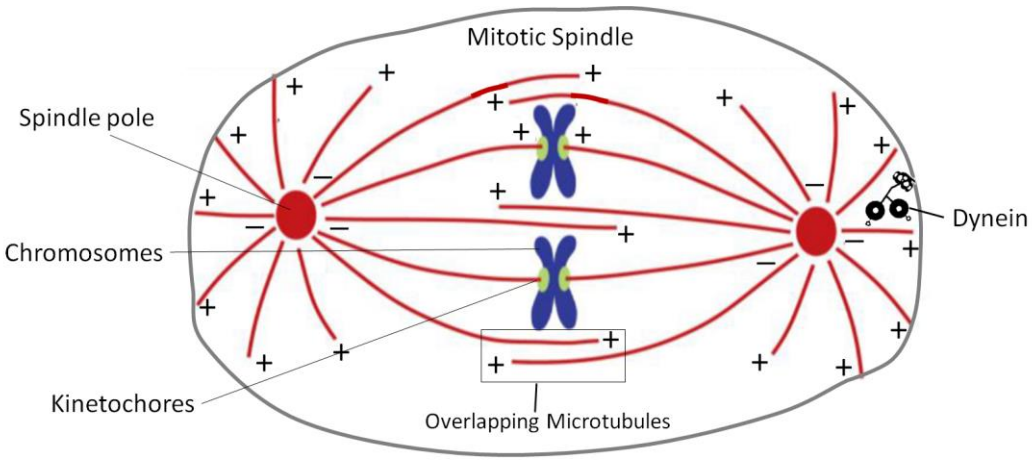
BB101 QUIZ 31 MAY. MODEL ANSWERS.

EACH QUESTION HAS 2.5 MARKS. TOTAL MARKS = 10.

Q1) Re-draw the Mitotic spindle & Label the following :- *(i) Plus and Minus ends of Microtubules (ii) Chromosomes (iii) Kinetochores (iv) Spindle Poles*. The Dynein shown generates force against the microtubule near it. Will Dynein bring together or separate the chromosomes? Why? Now Imagine that the same Dynein is generating force between the two Overlapping Microtubules. Will the Overlap Increase or Decrease? Draw and Explain.

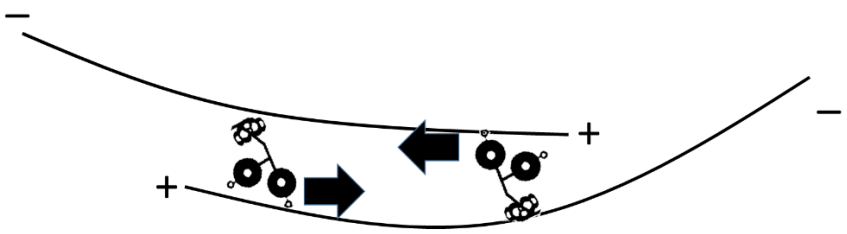
0.1 Mark for each labelling (Total = 0.1 x 5 = 0.5)
Dynein on plasma membrane part = 1 Mark
Dynein on Overlapping microtubules part = 1 Mark

Below is an image with required components labelled :-



Dynein at the plasma membrane will bind to microtubule and walk towards minus end of microtubule, while still remaining attached to the plasma membrane. This will generate a pulling force to move the spindle pole towards the cell membrane. Spindle pole is attached to the chromosomes via another microtubule. So, the dynein will separate the chromosomes.

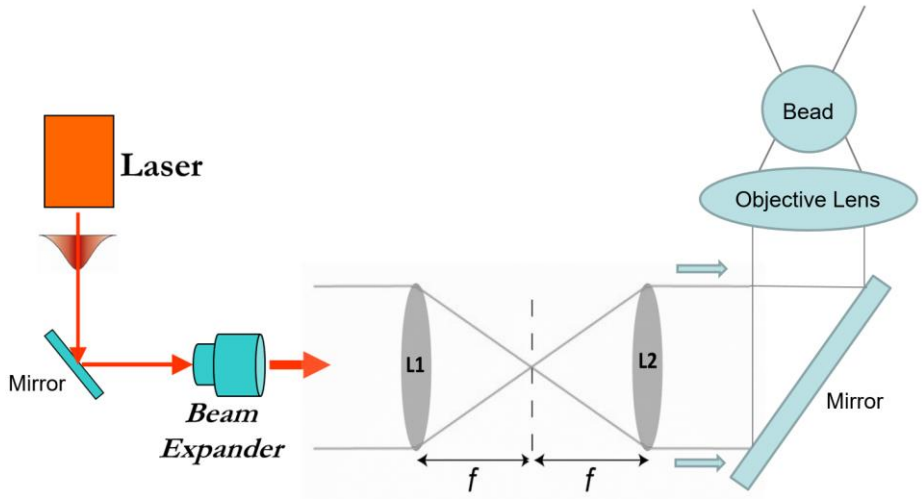
Below cartoon shows two dynein motors generating force in the microtubule overlap region. For each Dynein one microtubule is the cargo and it tries to walk towards minus end of other microtubule (see black arrows). Thus, the dyneins will pull the microtubules together and cause their overlap to INCREASE.



Q2) Re-draw the sketch shown with lenses L1 and L2 on your answer sheet.

1. Now draw and label the additional components needed to make a simple Optical Trap.
2. Show the location where you will trap a bead in your Optical Trap.
3. Explain with a drawing how the position of the trapped bead will change if you move L2 towards L1.

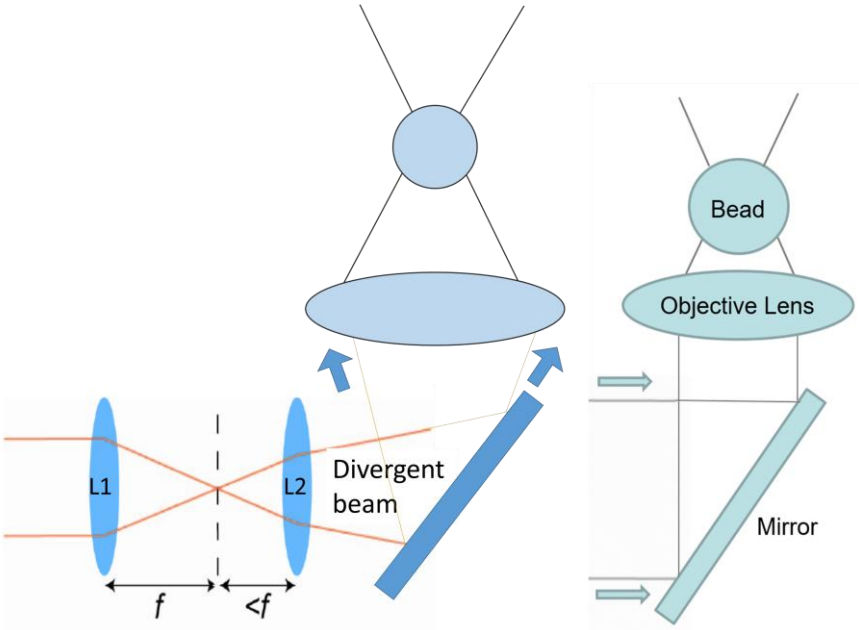
Part 1 = 1 mark
Part 2 = 0.5 marks
Part 3 = 1 mark



Addition components are drawn in above image. Location of trapped bead is shown.

When L2 is brought closer to L1 the beam emerging after L2 will become slightly divergent. So, the focus position of the light after the objective lens will also move farther away (upwards). Accordingly, the position of the trapped bead will also moved farther away from the objective lens (i.e. upwards). See figure below and Compare with original situation where we had parallel beams and distance between lenses was 2f.

Hence, we can move the position of trapped bead up in the chamber by moving the lenses L1 and L2 closer to each other. By the same argument, if we move the lens L2 away from L1 then the light coming out of L2 will be slightly convergent and the bead will move downwards. In this manner, the lenses L1 and L2 help to adjust the focus position of the trapped bead in the flow chamber.



Q3) Each statement below has **ONE** mistake.
Write the statement on your answer sheet after correcting this mistake.

i. G-Actin dimers hydrolyse ATP to form F-Actin
ii. An Optical trap exerts more force as the trapped object moves towards the trap centre
iii. The step size of Kinesin is 8×10^{-9} Nanometers
iv. Taxol is a drug that blocks ATP hydrolysis on microtubules
v. Myosin is needed to polymerize F-Actin at the rear end of a crawling cell

0.5 mark for each part

i. G-Actin **monomers** hydrolyse ATP to form F-Actin

ii. An Optical trap exerts more force as the trapped object moves **away from** the trap centre

OR

An Optical trap exerts **less** force as the trapped object moves towards the trap centre

iii. The step size of Kinesin is 8×10^{-9} **meters**

OR

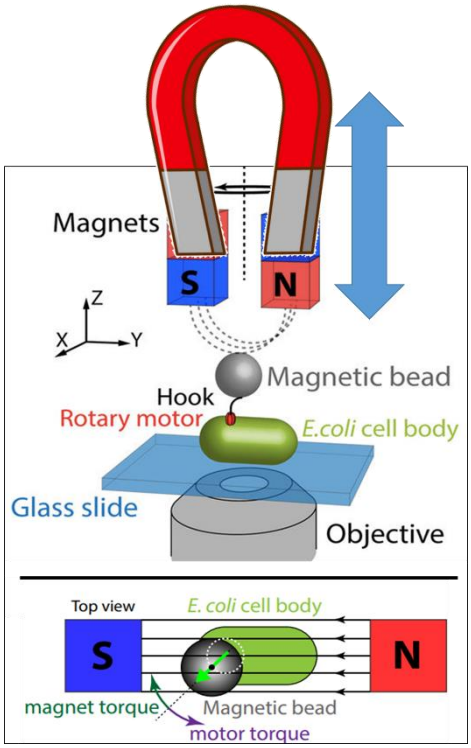
The step size of Kinesin is 8 **Nanometers**

iv. Taxol is a drug that blocks **GTP** hydrolysis on microtubules

v. Myosin is needed to **depolymerize** F-Actin at the rear end of a crawling cell

Q4) You have been given (i) A horseshoe magnet (ii) A bacteria that has one flagellum (iii) A magnetic bead. Explain with a drawing how you will measure the torque generated by the bacterial flagellar motor using these components.

No subdivision of marks.
Total of 2.5 depending on the answer



Students have to show some version of this experiment that I had discussed in class. The body of bacteria has to be attached to coverslip and the flagella has to be free to rotate. The magnetic bead has to be attached to flagella by some mechanism (how exactly flagella is attached to bead is not important). The horseshoe magnet will try to align the magnetic bead in the direction of the magnetic field of the horseshoe magnet. The motor will try to change this alignment when it tries to rotate. By recording the rotation of magnetic bead we can calculate the torque.

The magnet can be moved up/down (see double headed arrow) to vary the magnetic field.