ELE 4142 HW8 Name_____

1) You have been asked to design a VERY simple circuit to determine the direction of motion for the quadrature output of a mouse 20pts

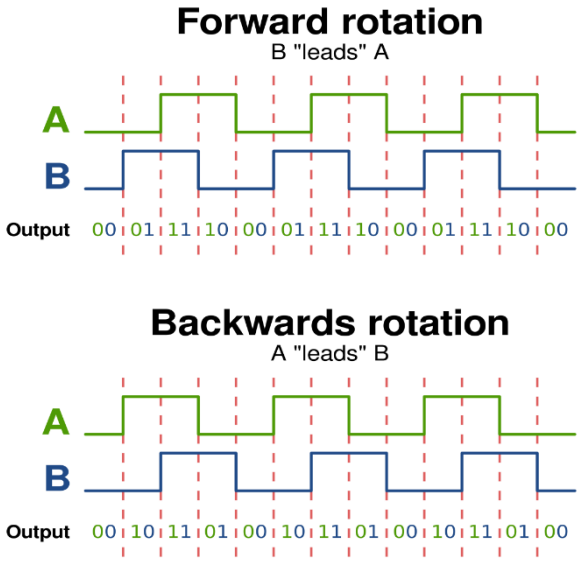
Design Requirements:

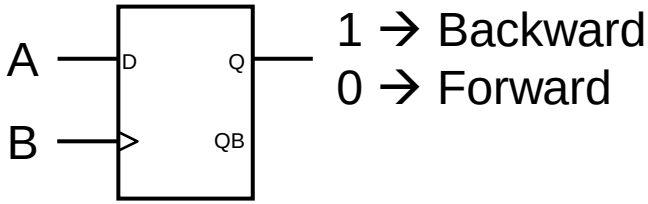
Forward or Backward. (don't over complicate it – direction only)

Available signals:

A, B

Explore several design spaces – there is a truly simple solution





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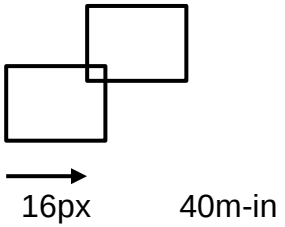
2) You have been tasked with calculating the required frame rate for a new optical mouse design 30pts



2.5in → 62.5cnts

Design Requirements:

Motion up to 25ips must be supported

System Specs:

20 x 20 sensor

Sensor resolution = 400 cpi

4x4 pixel minimum required to attain correlation

400cpi → pixel resolution of 2.5m-inch/pixel

Max motion of 16 pixels/frame → 0.04in / frame

25ips / 0.04in/frame = 625fps

400cpi * 25ips = 10,000 counts/s

Maximum allowed motion / frame would be 16 pixels in either direction

10,000 counts/s / 16 pixels/frame = 625 fps

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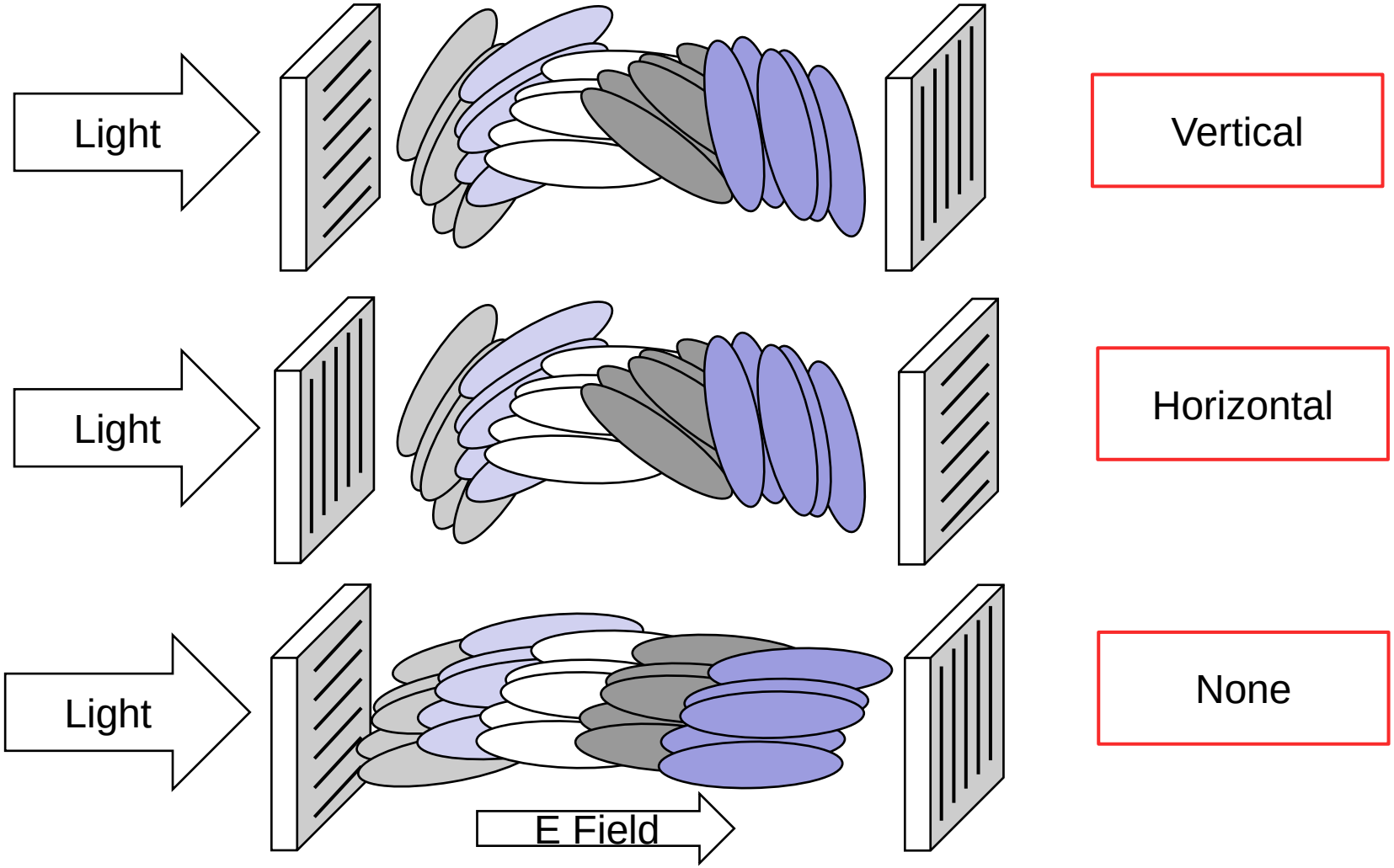
3) Assuming a Twisted Nematic Liquid Crystal – indicate the polarity of light exiting the structure: Horizontal, Vertical, None 10pts



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4) You have been assigned the job of sizing the Cell capacitance of a new OLED pixel cell. This cell will be used in a 1080p display operating at a 60Hz refresh rate. 30pts

Design Requirements:

Maintain 95% programmed brightness between refresh cycles at 75% of peak brightness

Known Parameters:

Peak programming voltage = 8V

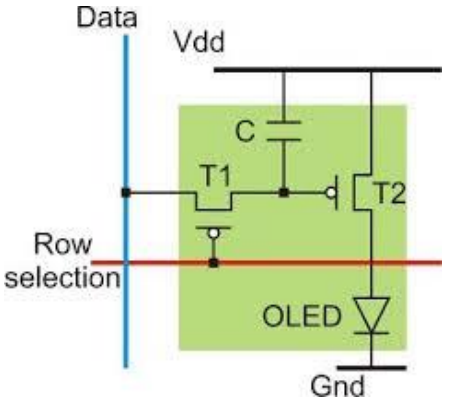
Parasitic capacitance on the source follower gate node = 5fF

Parasitic leakage on the source follower gate node is 0.5pA

Design Understanding:

Brightness is proportional to diode current

Diode current is proportional to the gate voltage of the source follower



Peak brightness ~ current

Current ~ gate voltage

100% peak brightness ← 100% programmed voltage

75% peak brightness ← 75% programmed voltage = 6V

95% → 5% drop → 300mV

$i=C\,dv/dt$ $C = i\,dt/dv$

i = 0.5pA, dv = 300mV, dt = (1/60) = 16.66ms → Ctotal = 27.8fF

Ccell = 22.7fF

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5a) Determine the difference in time for a specific individual pixel to update comparing a 1080p display operating at 120Hz and a 1080i display operating at 120Hz 5 pts

No difference – progressive or interlaced does not matter, only the refresh rate

5b) What is the fundamental physical principle behind Eink operation 5 pts

Electrosatics (Electrophoresis)