PROBLEM DOMAIN:

14 years old Vinnie has been playing video games ever since he can remember.
He seems to always get the 'hand me downs' from his older (20 years old) cousin Louie.
Recently, he has been totally frustrated by the inability of his by now 'ancient' computer, his latest 'hand me down', to play the new video games.
He complains that the video images are jumpy, blurry, skip and ripple constantly.
As it happens, this semester, his cousin Louie is enrolled in a Computer Organization and Architecture course at his University, so Vinnie, rightfully so, engages Louie to assist him in determining (diagnosing) WHAT the problem is and HOW can it be corrected.
He tells cousin Louie that he has been able to save a **very** small amount of money and asks him to help determine WHAT the **MINIMUM** specifications are, for whichever 'parts' (as he refers to the computer system components), are needed, to help him get by until he gets his next 'hand me down'.
He has heard that cousin Louie is saving up some money and soon??? will be buying a new, souped up, overclocked, water cooled Gaming Computer, with gobs of memory and storage, equipped with the latest and greatest nVidia super-duper GPU Video Processor available!
So he figures that it is just a matter of time and once again, he will be getting Louie's current system which is already good enough.

PROBLEM DESCRIPTION/INFORMATION:

Louie first goes back and locates the specifications for the computer system he 'handed down' to Vinnie.
The Hardware specifications for the system components are as follows:

a) Main Memory:
- Capacity: 2^32 Words;
- Word: 4 bytes;
- Addressability: Word;
- Unit of transfer/Data register (buffer): Word;

b) Bus:
- Data Lines Width: 1 byte
- Address Lines Width: 4 bytes
- Control Lines Width: 1 byte
- Bus Clock Cycle (time): 10MH
- Transfer rate: 1 byte per cycle

c) Processor:
- 32 bit, with 32 bit data/address registers (buffers) and 32 bit internal paths/registers.

d) Display unit: 1920 x 1080 pixels, with a refresh rate of 30 frames per second.

PROBLEM Solution Steps:
First of all, Louie recalls from one of his recent homework, that he needs to VERIFY/ASCERTAIN/PROVE that indeed the current system configuration is in fact UNABLE to sustain the video display requirements.
SO, he performs the following steps:

1) Assumes that the data must pass over the bus, TWICE, once from the CD/DVD to the memory and once from the memory to the GPU's memory. Assumes that a frame screen pixel is represented by a byte. Calculates WHAT the 'MINIMUM'('necessary and sufficient') data transfer rate requirements are, in 'bytes/second', to sustain the display's required refresh rate.

2) Calculates WHAT the 'ACTUAL' refresh rate is, based on the current configuration.
Assumes that the speed at which the processor AND main memory can act in responding to a memory access request is MUCH faster than the bus cycle speed, so as to have practically no effect on the transfer rate.

3) Compares and determines IF INDEED, the 'actual' is LESS THAN the MIMIMUM 'required'.

4) IF NOT: THIS DOES NOT HAPPEN! OTHERWISE, WHY THE DISPLAY PROBLEMS?

5) IF YES: then he has proved that indeed, there is a deficiency and/or a mismatch in one (or more) of the components, which is causing the video display problems.

6) He then examines the components specs to determine IF there are one or more mismatched components, by examining both the 'width' compatibility and/or any 'timing' factors.

7) Then based on the calculations in step 1), he proceeds to determine WHAT the MINIMUM specifications are/should be for the offending component(s) in terms of both 'width' and 'timing '(clock rate).

8) Since he really likes his kid cousin, Louie then offers to help him buy the component(s), providing any extra money if needed and then proceeds to install them and test and verify that the new System PERFORMS!

HAPPY ENDING! Vinnie was SOOOOO appreciative of the work that Louie did for him, that he frantically tested ALL the video games that he had been unable to use and was in heaven since they all worked now. After he had calmed down, he then went on to Twitter, Facebook and some nerdy blogs to post news of the miracle that his 'smart' cousin Louie had accomplished.

TO DO/SUBMIT:
YOU ARE LOUIE! MAKE VINNIE HAPPY AND JUST DO IT!
SUBMIT a detailed account of HOW you performed each step, HOW you arrived at each result and HOW you reasoned and arrived at the correct requirements.

ORDERS of TIME MAGNITUDES

10^9 - 1 nanosecond - ns - One billionth of one second

1 ns: Time to execute one machine cycle by a 1 GHz microprocessor

10^6 - 1 microsecond - µs One millionth of one second (µ is the Greek letter Mi/Mu)

1 µs: Time to execute one machine cycle by an Intel 80186 microprocessor

10^3 - 1 millisecond - ms One thousandth of one second

1 ms: time for a neuron in human brain to fire one impulse and return to rest

10^0 - 1 second – s One second

1 s: an eternity in computer time…

CLOCK TIMINGS: The **hertz(Hz)** is equivalent to cycles per second. As an SI unit, **Hz** can be prefixed; commonly used multiples are **kHz** (kilohertz, 10^3 Hz), **MHz** (megahertz, 10^6 Hz) and **GHz** (gigahertz, 10^9 Hz). One hertz simply means **"one cycle per second"** (typically that which is being counted is a complete cycle); 100 Hz means "one hundred cycles per second", and so on. The unit may be applied to any periodic event—for example, a computer clock might be said to tick at 1 GHz, implying that the clock produces 10^9 ticks every second. Each cycle therefore lasts 1s/10^9 or 1 ns(one nanosecond).