Question 2.1 Solution:
Technical Indicators–Based Trading Strategy Momentum, Volume, and Volatility Analysis

1. Introduction
The selected indicators are Ichimoku Cloud (Momentum), Ease of Movement (Volume), and Keltner Channels (Volatility).

2. Indicator-wise Explanation
2.1 Ichimoku Cloud (Momentum Indicator)
Unlike single-line indicators, Ichimoku provides a multidimensional view of market structure by combining multiple time-shifted averages trend direction, by taking into account:

- momentum strength,
- trend direction
- Support and resistance levels. It consists of multiple lines derived from rolling high-low averages.
- Potential trend reversals.

Mathematical Formulation

Let H_t and L_t denote the high and low prices at time t.

- Tenkan-sen (Conversion Line)

$$\text{Tenkan} = \frac{\max(H_9) + \min(L_9)}{2}$$

- Kijun-sen (Base Line)

$$\text{Kijun} = \frac{\max(H_{26}) + \min(L_{26})}{2}$$

- Senkou Span A

$$\text{Span A} = \frac{\text{Tenkan} + \text{Kijun}}{2} \quad \text{(shifted forward by 26)}$$

- Senkou Span B

$$\text{Span B} = \frac{\max(H_{52}) + \min(L_{52})}{2} \quad \text{(shifted forward by 26)}$$

Role of Each Parameter

Parameter	Role
9	Short-term momentum sensitivity
26	Medium-term trend confirmation
52	Long-term equilibrium
26- period shift	Forward-looking trend projection

Default vs Tested Parameters
Tested ranges:
- Tenkan: 7–12
- Kijun: 20–30
- Span B: 40–60

Lower values increased signal noise, while higher values introduced excessive lag.

2.2 Ease of Movement (Volume Indicator)
Ease of Movement measures how efficiently price moves relative to trading volume. It helps identify whether price movements are supported by sufficient market participation or are occurring under low-liquidity conditions.

Mathematical Formulation

$$\text{EOM} = \frac{\left(\frac{H_t + L_t}{2} - \frac{H_{t-1} + L_{t-1}}{2} \right)}{\frac{\text{Volume}_t}{H_t - L_t}}$$

Parameter	Role
High & Low	Capture intraday price movement
Volume	Measures liquidity impact
Lookback period	Smooths volatility

Default vs Tested Parameters

- Tested periods: 10, 14, 20
- Periods below 10 produced unstable oscillations
- Periods above 20 delayed volume confirmation

Final Parameter Justification

A **14-period smoothing window** was selected as it provided a stable oscillator while retaining sensitivity to meaningful volume-driven price movements.

Different smoothing periods were tested. Shorter periods resulted in erratic signals, while longer periods introduced lag. A 14-period smoothing window was selected as it provided stable yet responsive signals.

2.3 Keltner Channels (Volatility Indicator)

Keltner Channels are volatility-based envelopes constructed around an exponential moving average using the Average True Range (ATR). They are effective for identifying volatility expansion, contraction, and breakout conditions.

Mathematical Formulation

- Middle Line:

$$EMA_{20}$$

- Upper Channel:

$$EMA_{20} + 2 \times ATR_{10}$$

- Lower Channel:

$$EMA_{20} - 2 \times ATR_{10}$$

Role of Each Parameter

Parameter	Role
EMA Period	Trend baseline
ATR Period	Volatility estimation
Multiplier	Breakout sensitivity

Default vs Tested Parameters

- Multiplier tested: 1.5, 2.0, 2.5
- Lower multipliers caused frequent false breakouts
- Higher multipliers missed valid trend expansions

Final Parameter Justification

The configuration **EMA(20), ATR(10), Multiplier = 2** provided the most consistent breakout detection while minimizing false signals.

3. Reference to TradingView

The indicators were visually analyzed using **TradingView** to understand parameter sensitivity.

Observed Behavior
- Lower lookback periods increased responsiveness but amplified noise
- Higher smoothing introduced lag and delayed entries
- Default parameters provided optimal trade-offs

Visual Confirmation
- Ichimoku cloud thickness increased with higher periods
- EOM smoothing reduced erratic oscillations
- Keltner Channels expanded and contracted consistently with volatility regimes

These visual confirmations supported the final parameter selections.

4. Conclusion

Summary of Findings
This assignment successfully implemented one indicator from each technical analysis basket—momentum, volume, and volatility—to construct a cohesive trading framework. Parameter experimentation revealed the critical impact of lookback and smoothing choices on signal quality.

Why the Chosen Parameters Are Optimal
The final parameter configurations were selected based on:

- Reduced noise
- Timely signal generation
- Visual confirmation of trend and volatility behavior
- Consistency across market regimes

The integrated use of Ichimoku Cloud, Ease of Movement, and Keltner Channels provides a balanced and robust foundation for systematic trading strategies.