Answers without **supporting work** or **necessary unit** will not be given full credit. If the meaning of the question isn't clear, please ask TA! You have **25mins** to complete this mini-test.

Q.1 Figure 1. shows an infinite wire carries a current $\vec{I} = 49$ [A] pointing toward y direction, the linear density of the wire $\mu = 2$ [kg m^{-1}], gravitational acceleration $g = 9.8$ [m s^{-1}], if we want to generate enough magnetic force to lift the wire. **(a)** What is the minimum magnitude of magnetic field we need to place in this system? (7 point) **(b)** What is the direction of this magnetic field? (3 point)

$\vec{F_B} + m\vec{g} = 0$

$\lambda L B \sin 90° + \mu L g = 0$

$49 \times B + 2 \times 9.8 = 0$

$B = -0.4T$ (a)

(b) $-x$ direction : $(-1, 0, 0)$

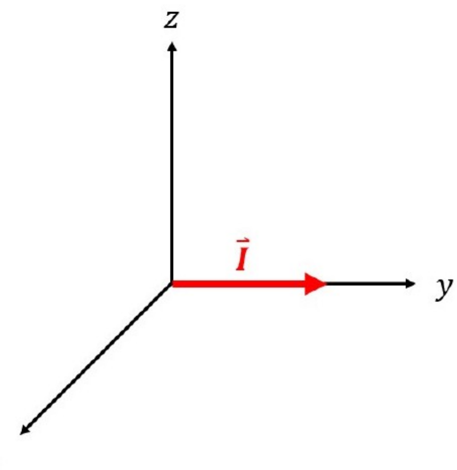
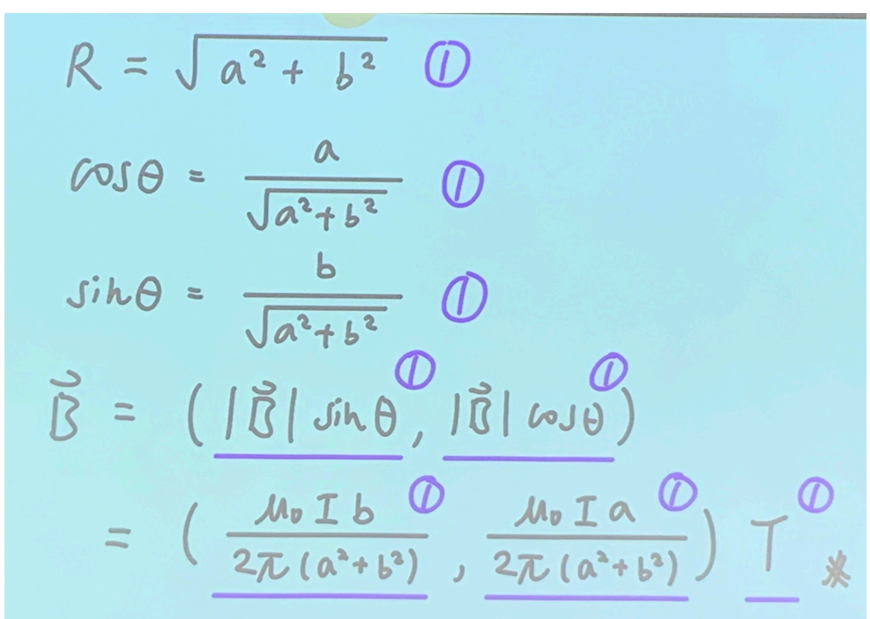


Figure 1

Q.2 There is an infinite length of wire lies on x-y plane. Its current, I $[A]$, flows from $-y$ to $+y$ direction. The distance between the wire and the original point $(0, 0, 0)$ is a $[m]$. The permeability constant is μ_0 $[\frac{T \cdot m}{A}]$. Please write down the magnetic field at point $(0, 0, b$ $[m])$. (10 points)



$R = \sqrt{a^2 + b^2}$ ①

$\cos\theta = \frac{a}{\sqrt{a^2+b^2}}$ ①

$\sin\theta = \frac{b}{\sqrt{a^2+b^2}}$ ①

$\vec{B} = (|\vec{B}| \sin\theta, |\vec{B}| \cos\theta)$ ① ①

$= \left(\frac{\mu_0 I b}{2\pi(a^2+b^2)}, \frac{\mu_0 I a}{2\pi(a^2+b^2)} \right) T$ ① ① ① ※