Question 1

(a)

(b) Which of the following explains ultimately why angular momentum is not conserved along the lower branches of the Hadley circulation?
Tick the correct answer(s). There can be more than one correct answer.

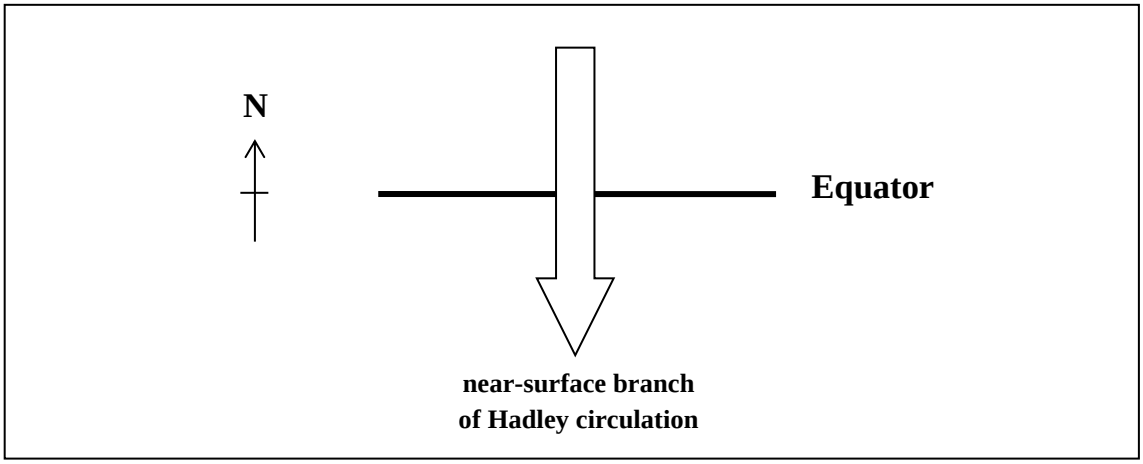
☐ I
☐ II
☐ III
☐ IV

(c)

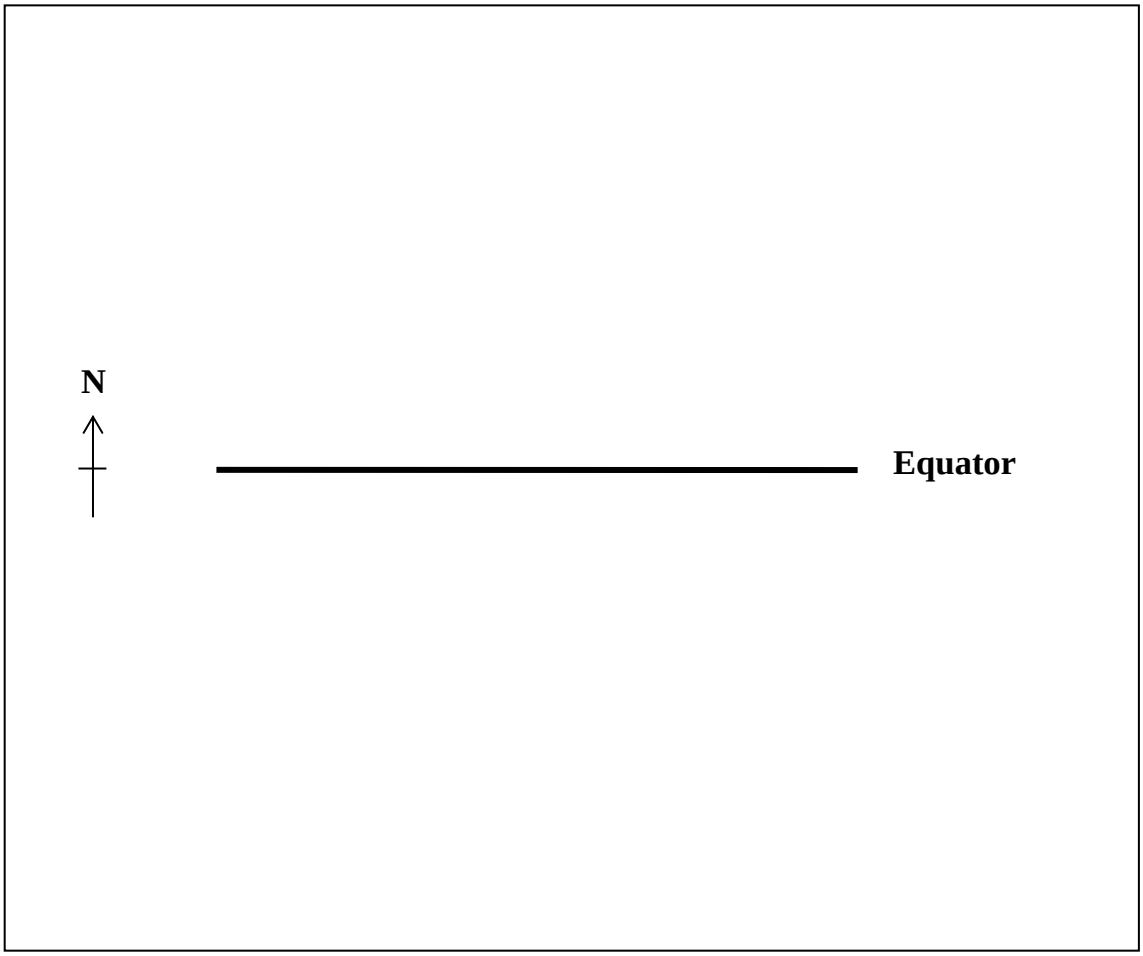
Hence, which hemisphere below has a stronger atmospheric jet stream?

☐ I
☐ II
☐ III

(d)


N
Equator
near-surface branch
of Hadley circulation

(e)


N
Equator

(f)

(g)

(h)

(i) (A)

(i) (B)

(j)

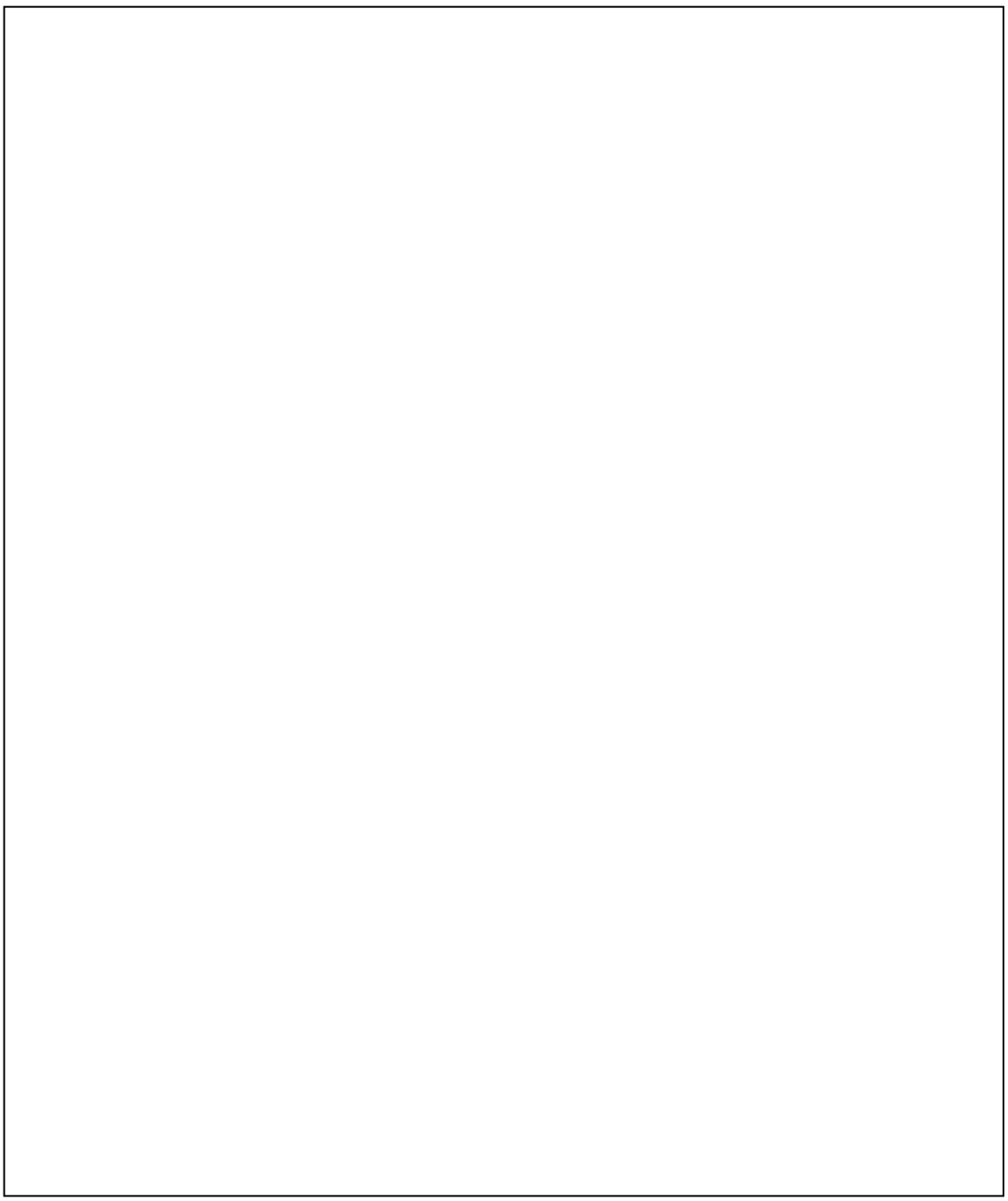
(k)

(l) Which of the following statements explains why $\varepsilon$ is less than the ideal value? Tick the correct answer(s). There can be more than one correct answer.

☐ I
☐ II
☐ III
☐ IV

Question 2

(a)



(b)

(c) (i)

(ii)

(d) (i)

(ii)

(iii) If the electron wave is a spherical wave instead of a plane wave, is the fringe spacing larger, the same or smaller than the fringe spacing calculated in (ii)?

☐ Larger
☐ Same
☐ Smaller

(d) (iv)

(v)

Question 3

(a)

Diagram of an ideal gravitational lensing system

(b)

Image of the source *as seen from earth*

(c)

Image of the source *as seen from earth*

Diagram to explain source-lens system

(d)

(e)

(f) Consider the case where we have a lensing object of the order of a few solar masses ($M \sim$ a few $\times 10^{30}$ kg) in the nearby regions of the galaxy (distance $D_L \sim$ a few $\times 10^{18}$ m away) and a source object somewhat further out ($D_S \sim$ a few $\times D_L$). Which of the following apply in this case?

Choose the following conditions that apply to the case as described in the question:

- ☐ $\alpha$ is large and $\tan\alpha$, $\sin\alpha$, $\cos\alpha$ must be calculated exactly
- ☐ $\alpha$ is small and the small angle approximations to $\tan\alpha$, $\sin\alpha$, $\cos\alpha$ are permissible
- ☐ $\alpha$ is irrelevant and need not be calculated
- ☐ $\theta_E$ is large and $\tan\theta_E$, $\sin\theta_E$, $\cos\theta_E$ must be calculated exactly
- ☐ $\theta_E$ is small and the small angle approximations to $\tan\theta_E$, $\sin\theta_E$, $\cos\theta_E$ are permissible
- ☐ $\theta_E$ is irrelevant and need not be calculated

(g)

(h)