OCES 2003 Midterm, Spring 2023

Julian Mak (jclmak@ust.hk)

Set on: Fri 24th Mar; due: Fri 24th Mar

Blurb

- The midterm is multiple choice of 20 questions and marked out 30
  - 25 is roughly around the A- boundary, anything below 15 is probably a fail
- Olympiad style: 2 marks for each correct answer, -1 for each incorrect answer, 0 for skipping
  - there are actually 40 marks available, but even if you get 40/30 you still only get 30/30
  - you can get full marks without answering all questions
  - you should be thinking about 3 minutes per question
  - questions are a mix of interpretation/recall and computational questions
- Hand in the present stapled document with answers circled:
  - no marking to be interpreted as skipping the question, or you can explicitly write "skip", up to you
  - working optional but ultimately no marks given there, but it might be easier for us to point out where you went wrong if you did go wrong

!!! By handing something in, you agree to the usual Academic Honour code and Integrity declarations. For more, see http://qa.ust.hk/aos/academic_integrity.html.

Don’t panic, and read the question carefully

Problems

1. River discharge into the ocean modifies the ocean's
   (a) mass
   (b) salinity
   (c) momentum
   (d) all of these
2. Buoyancy given by $b \sim (\Delta\rho/\rho)g$ has units of
   (a) force
   (b) velocity
   (c) acceleration
   (d) mass
3. Thermodynamic forcing as given in the lectures directly affect
   (a) momentum
   (b) temperature and/or salinity
   (c) both (*a*) and (*b*)
   (d) neither (*a*) or (*b*)
4. In the Northern hemisphere, and assuming geostrophic balance, geostrophic flow would be
   (a) to the right of the negative pressure gradient
   (b) to the left of the negative pressure gradient
   (c) directed to the right of the isobars
   (d) directed to the left of the isobars
5. In a subtropical gyre with high SSH at the centre, by definition the negative pressure gradient is
   (a) directed along isobars
   (b) zero
   (c) outwards from the centre of the gyre
   (d) none of the other answers here are correct
6. A subtropical gyre by definition is a
   (a) cyclonic region
   (b) anti-cyclonic region
   (c) positive curl region
   (d) negative curl region

7. From Stommel's original model as discussed in the past two lectures, one of the key dynamical ingredient to the overall gyre circulation is

   (a) wind forcing
   (b) buoyancy forcing
   (c) eddies
   (d) bottom bathymetry

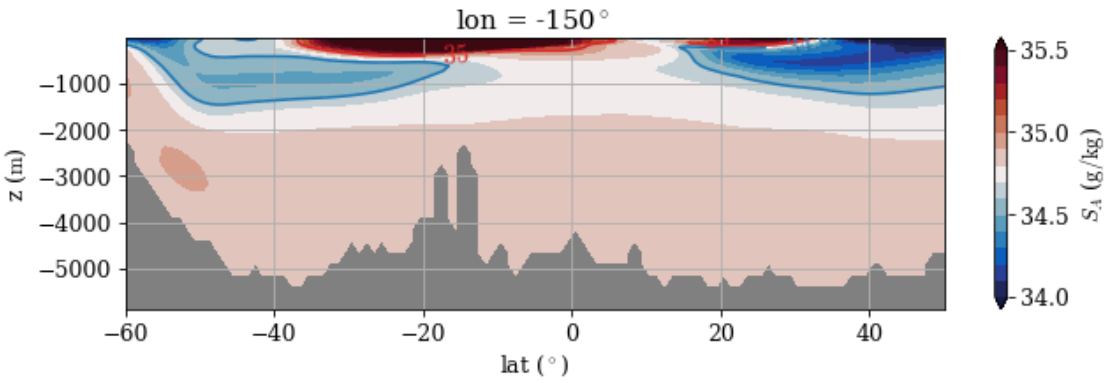
8. If the Earth's rotation reverses, and assuming the associated wind patterns stay fixed (they won't stay fixed but for argument sake lets say they do), then

   (a) we still get western intensification
   (b) the Sverdrup interior flow will reverse directions
   (c) there is no intensification on either side, and the gyre circulation will become symmetric
   (d) no vorticity balance possible

9. For a uniform wind pointing to the East wholly in the Southern Hemisphere, the theoretical Ekman transport would be

   (a) zero because there is no wind curl
   (b) zero because there is no Coriolis effect
   (c) to the South
   (d) to the North

10. Here is a meridional section of salinity in the Pacific:



   Which of the following statement is true?

   (a) neither (*c*) or (*d*)
   (b) both (*c*) and (*d*)
   (c) water is fresher (blue) at mid-depth so stratification is unstable
   (d) the graph is wrong because salty water (red) is at the equator even though there is lots of precipitation there which should lead to a fresh water signal

11. The Reynolds number Re = UL/ν of the Gulf Stream system is expected to be

    (a) zero
    (b) less than 1
    (c) about 1
    (d) much larger than 1

12. Given the Ekman number is defined as Ek = Ro/Re, for the Gulf Stream system the implied Ekman number is expected to be

    (a) massive
    (b) about 1
    (c) tiny
    (d) zero

13. If in-situ temperature and thus density really were the dynamical variables of interest, then we would expect to have

    (a) very little overturning circulation implied by density
    (b) both (*a*) and (*c*)
    (c) unstable abyssal stratification implied by temperature
    (d) neither (*a*) or (*c*)

14. In Hong Kong during the Winter months we experience a South-Westward wind, which implies a coastal Ekman

    (a) downwelling
    (b) off-shore surface transport
    (c) none of the other answers here are correct
    (d) upwelling

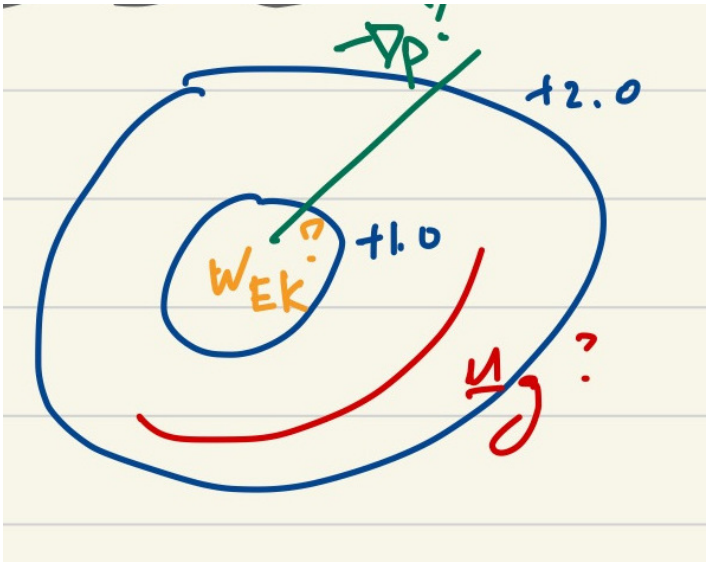
15. Monsoons are

    (a) seasonal variations in the solar forcing
    (b) yearly variations in the rain
    (c) none of the answers here
    (d) daily variations in the wind

16. For a purely eastward flow in the Northern Hemisphere that is decreasing in magnitude as you go north, that flow

    (a) neither (*c*) or (*d*)
    (b) both (*c*) and (*d*)
    (c) is cyclonic
    (d) has positive curl

17. Here is graph from one of the homeworks:



If I interpret the blue lines (the ones with +1.0 and +2.0) as sea surface isotherm *anomalies* instead of SSH, the pressure gradient (the green line) at the ocean surface in this instance

(a) can't say anything
(b) points out from the centre
(c) points into the centre
(d) is zero

18. If the ocean is completely fresh and the deeper parts of the ocean colder than 2° C uniformly warms by 1° C, then we expect

(a) the sea level will increase
(b) none of the other answers here are correct
(c) the total ocean mass will increase
(d) the salinity will increase

19. Which of these are valid units of pressure when they are to be interpreted literally?

(a) pig weight on Earth per biscuit area
(b) bars per hour
(c) meters per potato mass
(d) pounds per square inch (PSI)

20. Which of the following state is the most correct?

(a) anti-cyclonic curl leads to flow convergence in the Northern Hemisphere
(b) cyclonic eddies are high pressure regions
(c) surface flow divergence has associated Ekman downwelling
(d) Ekman downwelling promotes surface biological activity via changes to vertical nutrient supply