We must identify the pipeline's shortest cycle time before we can determine the highest clock frequency at which the pipeline can function.

Since the pipeline can't move on to the next stage until the previous stage has finished its operation and latched its output, the stage with the longest delay plus the latch delay determines the minimum cycle time. The minimal cycle time is therefore provided by:

Minimum cycle time equals maximum (stage delays) plus latch delay

Since the latch delay in this instance is 5 ns and the maximum stage delay is 42 ns, the minimum cycle time is:

The minimum cycle time is equal to 42ns plus 5ns, or 47ns.

Since the clock period is inversely proportional to the clock frequency, the maximum clock

maximum clock frequency = 1 / minimum cycle time

Substituting the value of the minimum cycle time, we get:

maximum clock frequency = 1 / 47 ns = 21.28 MHz

Therefore, the maximum clock frequency with which the pipeline can operate is 21.28 MHz.

2. A

A microcontroller would be the best kind of gadget for this situation. The devices will be battery-powered with solar cells to maintain the batteries' charge because the application only requires little power usage. Microcontrollers are perfect for battery-powered applications because of their low power consumption. They can be set up to disable the sensors when not in use and to reawaken them in response to a vibration sensor trigger.

Microcontrollers can also be combined with other system parts like sensors and wireless communication modules because they are simple to program. Additionally, they are economical, which is crucial when deploying 1000 or more sensors.

Simple tasks are needed for the application, like reading the vibration sensor and wirelessly communicating the results. These activities can be completed with the minimal processing and memory that microcontrollers have.

A microcontroller, in general, is the best kind of device for this situation since it satisfies the demands of low power consumption, cost-effectiveness, and straightforward jobs.

B. For this scenario, the most suitable type of device would be an FPGA. The application requires high-speed data processing and handling of a wide variety of non-standard sensors, which can be implemented using custom logic functions programmed into the FPGA.

FPGAs have a high degree of flexibility and can be programmed to implement custom logic functions that can process data in parallel. They have very low latency and high throughput, which makes them ideal for real-time processing applications. In addition, FPGAs can be configured to interface with a variety of sensors and output devices, such as the motor and servo controllers in this scenario.

FPGAs are also well-suited for interfacing with USB connections, which can be implemented using dedicated USB controllers integrated into the FPGA. They can handle the high-speed data rates required for the 100KB of data per second and the three SPI streams.

Overall, an FPGA is the most suitable type of device for this scenario because it meets the requirements of high-speed data processing, interfacing with non-standard sensors, and interfacing with a variety of output devices and USB connections.