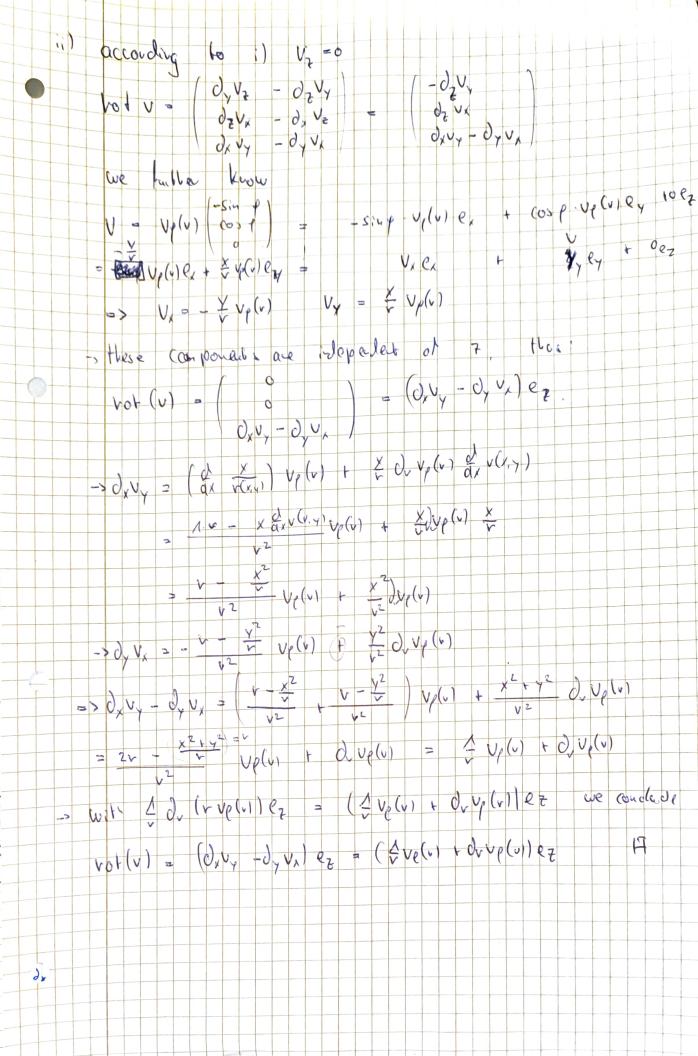
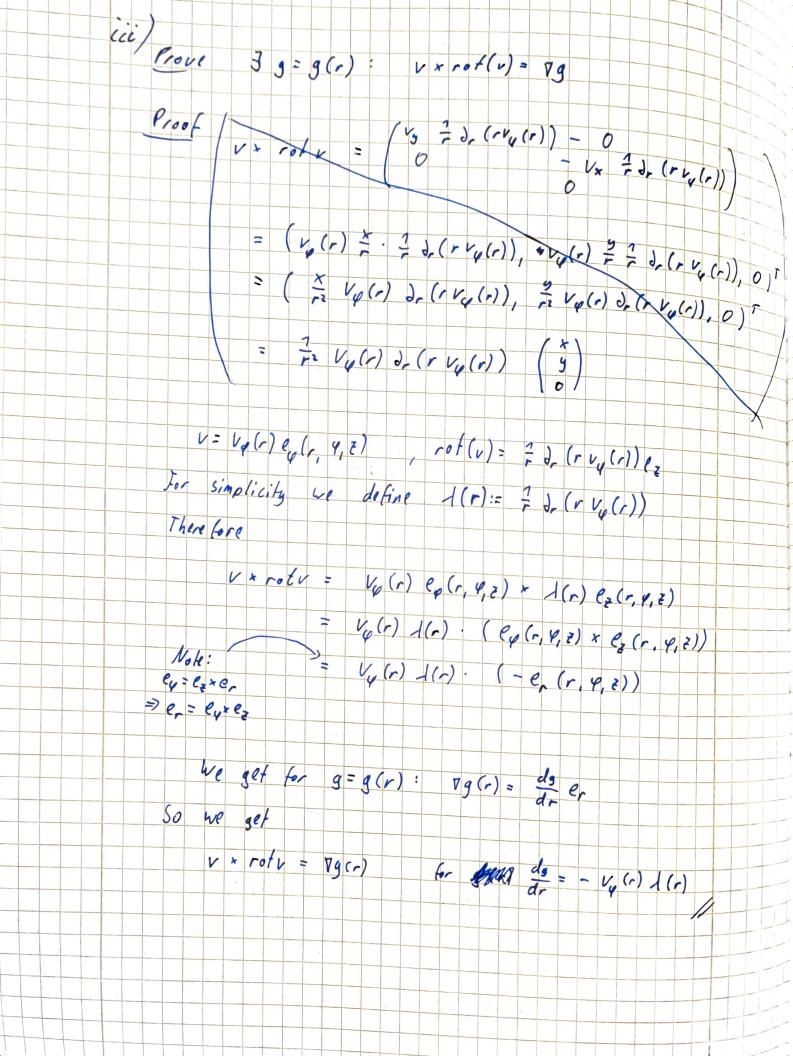
Numerics of incompressible flows 1 (SS 25) Homework 2

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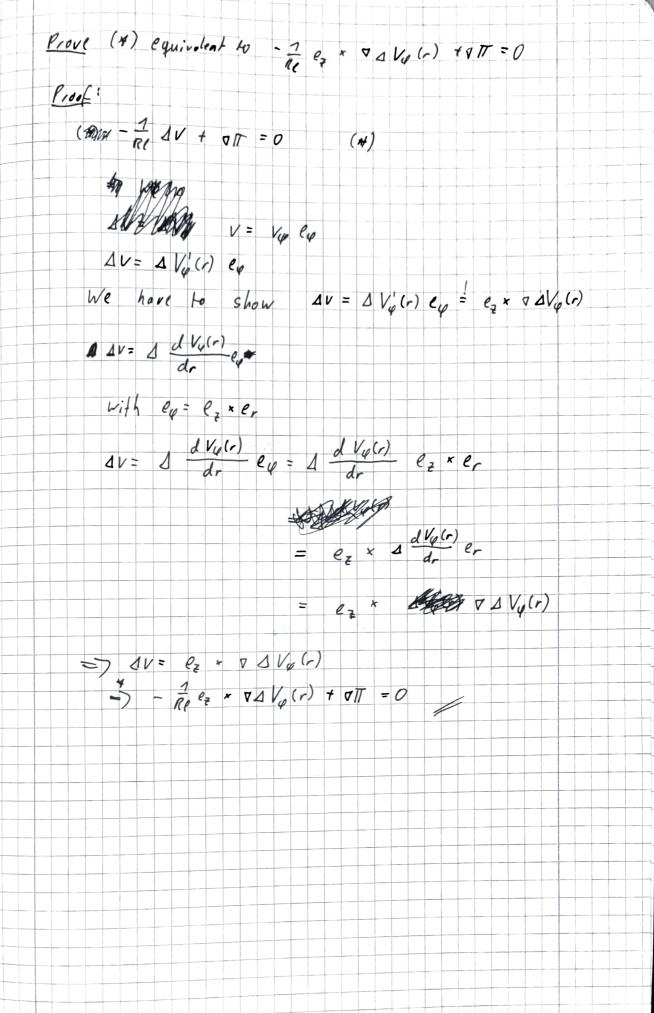
Due: 21 May

Homework ? Gercise 1 V(x,4,7)= V4(r) 0 e4(r,4,2) p: 2-> R P(x,y, Z) = p(r) c) Prove div v = 0 Proof Witho the Noke from Ex 1 we have div v = = = = (- v) + = = du vo + dz 42 Since V = Vy eq we can say VANA V = VZ = O => div v = = = 2 du vy in respect to 4 is O (2, 4 = 0)





b.) Prove: If solution has assumed symmetry, then: - 2 AV + VII = 0 4 7 11 - 9 Proof: We use Homework 16: (v · V) v = = 7 11 v 112 - v x rot v and put in the results from Ex 1cic: $(v \cdot \nabla)v = \frac{2}{2} \nabla ||v||^2 - \nabla g \qquad \text{with} \qquad \frac{dg}{dr} = -V_{ip}(r)\lambda(r)$ The Navier stokes equation with o on the Krightside, can be withen as - Re IV + (v. A)v + Ap=0 where p is pressure. Therefore we get $-\frac{7}{R\rho} \Delta v + \left(\frac{7}{2} \nabla ||v||^2 - \nabla g\right) + \nabla \rho = 0$ This can be rewritten - = 1 1v + \(\frac{1}{2} ||v||^2 - g + p \) = 0 and which is - 2 1v + VIT = 0 where IT = pt = 11v112-q and = = - Vq(r) ((r) Ex 7 a.) Vy = 4 Prove 3 de scalar - volued 4(1): VAVy = 40, The Laplacian of a vector field in colindrical coordinants 1s definited as $\Delta V = (\nabla \cdot \nabla) V = \nabla (\nabla \cdot \nu) - \nabla \times (\nabla \times \nu)$ = Vdivv - Vxrofv we know from 10 and 100 ports of it: AV = rdir v - V rrotu 7: - 0 - 0 - 2 - 2 (r v4 (-)) c2 = - V × ((r) · ez Define - V/(r) x e2 -1(1)= ... = - d/(r) er x ez = _ d1(1) (en x ez) Note = - ds(r) ey = - d (2 d, (r v, (r)) ey on de Vo(r) = Vulor & Se Vulor Vulor en = Vulor) en 50 1 v = - d (- d (r v (r)) ex =) 1 /2 = - d (= dr (r /4 (r)) /2 =) What When I Define 1 := - d (+ 2, (+ V6 (-)) =7 V 1/4 = V 1 4 We see I = I(r). There fare the gradient DI(r) 15 only in ex-direction =) Then is a scalor valued funct. 4(r)



$$\begin{array}{c} 3, \\ -\frac{\pi}{R} \cdot \frac{1}{2} \times \nabla \Delta V_{0}(r) + \nabla \Pi = 0 \\ \\ \stackrel{?}{=} \\ -\frac{\pi}{R} \cdot \frac{1}{2} \times \nabla \Delta V_{0}(r) + \nabla \Pi = 0 \\ \\ \stackrel{?}{=} \\ -\frac{\pi}{R} \cdot \frac{1}{2} \times \nabla \Delta V_{0}(r) + \nabla \Pi = 0 \\ \\ \stackrel{?}{=} \\ -\frac{\pi}{R} \cdot \frac{1}{2} \times \nabla \Delta V_{0}(r) + \nabla \Pi = 0 \\ \\ \stackrel{?}{=} \\ -\frac{\pi}{R} \cdot \frac{1}{2} \times \nabla \Delta V_{0}(r) + \nabla \Pi = 0 \\ \\ \stackrel{?}{=} \\ -\frac{\pi}{R} \cdot \frac{1}{2} \times \nabla \Delta V_{0}(r) + \nabla \Pi = 0 \\ \\ \stackrel{?}{=} \\ -\frac{\pi}{R} \cdot \frac{1}{2} \times \nabla \Delta V_{0}(r) + \nabla \Pi = 0 \\ \\ \stackrel{?}{=} \\ -\frac{\pi}{R} \cdot \frac{1}{2} \times \nabla \Delta V_{0}(r) + \nabla \Pi = 0 \\ \\ \stackrel{?}{=} \\ -\frac{\pi}{R} \cdot \frac{1}{2} \times \nabla \Delta V_{0}(r) + \nabla \Pi = 0 \\ \\ \stackrel{?}{=} \\ -\frac{\pi}{R} \cdot \frac{1}{2} \times \nabla \Delta V_{0}(r) + \nabla \Pi = 0 \\ \\ \stackrel{?}{=} \\ -\frac{\pi}{R} \cdot \frac{1}{2} \times \nabla \Delta V_{0}(r) + \nabla \Pi = 0 \\ \\ \stackrel{?}{=} \\ -\frac{\pi}{R} \cdot \frac{1}{2} \times \nabla \Delta V_{0}(r) + \nabla \Pi = 0 \\ \\ \stackrel{?}{=} \\ -\frac{\pi}{R} \cdot \frac{1}{2} \times \nabla \Delta V_{0}(r) + \nabla \Pi = 0 \\ \\ \stackrel{?}{=} \\ -\frac{\pi}{R} \cdot \frac{1}{2} \times \nabla \Delta V_{0}(r) + \nabla \Pi = 0 \\ \\ \stackrel{?}{=} \\ -\frac{\pi}{R} \cdot \frac{1}{2} \times \nabla \Delta V_{0}(r) + \nabla \Pi = 0 \\ \\ \stackrel{?}{=} \\ -\frac{\pi}{R} \cdot \frac{1}{2} \times \nabla \Delta V_{0}(r) + \nabla \Delta$$