The Key
Part I (50 Marks)

Q₁. Read carefully and choose the right answer of the following: (10 Marks) 1 Mark each qu

1. A sound wave is: **(C) longitudinal wave**	2. Heat is: **(A) energy transferred by a temperature difference**
3. During phase changes: **(C) the temperature remains the same**	4. Sound vibrations with frequencies more than 20,000 Hz are called: **(A) infrasonics**
5. When listening to tuning forks of frequency 256 Hz and 259 Hz, one hears the following number of beats per second: **(D) 3.0**	6. The heat required to change a substance from the solid to the liquid phase is: **(C) heat of sublimation**
7. By what heat transfer mechanism does the Sun warm the Earth? **(C) radiation**	8. To produce resonance it is necessary to use two waves: **(B) of same frequencies**
9. The molar heat capacity of an object is: **(D) heat per mole per temperature change**	10. What is the intensity level in decibels of a sound whose intensity is 10^{-8} W/m² (where $I_0 = 10^{-12}$ W/m²)? **(E) 40 dB.**

Q₂. (20 Marks)

Solution:

(a) One speaker is 4.50 m from the microphone and the other is: ③

$$= \sqrt{[(4.5)^2 + (2.0)^2]} = 4.92 \text{ m}$$

so the path difference is: ②

$$\Delta x = 4.92 \text{ m} - 4.5 \text{ m} = 0.42 \text{ m}$$

For constructive interference, the path difference is an integer number of wavelengths:

② $\Delta x = n\,\lambda$; $n = 0, 1, 2, 3,\ldots\ldots$ where: $\lambda = \dfrac{v}{f}$ or: ②

$$f_n = \frac{n\,v}{\Delta x} = \frac{n\,344}{0.42} = 820\,n; n = 1, 2, 3 \ldots\ldots$$ ②

So the possible frequencies are:

$$f_n = 820, 1640, 2460, \ldots\ldots \text{Hz}$$ ②

(b) Destructive interference occurs when the path difference is:

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$$\Delta x = (2n + 1)\,\lambda/2,\ n = 0, 1, 2, 3,\dots \text{ Or:} \quad \Bigg\}\ \text{③}$$

$$\Delta x = \lambda/2,\ 3\lambda/2,\ 5\lambda/2\dots\text{or } \Delta x = v/2f,\ 3v/2f,\ 5v/2f\dots = nv/f.$$

$$f_n = \frac{n\,v}{2\,\Delta x} = \frac{n\,344}{2(0.42)} = 410\,n;\, n = 1, 3, 5, \dots \quad \Bigg\}\ \text{②}$$

So the possible frequencies are:

$$f_n = 410, 1230, 2050, \dots \text{Hz} \quad \Bigg\}\ \text{②}$$

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Q3.   (20 Marks)

Solution:

IDENTIFY and SET UP: Use $Q = mc\Delta T$ for the temperature changes and $Q = mL$ for the phase changes.

EXECUTE: Heat must be added to do the following:

ice at $-10.0°C \rightarrow$ ice at $0°C$

$$Q_{ice} = mc_{ice}\Delta T = (18.0 \times 10^{-3}\ \text{kg})(2100\ \text{J/kg}\cdot\text{K})(0°C - (-10.0°C)) = 378\ \text{J} \quad \Bigg\}\ \text{④}$$

phase transition ice $(0°C) \rightarrow$ liquid water $(0°C)$(melting)

$$Q_{melt} = +mL_f = (18.0 \times 10^{-3}\ \text{kg})(334 \times 10^3\ \text{J/kg}) = 6.012 \times 10^3\ \text{J} \quad \Bigg\}\ \text{④}$$

water at $0°C$ (from melted ice) $\rightarrow$ water at $100°C$

$$Q_{water} = mc_{water}\Delta T = (18.0 \times 10^{-3}\ \text{kg})(4190\ \text{J/kg}\cdot\text{K})(100°C - 0°C) = 7.542 \times 10^3\ \text{J} \quad \Bigg\}\ \text{③}$$

phase transition water $(100°C) \rightarrow$ steam $(100°C)$(boiling)

$$Q_{boil} = +mL_v = (18.0 \times 10^{-3}\ \text{kg})(2256 \times 10^3\ \text{J/kg}) = 4.0608 \times 10^4\ \text{J} \quad \Bigg\}\ \text{③}$$

The total Q is $Q = 378\ \text{J} + 6.012 \times 10^3\ \text{J} + 7.542 \times 10^3\ \text{J} + 4.068 \times 10^4\ \text{J} = 5.45 \times 10^4\ \text{J} \quad \Big\}\ \text{④}$

$$(5.45 \times 10^4\ \text{J})(1\ \text{cal}/4.186\ \text{J}) = 1.30 \times 10^4\ \text{cal} \quad \Bigg\}\ \text{②}$$

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الناجحير 40
الراسير 35
ر النسبة / 53.35٪