OCES 2003 Midterm, Spring 2023

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Set on: Mon 25th Mar; due: Mon 25th 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. Which of these are technically admissible units for a volume *rate*?
   (a) $mm^3\ yr^{-1}$ (only one with L^3T^{-1})
   (b) ml
   (c) kg $month^{-1}$
   (d) kg m^3
2. River discharge into the ocean modifies the ocean's
   (a) mass
   (b) salinity
   (c) all of these (this one)
   (d) momentum
3. Hydrostatic balance is the balance between
   (a) Coriolis effect and horizontal pressure gradient
   (b) vertical pressure and weight (this one)
   (c) pressure gradient and viscosity
   (d) weight and horizontal pressure gradient
4. On Earth and by definition, gravity is acting
   (a) perpendicular to the ellipsoid everywhere
   (b) at 90° to the ocean sea surface everywhere
   (c) uniformly over the Earth's land surface everywhere
   (d) at right angles to the geoid everywhere (potential surface)
5. The Reynolds number associated with marine micro-organisms is expected to be
   (a) much larger than 1
   (b) about 1
   (c) much less than 1 (small length, slow flow)
   (d) zero
6. The Reynolds number of the Gulf Stream system is expected to be
   (a) much larger than 1 (large length)
   (b) about 1
   (c) less than 1
   (d) zero
7. From Stommel's original model as given in the lecture 11, the minimal dynamical ingredients to get western intensification are
   (a) buoyancy, wind, eddies

(b) bathymetry, friction, buoyancy

(c) β, bathymetry, eddies

(d) wind, β, friction (this one)

8. A subtropical gyre in both hemispheres is by definition a

   (a) cyclonic region

   (b) anti-cyclonic region (high pressure)

   (c) positive curl region

   (d) negative curl region

9. In a subtropical gyre with high SSH at the centre, by definition the negative pressure gradient is

   (a) outwards from the centre of the gyre (high pressure)

   (b) directed along isobars

   (c) zero

   (d) none of the other answers here are correct

10. If Rossby number is large, then a large-scale flow driven by the negative pressure gradient in the Northern Hemisphere would be

    (a) directed to the right of the negative pressure gradient

    (b) directed to the left of the negative pressure gradient

    (c) in the direction of the negative pressure gradient (no geostrophic balance)

    (d) in the direction opposite of the negative pressure gradient

11. For a uniform wind wholly in the Southern Hemisphere, the theoretical Ekman spiral associated would

    (a) not curve because there is no Coriolis effect

    (b) be zero (no curl)

    (c) curve anti-clockwise with depth

    (d) curve clockwise with depth

12. In Hong Kong during the Summer months we experience a South-Westerly wind, which implies a coastal Ekman

    (a) on-shore surface transport

    (b) very large

    (c) downwelling

    (d) upwelling (divergence and off-short transport)

13. Eastern boundary current systems are particularly active biological regions, largely because there is an ambient supply of nutrients via Ekman upwelling. Given these Eastern boundary currents are on the eastern side of the basins, because of Ekman upwelling we can immediately say that the winds governing these regions throughout the world should be

    (a) southwards

(b) poleward

(c) equatorward (Ekman flow off-shore in both hemispheres)

(d) very warm

14. Monsoons are

    (a) seasonal variations in the wind (this one)

    (b) seasonal variations in the pressure

    (c) yearly variations in the rain

    (d) daily variations in the wind

15. The Great Pacific Garbage Patch coinciding with the location of the Pacific subtropical gyre might be expected because the gyre

    (a) receives more rainfall

    (b) is a lower pressure region

    (c) all answers here are correct

    (d) is an area of flow convergence (high pressure region)

16. The β in relation to the Coriolis effect would be

    (a) zonal variations in the Coriolis effect

    (b) latitudinal variations in the Coriolis effect (this one)

    (c) temporal variations in the Coriolis effect

    (d) the Coriolis parameter

17. Supposing a mesoscale eddy under geostrophic balance starts with clockwise flow in the Southern Hemisphere and travels across the Equator to the Northern Hemisphere. Assuming the eddy stays intact and is not subject to flow instabilities, the eddy

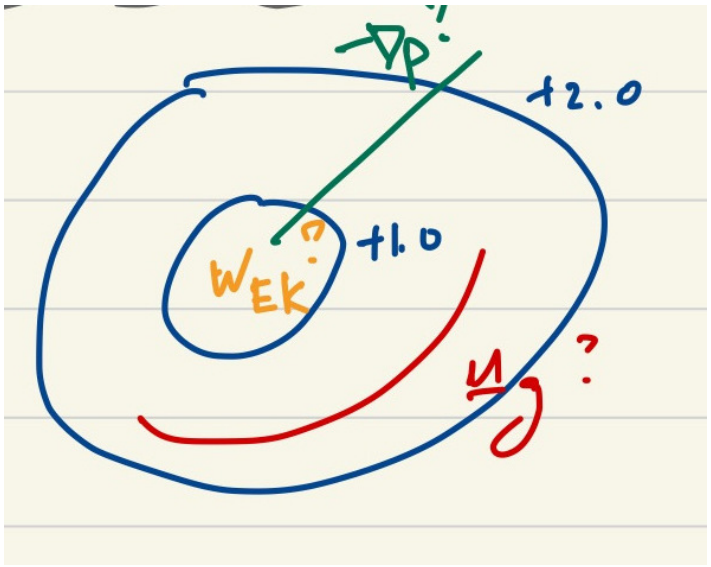
    (a) becomes anti-cyclonic (was cyclonic in SH, clockwise is anti-cyclonic in NH)

    (b) stays anti-cyclonic

    (c) becomes cyclonic

    (d) stays cyclonic

18. Here is the same graph as in Assignment 2:



Suppose I interpret the blue lines (the ones with +1.0 and +2.0) as *sea surface height anomalies*. If we are in the Southern Hemisphere, $\boldsymbol{u}_g$ would be circulating

(a) it wouldn't be circulating

(b) anti-clockwise

(c) clockwise (low pressure in NH)

(d) upwards

19. If the ocean is unstratified, the work done against buoyancy to bring up a parcel of water with weight 10,000 N (1m^3 volume of water with density 1000kg m^{-3}, subject to $g = 10\text{ m s}^{-2}$) from 4000m depth to the surface would be roughly

(a) 10^{-6} J

(b) 0 J (ocean unstratified)

(c) 10^{6} J

(d) 10^{6} kg

20. Taking the moon's mass to be 7.4×10^{22} kg and is at a distance of 3.8×10^{8} m away from the Earth's surface, with the gravitational constant $G = 6.7 \times 10^{-11}\text{ m}^3\text{ kg}^{-1}\text{ s}^{-2}$, the gravitational *acceleration* due to the moon on the Earth's surface is around

(a) $3.4 \times 10^{-5}\text{ m s}^{-1}$

(b) 1.4 inch s^2

(c) $3.4 \times 10^{-2}\text{ mm}^2\text{ s}^{-1}$

(d) 0.5 km hr^{-2} (only one that is an acceleration)