Jharkhand Polytechnic Physics

Sample Paper – 5

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 frequency is the:

(A) watt

(B) hertz

(C) joule

(D) newton

Q2. Which of the following is a base (fundamental) physical quantity?

(A) force

(B) area

(C) speed

(D) temperature

Q3. A cyclist moves with a speed of 18 km/h. Its speed in metre per second is:

(A) 5 m/s

(B) 10 m/s

(C) 18 m/s

(D) 3.6 m/s

Q4. The prefix *milli* stands for a factor of:

(A) 10^3

(B) 10^{-6}

(C) 10^{-3}

(D) 10^{-2}

Q5. A car moving at 20 m/s is brought to rest in 4 seconds by applying brakes. Its acceleration is:

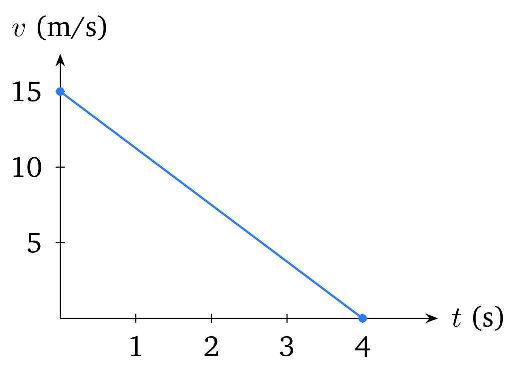
(A) $+5$ m/s^2

(B) -4 m/s^2

(C) -5 m/s^2

(D) -80 m/s^2

Q6. The velocity–time graph of a moving body is shown below. The graph represents:



(A) uniform retardation (deceleration)

(B) uniform acceleration

(C) constant velocity

(D) a body permanently at rest

Q7. A book lies at rest on a table and does not move on its own. This is because:

(A) no force at all acts on the book

(B) only the weight acts on the book

(C) the table exerts no force on the book

(D) the forces acting on the book are balanced

Q8. A force of 15 N acts on a body of mass 3 kg. The acceleration produced in the body is:

(A) 45 m/s^2

(B) 5 m/s^2

(C) 0.2 m/s^2

(D) 18 m/s^2

Q9. A swimmer pushes the water backward with the hands and moves forward. This is an example of:

(A) Newton's third law of motion

(B) Newton's first law of motion

(C) the law of conservation of energy

(D) the law of inertia of rest

Q10. The velocity of a body of mass 2 kg increases from 3 m/s to 8 m/s. The change in its momentum is:

(A) 22 kg m/s

(B) 16 kg m/s

(C) 10 kg m/s

(D) 6 kg m/s

Q11. Which one of the following statements about speed and velocity is correct?

(A) both speed and velocity are vector quantities

(B) both speed and velocity are scalar quantities

(C) speed is a vector and velocity is a scalar

(D) speed is a scalar quantity while velocity is a vector quantity

Q12. A force of 12 N pushes a body through a distance of 3 m in the direction of the force. The work done is:

(A) 4 J

(B) 36 J

(C) 15 J

(D) 9 J

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

(A) 12 J

(B) 24 J

(C) 6 J

(D) 18 J

Q14. A body of mass 2 kg is lifted to a height of 8 m. The gravitational potential energy gained by it is:

(A) 80 J

(B) 100 J

(C) 160 J

(D) 20 J

Q15. A pump does 150 J of work in 3 seconds. The power of the pump is:

(A) 450 W

(B) 50 W

(C) 0.02 W

(D) 153 W

Q16. When an electric fan is switched on and runs, it converts:

(A) mechanical energy into electrical energy

(B) electrical energy into heat energy only

(C) electrical energy into sound energy only

(D) electrical energy into mechanical energy

Q17. The weight of an object of mass 2.5 kg on the surface of the Earth is:

(A) 25 N

(B) 2.5 N

(C) 0.25 N

(D) 250 N

Q18. The acceleration due to gravity on the surface of the Moon is about _____ of that on the surface of the Earth.

(A) six times

(B) one-sixth

(C) equal to

(D) one-third

Q19. A stone is dropped from rest and falls freely for 1 second. The distance it falls is (take $g = 10$ m/s^2):

(A) 10 m

(B) 20 m

(C) 5 m

(D) 2.5 m

Q20. Which one of the following statements about the units of mass and weight is correct?

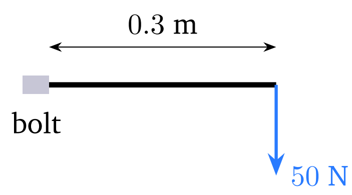
(A) both mass and weight are measured in kilogram

(B) both mass and weight are measured in newton

(C) mass is measured in newton and weight in kilogram

(D) mass is measured in kilogram and weight in newton

Q21. A force of 50 N is applied at the end of a spanner at a perpendicular distance of 0.3 m from a bolt, as shown. The moment of the force about the bolt is:



(A) 16.7 N m

(B) 15 N m

(C) 150 N m

(D) 0.006 N m

Q22. A body that is free to rotate is in rotational equilibrium when:

(A) the sum of the clockwise moments equals the sum of the anticlockwise moments

(B) the total force acting on it is maximum

(C) the clockwise moment is greater than the anticlockwise moment

(D) all the moments simply add up to a large value

Q23. In simple harmonic motion, the acceleration of the particle is zero at the:

(A) extreme position

(B) position midway between mean and extreme

(C) mean (equilibrium) position

(D) it is never zero anywhere

Q24. A simple pendulum completes one oscillation in a time period of 0.5 s. Its frequency is:

(A) 0.5 Hz

(B) 5 Hz

(C) 50 Hz

(D) 2 Hz

Q25. The temperature of a body is 310 K. Its value on the Celsius scale is:

(A) $37\,°$C

(B) $583\,°$C

(C) $273\,°$C

(D) $310\,°$C

Q26. When 8400 J of heat is supplied to 1 kg of water, the rise in its temperature is (specific heat of water $= 4200\ \mathrm{J\,kg^{-1}\,°C^{-1}}$):

(A) $4\,°$C

(B) $2\,°$C

(C) $0.5\,°$C

(D) $8400\,°$C

Q27. Which mode of heat transfer can take place even through a vacuum (empty space)?

(A) conduction

(B) convection

(C) both conduction and convection

(D) radiation

Q28. Water has its maximum density at a temperature of:

(A) $0\,^{\circ}\mathrm{C}$

(B) $100\,^{\circ}\mathrm{C}$

(C) $4\,^{\circ}\mathrm{C}$

(D) $-4\,^{\circ}\mathrm{C}$

Q29. While ice is melting into water, the temperature of the ice–water mixture:

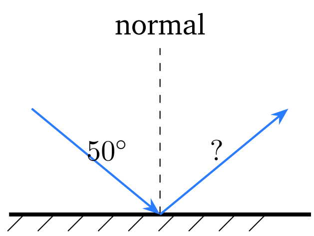
(A) remains constant

(B) increases steadily

(C) decreases steadily

(D) first rises and then falls

Q30. A ray of light strikes a plane mirror making an angle of incidence of 50° with the normal, as shown. The angle of reflection is:



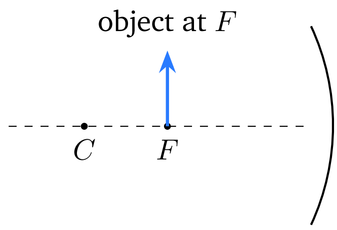
(A) 40°

(B) 50°

(C) 100°

(D) 0°

Q31. An object is placed exactly at the focus (F) of a concave mirror, as shown. The image is formed:



(A) at the focus F

(B) at the centre of curvature C

(C) behind the mirror

(D) at infinity

Q32. A convex mirror is preferred as a rear-view (side) mirror in vehicles because it:

(A) always forms a real image of the traffic

(B) magnifies the vehicles behind

(C) forms an erect, diminished image and gives a wide field of view

(D) makes objects appear closer than they really are

Q33. An object is placed 15 cm in front of a concave mirror of focal length 10 cm. Using the mirror formula, the image distance is:

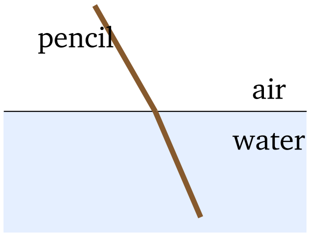
(A) -30 cm

(B) -15 cm

(C) $+30$ cm

(D) -6 cm

Q34. A straight pencil partly dipped in a glass of water appears bent at the water surface, as shown. This happens because of the:



(A) reflection of light

(B) refraction of light

(C) dispersion of light

(D) scattering of light

Q35. A convex lens forms the image of a very distant object, such as the Sun. The sharp image is formed at the:

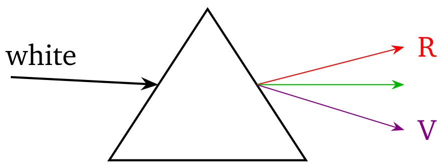
(A) optical centre of the lens

(B) twice the focal length of the lens

(C) focus of the lens

(D) infinity

Q36. When a beam of white light passes through a glass prism it spreads into seven colours, as shown. The colour that bends (deviates) the most is:



(A) red

(B) yellow

(C) green

(D) violet

Q37. A sound wave travels with a speed of 300 m/s and has a wavelength of 0.5 m. Its frequency is:

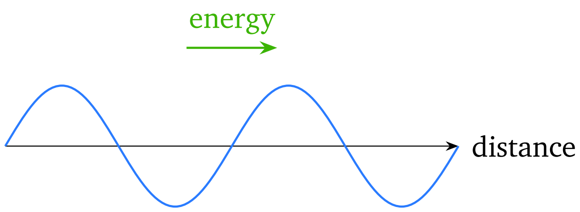
(A) 600 Hz

(B) 150 Hz

(C) 60 Hz

(D) 300 Hz

Q38. When a wave travels through a medium, as shown below, it transfers:



(A) matter only, from one place to another

(B) both matter and energy together

(C) energy without the bulk transfer of matter

(D) neither energy nor matter

Q39. The repeated reflection of sound that causes it to persist in a large hall even after the source has stopped is called:

(A) an echo

(B) reverberation

(C) resonance

(D) refraction

Q40. Sound waves of frequency above 20,000 Hz, which are used in medical imaging (sonography), are called:

(A) infrasound

(B) audible sound

(C) supersonic waves

(D) ultrasound

Q41. A current of 0.5 A flows through a resistor of resistance $20\,\Omega$. The potential difference across the resistor is:

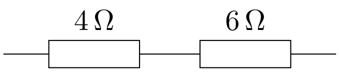
(A) 10 V

(B) 40 V

(C) 2.5 V

(D) 19.5 V

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



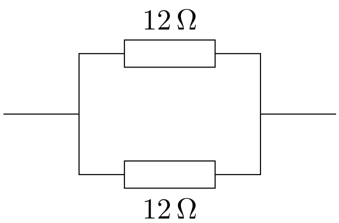
(A) $2.4\,\Omega$

(B) $5\,\Omega$

(C) $10\,\Omega$

(D) $24\,\Omega$

Q43. Two resistors, each of $12\,\Omega$, are connected in parallel, as shown. Their equivalent resistance is:



(A) $24\,\Omega$

(B) $6\,\Omega$

(C) $12\,\Omega$

(D) $144\,\Omega$

Q44. A current of 3 A flows through a resistor of resistance $2\,\Omega$. The electrical power dissipated in the resistor is:

(A) 36 W

(B) 12 W

(C) 6 W

(D) 18 W

Q45. An electric fuse protects a household circuit because it:

(A) increases the current in the circuit

(B) stores electric charge during use

(C) melts and breaks the circuit when the current exceeds a safe value

(D) reduces the supply voltage to the appliances

Q46. Which one of the following statements about the resistivity (specific resistance) of a conductor is correct?

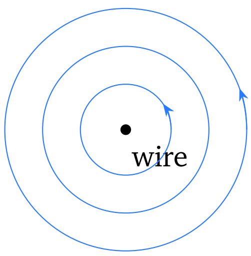
(A) it depends only on the material and its temperature, not on the dimensions of the wire

(B) it depends on the length of the wire

(C) it depends on the area of cross-section of the wire

(D) it has the same value for every material

Q47. The magnetic field lines around a long straight current-carrying wire are concentric circles, as shown. The magnetic field is strongest:



(A) far away from the wire

(B) close to the wire, where the circles are crowded together

(C) the same at every distance from the wire

(D) only exactly along the wire

Q48. In which one of the following devices is an electromagnet used?

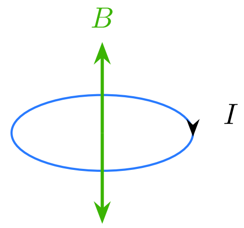
(A) a torch bulb

(B) a dry cell

(C) a mercury thermometer

(D) an electric bell

Q49. A circular loop carries a steady current I, as shown. At the centre of the loop, the magnetic field lines are:



(A) small circles, like those around a straight wire

(B) exactly zero

(C) straight and directed perpendicular to the plane of the loop

(D) lying flat in the plane of the loop

Q50. Fleming's right-hand rule is used to find the direction of the induced current in:

(A) an electric generator

(B) an electric motor

(C) a step-up transformer

(D) a simple battery cell

Detailed Solutions

Q1.

Solution

Concept — Frequency and its unit: Frequency is the number of oscillations (or cycles) completed in one second. Its SI unit is therefore "per second".

Step 1 — Build the unit: Frequency $= \dfrac{\text{number of cycles}}{\text{time in seconds}}$, so its unit is s^{-1} (one cycle per second).

Step 2 — Name the unit: This unit of one cycle per second is given the special name **hertz (Hz)**, after Heinrich Hertz.

Why other options are wrong:

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

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

Answer: (B) Go Back to Q1

Q2.

Solution

Concept — Fundamental quantities: The seven fundamental (base) quantities are length, mass, time, electric current, temperature, amount of substance and luminous intensity. Every other quantity is derived from these.

Step 1 — Test each option: Force, area and speed are all obtained by combining base quantities, so they are derived quantities.

Step 2 — Identify the base quantity: Among the choices, only **temperature** is one of the seven fundamental quantities.

Why other options are wrong:

- Force $=$ mass $\times$ acceleration (derived).
- Area $=$ length $\times$ length (derived).
- Speed $=$ distance / time (derived).

Final Answer: Temperature is the fundamental quantity $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q2

Q3.

Solution

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

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

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

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

Why other options are wrong:

- 10 and 3.6 come from using a wrong conversion factor.
- 18 is just the original number in km/h, not the converted value.

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

Answer: (A) Go Back to Q3

Q4.

Solution

Concept — Metric prefixes: A prefix placed before a unit multiplies it by a power of ten. The prefix *milli* means one-thousandth.

Step 1 — Recall the meaning: $\text{milli} = \frac{1}{1000}$.

Step 2 — Express as a power of ten: $\frac{1}{1000} = \frac{1}{10^3} = 10^{-3}$.

Why other options are wrong:

- 10^3 is the prefix kilo.
- 10^{-6} is the prefix micro.
- 10^{-2} is the prefix centi.

Final Answer: $\text{milli} = 10^{-3} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q4

Q5.

Solution

Concept — Equation of motion: For uniform acceleration, $v = u + at$. When a body slows down, the acceleration comes out negative (retardation).

Step 1 — List the data: $u = 20$ m/s, $v = 0$ (brought to rest), $t = 4$ s.

Step 2 — Rearrange the formula: $a = \dfrac{v-u}{t}$.

Step 3 — Substitute: $a = \dfrac{0-20}{4}$.

Step 4 — Compute: $a = \dfrac{-20}{4} = -5$ m/s^2.

Why other options are wrong:

- $+5$ has the wrong sign; the body is slowing down.
- -4 swaps the numbers wrongly.
- -80 multiplies instead of dividing.

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

Answer: (C) Go Back to Q5

Q6.

Solution

Concept — Velocity–time graph: On a v–t graph, a straight line that slopes downward means the velocity is decreasing at a steady rate.

Step 1 — Read the graph: The velocity starts at 15 m/s and falls steadily to 0 at $t = 4$ s.

Step 2 — Interpret the slope: The line is straight, so the rate of change of velocity is constant; the slope is negative, so the body is slowing down.

Step 3 — Name the motion: A constant rate of decrease of velocity is called uniform retardation (uniform deceleration).

Why other options are wrong:

- Uniform acceleration would slope upward.
- Constant velocity would be a horizontal line.
- A body at rest would lie along the time axis ($v = 0$).

Final Answer: The graph shows uniform retardation $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q6

Q7.

Solution

Concept — Newton's first law: A body stays at rest unless a net (unbalanced) external force acts on it.

Step 1 — Identify the forces: On the book act its weight (downward) and the normal reaction of the table (upward).

Step 2 — Compare them: These two forces are equal in size and opposite in direction, so they cancel out.

Step 3 — Conclude: The net force is zero, so the forces are balanced and the book stays at rest.

Why other options are wrong:

- Forces do act on the book; they are just balanced.
- Not only the weight acts; the table pushes up too.
- The table certainly exerts a normal force; otherwise the book would fall.

Final Answer: The book stays at rest because the forces are balanced $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q7

Q8.

Solution

Concept — Newton's second law: The acceleration of a body equals the net force divided by its mass, $a = \frac{F}{m}$.

Step 1 — List the data: $F = 15$ N, $m = 3$ kg.

Step 2 — Substitute: $a = \frac{15}{3}$.

Step 3 — Compute: $a = 5$ m/s^2.

Why other options are wrong:

- 45 multiplies force and mass.
- 0.2 divides mass by force.
- 18 adds force and mass.

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

$\boxed{\textbf{Answer: (B)}}$ 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 — Identify the action: The swimmer's hands push the water backward (action).

Step 2 — Identify the reaction: The water pushes the swimmer forward with an equal and opposite force (reaction).

Step 3 — Conclude: This forward push moves the swimmer ahead, which is a clear example of the third law.

Why other options are wrong:

- The first law deals with bodies at rest or in uniform motion.
- Conservation of energy is about energy changing form, not the push–pull pair.
- Inertia of rest describes a body resisting being set into motion.

Final Answer: A swimmer moving forward illustrates the third law $\Rightarrow \boxed{\text{A}}$

$\boxed{\textbf{Answer: (A)}}$ Go Back to Q9

Q10.

Solution

Concept — Change in momentum: Momentum $p = mv$, so the change in momentum is $\Delta p = m(v - u)$.

Step 1 — List the data: $m = 2$ kg, $u = 3$ m/s, $v = 8$ m/s.

Step 2 — Find the change in velocity: $v - u = 8 - 3 = 5$ m/s.

Step 3 — Substitute: $\Delta p = 2 \times 5$.

Step 4 — Compute: $\Delta p = 10$ kg m/s.

Why other options are wrong:

- 22 adds the velocities $(8 + 3)$ and then multiplies.
- 16 uses only the final velocity (2×8).
- 6 uses only the initial velocity (2×3).

Final Answer: Change in momentum $= 10$ kg m/s $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q10

Q11.

Solution

Concept — Scalars and vectors: A scalar has only magnitude, while a vector has both magnitude and direction.

Step 1 — Classify speed: Speed tells only how fast a body moves, with no direction, so it is a scalar.

Step 2 — Classify velocity: Velocity tells how fast and in which direction a body moves, so it is a vector.

Step 3 — Conclude: Speed is a scalar and velocity is a vector.

Why other options are wrong:

- Both being vectors is wrong; speed has no direction.
- Both being scalars is wrong; velocity has direction.
- Speed being a vector and velocity a scalar reverses the truth.

Final Answer: Speed is a scalar while velocity is a vector $\Rightarrow \boxed{\text{D}}$

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: $F = 12$ N, $s = 3$ m.

Step 2 — Substitute: $W = 12 \times 3$.

Step 3 — Compute: $W = 36$ J.

Why other options are wrong:

- 4 divides force by distance.
- 15 adds force and distance.
- 9 subtracts the two values.

Final Answer: Work done $= 36$ J $\Rightarrow \boxed{\text{B}}$

Answer: (B) 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: $m = 6$ kg, $v = 2$ m/s.

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

Step 3 — Substitute: $KE = \frac{1}{2} \times 6 \times 4$.

Step 4 — Compute: $\frac{1}{2} \times 6 = 3$, then $3 \times 4 = 12$ J.

Why other options are wrong:

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

Final Answer: Kinetic energy $= 12$ 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, $h = 8$ m.

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

Step 3 — Compute: $2 \times 10 = 20$, then $20 \times 8 = 160$ J.

Why other options are wrong:

- 80 leaves out the mass.

- 100 uses wrong values.
- 20 multiplies only mass and g.

Final Answer: Potential energy $= 160$ J $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q14

Q15.

Solution

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

Step 1 — List the data: $W = 150$ J, $t = 3$ s.

Step 2 — Substitute: $P = \dfrac{150}{3}$.

Step 3 — Compute: $P = 50$ W.

Why other options are wrong:

- 450 multiplies instead of dividing.
- 0.02 inverts the ratio.
- 153 adds the two values.

Final Answer: Power $= 50$ W $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q15

Q16.

Solution

Concept — Energy transformation: A device is named by the main useful energy change it brings about.

Step 1 — Identify the input: An electric fan is supplied with electrical energy from the mains.

Step 2 — Identify the output: This energy turns the blades, producing motion, which is mechanical energy.

Step 3 — State the conversion: So a fan mainly converts electrical energy into mechanical energy.

Why other options are wrong:

- Mechanical to electrical describes a generator.
- Some heat and sound are produced, but these are not the main useful output.
- The chief purpose is to move air, that is mechanical work.

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

Answer: (D) Go Back to Q16

Q17.

Solution

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

Step 1 — List the data: $m = 2.5$ kg, $g = 10$ m/s^2.

Step 2 — Substitute: $W = 2.5 \times 10$.

Step 3 — Compute: $W = 25$ N.

Why other options are wrong:

- 2.5 N is the mass value, not the weight.
- 0.25 N divides instead of multiplying.
- 250 N multiplies by an extra factor of ten.

Final Answer: Weight $= 25$ N $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q17

Q18.

Solution

Concept — Gravity on the Moon: The acceleration due to gravity depends on the mass and radius of the body. The Moon is much smaller and lighter than the Earth.

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

Step 2 — Confirm: This is why an astronaut can jump much higher on the Moon than on the Earth.

Why other options are wrong:

- "Six times" reverses the relation.

- "Equal to" is false; the Moon's gravity is far weaker.
- "One-third" is the wrong fraction.

Final Answer: Moon's gravity is about one-sixth of the Earth's $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q18

Q19.

Solution

Concept — Free fall: For a body dropped from rest, the distance fallen is $s = \frac{1}{2}gt^2$.

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

Step 2 — Square the time: $t^2 = 1^2 = 1$.

Step 3 — Substitute: $s = \frac{1}{2} \times 10 \times 1$.

Step 4 — Compute: $s = 5$ m.

Why other options are wrong:

- 10 forgets the factor $\frac{1}{2}$.
- 20 uses a wrong value.
- 2.5 halves the answer once more.

Final Answer: Distance fallen $= 5$ m $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q19

Q20.

Solution

Concept — Mass and weight: Mass is the amount of matter in a body, while weight is the gravitational force on that body.

Step 1 — Unit of mass: Mass is measured in kilogram (kg), the SI base unit.

Step 2 — Unit of weight: Weight is a force, so it is measured in newton (N).

Step 3 — Conclude: Mass is in kilogram and weight is in newton.

Why other options are wrong:

- Both in kilogram is wrong; weight is a force.

- Both in newton is wrong; mass is not a force.
- Mass in newton and weight in kilogram reverses the units.

Final Answer: Mass in kilogram and weight in newton $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q20

Q21.

Solution

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

Step 1 — List the data: $F = 50$ N, $d = 0.3$ m.

Step 2 — Substitute: moment $= 50 \times 0.3$.

Step 3 — Compute: moment $= 15$ N m.

Why other options are wrong:

- 16.7 divides force by distance.
- 150 uses $d = 3$ m instead of 0.3 m.
- 0.006 divides distance by force.

Final Answer: Moment of the force $= 15$ N m $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q21

Q22.

Solution

Concept — Principle of moments: A body free to rotate is balanced when the turning effects on the two sides cancel out.

Step 1 — State the principle: In rotational equilibrium, the sum of the clockwise moments equals the sum of the anticlockwise moments about the pivot.

Step 2 — Confirm: When these moments are equal, there is no net turning effect, so the body does not rotate.

Why other options are wrong:

- Equilibrium does not need the force to be maximum.
- If clockwise moment were greater, the body would rotate.

- Moments must balance, not simply add to a large value.

Final Answer: Clockwise moments equal anticlockwise moments $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q22

Q23.

Solution

Concept — Acceleration in SHM: In simple harmonic motion the acceleration is proportional to the displacement from the mean position and is directed towards it.

Step 1 — Write the relation: acceleration $\propto$ displacement from the mean position.

Step 2 — Find where it is zero: At the mean (equilibrium) position the displacement is zero, so the acceleration is also zero.

Step 3 — Conclude: Acceleration is zero at the mean position (and greatest at the extremes).

Why other options are wrong:

- At the extreme position the acceleration is maximum, not zero.
- Midway between mean and extreme the acceleration has a non-zero value.
- It is zero at the mean position, so "never zero" is wrong.

Final Answer: Acceleration is zero at the mean position $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q23

Q24.

Solution

Concept — Frequency and time period: Frequency is the number of oscillations per second and is the reciprocal of the time period, $f = \frac{1}{T}$.

Step 1 — List the data: $T = 0.5$ s.

Step 2 — Substitute: $f = \frac{1}{0.5}$.

Step 3 — Compute: $f = 2$ Hz.

Why other options are wrong:

- 0.5 Hz simply repeats the value of T.
- 5 Hz and 50 Hz come from misplacing the decimal point.

Final Answer: Frequency $= 2$ Hz $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q24

Q25.

Solution

Concept — Kelvin to Celsius: The Kelvin and Celsius scales are related by $^\circ\text{C} = \text{K} - 273$.

Step 1 — List the data: Temperature $= 310$ K.

Step 2 — Substitute: $^\circ\text{C} = 310 - 273$.

Step 3 — Compute: $^\circ\text{C} = 37\,^\circ\text{C}$.

Why other options are wrong:

- 583 adds 273 instead of subtracting it.
- 273 is only the conversion constant.
- 310 is the Kelvin value, left unchanged.

Final Answer: 310 K $= 37\,^\circ\text{C} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q25

Q26.

Solution

Concept — Heat and temperature rise: The heat supplied is $Q = mc\,\Delta T$, so the rise in temperature is $\Delta T = \dfrac{Q}{mc}$.

Step 1 — List the data: $Q = 8400$ J, $m = 1$ kg, $c = 4200\ \text{J}\,\text{kg}^{-1}\,^\circ\text{C}^{-1}$.

Step 2 — Substitute: $\Delta T = \dfrac{8400}{1 \times 4200}$.

Step 3 — Compute: $\Delta T = \dfrac{8400}{4200} = 2\,^\circ\text{C}$.

Why other options are wrong:

- 4 uses a wrong value of c.
- 0.5 inverts the ratio.

- 8400 ignores the mass and specific heat.

Final Answer: Rise in temperature $= 2\,°C \Rightarrow \boxed{B}$

Answer: (B) Go Back to Q26

Q27.

Solution

Concept — Modes of heat transfer: Conduction and convection both need a material medium to carry heat. Radiation transfers heat as electromagnetic waves and needs no medium at all.

Step 1 — Rule out conduction and convection: Both need particles of a medium, so they cannot occur through empty space.

Step 2 — Identify the answer: Heat from the Sun reaches the Earth across empty space, which shows radiation needs no medium.

Why other options are wrong:

- Conduction needs a solid medium in contact.
- Convection needs a moving fluid (liquid or gas).
- Hence the combination of conduction and convection also fails in a vacuum.

Final Answer: Radiation can occur through a vacuum $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q27

Q28.

Solution

Concept — Anomalous expansion of water: Unlike most liquids, water does not simply expand on heating from $0\,°C$; it first contracts up to $4\,°C$ and then expands.

Step 1 — Track the volume: As water is warmed from $0\,°C$ its volume decreases until $4\,°C$, then it begins to increase.

Step 2 — Link volume to density: The smallest volume occurs at $4\,°C$, and the smallest volume for a fixed mass means the greatest density.

Step 3 — Conclude: Water has its maximum density at $4\,°C$.

Why other options are wrong:

- At $0\,°C$ water is about to freeze and is less dense.

- At $100\,^{\circ}\mathrm{C}$ water is least dense (near boiling).
- $-4\,^{\circ}\mathrm{C}$ is below the freezing point of water.

Final Answer: Water is densest at $4\,^{\circ}\mathrm{C} \Rightarrow \boxed{\mathrm{C}}$

Answer: (C) Go Back to Q28

Q29.

Solution

Concept — Change of state: While a substance changes state, the heat supplied is used to overcome the forces between particles, not to raise the temperature.

Step 1 — Apply to melting ice: The heat going into the ice breaks the bonds and converts ice to water.

Step 2 — Effect on temperature: Because the energy is used for the change of state, the temperature of the ice–water mixture stays the same until all the ice has melted.

Step 3 — Conclude: The temperature remains constant during melting.

Why other options are wrong:

- It does not rise; the heat is the latent heat of fusion.
- It does not fall while melting.
- There is no rise-then-fall pattern during a steady melt.

Final Answer: The temperature stays constant during melting $\Rightarrow \boxed{\mathrm{A}}$

Answer: (A) Go Back to Q29

Q30.

Solution

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

Step 1 — Read the data: The angle of incidence is 50°.

Step 2 — Apply the law: angle of reflection $=$ angle of incidence.

Step 3 — Conclude: angle of reflection $= 50^{\circ}$.

Why other options are wrong:

- $40°$ wrongly measures the angle from the mirror surface.
- $100°$ doubles the angle of incidence.
- $0°$ would mean the ray travels along the normal, which it does not.

Final Answer: Angle of reflection $= 50° \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q30

Q31.

Solution

Concept — Concave mirror images: The position of the image in a concave mirror depends on where the object is placed.

Step 1 — Locate the object: The object is placed exactly at the focus F.

Step 2 — Trace the rays: Rays from an object at the focus reflect from the mirror and travel parallel to each other after reflection.

Step 3 — Conclude: Parallel reflected rays meet only at a very large distance, so the image is formed at infinity (highly magnified and real).

Why other options are wrong:

- The image is not at the focus for an object placed at the focus.
- It is not at the centre of curvature.
- A real image is not formed behind a concave mirror in this case.

Final Answer: The image is formed at infinity $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q31

Q32.

Solution

Concept — Convex mirror: A convex mirror always forms an erect, virtual and diminished image, and it can take in light from a wide region.

Step 1 — Recall the image: Whatever the object distance, a convex mirror gives a small, upright image.

Step 2 — Link to its use: Because the image is small, more of the surroundings fit in, giving a wide field of view of the traffic behind.

Step 3 — Conclude: This is why it is used as a rear-view mirror.

Why other options are wrong:

- It forms a virtual image, not a real one.
- It diminishes objects rather than magnifying them.
- It makes objects appear farther, not closer.

Final Answer: A convex mirror gives an erect, diminished image with a wide field of view $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q32

Q33.

Solution

Concept — Mirror formula: The mirror formula is $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$, with sign convention: distances measured against the incident light are negative.

Step 1 — List the data: For a concave mirror, $f = -10$ cm and $u = -15$ cm.

Step 2 — Rearrange for $\frac{1}{v}$: $\frac{1}{v} = \frac{1}{f} - \frac{1}{u}$.

Step 3 — Substitute: $\frac{1}{v} = \frac{1}{-10} - \frac{1}{-15} = -\frac{1}{10} + \frac{1}{15}$.

Step 4 — Take a common denominator: $-\frac{1}{10} + \frac{1}{15} = \frac{-3+2}{30} = \frac{-1}{30}$.

Step 5 — Invert: $v = -30$ cm (the image is real and in front of the mirror).

Why other options are wrong:

- -15 cm just repeats the object distance.
- $+30$ cm has the wrong sign (would be behind the mirror).
- -6 cm comes from a calculation slip.

Final Answer: Image distance $v = -30$ cm $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q33

Q34.

Solution

Concept — Refraction of light: When light passes from one medium to another, it changes speed and bends at the surface. This bending is called refraction.

Step 1 — Trace the light: Light from the lower part of the pencil travels from water into air and bends at the surface.

Step 2 — Effect on the eye: The bent rays reach the eye as if they came from a higher point, so the pencil looks broken or bent at the water level.

Step 3 — Conclude: The apparent bending is caused by refraction of light.

Why other options are wrong:

- Reflection would form a mirror image, not a bent pencil.
- Dispersion splits white light into colours, which is not seen here.
- Scattering spreads light in many directions and is unrelated.

Final Answer: The pencil appears bent because of refraction $\Rightarrow \boxed{\text{B}}$

$\boxed{\text{Answer: (B)}}$ Go Back to Q34

Q35.

Solution

Concept — Image of a distant object by a convex lens: Rays coming from a very distant object are nearly parallel. A convex lens brings parallel rays to a point at its focus.

Step 1 — Treat the rays as parallel: The Sun is so far away that its rays reaching the lens are practically parallel.

Step 2 — Apply the focusing property: A convex lens converges parallel rays to its principal focus.

Step 3 — Conclude: The sharp, real image of a distant object is formed at the focus of the lens.

Why other options are wrong:

- No image forms at the optical centre.
- An image at $2F$ is formed only for an object at $2F$, not at infinity.
- The image is at the focus, not at infinity.

Final Answer: The image of a distant object forms at the focus $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q35

Q36.

Solution

Concept — Dispersion through a prism: White light is split by a prism into seven colours because each colour bends by a different amount. The order is VIBGYOR.

Step 1 — Compare the bending: Violet light has the shortest wavelength and bends (deviates) the most; red light has the longest wavelength and bends the least.

Step 2 — Read the figure: The violet ray (V) leaves at the bottom, deviated most from the original path; the red ray (R) is deviated least.

Step 3 — Conclude: The colour that bends the most is violet.

Why other options are wrong:

- Red bends the least, not the most.
- Yellow and green bend by intermediate amounts.

Final Answer: Violet light bends the most $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q36

Q37.

Solution

Concept — Wave equation: The speed, frequency and wavelength of a wave are related by $v = f\lambda$, so $f = \frac{v}{\lambda}$.

Step 1 — List the data: $v = 300$ m/s, $\lambda = 0.5$ m.

Step 2 — Substitute: $f = \frac{300}{0.5}$.

Step 3 — Compute: $f = 600$ Hz.

Why other options are wrong:

- 150 multiplies instead of dividing.
- 60 misplaces the decimal point.
- 300 simply repeats the speed.

Final Answer: Frequency = 600 Hz ⇒ $\boxed{A}$

Answer: (A) Go Back to Q37

Q38.

Solution

Concept — What a wave transfers: A wave moves energy from one place to another. The particles of the medium only vibrate about their fixed positions; they are not carried along.

Step 1 — Watch the particles: Each particle of the medium moves up and down (or to and fro) about a mean position.

Step 2 — Follow the energy: The disturbance, and hence the energy, passes from particle to particle along the medium.

Step 3 — Conclude: The wave carries energy without the bulk transfer of matter.

Why other options are wrong:

- Matter is not carried from place to place by the wave.
- Both matter and energy together is wrong; only energy is transported.
- A wave does transfer energy, so "neither" is incorrect.

Final Answer: A wave transfers energy without transferring matter ⇒ $\boxed{C}$

Answer: (C) Go Back to Q38

Q39.

Solution

Concept — Reverberation: In a large hall, sound undergoes repeated reflections from the walls, ceiling and floor, so it lingers even after the source stops.

Step 1 — Identify the cause: The many overlapping reflections keep the sound alive in the room.

Step 2 — Name the effect: This persistence of sound due to repeated reflection is called reverberation.

Why other options are wrong:

- An echo is a single, clearly separated reflection.
- Resonance is the building up of vibration at a natural frequency.

- Refraction is the bending of sound, not its persistence.

Final Answer: The persistence of sound by repeated reflection is reverberation $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q39

Q40.

Solution

Concept — Ranges of sound: Sound below 20 Hz is infrasound, between 20 Hz and $20{,}000$ Hz is audible, and above $20{,}000$ Hz is ultrasound.

Step 1 — Place the frequency: A frequency above $20{,}000$ Hz lies beyond the audible range.

Step 2 — Name it: Such high-frequency sound is called ultrasound, which is used in sonography (medical imaging).

Why other options are wrong:

- Infrasound is below 20 Hz.
- Audible sound lies between 20 Hz and $20{,}000$ Hz.
- "Supersonic" refers to speeds faster than sound, not to frequency.

Final Answer: Sound above $20{,}000$ Hz is ultrasound $\Rightarrow$ $\boxed{\text{D}}$

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: $I = 0.5$ A, $R = 20\,\Omega$.

Step 2 — Substitute: $V = 0.5 \times 20$.

Step 3 — Compute: $V = 10$ V.

Why other options are wrong:

- 40 divides R by I.
- 2.5 divides I wrongly.
- 19.5 subtracts the values.

Final Answer: Potential difference $= 10\text{ V} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q41

Q42.

Solution

Concept — Resistors in series: When resistors are joined end to end, the equivalent resistance is the sum of the individual resistances, $R = R_1 + R_2$.

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

Step 2 — Add them: $R = 4 + 6$.

Step 3 — Compute: $R = 10\,\Omega$.

Why other options are wrong:

- $2.4\,\Omega$ is the parallel value, not the series value.
- $5\,\Omega$ takes an average instead of the sum.
- $24\,\Omega$ multiplies the resistances.

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

Answer: (C) Go Back to Q42

Q43.

Solution

Concept — Equal resistors in parallel: For two equal resistors R in parallel, the equivalent resistance is half of one, $R_{eq} = \frac{R}{2}$.

Step 1 — List the data: Both resistors are $12\,\Omega$.

Step 2 — Use the formula: $R_{eq} = \frac{12}{2}$.

Step 3 — Compute: $R_{eq} = 6\,\Omega$.

Why other options are wrong:

- $24\,\Omega$ is the series value (sum).
- $12\,\Omega$ ignores the parallel combination.
- $144\,\Omega$ multiplies the two resistances.

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

$\boxed{\text{Answer: (B)}}$ Go Back to Q43

Q44.

Solution

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

Step 1 — List the data: $I = 3$ A, $R = 2\,\Omega$.

Step 2 — Square the current: $I^2 = 3^2 = 9$.

Step 3 — Substitute: $P = 9 \times 2$.

Step 4 — Compute: $P = 18$ W.

Why other options are wrong:

- 36 squares the wrong quantity.
- 12 uses I instead of I^2 ($3 \times 2 \times 2$ misapplied).
- 6 multiplies $I \times R$ without squaring the current.

Final Answer: Power dissipated $= 18$ W $\Rightarrow \boxed{\text{D}}$

$\boxed{\text{Answer: (D)}}$ Go Back to Q44

Q45.

Solution

Concept — Electric fuse: A fuse is a short piece of wire with a low melting point, placed in series with the circuit.

Step 1 — What happens on overload: If the current rises above a safe value, the fuse wire heats up and melts.

Step 2 — Effect of melting: When the fuse melts, the circuit breaks and the current stops, protecting the wiring and appliances.

Step 3 — Conclude: A fuse protects the circuit by melting and breaking it when the current is too large.

Why other options are wrong:

- A fuse does not increase the current.
- It does not store charge.
- It does not reduce the supply voltage.

Final Answer: A fuse melts and breaks the circuit on excess current $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q45

Q46.

Solution

Concept — Resistivity: Resistance depends on the material, length and area of a wire, but resistivity (specific resistance) is a property of the material itself.

Step 1 — Recall the relation: $R = \rho \frac{L}{A}$, where ρ is the resistivity.

Step 2 — Isolate the material property: Here ρ does not contain L or A; it depends only on the material and its temperature.

Step 3 — Conclude: Resistivity depends only on the nature of the material and its temperature, not on the dimensions of the wire.

Why other options are wrong:

- Length affects resistance R, not resistivity ρ.
- Area affects resistance R, not resistivity ρ.
- Resistivity differs from material to material, so it is not the same for all.

Final Answer: Resistivity depends only on the material and temperature $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q46

Q47.

Solution

Concept — Field around a straight wire: The magnetic field of a straight current-carrying wire forms concentric circles. The field is stronger where the lines are closer together.

Step 1 — Read the figure: Near the wire the circles are crowded; far from the wire they are widely spaced.

Step 2 — Link spacing to strength: Closely packed field lines mean a stronger field; widely spaced lines mean a weaker field.

Step 3 — Conclude: The field is strongest close to the wire.

Why other options are wrong:

- Far from the wire the field is weak, not strong.

- The field is not the same at every distance; it decreases outward.
- The field exists in the space around the wire, not only along it.

Final Answer: The field is strongest close to the wire $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q47

Q48.

Solution

Concept — Uses of electromagnets: An electromagnet is a coil wound on a soft-iron core that becomes magnetic only when current flows. Many devices use this on/off magnetism.

Step 1 — Examine the options: A torch bulb, a dry cell and a thermometer do not work on the magnetic effect of current.

Step 2 — Pick the device: An electric bell uses an electromagnet to attract an iron armature and strike the gong repeatedly.

Why other options are wrong:

- A torch bulb works by heating a filament (light from heat).
- A dry cell is a source of current, not an electromagnet.
- A mercury thermometer works by thermal expansion.

Final Answer: An electromagnet is used in an electric bell $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q48

Q49.

Solution

Concept — Field of a current loop: A circular current-carrying loop produces a magnetic field. At the centre of the loop, the field lines are straight.

Step 1 — Picture the field: Near the wire of the loop the lines are circular, but they straighten out as they reach the centre.

Step 2 — Direction at the centre: At the centre the field is directed straight through the loop, perpendicular to the plane of the loop.

Step 3 — Conclude: The field lines at the centre are straight and perpendicular to the plane of the loop.

Why other options are wrong:

- The lines are circular near the wire, but not at the centre.
- The field at the centre is not zero; it is in fact strong.
- The lines pass through the loop, not flat within its plane.

Final Answer: At the centre the field is straight and perpendicular to the loop $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q49

Q50.

Solution

Concept — Fleming's rules: Fleming's left-hand rule gives the direction of force on a current (motor), while Fleming's right-hand rule gives the direction of the induced current (generator).

Step 1 — Match the rule: The right-hand rule is used when a conductor moves in a magnetic field and a current is induced.

Step 2 — Identify the device: A device that produces an induced current in this way is an electric generator.

Step 3 — Conclude: Fleming's right-hand rule gives the direction of the induced current in a generator.

Why other options are wrong:

- A motor uses Fleming's left-hand rule.
- A transformer works on mutual induction, not this rule.
- A battery produces current by chemical action, not by induction.

Final Answer: The right-hand rule applies to a generator $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q50

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	B	2	D	3	A	4	C	5	C
6	A	7	D	8	B	9	A	10	C
11	D	12	B	13	A	14	C	15	B
16	D	17	A	18	B	19	C	20	D
21	B	22	A	23	C	24	D	25	A
26	B	27	D	28	C	29	A	30	B
31	D	32	C	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	C
46	A	47	B	48	D	49	C	50	A