus of a concave mirror, as shown. The reflected light then emerges as:



(A) a converging beam

(B) a diverging beam

(C) a strong parallel beam

(D) light scattered in all directions

Q32. A convex mirror is used as a rear-view (driving) mirror in vehicles mainly because it:

(A) forms a real image of the traffic behind

(B) gives an erect image and a wider field of view

(C) greatly magnifies the approaching vehicles

(D) does not form any image at all

Q33. According to the New Cartesian sign convention for mirrors, distances measured behind the mirror (opposite to the direction of incident light) are taken as:

(A) always negative

(B) always zero

(C) sometimes positive and sometimes negative

(D) positive

Q34. A coin lying at the bottom of a beaker filled with water appears to be raised when viewed from above. This happens because of the:

(A) refraction of light

(B) reflection of light

(C) dispersion of light

(D) total internal reflection of light

Q35. A simple magnifying glass used to read very small print is essentially a:

(A) plane mirror

(B) concave lens

(C) convex lens

(D) concave mirror

Q36. The number of colours into which white light splits up on passing through a glass prism is:

(A) 3

(B) 7

(C) 5

(D) 10

Q37. A sound wave of frequency 340 Hz has a wavelength of 1 m in air. The speed of the sound wave is:

(A) 341 m/s

(B) 170 m/s

(C) 0.003 m/s

(D) 340 m/s

Q38. In a sound wave travelling through air, the regions of high pressure and high density are called:

(A) compressions

(B) rarefactions

(C) crests

(D) troughs

Q39. In a large hall, sound continues to be heard for a while even after the source has stopped, because of repeated reflections. This effect is called:

(A) an echo

(B) refraction of sound

(C) reverberation

(D) resonance

Q40. Sound travels with the greatest speed when it passes through:

(A) air

(B) steel (a solid)

(C) water

(D) vacuum

Q41. A potential difference of 24 V is applied across a resistor of resistance $8\,\Omega$. The current flowing through it is:

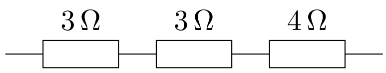
(A) 3 A

(B) 192 A

(C) 0.33 A

(D) 16 A

Q42. Three resistors of $3\,\Omega$, $3\,\Omega$ and $4\,\Omega$ are joined in series, as shown. Their equivalent resistance is:



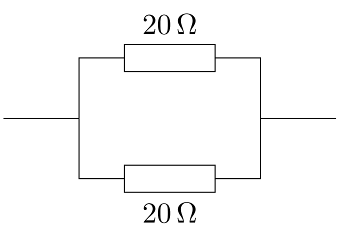
(A) $0.86\,\Omega$

(B) $1\,\Omega$

(C) $5\,\Omega$

(D) $10\,\Omega$

Q43. Two resistors, each of $20\,\Omega$, are connected in parallel, as shown. Their equivalent resistance is:



(A) $40\,\Omega$

(B) $10\,\Omega$

(C) $20\,\Omega$

(D) $5\,\Omega$

Q44. An electrical device works at 12 V and draws a current of 2 A. The power consumed by it is:

(A) 6 W

(B) 14 W

(C) 24 W

(D) 48 W

Q45. The commercial unit in which the electricity board measures the energy consumed in homes is the:

(A) kilowatt-hour (one "unit")

(B) watt

(C) volt

(D) ampere

Q46. For two wires of the same material and the same length, a thicker wire (one with a larger cross-sectional area) has:

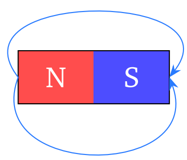
(A) more resistance than a thin wire

(B) the same resistance as a thin wire

(C) infinite resistance

(D) less resistance than a thin wire

Q47. The magnetic field of the bar magnet shown below is strongest at its:



(A) exact centre

(B) two poles

(C) middle of one flat face

(D) it is the same everywhere

Q48. Soft iron is preferred for the core of an electromagnet because it:

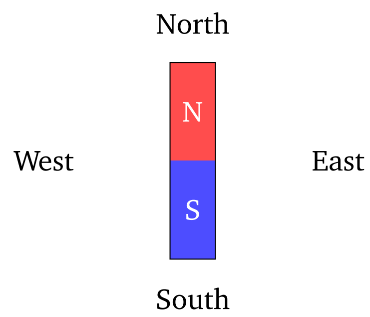
(A) keeps its magnetism permanently

(B) is a poor conductor of electricity

(C) gains and loses its magnetism quickly

(D) cannot be magnetised at all

Q49. A bar magnet suspended freely and allowed to come to rest, as shown, will always settle pointing in the:



(A) north–south direction

(B) east–west direction

(C) vertically downward direction

(D) direction of the nearest wall

Q50. The working of an electric motor is based on the fact that a current-carrying conductor placed in a magnetic field:

(A) gets heated up

(B) produces light

(C) loses all its current

(D) experiences a mechanical force

Detailed Solutions

Q1.

Solution

Concept — Units of electrical quantities: Resistance opposes the flow of current. From Ohm's law, resistance = voltage ÷ current, so its unit is built from the units of volt and ampere.

Step 1 — Build the unit: Unit of resistance = volt ÷ ampere = volt per ampere.

Step 2 — Name the unit: This combination is given the special name **ohm**, written with the symbol Ω.

Why other options are wrong:

- Ampere: SI unit of electric current.
- Volt: SI unit of potential difference.
- Watt: SI unit of power.

Final Answer: The SI unit of resistance is the ohm $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q1

Q2.

Solution

Concept — Fundamental and derived quantities: The seven fundamental quantities are length, mass, time, electric current, temperature, amount of substance and luminous intensity. Any quantity formed by combining these is a derived quantity.

Step 1 — Test each option: Length, time and temperature are all in the list of fundamental quantities.

Step 2 — Identify the derived quantity: Momentum = mass × velocity, which combines mass, length and time, so momentum is a **derived** quantity.

Why other options are wrong:

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

Final Answer: Momentum is the derived quantity $\Rightarrow \boxed{\text{D}}$

Answer: (D) 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 $= 108 \times \frac{5}{18}$ m/s.

Step 3 — Simplify: $108 \div 18 = 6$, then $6 \times 5 = 30$. So speed $= 30$ m/s.

Why other options are wrong:

- 36 and 54 come from using a wrong factor.
- 25 matches a different speed, not 108 km/h.

Final Answer: 108 km/h $= 30$ m/s $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q3

Q4.

Solution

Concept — Least count: The least count of a measuring instrument is the smallest value it can measure, which equals the size of one smallest division on its scale.

Step 1 — Read the metre scale: An ordinary metre scale is divided into millimetre marks, so its smallest division is 1 mm.

Step 2 — State the least count: Therefore the least count of a metre scale is 1 mm.

Why other options are wrong:

- 0.1 mm and 0.01 mm belong to a screw gauge or vernier callipers, which are finer instruments.
- 1 cm is the spacing of the larger marks, not the smallest division.

Final Answer: Least count of a metre scale $= 1$ mm $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q4

Q5.

Solution

Concept — Equation of motion: For uniform acceleration, $s = ut + \frac{1}{2}at^2$.

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

Step 2 — First term: $ut = 2 \times 2 = 4$ m.

Step 3 — Second term: $\frac{1}{2}at^2 = \frac{1}{2} \times 2 \times 2^2 = \frac{1}{2} \times 2 \times 4 = 4$ m.

Step 4 — Add the terms: $s = 4 + 4 = 8$ m.

Why other options are wrong:

- 4 m uses only one of the two terms.
- 12 m and 16 m use wrong values of t or a.

Final Answer: Distance covered $= 8$ m $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q5

Q6.

Solution

Concept — Distance–time graph: On a distance–time graph, the slope of the line gives the speed of the body. A steeper line means a greater speed.

Step 1 — Compare the slopes: The line for P rises more steeply than the line for Q over the same time.

Step 2 — Interpret the slopes: A steeper slope means more distance covered per second, so P has the greater speed.

Why other options are wrong:

- Q faster than P reverses the comparison.
- Equal speeds would need lines of equal steepness.
- Bodies at rest would give horizontal lines, but both lines slope upward.

Final Answer: P moves faster because its graph is steeper $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q6

Q7.

Solution

Concept — Inertia of motion: A moving body tends to keep moving. The velocity gained while running is carried into the jump.

Step 1 — Build up speed: By running first, the athlete gains a large forward velocity.

Step 2 — Carry it into the jump: Because of the inertia of motion, this velocity helps carry the athlete farther through the air during the jump.

Why other options are wrong:

- Running does not change the athlete's weight.
- Air resistance is not the reason for running before the jump.
- Gravity does not increase because of running.

Final Answer: The run-up uses the inertia of motion $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q7

Q8.

Solution

Concept — Newton's second law: The force on a body equals mass times acceleration, $F = ma$.

Step 1 — List the data: $m = 5$ kg, $a = 2$ m/s^2.

Step 2 — Substitute: $F = 5 \times 2$.

Step 3 — Compute: $F = 10$ N.

Why other options are wrong:

- 2.5 N divides mass by acceleration.
- 7 N adds mass and acceleration.
- 25 N uses a wrong factor.

Final Answer: Force $= 10$ 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, with the two forces acting on different bodies.

Step 1 — Apply to the balloon: The balloon pushes the air out through the opening (action).

Step 2 — Find the reaction: The escaping air pushes the balloon in the opposite direction (reaction), so the balloon moves forward.

Why other options are wrong:

- The first law describes rest or uniform motion, not this thrust.
- Conservation of energy is a different principle.
- Archimedes' principle is about buoyancy in fluids.

Final Answer: The balloon illustrates Newton's third law $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q9

Q10.

Solution

Concept — Conservation of momentum: In the absence of external forces, the total momentum of a system stays the same before and after an event.

Step 1 — Before firing: Both the gun and the bullet are at rest, so the total momentum is zero.

Step 2 — After firing: The bullet moves forward and the gun recoils backward. Their momenta are equal in size but opposite in direction, so they add up to zero again.

Step 3 — Conclude: The total momentum after firing equals its value before firing, which is zero.

Why other options are wrong:

- It cannot be greater, less or doubled, because momentum is conserved.

Final Answer: Total momentum stays zero (unchanged) $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q10

Q11.

Solution

Concept — Acceleration: Acceleration is the change in velocity divided by the time taken, $a = \dfrac{\Delta v}{\Delta t}$.

Step 1 — Find the change in velocity: $\Delta v = 30 - 0 = 30$ m/s.

Step 2 — Substitute: $a = \dfrac{30}{6}$.

Step 3 — Compute: $a = 5$ m/s^2.

Why other options are wrong:

- 6 m/s^2 swaps the numbers.
- 180 m/s^2 multiplies instead of dividing.
- 0.2 m/s^2 inverts the ratio.

Final Answer: Acceleration $= 5$ m/s^2 $\Rightarrow \boxed{\text{C}}$

Answer: (C) 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: $F = 9$ N, $s = 5$ m.

Step 2 — Substitute: $W = 9 \times 5$.

Step 3 — Compute: $W = 45$ J.

Why other options are wrong:

- 1.8 J divides force by distance.
- 14 J adds force and distance.
- 90 J uses a wrong factor.

Final Answer: Work done $= 45$ J $\Rightarrow \boxed{\text{D}}$

Answer: (D) 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: $m = 4$ kg, $v = 3$ m/s.

Step 2 — Square the velocity: $v^2 = 3^2 = 9$.

Step 3 — Substitute and compute: $KE = \frac{1}{2} \times 4 \times 9 = 2 \times 9 = 18$ J.

Why other options are wrong:

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

Final Answer: Kinetic energy $= 18$ J $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q13

Q14.

Solution

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

Step 1 — List the data: $m = 5$ kg, $g = 10$ m/s^2, $h = 8$ m.

Step 2 — Substitute: $PE = 5 \times 10 \times 8$.

Step 3 — Compute step by step: $5 \times 10 = 50$, then $50 \times 8 = 400$. So $PE = 400$ J.

Why other options are wrong:

- 40 J leaves out the value of g.
- 200 J uses a wrong height.
- 13 J adds the values instead of multiplying.

Final Answer: Potential energy $= 400$ J $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q14

Q15.

Solution

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

Step 1 — List the data: $W = 1000$ J, $t = 25$ s.

Step 2 — Substitute: $P = \dfrac{1000}{25}$.

Step 3 — Compute: $P = 40$ W.

Why other options are wrong:

- 25000 W multiplies instead of dividing.
- 1025 W adds the values.
- 0.025 W inverts the ratio.

Final Answer: Power $= 40$ W $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q15

Q16.

Solution

Concept — Conservation of mechanical energy: In free fall (no air resistance), the total mechanical energy stays constant, so any loss in potential energy appears as an equal gain in kinetic energy.

Step 1 — As the ball falls: Its height decreases, so its potential energy mgh decreases.

Step 2 — Energy is conserved: The decrease in potential energy is converted into an equal increase in kinetic energy, so the ball speeds up.

Why other options are wrong:

- Potential energy cannot increase as the ball falls.
- Potential energy does not stay constant; it decreases.
- No heat is produced in ideal free fall.

Final Answer: PE decreases and becomes an equal amount of KE $\Rightarrow \boxed{\text{D}}$

Answer: (D) 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: $m = 15$ kg, $g = 10$ m/s^2.

Step 2 — Substitute: $W = 15 \times 10$.

Step 3 — Compute: $W = 150$ N.

Why other options are wrong:

- 15 N is only the mass value, not the weight.
- 1.5 N divides instead of multiplying.
- 300 N uses a wrong value of g.

Final Answer: Weight $= 150$ N $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q17

Q18.

Solution

Concept — Inverse square law: The gravitational force varies as $F \propto \frac{1}{r^2}$, so if the distance changes by a factor, the force changes by the square of that factor.

Step 1 — Note the change in distance: The distance is doubled, so it becomes $2r$.

Step 2 — Apply the inverse square: The force changes by $\frac{1}{2^2} = \frac{1}{4}$.

Step 3 — Conclude: The new force is $\frac{F}{4}$, one-fourth of the original.

Why other options are wrong:

- Doubling or quadrupling the force ignores the inverse relationship.
- Halving the force uses $1/r$ instead of $1/r^2$.

Final Answer: The force becomes one-fourth $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q18

Q19.

Solution

Concept — Free fall: For a body dropped from rest, the velocity after time t is $v = gt$.

Step 1 — List the data: $u = 0$, $g = 10$ m/s^2, $t = 5$ s.

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

Step 3 — Compute: $v = 50$ m/s.

Why other options are wrong:

- 25 m/s uses a wrong factor.
- 5 m/s uses only the time.
- 100 m/s uses a wrong value of g.

Final Answer: Velocity after 5 s = 50 m/s $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q19

Q20.

Solution

Concept — Free fall is independent of mass: In the absence of air resistance, all bodies fall with the same acceleration g, no matter their mass.

Step 1 — Same acceleration: Both the stone and the feather accelerate downward at $g = 10$ m/s^2.

Step 2 — Same time: Starting from the same height with the same acceleration, they take the same time to fall.

Why other options are wrong:

- In a vacuum the heavier stone does not win; mass does not affect the fall.
- The feather does not arrive first either.
- Both bodies do reach the ground.

Final Answer: Both reach the ground at the same time $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q20

Q21.

Solution

Concept — Moment of a force: The moment (turning effect) about a point is moment $=$ force $\times$ perpendicular distance.

Step 1 — List the data: $F = 12$ N, $d = 0.25$ m.

Step 2 — Substitute: moment $= 12 \times 0.25$.

Step 3 — Compute: moment $= 3$ N m.

Why other options are wrong:

- 48 N m divides instead of multiplying.
- 0.02 N m inverts the relationship.
- 6 N m uses a wrong distance.

Final Answer: Moment of the force $= 3$ N m $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q21

Q22.

Solution

Concept — Principle of moments: A body pivoted at a point is balanced when the total anticlockwise moment about the pivot equals the total clockwise moment.

Step 1 — Apply to the beam: For the beam to stay level, the turning effect on one side must cancel the turning effect on the other side.

Step 2 — State the condition: Balance occurs when the anticlockwise moment equals the clockwise moment about the pivot.

Why other options are wrong:

- The material being uniform does not by itself guarantee balance once loads are added.
- Length of the beam alone does not decide balance.
- Placing the pivot at one end does not balance a loaded beam.

Final Answer: Balance needs equal anticlockwise and clockwise moments $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q22

Q23.

Solution

Concept — Time period of a pendulum: The time period is $T = 2\pi\sqrt{\frac{L}{g}}$, so T increases when the length L increases.

Step 1 — Identify the variable: Among the choices, only the length L appears in the formula.

Step 2 — Increase the length: Since $T \propto \sqrt{L}$, increasing the length makes the time period larger.

Why other options are wrong:

- Decreasing the length would make the period smaller.
- The mass of the bob does not affect the period.
- The amplitude (for small swings) does not affect the period.

Final Answer: Increasing the length increases the time period $\Rightarrow \boxed{\text{C}}$

$\boxed{\text{Answer: (C)}}$ Go Back to Q23

Q24.

Solution

Concept — Simple harmonic motion: SHM is a special back-and-forth (oscillatory) motion in which a body moves repeatedly about a fixed mean position, with a restoring force directed towards that position.

Step 1 — Note the repetition: The motion repeats after equal intervals of time, so it is periodic.

Step 2 — Note the path: The body swings to and fro about a central mean position.

Why other options are wrong:

- Circular motion at constant speed is not a to-and-fro motion.
- Straight-line motion with constant acceleration is not oscillatory.
- Random motion has no fixed pattern, so it is not SHM.

Final Answer: SHM is a periodic to-and-fro motion about a fixed point $\Rightarrow \boxed{\text{D}}$

$\boxed{\text{Answer: (D)}}$ Go Back to Q24

Q25.

Solution

Concept — Temperature conversion: To change Celsius into Fahrenheit, use $F = \frac{9}{5}C + 32$.

Step 1 — List the data: $C = 20\,°\mathrm{C}$.

Step 2 — Multiply by $\frac{9}{5}$: $\frac{9}{5} \times 20 = 9 \times 4 = 36$.

Step 3 — Add 32**:** $F = 36 + 32 = 68\,°\mathrm{F}$.

Why other options are wrong:

- $36\,°\mathrm{F}$ forgets to add 32.
- $52\,°\mathrm{F}$ adds 32 to 20 without the factor.
- $93\,°\mathrm{F}$ uses wrong arithmetic.

Final Answer: $20\,°\mathrm{C} = 68\,°\mathrm{F} \Rightarrow \boxed{\mathrm{B}}$

Answer: (B) Go Back to Q25

Q26.

Solution

Concept — Heat required: The heat needed is $Q = mc\Delta T$, where m is mass, c is specific heat and ΔT is the temperature rise.

Step 1 — List the data: $m = 0.5$ kg, $c = 400\ \mathrm{J\,kg^{-1}\,°C^{-1}}$, $\Delta T = 10\,°\mathrm{C}$.

Step 2 — Substitute: $Q = 0.5 \times 400 \times 10$.

Step 3 — Compute step by step: $0.5 \times 400 = 200$, then $200 \times 10 = 2000$. So $Q = 2000$ J.

Why other options are wrong:

- 200 J leaves out the temperature rise.
- 4000 J ignores the mass being 0.5 kg.
- 800 J uses wrong arithmetic.

Final Answer: Heat required $= 2000$ J $\Rightarrow \boxed{\mathrm{A}}$

Answer: (A) Go Back to Q26

Q27.

Solution

Concept — Conduction: In a solid such as metal, heat travels from the hot end to the cold end through the vibration of particles, without the particles themselves moving along. This is conduction.

Step 1 — Identify the medium: The spoon is a solid metal, and heat passes along it from the hot tea.

Step 2 — Name the process: Heat transfer through a solid in this way is called conduction.

Why other options are wrong:

- Convection happens in liquids and gases through the movement of the fluid.
- Radiation needs no medium and travels as waves.
- Advection is not a basic mode of heat transfer in this context.

Final Answer: The spoon gets hot by conduction $\Rightarrow \boxed{\text{D}}$

Answer: (D) **Go Back to Q27**

Q28.

Solution

Concept — Specific heat capacity: A substance with a high specific heat can absorb a large amount of heat for a small rise in temperature, which makes it a good coolant.

Step 1 — Why water cools well: Water has an unusually high specific heat capacity, so it can carry away a lot of heat without getting very hot itself.

Step 2 — Conclude: This is why water is used as a coolant in radiators.

Why other options are wrong:

- Water does not have a low boiling point.
- Density is not the reason water cools well.
- Refractive index has nothing to do with cooling.

Final Answer: Water is a good coolant due to its high specific heat $\Rightarrow \boxed{\text{C}}$

Answer: (C) **Go Back to Q28**

Q29.

Solution

Concept — Change of state: The melting point is the fixed temperature at which a solid turns into a liquid at a given pressure.

Step 1 — Identify the change: The question describes a solid changing into a liquid.

Step 2 — Name the temperature: The temperature at which this happens is the melting point.

Why other options are wrong:

- Boiling point is where a liquid turns into a gas.
- Dew point relates to condensation of water vapour.
- There is no quantity called the latent point.

Final Answer: The solid-to-liquid temperature is the melting point $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q29

Q30.

Solution

Concept — Law of reflection: The angle of reflection is always equal to the angle of incidence, both measured from the normal.

Step 1 — Read the angle of incidence: The incident ray makes 35° with the normal.

Step 2 — Apply the law: Angle of reflection = angle of incidence = 35°.

Why other options are wrong:

- 55° is the angle from the mirror surface, not from the normal.
- 70° doubles the angle of incidence.
- 0° would mean the ray returns along the normal, which is not the case.

Final Answer: Angle of reflection $= 35^\circ \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q30

Q31.

Solution

Concept — Concave mirror with source at focus: When a small bright source is placed exactly at the focus of a concave mirror, the reflected rays leave the mirror parallel to one another.

Step 1 — Use the property: Rays from the focus, after reflection, become parallel to the principal axis.

Step 2 — Interpret for a torch: This gives a strong, far-reaching parallel beam of light, which is exactly what a torch or headlight needs.

Why other options are wrong:

- A converging beam would form only if rays met at a point ahead.
- A diverging beam would spread out and not travel far.
- The light is not scattered randomly; it is well directed.

Final Answer: The reflected light is a strong parallel beam $\Rightarrow \boxed{\text{C}}$

$\boxed{\textbf{Answer: (C)}}$ Go Back to Q31

Q32.

Solution

Concept — Convex mirror: A convex mirror always forms an erect, diminished, virtual image and covers a wide area, giving a large field of view.

Step 1 — Image nature: The image is upright, so the driver sees vehicles the right way up.

Step 2 — Field of view: Because the image is small, a convex mirror shows a much larger region of the road behind.

Why other options are wrong:

- A convex mirror forms a virtual image, not a real one.
- It diminishes rather than magnifies the image.
- It certainly does form an image.

Final Answer: A convex mirror gives an erect image and a wide field of view $\Rightarrow \boxed{\text{B}}$

$\boxed{\textbf{Answer: (B)}}$ Go Back to Q32

Q33.

Solution

Concept — New Cartesian sign convention: Distances are measured from the pole of the mirror. Those measured in the direction of incident light are positive, and those measured opposite to it are negative; the pattern is fixed by where the object and image lie.

Step 1 — Locate "behind the mirror": Points behind the mirror lie in the direction opposite to the incident light, away from the object side.

Step 2 — Assign the sign: By the convention, distances measured behind the mirror are taken as positive.

Why other options are wrong:

- They are not always negative; that applies to real distances in front.
- They are not zero.
- The sign is fixed by the rule, not arbitrary.

Final Answer: Distances behind the mirror are taken as positive $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q33

Q34.

Solution

Concept — Apparent depth: When light travels from water into air, it bends (refracts) away from the normal, which makes objects under water appear shallower than they really are.

Step 1 — Trace the light: Light from the coin bends as it leaves the water surface.

Step 2 — Effect on the image: The bent rays appear to come from a point higher up, so the coin looks raised.

Why other options are wrong:

- Reflection would not raise the coin's apparent position.
- Dispersion only splits colours.
- Total internal reflection does not apply here.

Final Answer: The coin appears raised due to refraction $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q34

Q35.

Solution

Concept — Magnifying glass: A convex (converging) lens, when an object is held within its focal length, forms an enlarged, erect, virtual image. This is how a magnifying glass works.

Step 1 — Choose the lens: Only a convex lens can magnify the print this way.

Step 2 — Conclude: Therefore a simple magnifying glass is a convex lens.

Why other options are wrong:

- A plane mirror gives the same size, not a magnified image.
- A concave lens always gives a diminished image.
- A concave mirror is not used as a handheld reading magnifier.

Final Answer: A magnifying glass is a convex lens $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q35

Q36.

Solution

Concept — Dispersion of white light: White light is made up of seven colours. A prism bends each colour by a different amount and spreads them into a band called the spectrum.

Step 1 — Recall the colours: The seven colours are violet, indigo, blue, green, yellow, orange and red (VIBGYOR).

Step 2 — Count them: There are 7 colours.

Why other options are wrong:

- 3 are only the primary colours of light.
- 5 and 10 do not match the standard spectrum.

Final Answer: White light splits into 7 colours $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q36

Q37.

Solution

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

Step 1 — List the data: $f = 340$ Hz, $\lambda = 1$ m.

Step 2 — Substitute: $v = 340 \times 1$.

Step 3 — Compute: $v = 340$ m/s.

Why other options are wrong:

- 341 m/s adds instead of multiplying.
- 170 m/s halves the frequency.
- 0.003 m/s divides instead of multiplying.

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

Answer: (D) Go Back to Q37

Q38.

Solution

Concept — Sound as a longitudinal wave: As sound travels through air, it creates alternate regions where the air is squeezed together and where it is spread out.

Step 1 — Squeezed regions: Where the air particles come close together, the pressure and density are high. These are called compressions.

Step 2 — Identify the term: So the high-pressure, high-density regions are the compressions.

Why other options are wrong:

- Rarefactions are the low-pressure, low-density regions.
- Crests and troughs describe transverse waves, not sound in air.

Final Answer: High-pressure regions in a sound wave are compressions $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q38

Q39.

Solution

Concept — Reverberation: When sound is reflected repeatedly from the walls, ceiling and floor of a large hall, it lingers and is heard for some time after the source has stopped.

Step 1 — Identify the cause: The persistence of sound is due to many repeated reflections.

Step 2 — Name the effect: This continued, overlapping reflection of sound is called reverberation.

Why other options are wrong:

- A single, clearly separated reflection is an echo, not lingering sound.
- Refraction is the bending of sound, not its persistence.
- Resonance is a build-up of vibration at a natural frequency.

Final Answer: The lingering of sound in a hall is reverberation $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q39

Q40.

Solution

Concept — Speed of sound in different media: Sound needs a material medium, and it travels fastest where the particles are closely packed. So sound is fastest in solids, slower in liquids and slowest in gases.

Step 1 — Compare the media: Among air, water and steel, steel is the solid with the most tightly bound particles.

Step 2 — Conclude: Sound travels fastest through steel (a solid).

Why other options are wrong:

- Air is a gas, where sound is slowest of the three.
- Water is a liquid, faster than air but slower than steel.
- Sound cannot travel through a vacuum at all.

Final Answer: Sound is fastest in steel, a solid $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q40

Q41.

Solution

Concept — Ohm's law: The current is $I = \dfrac{V}{R}$, the voltage divided by the resistance.

Step 1 — List the data: $V = 24$ V, $R = 8\,\Omega$.

Step 2 — Substitute: $I = \dfrac{24}{8}$.

Step 3 — Compute: $I = 3$ A.

Why other options are wrong:

- 192 A multiplies instead of dividing.
- 0.33 A inverts the ratio.
- 16 A subtracts instead of dividing.

Final Answer: Current $= 3$ A $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q41

Q42.

Solution

Concept — Resistances in series: In a series connection, the equivalent resistance is the sum of the individual resistances, $R = R_1 + R_2 + R_3$.

Step 1 — List the values: $R_1 = 3\,\Omega$, $R_2 = 3\,\Omega$, $R_3 = 4\,\Omega$.

Step 2 — Add them: $R = 3 + 3 + 4$.

Step 3 — Compute: $R = 10\,\Omega$.

Why other options are wrong:

- $0.86\,\Omega$ and $1\,\Omega$ would be parallel-type values, not series.
- $5\,\Omega$ leaves out one of the resistors.

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

Answer: (D) Go Back to Q42

Q43.

Solution

Concept — Resistances in parallel: For two equal resistors in parallel, the equivalent resistance is half of one resistor: $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$.

Step 1 — Write the formula: $\frac{1}{R} = \frac{1}{20} + \frac{1}{20}$.

Step 2 — Add the fractions: $\frac{1}{R} = \frac{2}{20} = \frac{1}{10}$.

Step 3 — Take the reciprocal: $R = 10\,\Omega$.

Why other options are wrong:

- $40\,\Omega$ adds the resistors as if in series.
- $20\,\Omega$ ignores the second resistor.
- $5\,\Omega$ halves twice.

Final Answer: Parallel equivalent resistance $= 10\,\Omega \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q43

Q44.

Solution

Concept — Electric power: The power consumed is $P = VI$, the voltage times the current.

Step 1 — List the data: $V = 12$ V, $I = 2$ A.

Step 2 — Substitute: $P = 12 \times 2$.

Step 3 — Compute: $P = 24$ W.

Why other options are wrong:

- 6 W divides instead of multiplying.
- 14 W adds the values.
- 48 W uses a wrong factor.

Final Answer: Power consumed $= 24$ W $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q44

Q45.

Solution

Concept — Commercial unit of energy: Electrical energy used in homes is measured in kilowatt-hours. One kilowatt-hour is the energy used by a 1 kW appliance running for 1 hour, and is called one "unit".

Step 1 — Recall the unit: The electricity bill counts the number of kilowatt-hours consumed.

Step 2 — Conclude: The commercial unit of electrical energy is the kilowatt-hour (kWh).

Why other options are wrong:

- Watt is the unit of power, not of energy consumed.
- Volt is the unit of potential difference.
- Ampere is the unit of current.

Final Answer: Electrical energy is billed in kilowatt-hours $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q45

Q46.

Solution

Concept — Resistance and area: The resistance of a wire is inversely proportional to its cross-sectional area, $R \propto \frac{1}{A}$. So a thicker wire has a smaller resistance.

Step 1 — Compare the wires: The thicker wire has a larger cross-sectional area.

Step 2 — Apply the relation: A larger area means more room for current to flow, so the resistance is less.

Why other options are wrong:

- More resistance would need a thinner wire.
- The resistance is not the same; it depends on the area.
- The resistance is finite, not infinite.

Final Answer: A thicker wire has less resistance $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q46

Q47.

Solution

Concept — Field of a bar magnet: The magnetic field of a bar magnet is strongest where the field lines are most crowded, which is at the two ends, the poles.

Step 1 — Look at the field lines: The lines are packed closely together near the north and south poles.

Step 2 — Conclude: Crowded field lines mean a strong field, so the field is strongest at the poles.

Why other options are wrong:

- At the centre of the magnet the field is weakest.
- The middle of a face is not where the lines crowd.
- The field is not the same everywhere; it is stronger near the poles.

Final Answer: The magnetic field is strongest at the poles $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q47

Q48.

Solution

Concept — Soft iron core: Soft iron becomes strongly magnetic when current flows around it and loses almost all its magnetism the moment the current stops.

Step 1 — Need of an electromagnet: An electromagnet must be magnetic only while the current is on, so its magnetism can be switched on and off.

Step 2 — Match the property: Soft iron gains and loses magnetism quickly, which is exactly what is required.

Why other options are wrong:

- Keeping magnetism permanently is a property of steel, used for permanent magnets.
- Being a poor conductor is not the reason soft iron is chosen.
- Soft iron can certainly be magnetised.

Final Answer: Soft iron is used because it gains and loses magnetism quickly $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q48

Q49.

Solution

Concept — Freely suspended magnet: A bar magnet that can swing freely behaves like a compass needle. It turns until it lines up with the Earth's magnetic field.

Step 1 — Earth as a magnet: The Earth itself acts like a huge magnet, so it exerts a turning effect on the suspended magnet.

Step 2 — Final resting direction: The magnet comes to rest pointing along the north–south direction.

Why other options are wrong:

- It does not settle east–west.
- It does not point vertically downward.
- It is not affected by nearby walls.

Final Answer: A freely suspended magnet points north–south $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q49

Q50.

Solution

Concept — Principle of an electric motor: A current-carrying conductor placed in a magnetic field experiences a force. A motor uses this force to turn a coil.

Step 1 — The force on the coil: When current flows in the coil sitting in a magnetic field, each side of the coil feels a force.

Step 2 — The effect: These forces act in opposite directions on the two sides, producing a turning effect that rotates the coil.

Why other options are wrong:

- Heating is the basis of a heater, not a motor.
- Producing light describes a lamp.
- The conductor does not lose its current.

Final Answer: A motor works because the conductor experiences a force $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q50

Answer Key

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