## Observational Cosmology Year 3 Assessed Problems # 3

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due on December 13, 2019 at 3:30 pm (Submit to box outside ESO)

[Note: For parts of this assignment, you will need to write some (very simple) code.]

For all questions, consider a flat, matter-dominated universe, and an object of physical size L.

- 1. Calculate the redshift at which the angle subtended by this object appears the smallest. [2]
- 2. Plot the angle as a function of redshift in the interval  $0 \le z \le 10$ . [2]
- 3. Find the analytic expression (at the leading order) for the asymptotic behaviour of the angle above as a function of redshift in the limit of small and large redshifts, z. [2]
- 4. In the limit of small redshift, derive the range of z over which your approximation differs from the exact result by no more than 10%. [2]
- 5. Suppose you would like to calculate the angular diameter distance between two objects. These objects are at  $z_1$  and  $z_2$  and neither  $z_1$  or  $z_2 = 0$ . Would it be correct to calculate the angular diameter distance to each from z = 0 and then subtract the two distances? Why or why not? [2]

## Guidelines

• This sheet accounts for 10% of the credit of the course. Marks are in bold within brackets.