320.

(a) $v_{circ} = \sqrt{\frac{GM}{r}} = \sqrt{\frac{6.67E-11 mks \times 2E30 \text{ kg}}{40 \times 1.5e11 \text{m}}} = 4.72 \text{ km/s}$

(b) similar calculation: $v_{circ} = 29.7$ km/s

(c) In one day, the comet moves 4.72 km/s $\times$ 86400 s/day = 4.08×10^5 km. At a distance of 40 AU, this angle is 4.08E5 km / (40 $\times 1.5E8$ km) rad = 6.8e-5 rad = 6.8e-5 rad $\times$ 206265"/rad = 14.0". So the comet moves 14"/day forwards.

[You could have just used the formula for angular velocity to do this: $\omega = v / r$.]

(d) Similar calculation, except you use the earth's motion of 29.7 km/s. A simple diagram will convince you that this motion is in the opposite direction to the answer in (c) - or see me - just like retrograde motion that we discussed in class. The angular velocity is 88.3 arcsec/day.

(e) The net motion of the comet is 88.3 - 14.0 = 74.3"/day, in a direction opposite to the comet's motion. The earth's orbital motion dominates by far!

501.

parallax["] = 1 / d [pc]

Therefor parallax=1/250" = 0.004". This is marginal. I said in the notes that you could measure parallax to 0.001"; the text says 0.01". So either answer is correct. For reference I think the text meant to say "parallax can be measured reasonably accurately to 0.01 arcsec".

502.

The simple way: Pluto is 39 times further away than the earth is from the sun, so parallax has to be 39 times bigger. Therefore the parallax angle is 39 x 0.004" = 0.156 arcsec.

The more detailed way:

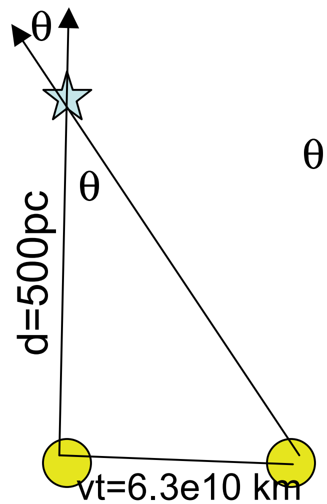
$\Delta\theta = 39AU / d_{AU}$ rad$=39 \times 206265 / d_{AU}$ arcsec

But $d_{AU} = 206265 d_{pc}$. So substituting above, the 206265's cancel out and we're left with:

$\Delta\theta = 39 / d_{pc}$ arcsec, which for d=250pc works out to 0.156 arcsec as above.

504.

The sun moves vt=20 km/s x 100 yr x (3.16E7 s/yr) = 6.32e10 km in 100 yr. You can ignore the earth's motion around the sun and the earth's rotation in all this. So the basic diagram looks like:



θ=vt/d rad = 6.3e10km / (500 pc x 3.1e13 km/pc)

= 4.065e-6 rad

x 206265 "/rad = 0.84 arcsec

[I realize that "change in position" was a bit ambiguous; what I meant to say was "change in angular position on the sky". So I will accept the answer 6.3e10 km.]