Jharkhand Polytechnic Physics

Sample Paper – 4

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 pressure is the:

(A) Newton

(B) Joule

(C) Pascal

(D) Watt

Q2. Among the quantities given below, the derived quantity is:

(A) Velocity

(B) Time

(C) Mass

(D) Temperature

Q3. A boy walks with a speed of 5 m/s. His speed expressed in kilometre per hour is:

(A) 15 km/h

(B) 18 km/h

(C) 25 km/h

(D) 10 km/h

Q4. The least count of an ordinary screw gauge (micrometer) is:

(A) 1 mm

(B) 0.1 mm

(C) 0.001 mm

(D) 0.01 mm

Q5. A car starting from rest accelerates uniformly at 4 m/s^2 and reaches a velocity of 20 m/s. The time taken is:

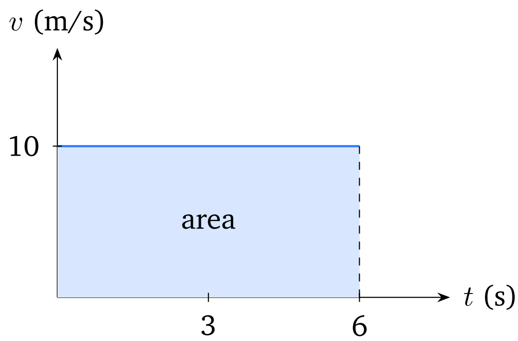
(A) 5 s

(B) 4 s

(C) 80 s

(D) 16 s

Q6. The velocity–time graph of a body moving with a constant velocity of 10 m/s for 6 s is shown. The displacement of the body (area under the graph) is:



(A) 16 m

(B) 10 m

(C) 60 m

(D) 600 m

Q7. Newton's third law states that to every action there is an equal and opposite reaction. An important feature of this action–reaction pair is that the two forces:

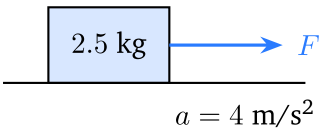
(A) act on the same body

(B) act on two different bodies

(C) are unequal in magnitude

(D) act in the same direction

Q8. A block of mass 2.5 kg is pulled along a smooth horizontal floor so that it accelerates at 4 m/s^2, as shown. The force applied on the block is:



(A) 0.625 N

(B) 6.5 N

(C) 2.5 N

(D) 10 N

Q9. The forward motion of a rocket through space is based on:

(A) Newton's third law of motion

(B) Newton's first law of motion

(C) Archimedes' principle

(D) the law of conservation of energy

Q10. The linear momentum of a body of mass 3 kg moving with a velocity of 4 m/s is:

(A) 7 kg m/s

(B) 12 kg m/s

(C) 0.75 kg m/s

(D) 1.33 kg m/s

Q11. A body covers equal distances in equal intervals of time, however small the intervals may be. The body is said to be in:

(A) non-uniform motion

(B) circular motion

(C) accelerated motion

(D) uniform motion

Q12. A constant force of 8 N moves a body through a distance of 5 m in the direction of the force. The work done is:

(A) 1.6 J

(B) 13 J

(C) 40 J

(D) 3 J

Q13. The kinetic energy of a body of mass 2 kg moving with a speed of 4 m/s is:

(A) 16 J

(B) 8 J

(C) 4 J

(D) 32 J

Q14. A body of mass 2 kg is lifted to a height of 3 m. The gravitational potential energy gained by it is:

(A) 6 J

(B) 30 J

(C) 23 J

(D) 60 J

Q15. A pump does 300 J of work in 5 seconds. The power of the pump is:

(A) 1500 W

(B) 60 W

(C) 305 W

(D) 15 W

Q16. A coolie carries a heavy box on his head and walks steadily on a level horizontal platform. The work done by the force of gravity on the box is:

(A) maximum

(B) equal to mgh

(C) zero

(D) negative and very large

Q17. The weight of an object of mass 20 kg on the surface of the Earth is:

(A) 20 N

(B) 2 N

(C) 200 N

(D) 100 N

Q18. According to Newton's universal law of gravitation, the gravitational force between two bodies is directly proportional to the:

(A) sum of their masses

(B) product of their masses

(C) square of the distance between them

(D) difference of their masses

Q19. A stone is dropped from rest and falls freely for 3 seconds. Its velocity at that instant (take $g = 10$ m/s^2) is:

(A) 30 m/s

(B) 45 m/s

(C) 13 m/s

(D) 3.3 m/s

Q20. When a body is taken from the Earth to the Moon, which one of the following quantities remains unchanged?

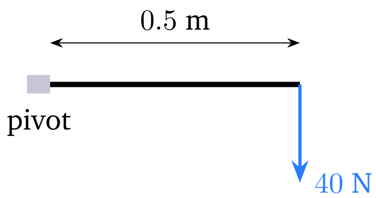
(A) its weight

(B) the gravitational force acting on it

(C) the value of g at its location

(D) its mass

Q21. A force of 40 N is applied at the end of a long handle at a perpendicular distance of 0.5 m from the pivot, as shown. The moment of the force about the pivot is:



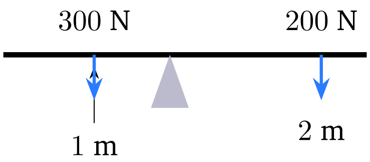
(A) 80 N m

(B) 40 N m

(C) 0.0125 N m

(D) 20 N m

Q22. On a seesaw, a weight of 300 N is placed 1 m to the left of the pivot and a weight of 200 N is placed 2 m to the right of the pivot, as shown. Which side of the seesaw goes down?



(A) the right side (the 200 N weight goes down)

(B) the left side (the 300 N weight goes down)

(C) it stays perfectly balanced

(D) it depends on the height of the weights

Q23. For small oscillations, the time period of a simple pendulum is independent of the:

(A) length of the pendulum

(B) acceleration due to gravity

(C) amplitude of oscillation

(D) both length and gravity

Q24. During one complete oscillation of a simple pendulum, the bob passes through its mean (equilibrium) position:

(A) once

(B) twice

(C) three times

(D) four times

Q25. The boiling point of water is $100\,^\circ\mathrm{C}$. Its value on the Fahrenheit scale is:

(A) $180\,^\circ\mathrm{F}$

(B) $212\,^\circ\mathrm{F}$

(C) $132\,^\circ\mathrm{F}$

(D) $373\,^\circ\mathrm{F}$

Q26. How much heat is required to raise the temperature of 0.2 kg of water by $25\,°\text{C}$? (Specific heat of water $= 4200$ J kg^{-1} °C^{-1})

(A) 8400 J

(B) 4200 J

(C) 2100 J

(D) 21000 J

Q27. The mode of heat transfer that can take place even through a vacuum (without any material medium) is:

(A) conduction

(B) convection

(C) radiation

(D) conduction and convection together

Q28. Which one of the following is the best conductor of heat?

(A) copper

(B) wood

(C) plastic

(D) glass

Q29. A vacuum (thermos) flask is able to keep liquids hot or cold for a long time mainly because it:

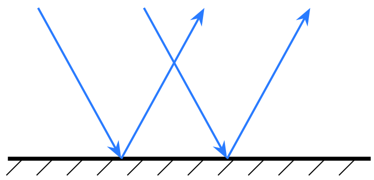
(A) increases the rate of heat transfer

(B) minimises heat transfer by conduction, convection and radiation

(C) stops only the conduction of heat

(D) works only for hot liquids

Q30. Two parallel rays of light strike a plane mirror as shown. After reflection, the two reflected rays are:



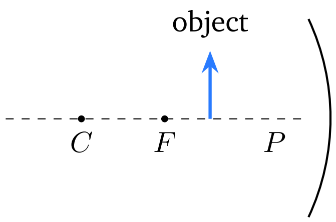
(A) parallel to each other

(B) converging to a single point

(C) diverging from a single point

(D) perpendicular to each other

Q31. An object is placed between the pole (P) and the focus (F) of a concave mirror, as shown. The image formed is:



(A) real, inverted and diminished

(B) real, inverted and magnified

(C) virtual, erect and magnified

(D) real and of the same size

Q32. The radius of curvature of a concave mirror is 30 cm. Its focal length is:

(A) 60 cm

(B) 30 cm

(C) 7.5 cm

(D) 15 cm

Q33. The refractive index of ordinary glass is approximately:

(A) 1.0

(B) 1.5

(C) 2.5

(D) 0.5

Q34. The power of a convex lens of focal length 25 cm is:

(A) 4 D

(B) 25 D

(C) 0.25 D

(D) 2 D

Q35. A person suffering from hypermetropia (long sight) can be helped by using spectacles fitted with a:

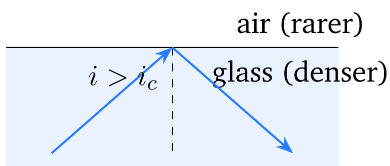
(A) concave lens

(B) plane glass plate

(C) convex lens

(D) cylindrical lens

Q36. Total internal reflection of light, shown below, can take place only when light travels from:



(A) a rarer medium to a denser medium

(B) air to glass at any angle

(C) vacuum to water at a small angle

(D) a denser medium to a rarer medium with the angle of incidence greater than the critical angle

Q37. A sound wave has a frequency of 200 Hz and a wavelength of 1.7 m. The speed of the sound wave is:

(A) 201.7 m/s

(B) 340 m/s

(C) 117.6 m/s

(D) 170 m/s

Q38. Which one of the following statements is correct?

(A) Light waves are transverse while sound waves are longitudinal.

(B) Both light and sound waves are transverse.

(C) Both light and sound waves are longitudinal.

(D) Light waves are longitudinal while sound waves are transverse.

Q39. A megaphone (speaking tube) is used to direct sound in one particular direction. It works on the principle of:

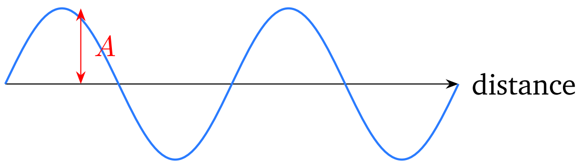
(A) refraction of sound

(B) dispersion of sound

(C) absorption of sound

(D) reflection of sound

Q40. The loudness of a musical sound is determined mainly by the property of the wave marked in the figure below. This property is the:



(A) frequency

(B) wavelength

(C) amplitude

(D) speed

Q41. A potential difference of 10 V is applied across a resistor and a current of 2 A flows through it. The resistance of the resistor is:

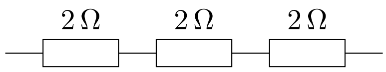
(A) $5\,\Omega$

(B) $20\,\Omega$

(C) $12\,\Omega$

(D) $0.2\,\Omega$

Q42. Three resistors, each of $2\,\Omega$, are connected in series, as shown. Their equivalent resistance is:



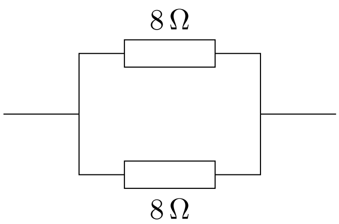
(A) $0.67\,\Omega$

(B) $6\,\Omega$

(C) $2\,\Omega$

(D) $8\,\Omega$

Q43. Two resistors, each of $8\,\Omega$, are connected in parallel, as shown. Their equivalent resistance is:



(A) $16\,\Omega$

(B) $8\,\Omega$

(C) $4\,\Omega$

(D) $64\,\Omega$

Q44. An electric heater operates at 200 V and draws a current of 5 A. The power consumed by it is:

(A) 40 W

(B) 205 W

(C) 100 W

(D) 1000 W

Q45. The earth wire in a domestic electrical circuit is provided mainly to:

(A) carry the main working current

(B) protect the user from electric shock by giving a low-resistance path to the ground

(C) increase the supply voltage

(D) reduce the current in the live wire

Q46. The electrical resistance of a uniform metallic wire is:

(A) inversely proportional to its area of cross-section

(B) directly proportional to its area of cross-section

(C) independent of its length

(D) inversely proportional to its length

Q47. Two magnetic field lines can never intersect (cross) each other. The reason is that at the point of intersection:

(A) the field lines are imaginary

(B) the magnetic field is always uniform

(C) the field lines are always straight

(D) the magnetic field would have two directions, which is impossible

Q48. An electromagnet can be made by winding an insulated copper wire around an iron nail and then connecting the ends of the wire to a:

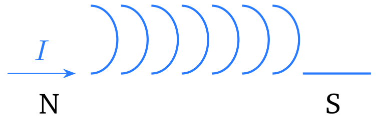
(A) permanent magnet

(B) resistor alone

(C) battery (cell)

(D) capacitor

Q49. For the current-carrying solenoid shown, the polarity of its ends (which end is north and which is south):



(A) reverses if the direction of the current is reversed

(B) never changes under any condition

(C) depends only on the length of the solenoid

(D) depends on the colour of the copper wire

Q50. An electric generator (dynamo) works on the principle of:

(A) the heating effect of electric current

(B) electromagnetic induction

(C) the chemical effect of electric current

(D) electrostatic attraction

Detailed Solutions

Q1.

Solution

Concept — Pressure and its unit: Pressure is defined as force acting per unit area, $P = \dfrac{F}{A}$. Its unit is therefore built from the units of force and area.

Step 1 — Build the unit: Unit of pressure $= \dfrac{\text{newton}}{\text{metre}^2} = \text{N/m}^2$.

Step 2 — Name the unit: This combination is given the special name **pascal (Pa)** in honour of Blaise Pascal.

Why other options are wrong:

- Newton: SI unit of force.
- Joule: SI unit of work or energy.
- Watt: SI unit of power.

Final Answer: The SI unit of pressure is the pascal $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q1

Q2.

Solution

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

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

Step 2 — Identify the derived quantity: Velocity $= \dfrac{\text{displacement}}{\text{time}}$, so it is built from length and time and is therefore a derived quantity.

Why other options are wrong:

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

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

Answer: (A) Go Back to Q2

Q3.

Solution

Concept — Unit conversion: To change m/s into km/h, multiply by $\frac{3600}{1000} = \frac{18}{5}$.

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

Step 2 — Substitute the value: Speed $= 5 \times \frac{18}{5}$ km/h.

Step 3 — Simplify: The 5 in the numerator cancels the 5 in the denominator, leaving 18. So speed $= 18$ km/h.

Why other options are wrong:

- 15 and 25 come from using a wrong factor.
- 10 uses the factor $\frac{5}{18}$ (the reverse conversion) by mistake.

Final Answer: 5 m/s $= 18$ km/h $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q3

Q4.

Solution

Concept — Least count: The least count of an instrument is the smallest length it can measure accurately.

Step 1 — Recall the value: A standard screw gauge (micrometer) has a pitch of 1 mm and 100 divisions on the circular scale.

Step 2 — Compute the least count: Least count $= \frac{\text{pitch}}{\text{number of divisions}} = \frac{1 \text{ mm}}{100} = 0.01$ mm.

Why other options are wrong:

- 1 mm is the least count of an ordinary metre scale.
- 0.1 mm (0.01 cm) is the least count of a vernier callipers.
- 0.001 mm is far finer than a screw gauge can read.

Final Answer: Least count of a screw gauge $= 0.01$ mm $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q4

Q5.

Solution

Concept — Equation of motion: For uniform acceleration, $v = u + at$. Rearranged to find time, $t = \frac{v-u}{a}$.

Step 1 — List the data: $u = 0$ (starts from rest), $v = 20$ m/s, $a = 4$ m/s^2.

Step 2 — Substitute: $t = \frac{20-0}{4}$.

Step 3 — Compute: $t = \frac{20}{4} = 5$ s.

Why other options are wrong:

- 4 s simply repeats the acceleration value.
- 80 s multiplies v by a instead of dividing.
- 16 s subtracts 4 from 20.

Final Answer: Time taken $= 5$ s $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q5

Q6.

Solution

Concept — Area under a velocity–time graph: The area enclosed between the v–t graph and the time axis gives the displacement of the body.

Step 1 — Read the graph: The velocity stays constant at 10 m/s while the time runs from 0 to 6 s, so the shaded region is a rectangle.

Step 2 — Write the area: Area $=$ length $\times$ breadth $=$ velocity $\times$ time $= 10 \times 6$.

Step 3 — Compute: Displacement $= 60$ m.

Why other options are wrong:

- 16 m adds the numbers instead of multiplying.
- 10 m ignores the time.
- 600 m multiplies by an extra factor of 10.

Final Answer: Displacement $= 60$ m $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q6

Q7.

Solution

Concept — Newton's third law: For every action there is an equal and opposite reaction. The crucial point is where each of the two forces acts.

Step 1 — Identify the two forces: The action force and the reaction force are always equal in magnitude and opposite in direction.

Step 2 — Locate the forces: The action acts on one body and the reaction acts on the other body, so the pair acts on **two different bodies**. (This is why they never cancel each other.)

Why other options are wrong:

- If both acted on the same body they would cancel and produce no motion.
- The two forces are equal, not unequal.
- They are opposite in direction, not in the same direction.

Final Answer: The action–reaction pair acts on two different bodies $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q7

Q8.

Solution

Concept — Newton's second law: The force needed to accelerate a body is $F = ma$, the product of mass and acceleration.

Step 1 — List the data: $m = 2.5$ kg, $a = 4$ m/s^2.

Step 2 — Substitute: $F = 2.5 \times 4$.

Step 3 — Compute: $F = 10$ N.

Why other options are wrong:

- 0.625 N divides mass by acceleration.
- 6.5 N adds mass and acceleration.
- 2.5 N is just the mass value, not the force.

Final Answer: Force applied $= 10$ N $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q8

Q9.

Solution

Concept — Rocket propulsion: A rocket burns fuel and pushes hot gases out backward at high speed (action). By Newton's third law, the gases push the rocket forward (reaction).

Step 1 — Identify the action: The engine ejects exhaust gases downward/backward.

Step 2 — Identify the reaction: The equal and opposite reaction drives the rocket forward, so the motion is based on **Newton's third law of motion**.

Why other options are wrong:

- The first law only describes inertia, not the thrust.
- Archimedes' principle deals with buoyancy in fluids.
- Conservation of energy explains energy changes, not the forward thrust mechanism.

Final Answer: Rocket motion is based on 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: $m = 3$ kg, $v = 4$ m/s.

Step 2 — Substitute: $p = 3 \times 4$.

Step 3 — Compute: $p = 12$ kg m/s.

Why other options are wrong:

- 7 adds mass and velocity.
- 0.75 divides mass by velocity.
- 1.33 divides velocity by mass.

Final Answer: Momentum $= 12$ kg m/s $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q10

Q11.

Solution

Concept — Uniform motion: A body is in uniform motion if it covers equal distances in equal intervals of time, no matter how small those intervals are.

Step 1 — Match the definition: The statement in the question is exactly the definition of uniform motion.

Step 2 — Conclude: The velocity is constant, so the body is in **uniform motion**.

Why other options are wrong:

- Non-uniform motion means unequal distances in equal times.
- Circular motion involves a continuously changing direction.
- Accelerated motion means the velocity is changing.

Final Answer: The body is in uniform motion $\Rightarrow \boxed{\text{D}}$

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: $F = 8$ N, $s = 5$ m.

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

Step 3 — Compute: $W = 40$ J.

Why other options are wrong:

- 1.6 J divides force by distance.
- 13 J adds force and distance.
- 3 J subtracts the values.

Final Answer: Work done $= 40$ 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, $v = 4$ m/s.

Step 2 — Square the velocity: $v^2 = 4^2 = 16$.

Step 3 — Substitute and compute: $KE = \frac{1}{2} \times 2 \times 16 = 16$ J.

Why other options are wrong:

- 8 J uses v instead of v^2.
- 4 J leaves out the mass.
- 32 J forgets the factor $\frac{1}{2}$.

Final Answer: Kinetic energy $= 16$ 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: $m = 2$ kg, $g = 10$ m/s^2, $h = 3$ m.

Step 2 — Substitute: $PE = 2 \times 10 \times 3$.

Step 3 — Compute: $PE = 60$ J.

Why other options are wrong:

- 6 J leaves out the factor g.
- 30 J uses half the value of g.
- 23 J adds the numbers instead of multiplying.

Final Answer: Potential energy $= 60$ 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, $t = 5$ s.

Step 2 — Substitute: $P = \dfrac{300}{5}$.

Step 3 — Compute: $P = 60$ W.

Why other options are wrong:

- 1500 W multiplies instead of dividing.
- 305 W adds the values.
- 15 W inverts the ratio (divides 75 wrongly).

Final Answer: Power $= 60$ W $\Rightarrow \boxed{\text{B}}$

$\boxed{\textbf{Answer: (B)}}$ **Go Back to Q15**

Q16.

Solution

Concept — Work and the angle between force and displacement: Work $W = F\,s\cos\theta$. When the force is perpendicular to the displacement, $\theta = 90^\circ$ and $\cos 90^\circ = 0$, so the work done is zero.

Step 1 — Identify the directions: The force of gravity on the box acts vertically downward, while the coolie moves horizontally on a level platform.

Step 2 — Find the angle: The force (downward) and the displacement (horizontal) are at 90° to each other.

Step 3 — Apply the formula: $W = F\,s\cos 90^\circ = F\,s \times 0 = 0$.

Why other options are wrong:

- "Maximum" would need the force along the motion.
- mgh applies only when the box is raised vertically.
- There is no large negative work; the work is simply zero.

Final Answer: Work done by gravity $=$ zero $\Rightarrow \boxed{\text{C}}$

$\boxed{\textbf{Answer: (C)}}$ **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: $m = 20$ kg, $g = 10$ m/s^2.

Step 2 — Substitute: $W = 20 \times 10$.

Step 3 — Compute: $W = 200$ N.

Why other options are wrong:

- 20 N is only the mass value.
- 2 N divides instead of multiplying.
- 100 N uses half the value of g.

Final Answer: Weight $= 200$ N $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q17

Q18.

Solution

Concept — Universal law of gravitation: The force between two masses is $F = G\dfrac{m_1 m_2}{r^2}$. The numerator contains the product $m_1 m_2$.

Step 1 — Focus on the masses: Because $m_1 m_2$ is in the numerator, the force is directly proportional to the product of the two masses.

Step 2 — Confirm: Doubling either mass doubles the force.

Why other options are wrong:

- The sum of the masses does not appear in the law.
- The force is inversely (not directly) proportional to the square of the distance.
- The difference of the masses does not appear in the law.

Final Answer: Force $\propto$ product of the masses $\Rightarrow \boxed{\text{B}}$

Answer: (B) 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, $t = 3$ s.

Step 2 — Substitute: $v = 10 \times 3$.

Step 3 — Compute: $v = 30$ m/s.

Why other options are wrong:

- 45 m/s uses the distance formula $\frac{1}{2}gt^2$ by mistake.
- 13 m/s adds g and t.
- 3.3 m/s divides t by g.

Final Answer: Velocity after 3 s $= 30$ m/s $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q19

Q20.

Solution

Concept — Mass versus weight: Mass is the amount of matter in a body and stays the same everywhere. Weight is mg and changes with the local value of g.

Step 1 — Check g: On the Moon g is about one-sixth of its value on the Earth, so g itself changes.

Step 2 — Check weight and gravitational force: Since both depend on g, the weight and the gravitational force on the body also change.

Step 3 — Identify the unchanged quantity: Only the **mass** stays the same on the Earth and on the Moon.

Why other options are wrong:

- Weight decreases on the Moon.
- The gravitational force on the body decreases on the Moon.
- The value of g is smaller on the Moon.

Final Answer: Mass remains unchanged $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q20

Q21.

Solution

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

Step 1 — List the data: $F = 40$ N, $d = 0.5$ m.

Step 2 — Substitute: $M = 40 \times 0.5$.

Step 3 — Compute: $M = 20$ N m.

Why other options are wrong:

- 80 N m multiplies by 2 instead of by 0.5.
- 40 N m ignores the distance.
- 0.0125 N m divides the values wrongly.

Final Answer: Moment of the force $= 20$ N m $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q21

Q22.

Solution

Concept — Principle of moments: A seesaw tips towards the side with the larger turning moment, where moment = force × distance from the pivot.

Step 1 — Left-side moment: $M_{\text{left}} = 300\text{ N} \times 1\text{ m} = 300$ N m.

Step 2 — Right-side moment: $M_{\text{right}} = 200\text{ N} \times 2\text{ m} = 400$ N m.

Step 3 — Compare: $M_{\text{right}} = 400\text{ N m} > M_{\text{left}} = 300$ N m, so the right side has the greater turning effect and goes down.

Why other options are wrong:

- The left side has the larger weight but the smaller moment, so it rises.
- The moments are unequal, so it cannot stay balanced.
- The result depends on the moments, not on the height of the weights.

Final Answer: The right side (the 200 N weight) goes down $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q22

Q23.

Solution

Concept — Time period of a simple pendulum: For small swings, $T = 2\pi\sqrt{\frac{L}{g}}$, where L is the length and g is the acceleration due to gravity.

Step 1 — Read the formula: T depends only on L and g.

Step 2 — Identify what is absent: The amplitude (and the mass of the bob) does not appear in the formula, so T is independent of the amplitude for small oscillations.

Why other options are wrong:

- T does depend on the length L.
- T does depend on the value of g.
- T depends on both L and g, so this is the opposite of "independent".

Final Answer: T is independent of the amplitude $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q23

Q24.

Solution

Concept — One complete oscillation: One complete oscillation is the full to-and-fro journey of the bob back to its starting point.

Step 1 — Trace the motion: Starting from one extreme, the bob swings through the mean position to the other extreme (crossing the mean once), then swings back through the mean position again to its start (crossing the mean a second time).

Step 2 — Count the crossings: The bob passes through the mean position **twice** in one complete oscillation.

Why other options are wrong:

- "Once" is only half an oscillation.
- "Three times" or "four times" would be more than one full oscillation.

Final Answer: The bob crosses the mean position twice $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q24

Q25.

Solution

Concept — Celsius to Fahrenheit: The conversion is $F = \frac{9}{5}C + 32$.

Step 1 — List the data: $C = 100\,^\circ\mathrm{C}$.

Step 2 — Multiply by $\frac{9}{5}$: $\frac{9}{5} \times 100 = 180$.

Step 3 — Add 32**:** $F = 180 + 32 = 212\,^\circ\mathrm{F}$.

Why other options are wrong:

- $180\,^\circ$F forgets to add 32.
- $132\,^\circ$F adds 32 to a wrong product.
- $373\,^\circ$F is the Kelvin value, not Fahrenheit.

Final Answer: $100\,^\circ\mathrm{C} = 212\,^\circ\mathrm{F} \Rightarrow \boxed{\mathrm{B}}$

Answer: (B) Go Back to Q25

Q26.

Solution

Concept — Heat and specific heat: The heat needed to change the temperature of a body is $Q = mc\,\Delta T$.

Step 1 — List the data: $m = 0.2$ kg, $c = 4200\ \mathrm{J\,kg^{-1}\,^\circ C^{-1}}$, $\Delta T = 25\,^\circ\mathrm{C}$.

Step 2 — Substitute: $Q = 0.2 \times 4200 \times 25$.

Step 3 — Compute step by step: $0.2 \times 4200 = 840$, then $840 \times 25 = 21000$ J.

Why other options are wrong:

- 8400 J uses $\Delta T = 10$ instead of 25.
- 4200 J uses only the specific heat.
- 2100 J uses $\Delta T = 2.5$.

Final Answer: Heat required $= 21000$ J $\Rightarrow \boxed{\mathrm{D}}$

Answer: (D) Go Back to Q26

Q27.

Solution

Concept — Modes of heat transfer: Conduction needs a solid medium, convection needs a moving fluid, but radiation needs no medium at all.

Step 1 — Test each mode: Conduction and convection both require particles of matter to carry the heat.

Step 2 — Identify the vacuum mode: Radiation transfers heat as electromagnetic waves and can travel through empty space, which is how the Sun's heat reaches the Earth.

Why other options are wrong:

- Conduction cannot occur through a vacuum.
- Convection needs a fluid medium.
- "Conduction and convection together" still need matter.

Final Answer: Heat travels through vacuum by radiation $\Rightarrow \boxed{\text{C}}$

$\boxed{\text{Answer: (C)}}$ Go Back to Q27

Q28.

Solution

Concept — Conductors of heat: Metals contain free electrons that carry thermal energy quickly, making them good conductors of heat. Non-metals are poor conductors (insulators).

Step 1 — Sort the options: Wood, plastic and glass are non-metals and are poor conductors of heat.

Step 2 — Pick the metal: Copper is a metal and is among the best conductors of heat.

Why other options are wrong:

- Wood is a good thermal insulator.
- Plastic is an insulator.
- Glass conducts heat very poorly.

Final Answer: Copper is the best conductor of heat $\Rightarrow \boxed{\text{A}}$

$\boxed{\text{Answer: (A)}}$ Go Back to Q28

Q29.

Solution

Concept — Thermos flask: A vacuum flask is designed to cut down heat flow by all three modes of heat transfer, so the contents stay hot or cold for a long time.

Step 1 — Vacuum between walls: The vacuum between the double glass walls stops conduction and convection.

Step 2 — Silvered walls: The shiny silvered surfaces reflect heat and reduce radiation.

Step 3 — Combine: Together these features **minimise heat transfer by conduction, convection and radiation**.

Why other options are wrong:

- It reduces, never increases, heat transfer.
- It blocks more than just conduction.
- It works for both hot and cold liquids.

Final Answer: It minimises all three modes of heat transfer $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q29

Q30.

Solution

Concept — Reflection at a plane mirror: A plane mirror obeys the laws of reflection at every point, and a flat mirror does not change the relative directions of a parallel beam.

Step 1 — Apply the law of reflection: Each ray reflects with its angle of reflection equal to its angle of incidence.

Step 2 — Compare the two rays: Since both rays strike a flat surface at the same angle, their reflected rays also make the same angle and stay **parallel to each other**.

Why other options are wrong:

- A converging beam needs a concave mirror.
- A diverging beam needs a convex mirror.
- A plane mirror does not turn the rays perpendicular to each other.

Final Answer: The reflected rays remain parallel $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q30

Q31.

Solution

Concept — Concave mirror image (object between P and F): When the object lies between the pole and the focus of a concave mirror, the reflected rays diverge and appear to come from behind the mirror.

Step 1 — Locate the image: The diverging reflected rays meet only when produced backward, so the image forms behind the mirror and is virtual.

Step 2 — Describe the image: The image is **virtual, erect and magnified** (this is how a shaving or makeup mirror enlarges the face).

Why other options are wrong:

- A real, inverted, diminished image forms when the object is beyond C.
- A real, inverted, magnified image forms when the object is between F and C.
- A same-size real image forms only when the object is exactly at C.

Final Answer: The image is virtual, erect and magnified $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q31

Q32.

Solution

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

Step 1 — List the data: $R = 30$ cm.

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

Step 3 — Compute: $f = 15$ cm.

Why other options are wrong:

- 60 cm doubles R instead of halving it.
- 30 cm just repeats R.
- 7.5 cm divides R by 4.

Final Answer: Focal length $= 15$ cm $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q32

Q33.

Solution

Concept — Refractive index: The refractive index of a medium measures how much it slows down and bends light compared with a vacuum (or air).

Step 1 — Recall the value: Ordinary glass has a refractive index of about 1.5.

Step 2 — Interpret: This means light travels about 1.5 times slower in glass than in air.

Why other options are wrong:

- 1.0 is the value for air or vacuum.
- 2.5 is far too high for ordinary glass (closer to diamond's 2.4).
- A refractive index cannot be less than 1, so 0.5 is impossible.

Final Answer: Refractive index of glass $\approx 1.5 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q33

Q34.

Solution

Concept — Power of a lens: The power of a lens is the reciprocal of its focal length in metres, $P = \dfrac{1}{f\ (\text{in m})}$.

Step 1 — Convert the focal length: $f = 25$ cm $= 0.25$ m.

Step 2 — Substitute: $P = \dfrac{1}{0.25}$.

Step 3 — Compute: $P = 4$ D.

Why other options are wrong:

- 25 D forgets to convert cm to m.
- 0.25 D uses f in metres without taking the reciprocal.
- 2 D corresponds to $f = 50$ cm, not 25 cm.

Final Answer: Power of the lens $= 4$ D $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q34

Q35.

Solution

Concept — Hypermetropia (long sight): A long-sighted eye forms the image of nearby objects behind the retina because its converging power is too weak. A converging (convex) lens adds the missing power.

Step 1 — Identify the defect: In hypermetropia the near point moves away, so close objects look blurred.

Step 2 — Choose the correction: A **convex lens** converges the rays earlier so the image forms on the retina.

Why other options are wrong:

- A concave lens corrects myopia (short sight).
- A plane glass plate has no focusing power.
- A cylindrical lens corrects astigmatism.

Final Answer: Hypermetropia is corrected by a convex lens $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q35

Q36.

Solution

Concept — Total internal reflection (TIR): TIR occurs when light tries to pass from a denser medium into a rarer medium and the angle of incidence is greater than the critical angle. The light is then completely reflected back into the denser medium.

Step 1 — Direction of travel: The light must move from a denser medium (such as glass or water) towards a rarer medium (such as air).

Step 2 — Angle condition: The angle of incidence must exceed the critical angle, $i > i_c$, as shown in the figure.

Why other options are wrong:

- Going from rarer to denser, light bends towards the normal and refracts, never TIR.
- Air to glass is rarer to denser, so TIR cannot happen.
- Vacuum to water is rarer to denser, and a small angle gives ordinary refraction.

Final Answer: TIR needs denser to rarer with $i > i_c \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q36

Q37.

Solution

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

Step 1 — List the data: $f = 200$ Hz, $\lambda = 1.7$ m.

Step 2 — Substitute: $v = 200 \times 1.7$.

Step 3 — Compute: $v = 340$ m/s.

Why other options are wrong:

- 201.7 m/s adds the values instead of multiplying.
- 117.6 m/s divides f by λ.
- 170 m/s halves the correct product.

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

Answer: (B) Go Back to Q37

Q38.

Solution

Concept — Transverse and longitudinal waves: In a transverse wave the particles vibrate perpendicular to the direction of travel; in a longitudinal wave they vibrate along the direction of travel.

Step 1 — Classify light: Light is an electromagnetic wave in which the fields vibrate perpendicular to the direction of travel, so light is transverse.

Step 2 — Classify sound: Sound travels as compressions and rarefactions, with particles vibrating along the direction of travel, so sound is longitudinal.

Why other options are wrong:

- Sound is not transverse, so "both transverse" is wrong.
- Light is not longitudinal, so "both longitudinal" is wrong.
- The last option swaps the two types.

Final Answer: Light is transverse and sound is longitudinal $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q38

Q39.

Solution

Concept — Reflection of sound: A megaphone has a conical tube whose walls repeatedly reflect the sound waves, sending them forward in a narrow beam instead of letting them spread in all directions.

Step 1 — Trace the sound: The sound from the speaker strikes the smooth inner walls of the cone.

Step 2 — Apply the principle: These successive reflections channel the sound in one direction, so the megaphone works on the **reflection of sound**.

Why other options are wrong:

- Refraction is the bending of sound, not its concentration.
- Dispersion is the spreading of sound, the opposite of what a megaphone does.
- Absorption would weaken the sound, not direct it.

Final Answer: A megaphone works on the reflection of sound $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q39

Q40.

Solution

Concept — Loudness and amplitude: The loudness of a sound depends on the amount of energy carried by the wave, which is governed by its amplitude (the maximum displacement A shown in the figure).

Step 1 — Read the figure: The marked quantity A is the height of the wave from the axis to the crest, that is the amplitude.

Step 2 — Link to loudness: A larger amplitude carries more energy and produces a louder sound, so loudness depends on the **amplitude**.

Why other options are wrong:

- Frequency decides the pitch, not the loudness.
- Wavelength is the spacing of the wave, not its loudness.
- Speed depends on the medium, not on how loud the sound is.

Final Answer: Loudness depends on the amplitude $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q40

Q41.

Solution

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

Step 1 — List the data: $V = 10$ V, $I = 2$ A.

Step 2 — Substitute: $R = \frac{10}{2}$.

Step 3 — Compute: $R = 5\,\Omega$.

Why other options are wrong:

- $20\,\Omega$ multiplies V and I.
- $12\,\Omega$ adds V and I.
- $0.2\,\Omega$ inverts the ratio.

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

Answer: (A) Go Back to Q41

Q42.

Solution

Concept — Resistors in series: In a series combination the equivalent resistance is the sum of the individual resistances, $R_s = R_1 + R_2 + R_3$.

Step 1 — List the data: $R_1 = R_2 = R_3 = 2\,\Omega$.

Step 2 — Substitute: $R_s = 2 + 2 + 2$.

Step 3 — Compute: $R_s = 6\,\Omega$.

Why other options are wrong:

- $0.67\,\Omega$ is the parallel result of three $2\,\Omega$ resistors.
- $2\,\Omega$ is just one resistor.
- $8\,\Omega$ adds an extra $2\,\Omega$.

Final Answer: Equivalent series resistance $= 6\,\Omega \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q42

Q43.

Solution

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

Step 1 — Write the formula: $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$.

Step 2 — Substitute: $\frac{1}{R_p} = \frac{1}{8} + \frac{1}{8} = \frac{2}{8} = \frac{1}{4}$.

Step 3 — Invert: $R_p = 4\,\Omega$.

Why other options are wrong:

- $16\,\Omega$ adds the resistors (that is the series value).
- $8\,\Omega$ is just one resistor.
- $64\,\Omega$ multiplies the two resistors.

Final Answer: Equivalent parallel resistance $= 4\,\Omega \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q43

Q44.

Solution

Concept — Electric power: The power consumed by an appliance is $P = VI$, the product of the voltage and the current.

Step 1 — List the data: $V = 200$ V, $I = 5$ A.

Step 2 — Substitute: $P = 200 \times 5$.

Step 3 — Compute: $P = 1000$ W.

Why other options are wrong:

- 40 W divides V by I.
- 205 W adds V and I.
- 100 W halves the current wrongly.

Final Answer: Power consumed $= 1000$ W $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q44

Q45.

Solution

Concept — Earthing: The earth wire connects the metal body of an appliance to the ground through a very low-resistance path.

Step 1 — Normal working: In normal use the earth wire carries no current.

Step 2 — During a fault: If the live wire touches the metal casing, the earth wire lets the large fault current flow safely into the ground, so the user does not get a shock. This is its main purpose: **to protect the user from electric shock**.

Why other options are wrong:

- The main working current is carried by the live and neutral wires.
- The earth wire does not raise the supply voltage.
- It does not regulate or reduce the current in the live wire.

Final Answer: The earth wire protects the user from electric shock $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q45

Q46.

Solution

Concept — Resistance of a wire: The resistance of a uniform wire is $R = \rho\dfrac{L}{A}$, where ρ is the resistivity, L the length and A the area of cross-section.

Step 1 — Examine the formula: Because A is in the denominator, R becomes smaller when A becomes larger.

Step 2 — State the relation: Therefore the resistance is **inversely proportional to the area of cross-section** (a thicker wire has less resistance).

Why other options are wrong:

- It is inversely, not directly, proportional to the area.
- Resistance does depend on the length ($R \propto L$).
- It is directly proportional to the length, not inversely.

Final Answer: $R \propto \dfrac{1}{A} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q46

Q47.

Solution

Concept — Magnetic field lines: The tangent to a field line at any point gives the single, definite direction of the magnetic field at that point.

Step 1 — Suppose they crossed: If two field lines were to intersect, there would be two different tangents at the crossing point.

Step 2 — Reach the contradiction: That would mean the magnetic field points in two directions at the same point, which is impossible. Hence field lines never cross.

Why other options are wrong:

- Field lines are a real, useful representation of the field, not just imaginary.
- The field need not be uniform for this rule to hold.
- Field lines are usually curved, not always straight.

Final Answer: Crossing would give two field directions at one point $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q47

Q48.

Solution

Concept — Making an electromagnet: An electromagnet is produced by passing an electric current through a coil wound on a soft-iron (nail) core. The current is the source of the magnetic field.

Step 1 — Set up the coil: Wind insulated copper wire many times around the iron nail.

Step 2 — Supply the current: Connect the ends of the wire to a **battery (cell)**; the current then magnetises the nail and it behaves as a magnet.

Why other options are wrong:

- Connecting to a permanent magnet supplies no current.
- A resistor alone carries no source of current.
- A capacitor stores charge but does not drive a steady current to magnetise the nail.

Final Answer: The coil must be connected to a battery $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q48

Q49.

Solution

Concept — Polarity of a solenoid: The end of a current-carrying solenoid where the current appears to flow anticlockwise behaves as a north pole, and the clockwise end as a south pole.

Step 1 — Link polarity to current: The sense of the current decides which end is north and which is south.

Step 2 — Reverse the current: If the direction of the current is reversed, the apparent rotation at each end reverses, so the north and south poles swap. The polarity therefore **reverses when the current is reversed**.

Why other options are wrong:

- The polarity does change, so "never changes" is wrong.
- It depends on the current direction, not on the length.
- The colour of the wire has no effect on polarity.

Final Answer: The polarity reverses if the current is reversed $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q49

Q50.

Solution

Concept — Electric generator: A generator converts mechanical energy into electrical energy. It works on the principle of electromagnetic induction: when a coil is rotated in a magnetic field, a changing magnetic flux induces an electric current in the coil.

Step 1 — Rotate the coil: Mechanical energy turns a coil between the poles of a magnet.

Step 2 — Induce the current: The changing flux through the coil induces an e.m.f., so the generator works on **electromagnetic induction**.

Why other options are wrong:

- The heating effect of current is used in heaters, not generators.
- The chemical effect of current operates in electrolysis and cells.
- Electrostatic attraction is a force between charges, not the generator principle.

Final Answer: A generator works on electromagnetic induction $\Rightarrow \boxed{B}$

$\boxed{\text{Answer: (B)}}$ Go Back to Q50

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	C	2	A	3	B	4	D	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	C	18	B	19	A	20	D
21	D	22	A	23	C	24	B	25	B
26	D	27	C	28	A	29	B	30	A
31	C	32	D	33	B	34	A	35	C
36	D	37	B	38	A	39	D	40	C
41	A	42	B	43	C	44	D	45	B
46	A	47	D	48	C	49	A	50	B