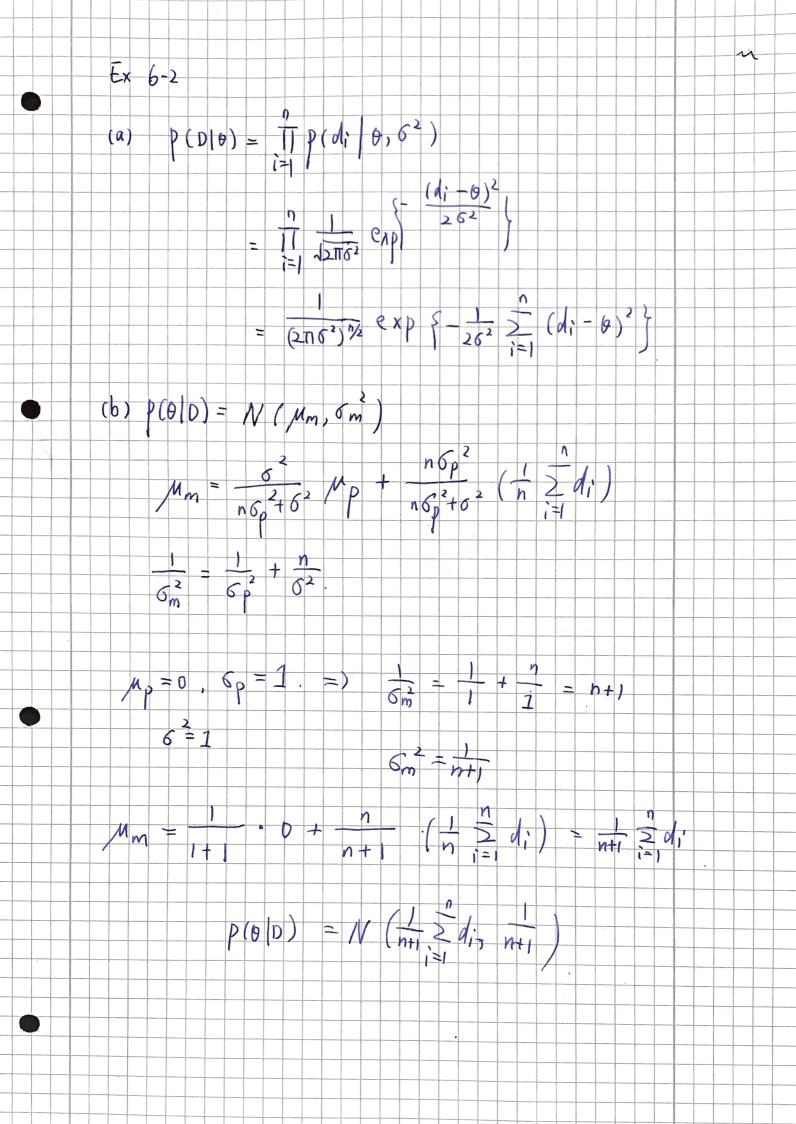
Ex6-1.  $P(A|B) = \frac{P(A,B)}{P(B)} = \frac{P(A,B)}{\int P(B|A)P(B)}$ Bayes' theorem: probability: 0 > PCA)  $P(B) = \sum_{j} P(B|A_j) P(A_j)$ likelihood: P(A 10) P(A:1B) = 2(B|A) P(A:) T = 2 P(B|A;) P(A;) 0: Continus. likelihood  $P(O|D) = P(O|O^*D(O) \leftarrow Prior P(O,O)$ 5 p(010) p(0) do. Sp(0,0) de - normalization Posterior KL (Q(0)11 P(010) +1 =  $\int Q(\theta) \log \frac{Q(\theta)}{P(\theta|0)} d\theta + \int Q(\theta) \log \frac{P(\theta,0)}{Q(\theta)} d\theta$ JQ(0) hog Q(6) P(0/P)P(0) d8. = 1 Q (0) hoy P(D) do log PCD) / QCO) do = log PCD)

(b) lower bound: Let (A, ≤) is a partial ordered set z is a lower bound if \$\frac{1}{2} \in A. S.t. YXEBCA, XZZ  $KL(Q(\theta)||P(\theta|D)) = \int Q(\theta) \cdot \log \frac{Q(\theta)}{P(\theta|D)} d\theta$ Gibbs' inequality.  $P = \{P_1, \dots, P_n\}$   $P = \{P_1, \dots, P_n\}$  P =KL (Q(0) // (0/0)) >0 KL + L = log P(D)L = log p(D) - KL = log p(D) => Lis a lower bound. with KL(PIIQ) zero is iif P = Q almost every where a.e.



 $P(\theta|D) = \frac{P(D|\theta)P(\theta)}{P(D)}$ (C) TT = N(0,62) · N(up, 6p2)  $\int \prod_{i=1}^{n} N(\theta, \delta^{2}) \cdot N(\mu_{p}, \delta_{p}^{2}) d\theta$ If P(0) changes, then P(0)'s conjugated prior might not have a analytical solution. Gaussian likelihood is self conjugated conjugated distribution: prior dist as same as posterior dis conjugated priors leads to closed-form expression for the posterior.