

Math 181 Honors Quiz 10 Version A

1. Find the following derivatives:

(i)  $\frac{d}{dx} \frac{\sin(x+1)}{2+\cos x}$

(ii)  $\frac{d}{dx} \arcsin x$

(iii)  $\frac{d}{dx} (x \log(1+x^2))$

(iv)  $\frac{d}{dx} x^{(x^x)}$

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2. Answer one of the following:

- (i) Let  $f$  be twice continuously differentiable on an open interval and  $z$  a zero of  $f$  such that  $f'(z) \neq 0$ . Prove that repeated applications of Newton's recipe

$$z_{n+1} = z_n - \frac{f(z_n)}{f'(z_n)}$$

yields a sequence of approximations  $z_1, z_2, \dots$  that converge to  $z$  provided that the first approximation  $z_1$  is close enough to  $z$ .

- (ii) A person, idealized as a particle of mass  $m$ , jumps vertically starting from a crouching position. Suppose the height of their head is initially  $b$  and at the moment  $t_1$  when their feet leave the ground it is  $h$ . Let  $f$  be the force exerted by their feet while jumping and  $-gm$  be the force of gravity. Find  $t_1$  as a function of  $b, f, g, h$  and  $m$ .