

Exam feedback 2017 space physics

JE, July 2017

Question 1 (compulsory)

- (i) In part (a), the majority of candidates were able to name the three waves, and most could describe their physics correctly. Many however forgot to mention the role of magnetic tension in the physics of the Alfvén wave. Part (b) was completed successfully by the majority of candidates, as was part (c). In part (d), the diagrams were of variable quality, with full marks only being awarded for a completely correct and fully annotated diagram. It is worth noting that as long as the axes crossing points were noted correctly, and the curves were identified correctly, it was not necessary to draw perfect ellipses.
- (ii) Many candidates had difficulty identifying precisely where flux ropes are observed in space. The analysis of the flux rope field was generally done well. The quality of the sketches was variable, but only a small fraction of the marks were awarded for this.
- (iii) Although most candidates correctly identified the role of pressure balance, the fundamental role of frozen in plasma was surprisingly not mentioned quite often. Diagrams were again of variable quality and accuracy. Some candidates confused the termination shock and the heliospheric bow shock. Most were able to identify the heliopause.

Question 2

- (i) Most candidates were able to answer this part well, although a mistake sometimes seen in a number of answers was that the precise physics was not adequately explained.
- (ii) Most candidates who attempted this part did it well. There was some confusion with the coordinate system.
- (iii) And (iv). The calculations were usually performed accurately for the most part, but more mistakes were made in the last part – the behaviour of Neptune and the name of the plasma region inside the flowline were wrong.

Question 3

- (i) Most candidates answered this correctly. A common mistake was to forget the normal component of the upstream velocity in the definition of the Mach number.
- (ii) Most candidates could do the first two parts satisfactorily. Of those who attempted the third part, to show the tangential electric field is conserved, most were able to demonstrate the necessary elements of the solution. This then led naturally to the required result remembering that B_n is 0.
- (iii) Diagrams here were of extremely variable quality. The definition of the foreshock was usually given correctly where attempted.

Question 4

- (i) This was done mostly successfully
- (ii) The diagrams were drawn fairly well, but rarely completely and accurately. The derivation was usually well done
- (iii) This part presented few problems for those who attempted it
- (iv) A surprising number of calculation errors were made in this section. For the commentary at the end it was necessary to report more than the answer in words to gain full marks.

Question 5

- (i) Most candidates completed this correctly. Some students forgot a factor of 2π
- (ii) Again most candidates completed this correctly, but some did not draw the drift diagram correctly, and some forgot that this is a vector calculation
- (iii) Most candidates were able to calculate the drift step, and the gyroradius. Errors carried forward were not penalised. Any reasonable answers to the last part were accepted, but the amount of marks depended on the detail of the answer.
- (iv) Most candidates were able to recall how the motion is affected in part (a), with the amount of marks depending on the detail of the answer. The second part was the most challenging conceptually, but most of the marks were given for the method and its key elements, rather than for the final correct numerical answer.