Jharkhand Polytechnic Physics

Sample Paper – 2

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 work (and of energy) is the:

(A) newton

(B) watt

(C) joule

(D) pascal

Q2. Which one of the following is a **derived** physical quantity?

(A) area

(B) time

(C) mass

(D) temperature

Q3. A cyclist moves with a speed of 36 km/h. Its speed in metre per second is:

(A) 6 m/s

(B) 10 m/s

(C) 36 m/s

(D) 20 m/s

Q4. The least count of an ordinary vernier callipers is usually:

(A) 1 mm

(B) 1 cm

(C) 0.001 mm

(D) 0.01 cm

Q5. A body starting from rest moves with a uniform acceleration of 2 m/s^2. The distance it covers in 3 seconds is:

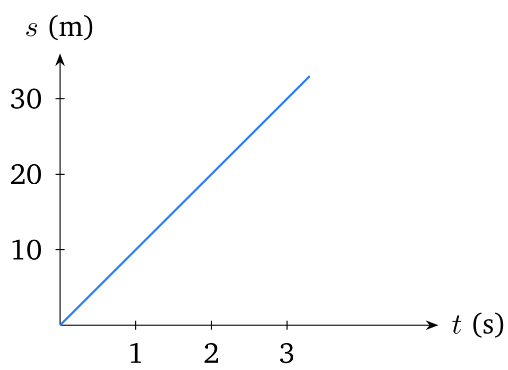
(A) 9 m

(B) 18 m

(C) 6 m

(D) 12 m

Q6. The distance–time graph of a moving body is a straight line passing through the origin, as shown. The body is moving with:



(A) uniform acceleration

(B) continuously increasing speed

(C) zero speed (at rest)

(D) uniform (constant) speed

Q7. According to Newton's second law of motion, the net force acting on a body is directly proportional to the:

(A) velocity of the body

(B) rate of change of its momentum

(C) displacement of the body

(D) mass of the body only

Q8. A body of mass 4 kg is given an acceleration of 3 m/s^2. The force acting on it is:

(A) 7 N

(B) 1.33 N

(C) 12 N

(D) 24 N

Q9. Which of the following best illustrates Newton's third law of motion?

(A) Rowing a boat: the oars push the water backward and the boat moves forward

(B) A stone falling freely under gravity

(C) A car speeding up on a straight road

(D) A top spinning about its axis

Q10. A force of 10 N acts on a body for 2 seconds. The impulse given to the body is:

(A) 5 N s

(B) 12 N s

(C) 0.2 N s

(D) 20 N s

Q11. An athlete runs exactly once around a circular track of radius r and returns to the starting point. The magnitude of the displacement is:

(A) $2\pi r$

(B) zero

(C) r

(D) πr

Q12. A force of 15 N moves a body through a distance of 4 m in the direction of the force. The work done is:

(A) 19 J

(B) 3.75 J

(C) 60 J

(D) 11 J

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

(A) 8 J

(B) 16 J

(C) 4 J

(D) 2 J

Q14. A body of mass 3 kg is raised to a height of 10 m. The gravitational potential energy gained is:

(A) 30 J

(B) 150 J

(C) 13 J

(D) 300 J

Q15. A motor does 600 J of work in 20 seconds. Its power is:

(A) 12000 W

(B) 30 W

(C) 620 W

(D) 0.03 W

Q16. The commercial unit of electrical energy (the "unit" on an electricity bill) is the:

(A) watt

(B) joule

(C) kilowatt-hour

(D) volt

Q17. The weight of an object of mass 8 kg on the surface of the Earth is:

(A) 80 N

(B) 8 N

(C) 0.8 N

(D) 800 N

Q18. The approximate value of the acceleration due to gravity near the surface of the Earth is:

(A) 8.9 m/s^2

(B) 9.8 m/s^2

(C) 98 m/s^2

(D) 0.98 m/s^2

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

(A) 5 m/s

(B) 40 m/s

(C) 10 m/s

(D) 20 m/s

Q20. Which one of the following quantities of a body remains the same whether the body is on the Earth, on the Moon, or in deep space?

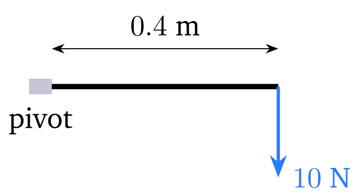
(A) its weight

(B) the gravitational force acting on it

(C) its mass

(D) the acceleration due to gravity at its location

Q21. A force of 10 N is applied at the end of a horizontal rod at a perpendicular distance of 0.4 m from the pivot, as shown. The moment of the force about the pivot is:



(A) 25 N m

(B) 4 N m

(C) 0.04 N m

(D) 14 N m

Q22. A seesaw is perfectly balanced about its central pivot. According to the principle of moments, this means that the:

(A) clockwise moment equals the anticlockwise moment

(B) total weight on both sides is zero

(C) clockwise moment is greater than the anticlockwise moment

(D) heavier child always moves down

Q23. In simple harmonic motion, the speed of the particle is maximum at the:

(A) extreme position

(B) position midway between mean and extreme

(C) it is constant everywhere

(D) mean (equilibrium) position

Q24. One complete to-and-fro motion of a vibrating body is called one:

(A) wavelength

(B) amplitude

(C) oscillation

(D) frequency

Q25. A temperature of $27\,^{\circ}\mathrm{C}$, expressed on the Kelvin scale, is:

(A) 300 K

(B) 246 K

(C) 27 K

(D) 273 K

Q26. How much heat is required to raise the temperature of 2 kg of aluminium by $5\,^{\circ}\mathrm{C}$? (Specific heat of aluminium $= 900\ \mathrm{J\,kg^{-1}\,^{\circ}C^{-1}}$)

(A) 4500 J

(B) 9000 J

(C) 18000 J

(D) 1800 J

Q27. The mode of heat transfer that takes place by the actual movement of heated particles, mainly in liquids and gases, is called:

(A) conduction

(B) radiation

(C) reflection

(D) convection

Q28. The quantity of heat required to raise the temperature of 1 kg of a substance by 1 °C is called its:

(A) latent heat

(B) heat capacity

(C) specific heat capacity

(D) thermal conductivity

Q29. During the day, a cool breeze blows from the sea towards the land. This sea breeze is an example of:

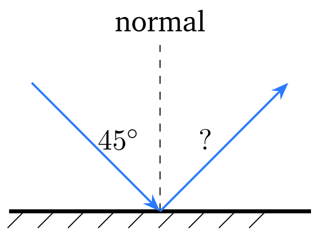
(A) convection

(B) conduction

(C) radiation

(D) reflection

Q30. A ray of light strikes a plane mirror making an angle of incidence of 45° with the normal, as shown. The angle of reflection is:



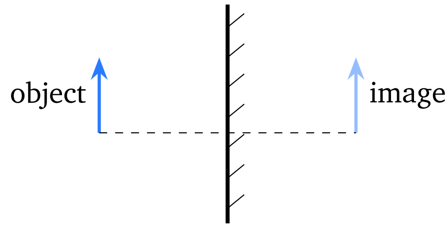
(A) 90°

(B) $45°$

(C) $0°$

(D) $22.5°$

Q31. An object is placed in front of a plane mirror, as shown. The image formed by the plane mirror is:



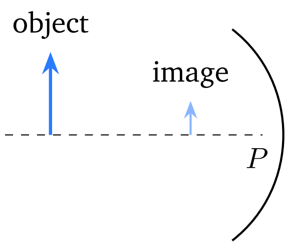
(A) real, inverted and magnified

(B) real, erect and diminished

(C) virtual, erect and of the same size

(D) virtual, inverted and magnified

Q32. An object is placed in front of a convex mirror, as shown. The image formed is always:



(A) real, inverted and magnified

(B) real, erect and of the same size

(C) virtual, inverted and diminished

(D) virtual, erect and diminished

Q33. The magnification produced by a mirror is given by $m = -\frac{v}{u}$. If the value of m comes out to be **negative**, the image formed is:

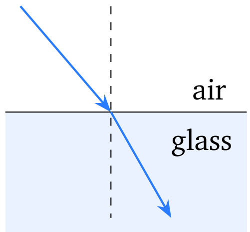
(A) real and inverted

(B) virtual and erect

(C) formed at infinity

(D) always of the same size

Q34. The refractive index of a medium is $n = \frac{c}{v}$, where c is the speed of light in vacuum and v is its speed in the medium, as illustrated by the bending of light entering glass. This relation shows that light travels:



(A) faster in a denser medium

(B) slower in a denser (higher index) medium

(C) at the same speed in all media

(D) only in straight lines inside glass

Q35. A convex (converging) lens always:

(A) spreads out a parallel beam of light

(B) is unable to form a real image

(C) brings a parallel beam of light to a focus

(D) has a negative focal length

Q36. The formation of a rainbow in the sky after rain is mainly due to:

(A) reflection of light alone

(B) refraction of light alone

(C) absorption of light by clouds

(D) dispersion and internal reflection of sunlight inside water droplets

Q37. A sound wave has a frequency of 500 Hz and a wavelength of 0.6 m. The speed of the sound wave is:

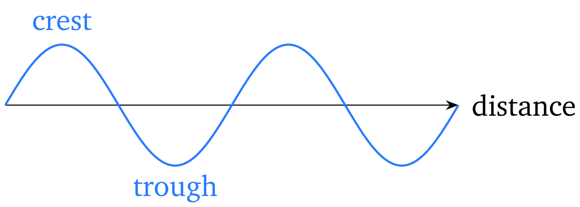
(A) 300 m/s

(B) 833 m/s

(C) 500.6 m/s

(D) 0.0012 m/s

Q38. A wave in which the particles of the medium move up and down to form crests and troughs, as shown, is a:



(A) longitudinal wave

(B) ordinary sound wave in air

(C) transverse wave

(D) compressional wave

Q39. SONAR, the device used to measure the depth of the sea and to detect underwater objects, works using:

(A) infrared waves

(B) ultrasonic (ultrasound) waves

(C) radio waves

(D) ordinary audible sound only

Q40. The range of frequencies that a normal human ear can hear is approximately:

(A) 2 Hz to 200 Hz

(B) 200 Hz to 2000 Hz

(C) 20 kHz to 200 kHz

(D) 20 Hz to 20,000 Hz

Q41. A current of 3 A flows through a resistor of resistance $4\,\Omega$. The potential difference across the resistor is:

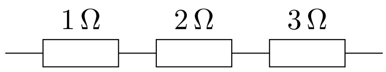
(A) 12 V

(B) 0.75 V

(C) 7 V

(D) 1.33 V

Q42. Three resistors of $1\,\Omega$, $2\,\Omega$ and $3\,\Omega$ are connected in series, as shown. Their equivalent resistance is:



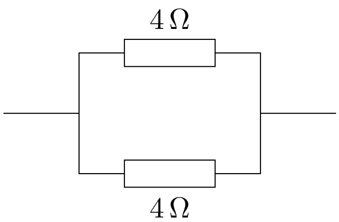
(A) $0.55\,\Omega$

(B) $1\,\Omega$

(C) $6\,\Omega$

(D) $11\,\Omega$

Q43. Two resistors, each of $4\,\Omega$, are connected in parallel, as shown. Their equivalent resistance is:



(A) $8\,\Omega$

(B) $2\,\Omega$

(C) $4\,\Omega$

(D) $16\,\Omega$

Q44. A current of 2 A flows through a resistor of $5\,\Omega$. The power dissipated in the resistor is:

(A) 10 W

(B) 40 W

(C) 100 W

(D) 20 W

Q45. In a household electric circuit, the main purpose of the earth (earthing) wire is to:

(A) provide a safe path for leakage current and protect the user from electric shock

(B) increase the current supplied to the appliance

(C) supply electrical power to the appliance

(D) reduce the supply voltage of the mains

Q46. For a uniform metal wire of fixed material and cross-section, the electrical resistance is:

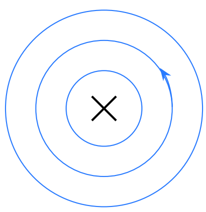
(A) inversely proportional to its length

(B) directly proportional to its length

(C) independent of its length

(D) proportional to the square of its length

Q47. The direction of the magnetic field produced around a straight current-carrying conductor (shown perpendicular to the page) is found using:



wire $\perp$ page

(A) Fleming's left-hand rule

(B) Ohm's law

(C) the right-hand thumb rule (Maxwell's corkscrew rule)

(D) Newton's third law

Q48. Powerful electromagnets are used in cranes at scrap yards mainly to:

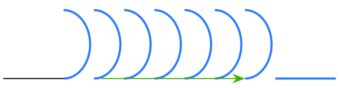
(A) generate electricity

(B) measure electric current

(C) store electric charge

(D) lift and move heavy iron and steel objects

Q49. The magnetic field in the central region inside a long current-carrying solenoid, shown below, is:



field inside

(A) zero everywhere

(B) uniform and directed along the axis

(C) strongest at the ends and zero at the centre

(D) in the form of circles around the axis

Q50. An electric generator (dynamo) is a device that converts:

(A) mechanical energy into electrical energy

(B) electrical energy into mechanical energy

(C) heat energy into electrical energy

(D) chemical energy into electrical energy

Detailed Solutions

Q1.

Solution

Concept — Units of work and energy: Work is done when a force moves a body through a distance, $W = F \times s$. Energy is the capacity to do work, so both share the same unit.

Step 1 — Build the unit: Unit of work = unit of force × unit of distance = newton × metre = N m.

Step 2 — Name the unit: The combination 1 N m is given the special name **joule (J)**.

Why other options are wrong:

- Newton: SI unit of force.
- Watt: SI unit of power.
- Pascal: SI unit of pressure.

Final Answer: The SI unit of work and energy is the joule $\Rightarrow \boxed{\text{C}}$

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 built by combining these is a derived quantity.

Step 1 — Test each option: Time, mass and temperature are each one of the seven fundamental quantities.

Step 2 — Identify the derived quantity: Area = length × length, so it is built from a base quantity 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: Area 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 $\frac{1000}{3600} = \frac{5}{18}$.

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

Step 2 — Substitute the value: Speed $= 36 \times \frac{5}{18}$ m/s.

Step 3 — Simplify: $36 \div 18 = 2$, then $2 \times 5 = 10$. So speed $= 10$ m/s.

Why other options are wrong:

- 6 m/s divides by 6 instead of using the correct factor.
- 36 m/s leaves the value unchanged.
- 20 m/s uses double the correct factor.

Final Answer: 36 km/h $= 10$ m/s $\Rightarrow \boxed{\text{B}}$

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. For a vernier callipers it equals one main-scale division minus one vernier-scale division.

Step 1 — Recall the standard value: For an ordinary vernier callipers, 1 main-scale division $= 1$ mm and 10 vernier divisions cover 9 mm.

Step 2 — Compute: Least count $= 1$ mm $- \frac{9}{10}$ mm $= 0.1$ mm $= 0.01$ cm.

Why other options are wrong:

- 1 mm is the least count of an ordinary metre scale.
- 1 cm is far too large for any precision instrument.
- 0.001 mm is finer than a callipers can read.

Final Answer: Least count of vernier callipers $= 0.01$ cm $\Rightarrow \boxed{\text{D}}$

Answer: (D) 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: $u = 0$ (starts from rest), $a = 2$ m/s^2, $t = 3$ s.

Step 2 — Substitute: $s = (0 \times 3) + \frac{1}{2} \times 2 \times 3^2$.

Step 3 — Square the time: $3^2 = 9$.

Step 4 — Compute: $s = \frac{1}{2} \times 2 \times 9 = 9$ m.

Why other options are wrong:

- 18 m forgets the factor $\frac{1}{2}$.
- 6 m uses t instead of t^2.
- 12 m uses a wrong product.

Final Answer: Distance covered $= 9$ m $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q5

Q6.

Solution

Concept — Distance–time graph: On a distance–time graph the slope gives the speed. A straight line means the slope is constant.

Step 1 — Read the graph: The graph is a straight line passing through the origin, so equal distances are covered in equal intervals of time.

Step 2 — Interpret the slope: A constant slope means the speed does not change, i.e. the body moves with uniform (constant) speed.

Why other options are wrong:

- Uniform acceleration would give a curved distance–time graph.
- Continuously increasing speed would also curve upward.
- A body at rest would give a horizontal line.

Final Answer: The body moves with uniform speed $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q6

Q7.

Solution

Concept — Newton's second law: The net force on a body equals the rate of change of its momentum, $F = \dfrac{\Delta p}{\Delta t}$.

Step 1 — State the law: Force is directly proportional to the rate of change of momentum and acts in the direction of that change.

Step 2 — Connect to $F = ma$: For constant mass, $\dfrac{\Delta p}{\Delta t} = m\dfrac{\Delta v}{\Delta t} = ma$, which is the familiar form.

Why other options are wrong:

- Force is not proportional to velocity itself.
- Force is not proportional to displacement.
- Force depends on both mass and acceleration, not on mass alone.

Final Answer: Force $\propto$ rate of change of momentum $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q7

Q8.

Solution

Concept — Newton's second law: The force on a body is $F = m \times a$.

Step 1 — List the data: $m = 4$ kg, $a = 3$ m/s^2.

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

Step 3 — Compute: $F = 12$ N.

Why other options are wrong:

- 7 N adds mass and acceleration.
- 1.33 N divides mass by acceleration.
- 24 N multiplies by an extra factor of 2.

Final Answer: Force $= 12$ N $\Rightarrow \boxed{\text{C}}$

Answer: (C) 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 two different bodies.

Step 1 — Apply to rowing: The oars push the water backward (action), and the water pushes the boat forward with an equal and opposite force (reaction).

Step 2 — Confirm the pair: The backward force on the water and the forward force on the boat form an action–reaction pair.

Why other options are wrong:

- A freely falling stone illustrates gravity.
- A car speeding up illustrates the second law.
- A spinning top illustrates rotational motion, not action–reaction.

Final Answer: Rowing a boat illustrates the third law $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q9

Q10.

Solution

Concept — Impulse: Impulse equals the product of force and the time for which it acts, $J = F \times t$. Its unit is the newton-second (N s).

Step 1 — List the data: $F = 10$ N, $t = 2$ s.

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

Step 3 — Compute: $J = 20$ N s.

Why other options are wrong:

- 5 N s divides force by time.
- 12 N s adds force and time.
- 0.2 N s divides time by force.

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

Answer: (D) Go Back to Q10

Q11.

Solution

Concept — Distance and displacement: Displacement is the straight-line distance from the start point to the end point, measured in a particular direction.

Step 1 — Locate start and end: The athlete runs once around the circular track and returns to the same starting point.

Step 2 — Find the displacement: Since the final position coincides with the initial position, the displacement is zero.

Step 3 — Compare with distance: The distance travelled is the full circumference $2\pi r$, but displacement is still zero.

Why other options are wrong:

- $2\pi r$ is the distance, not the displacement.
- r and πr do not correspond to a complete loop returning to the start.

Final Answer: Displacement $=$ zero $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q11

Q12.

Solution

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

Step 1 — List the data: $F = 15$ N, $s = 4$ m.

Step 2 — Substitute: $W = 15 \times 4$.

Step 3 — Compute: $W = 60$ J.

Why other options are wrong:

- 19 J adds force and distance.
- 3.75 J divides force by distance.
- 11 J subtracts the values.

Final Answer: Work done $= 60$ 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: $m = 4$ kg, $v = 2$ m/s.

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

Step 3 — Substitute and compute: $KE = \frac{1}{2} \times 4 \times 4 = 8$ J.

Why other options are wrong:

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

Final Answer: Kinetic energy $= 8$ 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: $m = 3$ kg, $g = 10$ m/s^2, $h = 10$ m.

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

Step 3 — Compute: $PE = 300$ J.

Why other options are wrong:

- 30 J and 150 J leave out a factor.
- 13 J adds the values instead of multiplying.

Final Answer: Potential energy $= 300$ 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: $W = 600$ J, $t = 20$ s.

Step 2 — Substitute: $P = \dfrac{600}{20}$.

Step 3 — Compute: $P = 30$ W.

Why other options are wrong:

- 12000 W multiplies instead of dividing.
- 620 W adds the values.
- 0.03 W inverts the ratio.

Final Answer: Power $= 30$ W $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q15

Q16.

Solution

Concept — Commercial unit of electrical energy: Although the SI unit of energy is the joule, electricity boards measure consumption in a larger, more practical unit.

Step 1 — Define the unit: One kilowatt-hour (kWh) is the energy used by a 1 kilowatt appliance running for 1 hour.

Step 2 — Relate to the joule: 1 kWh $= 1000$ W $\times$ 3600 s $= 3.6 \times 10^6$ J, which is the "unit" on an electricity bill.

Why other options are wrong:

- Watt is the unit of power, not energy.
- Joule is the SI unit but is too small for billing.
- Volt is the unit of potential difference.

Final Answer: The commercial unit is the kilowatt-hour $\Rightarrow \boxed{\text{C}}$

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: $m = 8$ kg, $g = 10$ m/s^2.

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

Step 3 — Compute: $W = 80$ N.

Why other options are wrong:

- 8 N is the mass value, not the weight.
- 0.8 N divides instead of multiplying.
- 800 N multiplies by an extra factor of 10.

Final Answer: Weight $= 80$ N $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q17

Q18.

Solution

Concept — Acceleration due to gravity: Near the Earth's surface, every freely falling body speeds up at a fixed rate g.

Step 1 — Recall the standard value: The accepted value of g near the Earth's surface is about 9.8 m/s^2.

Step 2 — Note the approximation: For quick calculations it is often rounded to 10 m/s^2.

Why other options are wrong:

- 8.9 m/s^2 reverses the digits.
- 98 m/s^2 is ten times too large.
- 0.98 m/s^2 is ten times too small.

Final Answer: $g \approx 9.8$ m/s$^2 \Rightarrow \boxed{\text{B}}$

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, $t = 2$ s.

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

Step 3 — Compute: $v = 20$ m/s.

Why other options are wrong:

- 5 m/s divides instead of multiplying.
- 40 m/s multiplies by an extra factor of 2.
- 10 m/s is only the value of g.

Final Answer: Velocity after 2 s = 20 m/s $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q19

Q20.

Solution

Concept — Mass versus weight: Mass is the amount of matter in a body and does not depend on location. Weight is the gravitational force on the body and changes with g.

Step 1 — Test weight: Weight $= mg$ changes when g changes, so it differs on the Earth, the Moon and in space.

Step 2 — Test mass: The amount of matter stays the same everywhere, so mass is unchanged.

Why other options are wrong:

- Weight depends on the local gravity.
- Gravitational force on the body changes with location.
- The acceleration due to gravity differs from place to place.

Final Answer: Mass remains the same everywhere $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q20

Q21.

Solution

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

Step 1 — List the data: $F = 10$ N, $d = 0.4$ m.

Step 2 — Substitute: moment $= 10 \times 0.4$.

Step 3 — Compute: moment $= 4$ N m.

Why other options are wrong:

- 25 N m divides force by distance.
- 0.04 N m divides by an extra factor of 100.
- 14 N m adds force and distance.

Final Answer: Moment of the force $= 4$ N m $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q21

Q22.

Solution

Concept — Principle of moments: A body is in rotational equilibrium when the total clockwise moment about the pivot equals the total anticlockwise moment.

Step 1 — Apply to the seesaw: A balanced seesaw is in rotational equilibrium, so the moments on the two sides must be equal.

Step 2 — State the condition: Clockwise moment = anticlockwise moment.

Why other options are wrong:

- The total weight on the two sides need not be zero.
- If the clockwise moment were greater, the seesaw would not balance.
- A heavier child can still balance a lighter one by sitting closer to the pivot.

Final Answer: Clockwise moment = anticlockwise moment $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q22

Q23.

Solution

Concept — Simple harmonic motion: In SHM the speed is greatest where the displacement is least and zero where the displacement is greatest.

Step 1 — Locate maximum speed: At the mean (equilibrium) position the displacement is zero and all the energy is kinetic, so the speed is maximum.

Step 2 — Locate minimum speed: At the extreme positions the body momentarily stops, so the speed there is zero.

Why other options are wrong:

- At the extreme position the speed is zero.
- Midway the speed is between zero and maximum.
- The speed is not constant in SHM.

Final Answer: Speed is maximum at the mean position $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q23

Q24.

Solution

Concept — Oscillation: A complete to-and-fro movement of a vibrating body about its mean position is the basic repeating unit of its motion.

Step 1 — Define one cycle: When the body moves from the mean position to one extreme, back through the mean to the other extreme, and returns to the mean, it has completed one full cycle.

Step 2 — Name it: This one complete cycle is called one oscillation (or one vibration).

Why other options are wrong:

- Wavelength is a length, not a motion.
- Amplitude is the maximum displacement.
- Frequency is the number of oscillations per second.

Final Answer: One complete to-and-fro motion is one oscillation $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q24

Q25.

Solution

Concept — Celsius to Kelvin: To convert a Celsius temperature into kelvin, add 273: $T(\mathrm{K}) = t(^\circ\mathrm{C}) + 273$.

Step 1 — List the data: $t = 27\,^\circ$C.

Step 2 — Substitute: $T = 27 + 273$.

Step 3 — Compute: $T = 300$ K.

Why other options are wrong:

- 246 K subtracts 27 instead of adding.
- 27 K leaves the value unchanged.
- 273 K forgets to add the 27.

Final Answer: $27\,^\circ\mathrm{C} = 300\ \mathrm{K} \Rightarrow \boxed{\mathrm{A}}$

Answer: (A) 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: $m = 2$ kg, $c = 900\ \mathrm{J\,kg^{-1}\,^\circ C^{-1}}$, $\Delta T = 5\,^\circ$C.

Step 2 — Substitute: $Q = 2 \times 900 \times 5$.

Step 3 — Multiply step by step: $2 \times 900 = 1800$, then $1800 \times 5 = 9000$.

Step 4 — State the result: $Q = 9000$ J.

Why other options are wrong:

- 4500 J uses half the mass.
- 18000 J uses double the temperature change.
- 1800 J leaves out the temperature change.

Final Answer: Heat required $= 9000\ \mathrm{J} \Rightarrow \boxed{\mathrm{B}}$

Answer: (B) Go Back to Q26

Q27.

Solution

Concept — Modes of heat transfer: Heat travels by conduction, convection or radiation. Convection involves the bulk movement of heated particles of a fluid.

Step 1 — Identify the process: When a fluid is heated, the warmer, lighter portion rises and the cooler portion sinks, setting up circulating currents that carry heat.

Step 2 — Name it: This transfer by the actual movement of heated particles is called convection, and it occurs mainly in liquids and gases.

Why other options are wrong:

- Conduction transfers heat through a solid without bulk movement.
- Radiation needs no medium at all.
- Reflection is a property of light and sound, not a mode of heat flow.

Final Answer: The process is convection $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q27

Q28.

Solution

Concept — Specific heat capacity: It measures how much heat a unit mass of a substance needs for a unit rise in temperature.

Step 1 — State the definition: The heat required to raise the temperature of 1 kg of a substance by $1\,^\circ\text{C}$ is its specific heat capacity.

Step 2 — Note the unit: Its SI unit is $\text{J}\,\text{kg}^{-1}\,^\circ\text{C}^{-1}$.

Why other options are wrong:

- Latent heat is the heat for a change of state at constant temperature.
- Heat capacity refers to the whole body, not unit mass.
- Thermal conductivity describes how well a material conducts heat.

Final Answer: The quantity is specific heat capacity $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q28

Q29.

Solution

Concept — Convection in nature: Land and sea breezes are caused by the uneven heating of land and water, which sets up convection currents in the air.

Step 1 — Describe the day-time situation: During the day the land heats faster than the sea, so the warm air over the land rises.

Step 2 — Trace the breeze: Cooler air from over the sea moves in to take its place, giving the sea breeze. This air movement is convection.

Why other options are wrong:

- Conduction does not move air over large distances.
- Radiation does not require the bulk flow of air seen here.
- Reflection is not a mode of heat transfer.

Final Answer: A sea breeze is an example of convection $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q29

Q30.

Solution

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

Step 1 — Read the data: The angle of incidence is 45° from the normal.

Step 2 — Apply the law: Angle of reflection $=$ angle of incidence $= 45^\circ$.

Why other options are wrong:

- 90° would mean the reflected ray runs along the mirror.
- 0° would require the ray to strike along the normal.
- 22.5° halves the angle, which is not what the law says.

Final Answer: Angle of reflection $= 45^\circ \Rightarrow \boxed{B}$

Answer: (B) Go Back to Q30

Q31.

Solution

Concept — Image in a plane mirror: A plane mirror forms an image that is virtual, erect, the same size as the object, and laterally inverted, located as far behind the mirror as the object is in front.

Step 1 — Check whether it is real or virtual: The reflected rays only appear to come from behind the mirror, so the image is virtual.

Step 2 — Check the size and orientation: The image is the same size as the object and is erect (upright).

Why other options are wrong:

- A plane mirror cannot form a real image.
- The image is neither diminished nor magnified.
- The image is erect, not inverted.

Final Answer: The image is virtual, erect and of the same size $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q31

Q32.

Solution

Concept — Image in a convex mirror: A convex mirror always forms a virtual, erect and diminished image, whatever the position of the object.

Step 1 — Trace the rays: The reflected rays diverge, so they only appear to meet behind the mirror, giving a virtual image.

Step 2 — Note size and orientation: The image is smaller than the object (diminished) and erect, which is why convex mirrors give a wide field of view.

Why other options are wrong:

- A convex mirror never forms a real, magnified image.
- It does not form a real, same-size image.
- The image is erect, not inverted.

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

Answer: (D) Go Back to Q32

Q33.

Solution

Concept — Sign of magnification: For mirrors, $m = -\frac{v}{u}$. The sign of m tells whether the image is erect or inverted.

Step 1 — Interpret a negative m: A negative magnification means the image height has the opposite sign to the object height, so the image is inverted.

Step 2 — Link to image type: An inverted image formed by a mirror is a real image.

Why other options are wrong:

- A virtual, erect image corresponds to a positive m.
- An image at infinity is a special limiting case, not implied by a negative m.
- A negative m does not, by itself, mean the image is the same size.

Final Answer: A negative m means the image is real and inverted $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q33

Q34.

Solution

Concept — Refractive index: The refractive index is $n = \frac{c}{v}$, the ratio of the speed of light in vacuum to its speed in the medium.

Step 1 — Rearrange: From $n = \frac{c}{v}$ we get $v = \frac{c}{n}$.

Step 2 — Interpret: A denser medium has a larger n, so $v = \frac{c}{n}$ is smaller. Hence light travels more slowly in a denser medium, which is why it bends towards the normal on entering glass.

Why other options are wrong:

- Light does not speed up in a denser medium.
- Its speed is not the same in all media.
- Light can bend at the surfaces, so it does not stay in one straight line throughout.

Final Answer: Light travels slower in a denser medium $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q34

Q35.

Solution

Concept — Convex lens: A convex lens is thicker in the middle and converges light.

Step 1 — Trace a parallel beam: Rays of light parallel to the principal axis are bent inward by the lens.

Step 2 — Locate the meeting point: These refracted rays meet at the principal focus, so the lens brings a parallel beam to a focus.

Why other options are wrong:

- A concave lens spreads out a parallel beam, not a convex lens.
- A convex lens can form a real image for many object positions.
- A convex lens has a positive focal length.

Final Answer: A convex lens brings a parallel beam to a focus $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q35

Q36.

Solution

Concept — Formation of a rainbow: A rainbow forms when sunlight interacts with tiny water droplets in the air after rain.

Step 1 — Light enters a droplet: Sunlight is refracted as it enters a droplet and splits into its colours (dispersion).

Step 2 — Light reflects and leaves: The separated colours are internally reflected at the back of the droplet and refracted again on leaving, sending the spread-out colours to the observer.

Why other options are wrong:

- Reflection alone cannot separate white light into colours.
- Refraction alone, without internal reflection, does not give the rainbow pattern.
- Absorption would remove light, not produce colours.

Final Answer: A rainbow is due to dispersion and internal reflection in water droplets $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q36

Q37.

Solution

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

Step 1 — List the data: $f = 500$ Hz, $\lambda = 0.6$ m.

Step 2 — Substitute: $v = 500 \times 0.6$.

Step 3 — Compute: $v = 300$ m/s.

Why other options are wrong:

- 833 m/s divides frequency by wavelength.
- 500.6 m/s adds the two values.
- 0.0012 m/s divides wavelength by frequency.

Final Answer: Speed of the wave $= 300$ m/s $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q37

Q38.

Solution

Concept — Transverse waves: In a transverse wave the particles of the medium vibrate at right angles to the direction in which the wave travels, producing crests and troughs.

Step 1 — Read the figure: The figure shows alternate high points (crests) and low points (troughs), which are the signature of a transverse wave.

Step 2 — Identify the wave: A wave with crests and troughs, with particles moving up and down, is a transverse wave.

Why other options are wrong:

- A longitudinal wave has compressions and rarefactions, not crests and troughs.
- Sound in air is longitudinal, not transverse.
- A compressional wave is just another name for a longitudinal wave.

Final Answer: A wave with crests and troughs is a transverse wave $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q38

Q39.

Solution

Concept — SONAR: SONAR (Sound Navigation And Ranging) sends out high-frequency sound and listens for the echo to find distances under water.

Step 1 — Identify the waves: SONAR uses ultrasonic waves, whose frequency is above 20 kHz, because they travel in well-defined beams and reflect clearly from objects.

Step 2 — Use the echo: The time taken for the echo to return gives the depth of the sea, using distance $= \dfrac{v \times t}{2}$.

Why other options are wrong:

- Infrared and radio waves are electromagnetic, and radio does not travel well in water for this use.
- Ordinary audible sound spreads out too much for accurate ranging.

Final Answer: SONAR uses ultrasonic waves $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q39

Q40.

Solution

Concept — Audible range: The human ear can detect sound only within a fixed band of frequencies.

Step 1 — State the lower limit: The lowest frequency a normal ear can hear is about 20 Hz.

Step 2 — State the upper limit: The highest frequency is about $20{,}000$ Hz (20 kHz). So the audible range is 20 Hz to $20{,}000$ Hz.

Why other options are wrong:

- 2 Hz to 200 Hz lies partly in the infrasonic (inaudible) region.
- 200 Hz to 2000 Hz is only a part of the full range.
- 20 kHz to 200 kHz is the ultrasonic (inaudible) region.

Final Answer: Audible range $= 20$ Hz to $20{,}000$ Hz $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q40

Q41.

Solution

Concept — Ohm's law: The potential difference across a resistor is $V = I \times R$.

Step 1 — List the data: $I = 3$ A, $R = 4\,\Omega$.

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

Step 3 — Compute: $V = 12$ V.

Why other options are wrong:

- 0.75 V divides current by resistance.
- 7 V adds current and resistance.
- 1.33 V divides resistance by current.

Final Answer: Potential difference $= 12$ V $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q41

Q42.

Solution

Concept — Resistors 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 data: $R_1 = 1\,\Omega$, $R_2 = 2\,\Omega$, $R_3 = 3\,\Omega$.

Step 2 — Add them: $R = 1 + 2 + 3$.

Step 3 — Compute: $R = 6\,\Omega$.

Why other options are wrong:

- $0.55\,\Omega$ uses the parallel formula.
- $1\,\Omega$ takes only the smallest resistor.
- $11\,\Omega$ adds an extra value.

Final Answer: Equivalent resistance $= 6\,\Omega \Rightarrow \boxed{C}$

Answer: (C) Go Back to Q42

Q43.

Solution

Concept — Resistors in parallel: For two equal resistors in parallel, $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$.

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

Step 2 — Add the reciprocals: $\frac{1}{R} = \frac{1}{4} + \frac{1}{4} = \frac{2}{4}$.

Step 3 — Simplify: $\frac{1}{R} = \frac{1}{2}$.

Step 4 — Invert: $R = 2\,\Omega$.

Why other options are wrong:

- $8\,\Omega$ adds the resistances as if in series.
- $4\,\Omega$ ignores the parallel combination.
- $16\,\Omega$ multiplies the two values.

Final Answer: Equivalent resistance $= 2\,\Omega \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q43

Q44.

Solution

Concept — Electric power: The power dissipated in a resistor is $P = I^2R$.

Step 1 — List the data: $I = 2$ A, $R = 5\,\Omega$.

Step 2 — Square the current: $I^2 = 2^2 = 4$.

Step 3 — Substitute and compute: $P = 4 \times 5 = 20$ W.

Why other options are wrong:

- 10 W uses I instead of I^2.
- 40 W doubles the correct value.
- 100 W squares the whole product wrongly.

Final Answer: Power dissipated $= 20$ 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 low-resistance path.

Step 1 — Describe a fault: If the live wire accidentally touches the metal body, the body would become live and dangerous.

Step 2 — Role of earthing: The earth wire carries this leakage current safely to the ground, keeping the body at a safe potential and protecting the user from electric shock.

Why other options are wrong:

- Earthing does not increase the current to the appliance.
- It does not supply power to the appliance.
- It does not change the supply voltage.

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

Answer: (A) Go Back to Q45

Q46.

Solution

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

Step 1 — Fix the other factors: The material (so ρ) and the cross-section A are stated to be fixed.

Step 2 — Examine the dependence on length: With ρ and A fixed, R is directly proportional to L. Doubling the length doubles the resistance.

Why other options are wrong:

- Resistance is inversely proportional to area, not to length.
- Resistance does depend on length.
- Resistance varies as L, not as L^2.

Final Answer: Resistance is directly proportional to length $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q46

Q47.

Solution

Concept — Magnetic field of a straight wire: A current-carrying straight wire is surrounded by circular magnetic field lines, and a rule is needed to fix their direction.

Step 1 — State the rule: The right-hand thumb rule says that if the thumb of the right hand points along the current, the curled fingers show the direction of the circular field lines.

Step 2 — Apply it: For the wire shown perpendicular to the page, this rule gives the sense (clockwise or anticlockwise) of the field circles.

Why other options are wrong:

- Fleming's left-hand rule gives the force on a current in a field, not the field of a wire.
- Ohm's law relates voltage and current, not field direction.
- Newton's third law is about action and reaction forces.

Final Answer: The right-hand thumb rule gives the field direction $\Rightarrow \boxed{\text{C}}$

$\boxed{\text{Answer: (C)}}$ Go Back to Q47

Q48.

Solution

Concept — Uses of electromagnets: An electromagnet is a temporary magnet whose magnetism can be switched on and off with the current. This makes it ideal for lifting magnetic materials.

Step 1 — Switch on: When the current is on, the crane's electromagnet becomes strongly magnetic and grips heavy iron and steel scrap.

Step 2 — Switch off: When the current is turned off, the magnetism disappears and the load is released. So electromagnets are used to lift and move heavy iron and steel.

Why other options are wrong:

- An electromagnet does not generate electricity by itself.
- It is not a current-measuring instrument.
- It does not store electric charge.

Final Answer: Crane electromagnets lift heavy iron and steel $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q48

Q49.

Solution

Concept — Field inside a solenoid: A long current-carrying solenoid produces a magnetic field that is the same in strength and direction throughout its central region.

Step 1 — Examine the field lines: Inside the solenoid the field lines are straight, equally spaced and parallel to the axis.

Step 2 — Conclude: Equally spaced, parallel field lines mean the field is uniform and directed along the axis.

Why other options are wrong:

- The field inside is not zero; it is strong and steady.
- The field is strong (not zero) at the centre and along the length.
- The field lines inside run along the axis, not in circles.

Final Answer: The field inside is uniform and along the axis $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q49

Q50.

Solution

Concept — Electric generator: A generator (dynamo) works on electromagnetic induction, in which a moving coil in a magnetic field produces a current.

Step 1 — Trace the input: An external agent rotates the coil in a magnetic field, supplying mechanical energy.

Step 2 — State the conversion: The changing magnetic flux induces an electric current, so the generator converts mechanical energy into electrical energy.

Why other options are wrong:

- Converting electrical into mechanical energy describes a motor.
- Heat-to-electrical describes a thermocouple.
- Chemical-to-electrical describes a cell or battery.

Final Answer: A generator converts mechanical energy into electrical energy $\Rightarrow \boxed{\text{A}}$

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