Clock speed of the Processor = 40 MHz

| Instruction Type | Instruction Count | Cycles per Instruction | cycles |
|---|---|---|---|
| Integer arithmetic | 45,000 | 1 | 45000 |
| Data transfer | 32,000 | 2 | 64000 |
| Floating point | 15,000 | 2 | 30000 |
| Control transfer | 8000 | 2 | 16000 |



- Total no: of cycles required to execute complete program
  - ➔ 45000+64000+30000+16000
  - ➔ 155000 cycles

**C=155000 cycles**

- Effective CPI= C/Ic
  - ➔ 155000/100000

**CPI = 1.55**

- MIPS rate= $f/CPI*10^6$
  $= 40/ 1.55*10^6$
  $=40*10^6/1.55*10^6$
  $= \mathbf{25.8}$

- Given f=40 MHz ➔ $\tau = 1/40$
  $T = Ic * CPI * \tau$
  $= 100000*1.55*1/40$
  $= 100000*1.55*0.025$
  $= 3875$
  $= \mathbf{3.875\ ms}$

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**Q2:**

3 enhancement with the following speed up are proposed for a new architecture

- $Speedup_1 = 30$
- $Speedup_2 = 20$
- $Speedup_3 = 15$

If enhancement 1 and 2 are each usable for 25% of the time, what fraction of the time must enhancement 3 be used to achieve an overall speed up of 10 ?

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**Q2:**

Consider the design of a three level memory hierarchy with the following specifications for memory characteristics:

| Memory level | Access time | Capacity | Cost/Kbyte |
|---|---|---|---|
| Cache | t1=25 ns | s1=512 Kbytes | c1=$1.25 |
| Main Memory | t2=903 ns | s2=32 Mbytes | c2=$0.2 |
| Disk array | t3=4 ms | s3 =39.8 Gbytes | c3=$0.0002 |

Hit ratio of cache memory is h1=0.98 and a hit ratio of main memory is h2=0.9.

(i) Calculate the effective access time.

(ii) Calculate the total memory cost.

EDULINE 11

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**Effective access time**

$T_{eff}$=h1t1+(1-h1)h2t2+(1-h1)(1-h2)h3t3

=0.98*25x$10^{-9}$+.02*.9*903x$10^{-9}$+.02*.1*1*4x$10^{-3}$

=24.5x$10^{-9}$+16.254x$10^{-9}$+.008x$10^{-3}$

=40.754 x$10^{-9}$ + .008x$10^{-3}$

=40.754x$10^{-9}$ +8000x$10^{-9}$

= 8040.754x$10^{-9}$

= **8.04 µsec.**

EDULINE 12

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**Q3:**

Determine the frequency of the pipeline if the stage delays are τ1 = 3ns, τ2 = τ3=5ns and τ4 =8 ns and the latch delay is 1 ns.

$\tau_{max=}$ 8ns

d = 1ns

$\tau = \tau_{max} + d = 8 * 10^{-9} + 1 * 10^{-9} = 9 * 10^{-9}$

$f = \frac{1}{\tau} = = \frac{1}{9 * 10^{-9}} = 111.11$ MHz

EDULINE 17

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