Answer Key: Kerala 10th Physics Model Question Paper 1

Section-A: Multiple Choice Questions ($4 \times 1 = 4$)

Q. No.	Answer	Justification (Textbook Reference)
1.	b) Oersted's experiment on magnetic effect of current	Oersted conducted an experiment where a current-carrying conductor caused a deflection in a pivoted magnetic needle, demonstrating the magnetic effect of current.
2.	b) Statement and reason are correct; however, the reason does not explain the statement.	**Statement is correct:** A magnetic field is formed around a current-carrying conductor. **Reason is correct:** The direction of the magnetic field can be determined using the right-hand thumb rule. **Explanation:** The rule describes the direction, but doesn't explain *why* the field is formed.
3.	b) Concentric circles around the wire	The experiment with magnetic compasses around a straight current-carrying wire on a cardboard shows the magnetic field lines are concentric circles.
4.	a) i and ii	The statement is based on the **Clock Rule** (or End Rule) for a current-carrying coil/solenoid. Clockwise current rotation indicates the **South pole** (i) , and magnetic flux lines **enter inward** (ii) on the south pole side.

Section-B: Short Answer Questions ($7 \times 2 = 14$)

5. A. (OR) A straight conductor carries current from A to B. Using the right-hand thumb rule, explain the direction of the magnetic field around it.

- **Explanation:** Imagine holding the conductor with your right hand such that your **thumb points in the direction of the electric current** (from A to B).
- The **fingers curled around the conductor** will indicate the direction of the magnetic field (which will be in the direction of the curl).

5. B. (OR) In Ampere's swimming rule...

- a) **What does this indicate about the magnetic field direction?**
  - This indicates that the **magnetic field's direction** around the conductor is such that it causes the North pole of the needle to deflect towards the person's **left** side. (This rule simply helps to determine the direction of the magnetic field, and thus the force it exerts on the magnetic pole).
- b) **Give one application of this rule in daily life.**
  - This rule, or Oersted's principle (which it relates to), is the basis for deflection instruments like **galvanometers**.

6. A pivoted magnetic needle is placed near a bar magnet.

- a) **What happens to the needle? Why?**
  - The magnetic needle **deflects**.
  - **Reason:** The magnetic needle is deflected due to the **attraction and repulsion** between its poles and the magnetic poles/field of the bar magnet.
- b) **If the bar magnet is replaced by a current-carrying wire, what change do you expect?**
  - The magnetic needle will **still deflect**.
  - **Change:** The deflection will cease immediately when the current is switched off, as the field is **temporary** (magnetic effect of current).

7. Electromagnetic induction is used in generators.

- a) **What is electromagnetic induction?**
  - It is the phenomenon of **inducing an emf** (electromotive force) across a conductor due to a **change in the magnetic flux** linked with the conductor (closed circuit).
- b) **Name one device where this principle is applied to produce electricity from mechanical energy.**
  - **Generator** (specifically AC generator or DC generator).

8. A coil with 100 turns has a current of 2 A flowing through it. If the current is reversed.

- **How does the direction of the field change? Explain briefly. (2)**

- The **direction of the magnetic field will be reversed**.
- **Explanation:** The direction of the magnetic field (or the polarity of the coil/solenoid's ends) depends directly on the **direction of the electric current** flowing through it. Reversing the current reverses the field direction, as shown by the Right Hand Thumb Rule for solenoids.

9. What is the magnetic effect of electric current? Give one real-life application, and explain how it works. (2)

- **Magnetic Effect:** The phenomenon where a **magnetic field is formed around a current-carrying conductor**. This field can exert a force on a magnetic needle.
- **Application: Electric Motor**.
- **Working (Brief):** An electric motor works on the motor principle, where a **current-carrying conductor (armature) placed in a magnetic field experiences a force** and rotates.

10. The figure shows a solenoid with current flowing through it.

- a) **What is the reason for the magnetic field inside the solenoid being uniform?**
  - The magnetic field lines are concentrated and **parallel to the axis** inside a solenoid, making the field **uniform** (similar to that inside a bar magnet).
- b) **Which rule can be used to find the polarity of its ends?**
  - **Right Hand Thumb Rule for Solenoids** (or the Clock Rule, where clockwise current is South pole, anticlockwise is North pole) .

11. A. (OR) A conductor is moved perpendicular to a magnetic field. Draw a simple diagram showing induced current and explain the direction using Fleming's right-hand rule. (2)

- **Diagram:** * **Explanation (Fleming's Right-Hand Rule):** Hold the thumb, first finger, and middle finger of your **right hand** mutually perpendicular.
  - The **Thumb** indicates the direction of **Motion** of the conductor.
  - The **First finger** indicates the direction of the **Field** (Magnetic field).
  - The **Middle finger** indicates the direction of the **Induced Current**.

11. B. (OR) The length of a conductor in a magnetic field is 20 cm, moving at $5\ m/s$ perpendicular to a 0.5 T field. Using a suitable scale, draw a diagram and find the induced emf.

- **Diagram (Sketch):** Draw a conductor (AB) moving perpendicular to a magnetic field (B), which could be represented by a U-shaped magnet. Show the velocity vector (v) and the induced current (I) (similar to Fig. 4.29 but for induction).
- **Calculation:**

- Induced emf, $\mathcal{E} = Blv$ (since motion is perpendicular, $\sin\theta = 1$) [This formula is generally implied/derived in the context of induction, although not explicitly provided in the provided text excerpts].
- $l = 20 \text{ cm} = 0.2 \text{ m}$
- $v = 5 \text{ m/s}$
- $B = 0.5 \text{ T}$
- $\mathcal{E} = 0.5 \text{ T} \times 0.2 \text{ m} \times 5 \text{ m/s} = \mathbf{0.5\ V}$

- **Note on Scale:** A scale diagram is not practical for this numerical question in an exam format but the instruction may require the sketch as above.

Section-C: Long Answer Questions ($6 \times 3 = 18$)

12. Factors affecting the strength of an electromagnet.

- a) **Arrange in order of increasing magnetic field strength: iron core, air core, soft iron core.**
  - Air core $<$ Iron core $<$ **Soft iron core** (Soft iron greatly enhances magnetic strength, as shown by deflection increase).
- b) **Which factor is most useful in lifting heavy objects in cranes? Explain.**
  - The most useful factor is the use of a **soft iron core** and the ability to **increase the current** flowing through the coil.
  - **Explanation:** Soft iron core significantly **increases the magnetic strength** by several magnitudes. The ability to vary the current allows the electromagnet to be **switched ON to lift** and **switched OFF to drop** the object, which is essential for crane operation.
- c) **Give one application in medical field (e.g., electromagnets in MRI).**
  - **MRI Scanner (Magnetic Resonance Imaging):** Uses very strong electromagnetic fields to produce detailed images of the body.

13. A. (OR) In an experiment with a current-carrying wire above a magnetic needle:

- a) **When current flows from A to B, the needle deflects clockwise. Justify.**
  - **Justification (SNC Rule/Oersted's observation):** This aligns with Oersted's observation/rule (often summarized as the SNC rule or Ampere's rule). When current flows from South to North **(from A to B in this context)**, the North pole of the magnetic needle (S-N, if placed along North-South) placed **above** it deflects to the West (which is the anticlockwise direction on a horizontal plane). If the needle is placed below, the deflection is opposite (clockwise). Assuming the current direction A to B is North-South, deflection direction depends on the convention used. In Oersted's setup, the deflection is often observed **anticlockwise** when

looking from above, if A to B is South to North. The specific justification required depends on the exact diagram/convention. However, the core principle is that the deflection direction is linked to the current direction .

- b) **If the wire is placed below, explain the change in deflection.**
  - The **direction of deflection will be reversed**.
  - **Explanation:** When the wire is moved from above to below the needle (or vice versa), the direction of the magnetic field experienced by the needle at its location is reversed, hence the deflection is reversed.
- c) **Calculate the time for one deflection cycle if frequency is 50 Hz (application in AC circuits).**
  - Time Period $(T) = \frac{1}{\text{Frequency}(f)}$
  - $T = \frac{1}{50 \text{ Hz}} = \mathbf{0.02} \text{ seconds}$

13. B. (OR) Oersted's experiment demonstrates the magnetic effect of electric current.

- a) **Describe the setup and what happens to the magnetic needle when current flows from A to B above it.**
  - **Setup:** A circuit containing a conducting rod (AB), battery, and switch is arranged such that the rod AB is placed **above and parallel to a pivoted magnetic needle**.
  - **Observation:** When the switch is turned on (current flows A to B), the magnetic needle **deflects** from its original position.
- b) **Explain the change if the current direction is reversed.**
  - If the current direction is reversed (from B to A), the magnetic needle deflects in the **opposite direction**.
- c) **What is the application of this in deflection instruments like galvanometers?**
  - The deflection instruments (like galvanometers) use this principle where the magnetic field produced by the current flowing through a coil causes a deflection that is proportional to the current, allowing the current to be measured.

14. A. (OR) In the figure, a current-carrying loop is shown.

- (a) **Identify the rule used to find field direction and draw its shape.**
  - **Rule: Right Hand Thumb Rule**.
  - **Shape of Field:** The magnetic field lines will be **concentric circles** around the conductor at any point, becoming less curved and eventually straight near the center of the loop.

- b) **Draw the magnetic field lines for the loop.**
    - The drawing should show the conductor passing perpendicularly through a surface (cardboard), and the field lines should be shown as **concentric circles** around the wire, with the direction marked by arrows (clockwise or anticlockwise depending on current direction).

14. B. (OR) Electromagnets are used in electric bells.

- a) **Where should the current be passed to make the armature attract?**
    - The current should be passed through the **coil wound around the soft iron piece** (the electromagnet core).
- b) **Draw the diagram of an electric bell and explain its working.**
    - **Diagram:** The diagram should show the key components: **electromagnet, soft iron armature, contact screw, hammer, gong** [This is a standard application of electromagnets not explicitly illustrated in the provided text excerpts, but mentioned as a use case, the function is implied].
    - **Working (Explanation):** When the switch is pressed, current flows through the coil, magnetizing the electromagnet. This magnet **attracts the soft iron armature**. The hammer attached to the armature strikes the gong, producing sound. As the armature moves, it **breaks the circuit** at the contact screw, de-magnetizing the electromagnet. The armature springs back, closing the circuit again, and the cycle repeats rapidly [The working principle is implied by the knowledge that electromagnets are used in electric bells].

15. Transformers are used in power distribution.

- a) **If a step-up transformer has primary 100 turns and secondary 500 turns, what is the voltage ratio?**
    - In a transformer, the voltage ratio $\left(\frac{V_s}{V_p}\right)$ is equal to the turns ratio $\left(\frac{N_s}{N_p}\right)$.
    - Voltage Ratio $= \frac{N_s}{N_p} = \frac{500}{100} = \mathbf{5:1}$
- b) **Explain how it steps up voltage with application in long-distance transmission.**
    - **Stepping up:** The step-up transformer has **more turns in the secondary coil** (N_s) than in the primary coil (N_p). This increases the voltage in the secondary circuit (output) proportional to the turns ratio [Implied from the function of transformers, although transformer theory is not explicitly in the provided unit].
    - **Application (Transmission):** Electricity is stepped up to **very high voltages** for long-distance transmission because the power loss as heat ($H = I^2Rt$) is dependent on the square of the current (I^2). By stepping up the voltage, the **current (I) is lowered** for the same amount of power ($P = VI$), which significantly reduces transmission losses [Implied from the application context of power transmission].

16. The figure shows induced emf in a coil due to a moving magnet. (The figure shows the N-pole moving towards the coil, and the induced current deflects the galvanometer).

- a) **In which direction is the induced current?**
  - The direction of the induced current must be such that it **opposes the motion** causing it (**Lenz's Law**). Since the North pole is moving **towards** the coil, the coil end facing the magnet must become a **North pole** to repel it.
  - Therefore, the induced current direction is **Anticlockwise** (when viewed from the magnet side), as anticlockwise current creates a North pole.
- b) **What is the polarity of the coil end facing the magnet?**
  - **North Pole** (to oppose the approaching North pole of the magnet, as per Lenz's Law) [Implied by Lenz's Law which is a consequence of electromagnetic induction].

17. This question is missing in the provided model paper.

Section-D: Extended Answer Questions ($4 \times 1 = 4$)

18. A. (OR) A solenoid is connected to a battery. A tuning fork of 256 Hz is brought near it after current flows.

- a) **The sound intensity increases due to resonance. Reason?**
  - **Reason:** The current in the solenoid creates a **magnetic field** (electromagnet). The alternating nature of the circuit/current causes the solenoid or a nearby component to **vibrate** at the supply frequency. When this mechanical vibration's frequency matches the **natural frequency of the tuning fork (256 Hz)**, the fork vibrates strongly (**resonance**), increasing the sound intensity [Vibration due to magnetic field is the motor principle, resonance concepts are applied in sound, though not explicitly in the provided text excerpts].
- b) **When current increases, vibration amplitude rises. Frequency of air column?**
  - The vibration frequency of the air column is equal to the **frequency of the sound source**, which is the **tuning fork's frequency, 256 Hz**. The frequency remains unchanged; only the intensity (amplitude) increases [General physics/sound concept].
- c) **To hear louder sound again, use higher or lower frequency fork? Justify.**
  - You need to use a fork whose frequency is **closer to the resonant frequency** (256 Hz) to maintain high amplitude. Whether higher or lower depends on the exact frequency difference. **Justification:** Loudness (amplitude) is highest when the driving frequency (the electromagnetic vibration) **matches the natural frequency** (256 Hz) [General physics/sound concept].
- d) **Nearby iron rod vibrates. Its natural frequency?**

- If the iron rod vibrates strongly due to the solenoid, its **natural frequency must be close to the driving frequency** (the solenoid's AC/vibration frequency) [General physics/sound concept].

18. B. (OR) A worker in a factory hears various machine sounds: 100 Hz, 15 Hz, 500 Hz, 18000 Hz, 25000 Hz, 1000 Hz.

- a) **Which frequencies are audible?**
  - **Audible Frequencies:** 100 Hz, 500 Hz, 18000 Hz, 1000 Hz.
- b) **What is the human audible range?**
  - The human audible range is approximately **20 Hz to 20,000 Hz (20 kHz)** [General physics/sound concept].
- c) **Name for sounds below lower limit (infrasound) with one application (e.g., earthquake detection).**
  - **Name: Infrasound** (Sounds with frequency $< 20 \text{ Hz}$).
  - **Application:** Detection of **earthquakes** (seismic waves) or tracking large animals like elephants (or other sources generating low-frequency vibrations) [General physics/sound concept].
- d) **Two uses of ultrasound (e.g., medical imaging, cleaning).**
  - **Ultrasound** (Sounds with frequency $> 20,000 \text{ Hz}$)
  - 1. **Medical Imaging (Sonography):** Used to produce internal images of the body.
  - 2. **Cleaning:** Used to clean delicate equipment in hard-to-reach places.
  - (Other uses: SONAR, welding plastics).