23S-PHYSICS-1B-LEC-3 Midterm1_typeA

SANJIT SARDA

TOTAL POINTS

31 / 40

QUESTION 1

1 Integrity Statement signature - required 0 / 0

✓ **- 0 pts** *Signed*

- 0 pts Not Signed

QUESTION 2

Section I) Multiple Choice 10 pts

2.1 Metal wire - stretching 2 / 2

✓ **- 0 pts** *Correct*

- 2 pts Incorrect

2.2 Motion of molecules in a liquid 2 / 2

✓ **- 0 pts** *Correct*

- 2 pts Incorrect

2.3 Direction of greatest pressure 2 / 2

- 0 pts Correct

✓ **- 0 pts** *Incorrect*

2.4 Dirigible can't rise indefinitely 0 / 2

- 0 pts Correct

✓ **- 2 pts** *Incorrect*

2.5 Velocity of viscous fluid in a pipe 0 / 2

- 0 pts Correct

✓ **- 2 pts** *Incorrect*

QUESTION 3

3 II.1) Minimum volume of iceberg 6 / 10

+ 10 pts Correct

✓ **+ 1 pts** *Attempted the question*

+ 4 pts Showed or implied that the buoyant force is equal to $$\rho g V$$, where $$\rho$$ is the density of seawater, $$g$$ is the gravitational constant, and $$V$$ is the volume of water displaced.

+ 3 pts **[Partial]** Showed or implied that the buoyant force is equal to $$\rho g V$$, but did not recognize that $$V$$ was the volume of the iceberg. Awarded in place of above.

✓ **+ 2 pts** ***[Partial]** had an incomplete or slightly incorrect expression for the buoyant force. Awarded in place of above.*

✓ **+ 2 pts** *Showed or implied that net force on the iceberg must equate to zero for it to float.*

✓ **+ 1 pts** *Found the weight of the iceberg and $$\rho_{ice} g V$$ and hence the total weight of the polar bear and the iceberg. This leads to the next credit:*

+ 0.5 pts Wrote or implied that $$m g + \rho_{ice} g V = \rho_{seawater} g V$$

+ 1 pts Rearranged the above into the final expression:
$$V=m/ (\rho_{seawater} - \rho_{ice}) $$

+ 1.5 pts **[Partial]** Had a similar but

incorrect expression due to a minor algebraic error. **Awarded in place of the above three credits.**

+ 0.5 pts Used the above equation to solve for the **correct** numerical value of $$V$$

+ 0 pts -

QUESTION 4

4 II.2) Height of reduced air pressure 10 / 10

✓ **+ 10 pts** *Wrote down the formula either Δp = □gh or Δp= - □gh.*

Represented the right units in the final answer.

Final answer numerically is right.

+ 9 pts Wrote down the formula either Δp = □gh or Δp= - □gh.

Represented the wrong units in the final answer.

+ 8 pts Wrote down the formula either Δp = □gh or Δp= - □gh.

Represented the right units in the final answer.

Mistook the pressure difference as 0.9 p atm rather than 0.1 p atm.

+ 8 pts Wrote down the formula either Δp = □gh or Δp= - □gh.

Represented the right units in the final answer.

Might have miscalculated the final answer.

+ 6 pts Wrote down the formula either Δp = □gh or Δp= - □gh.

+ 4 pts Lack of applying related formulae. Did not display all the necessary terms to calculate the height in formulae.

QUESTION 5

5 II.3) Flow and pressure in oil refinery 9 / 10

Part (a)

+ 2 pts Correct

✓ **+ 1 pts** *Correct equation for $$\frac{dV}{dt}$$*

+ 1 pts Correct numerical answer

+ 1 pts Effort

Part (b)

+ 1 pts Correct

✓ **+ 1 pts** *Error Carried Forward*

+ 0.5 pts Effort

Part (c)

+ 3 pts Correct

✓ **+ 3 pts** *Error Carried Forward*

+ 2 pts Correct Continuity equation $$\frac{dV}{dt}=A_1v_1 = A_2v_2$$

+ 1 pts Effort

Part (d)

+ 4 pts Correct

+ 2 pts Correct Bernoulli Eq $$P_1+\rho gh_1+\frac{1}{2}\rho v_1^2 = P_2+\rho gh_2+\frac{1}{2}\rho v_2^2$$

+ 1 pts Correct expression for $$P_2$$

+ 1 pts Correct numerical answer

+ 1 pts Effort

✓ **+ 4 pts** *Error Carried Forward*

+ 0 pts No answer

Name: Sanjit Sarda

Student ID #: 8059641031

Signature: Sanjit Sarda

April 11, 2023

Physics 1B Midterm Exam #1, version A

- You have 50 minutes to complete this exam. You MUST close the exam and hand it in at the front when time is up. Show your student ID when handing in your exam. If we have to come collect your exam from your row, your exam will be marked so that 25% will be immediately deducted.
- Numerical values in answers: quote values with 3 significant figures, for example, 0.262 or 3.72×10^3. Always specify the units, even for intermediate results, and quote your final answer in SI units unless indicated otherwise.

- Exam rules:
  - The last sheet of the exam is an equation sheet that may be torn off. Do not write on the equation sheet. Fit all relevant calculations on the front of the pages.
  - You can use any type of calculator that does not have internet capability. Silence and put away your cell phones and laptops.
  - Questions during the exam – you may raise your hand if you are seated near the end of a row, otherwise, unfortunately, you may need to come down to the front to ask.
  - You MUST sign and date the 2nd page entitled "Academic Integrity – A Bruin's Code of Conduct" in order to receive credit for your work.

- Remember to write down each step of your calculation, and explain your answers fully.

Score :

I.1-5	(Mult choice)	_____/10 points
II.1		_____/10 points
II.2		_____/10 points
II.3		_____/10 points
	Total	_____/40 points

Academic Integrity - A Bruin's Code of Conduct:

UCLA is a community of scholars committed to the values of integrity. In this community, all members including faculty, staff, and students alike are responsible for maintaining the highest standards of academic honesty and quality of academic work. As a student and member of the UCLA community, you are expected to demonstrate integrity in all of your academic endeavors. When accusations of academic dishonesty occur, the Office of the Dean of Students investigates and adjudicates suspected violations of this student code. Unacceptable behavior include cheating, fabrication or falsification, plagiarism, multiple submissions without instructor permission, using unauthorized study aids, facilitating academic misconduct, coercion regarding grading or evaluation of coursework, or collaboration not authorized by the instructor. Please review our campus' policy on academic integrity in the UCLA Student Conduct Code: https://deanofstudents.ucla.edu/individual-student-code

If you engage in these types of unacceptable behaviors in our course, then you will receive a zero as your score for that assignment. If you are caught cheating on an exam, then you will receive a score of zero for the entire exam. These allegations will be referred to the Office of the Dean of Students and can lead to formal disciplinary proceedings. Being found responsible for violations of academic integrity can result in disciplinary actions such as the loss of course credit for an entire term, suspension for several terms, or dismissal from the University. Such negative marks on your academic record may become a major obstacle to admission to graduate, medical, or professional school.

We cannot make exceptions to our campus' policy on academic integrity, and as we hopefully have communicated effectively here, penalties for violations of this policy are harsh. Please do not believe it if you hear that "everyone does it". The truth is, you usually don't hear about imposed disciplinary actions because they are kept confidential. So our advice, just don't do it! Let's embrace what it means to be a true Bruin and together be committed to the values of integrity.

By submitting my assignments and exams for grading in this course, I acknowledge the above-mentioned terms of the UCLA Student Code of Conduct, declare that my work will be solely my own, and that I will not communicate with anyone other than the instructor and proctors in any way during the exams.

Sanjit Sarda
Signature

09/11/2023
Date

Sarda Sanjit Sarda
Print Name

805964031
UID

$\frac{F}{\Delta L_1} = \frac{A_2}{\Delta L_2}$ $\Delta L_2 = \frac{A_2 \Delta L_1}{A_1}$

I) Multiple Choice - circle the *one* correct answer to each question.

1. A metal wire is replaced by another one having one half the diameter. If the tension force on the wire is the same, approximately by what factor does the amount of stretching (the elongation) change?

   a. 0.5
   b. 1.0
   c. 1.4
   d. 2.0
   e. 4.0

$= \frac{\pi \frac{r^2}{2^2}}{\pi r^2} \Delta l_1 < \frac{r^2}{4r^2} = \frac{1}{4}$

2. As discussed in class, one can draw an analogy between the motion of molecules in a liquid, in response to a parallel (sideways) force that is applied to the liquid surface, to which of the following:

   a. Slippery ball bearings.
   b. A block of Jello.
   c. Sticky rubber.
   d. Gooey shampoo.

3. Within a fluid at a given depth *h*, the pressure is greatest on a surface that faces:

   a. Sideways.
   b. Up.
   c. Down.
   d. The direction does not matter.

4. A rigid, lighter-than-air dirigible (a.k.a. Zeppelin) filled with helium cannot continue to rise indefinitely. This is because:

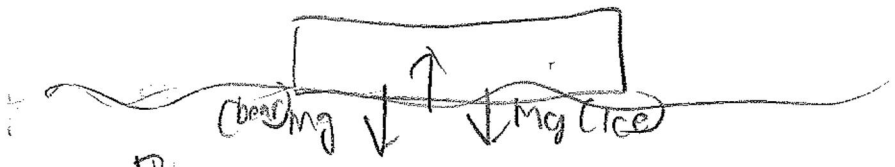
   a. Cold temperatures at high altitude cause the helium to liquify and bring down the dirigible.
   b. The helium leaks out.
   c. The air leaks into the dirigible.
   d. Atmospheric density is lower at high elevations, reducing buoyancy.
   e. Air gets progressively colder at high elevations, reducing buoyancy.

5. In a fluid with non-zero viscosity, the velocity of fluid flowing steadily in a pipe of constant diameter is:

   a. Highest next to the wall of the pipe.
   b. Highest at the center of the pipe.
   c. The same everywhere in the pipe.
   d. Highest where the pipe is highest.
   e. Lowest where the pipe is highest.

II.1 (10 points) An iceberg of fresh water ice floats on the sea. What minimum volume must the iceberg have in order that a polar bear of mass 400 kg could stay dry?

Relevant numbers: the density of salty sea water is $\rho_{sea} = 1.03 \times 10^3\ kg/m^3$, and the density of fresh water ice is $\rho_{ice} = 0.93 \times 10^3\ kg/m^3$.



$mg = F_p$

$\rho_{ice} = \frac{m}{V}$ $\therefore$ $mg = F_p = V \cdot \rho_{ice} \cdot g + (400\ kg)\, g$

$F_p = P \cdot A =$

$P \cdot A = V \cdot \rho_{ice} \cdot g + (400\ kg)\, g$

P

II.2 (10 points) Given that the density of air is $\rho(air) = 1.30\ kg/m^3$ near sea level, and using an approximation that the atmospheric density is constant with height, calculate at what elevation you would need to go to find the atmospheric air pressure reduced by 10% from its sea level value $p_{atm} = 1.01 \cdot 10^5\ N/m^2$.

[This "linear" calculation will get successively less accurate as the elevation gets higher because the air density is not actually constant but decreases.]

$P_2 - P_1 = -\rho g(y_2 - y_1)$

$P_1 = 1.01E5\ Nm^{-2}$, $P_2 = 90\% \cdot P_1 = 9.09E4\ Nm^{-2}$

$\therefore P_2 - P_1 = -\rho g(y_2 - y_1)$

$\therefore -1.01E4\ Nm^{-2} = -\rho g(y_2 - y_1)$

$\therefore \rho g h = 1.01E4\ Nm^{-2}$

$\therefore h = \frac{1.01E4\ Nm^{-2}}{(1.3\ kg\ m^{-3})(9.8\ ms^{-2})} = 792\ m$

II.3 (10 points): An oil refinery produces gasoline at a rate that would fill 50 tanker trucks with gasoline every hour. A cubic meter contains 800 kg of gasoline. A tanker truck has a capacity of about 40 cubic meters.

All of the gasoline flows through a single pipe. At point 1 in the pipe, the gauge pressure is 150 kPa and the diameter of the round pipe is 80 cm. At point 2 in the pipe, 8.0 m higher than at point 2, the pipe diameter is 40 cm.

a) (2 pts) Find the volume flow rate of the gasoline.
b) (1 pts) Find the mass flow rate of the gasoline.
c) (3 pts) Find the flow speeds v_1 at point 1 and v_2 at point 2 in the pipe.
d) (4 pts) Find the gauge pressure at point 2.

(a) ~~50 tankers~~ Volume = 50 tankers $= 50 \cdot 40\,m^3 = 200\,m^3$

Time = 1hr

$\therefore$ Vol Flow Rate $= \frac{Vol}{Time} = \frac{200\,m^3}{1hr} = \frac{200\,m^3}{3600s} = \frac{1}{18}\,m^3s^{-1}$

$= 0.0556\,m^3s^{-1}$

(b) $Mass = 800\,kgm^{-3} \cdot Volume$

$\therefore Mass = 800\,kgm^{-3}\,200m^3 = 160000\,kg$

Time $= 1hr = 3600s$

$\therefore$ Mass Flow Rate $= \frac{160000\,kg}{3600s} = \frac{1600}{36}\,kgs^{-1}$

$= \frac{400}{9}\,kgs^{-1}$

$= 44.4\,kgs^{-1}$

(c) @P1

$r_1 = 40cm = .4m$

$\therefore A_1 = \pi r^2 = 0.503m^2$

$\frac{\Delta V}{\Delta t} = A_1 v_1 \quad \therefore v_1 = \frac{\Delta V}{\Delta t} \cdot \frac{1}{A_1} = \frac{Vol\,Flow\,Rate}{Area} = \frac{.0556m^3s^{-1}}{.503m^2} = .111ms^{-1}$

$A_2 v_2 = A_1 v_1$

$A_2 = \pi r_2^2, \; r_2 = .2m \quad \therefore A_2 = 0.126m^2$

$v_2 = \frac{A_1}{A_2} v_1 = \frac{.503m^2}{.126m^2} .111ms^{-1} = .443ms^{-1}$

$\rho = \frac{m}{V} = 800kgm^3$

(d) $P_1 + \rho g y_1 + \frac{1}{2}\rho v_1^2 = P_2 + \rho g y_2 + \frac{1}{2}\rho v_2^2$

$\therefore P_2 = P_1 + \rho g(y_1 - y_2) + \frac{\rho}{2}(v_1^2 - v_2^2)$

$\therefore P_2 = 150E3Pa + (800kgm^3)(9.81ms^{-2})(-8m) + (800kgm^{-3})(.0123 - .196)m^2s^{-2}$

$\therefore P_2 = 87100Pa \quad \therefore$ Gauge Pressure $= 87100Pa - 1.01E5\,Pa$

$= -13900Pa$

(Extra sheet of paper for problem 3)