PHY3138/3147 REPORT
MARKS AND FEEDBACK

STUDENT'S NAME: Yolia Simon **ASSESSOR: AS&PGP**
DATE: 13 Jan 2025

Report **_32__ (50 max)**

COMMENTS (What improvements could the student have made to improve their mark?):

AS: All the expected components are present. The abstract gives an adequate outline of the project. The introduction, however, may benefit from restructuring: stating that the project is about studying the bubbles, and then explaining the Schlieren imaging as a tool for this purpose. The Theory section does not justify its name: instead, it introduces the basics of the Schlieren imaging method. It is a good idea to include the photos of experimental setup, but in the current form they are way too small;
formatting these to two columns would help. The section on experimental methods, paradoxically, introduces the theory of a buyovant bubble. It also introduces some assumptions which at first glance are incompatible: it is stated that the bubbles are accelerating and yet their rising rate is considered steady. Then, the results are presented. I expected to see a photo of a Schlieren-imaged bubble, but the author, unfortunately, decided not to include it. It is not clear if Fig.4 represents terminal velocity of the bubble, or the velocity sampled at some earlier time. The analysis of accelerations is even more confusing: it is not clear how the acceleration can be negative at all times, given that the bubble starts with zero velocity. It is also not quite clear if this acceleration is computed or measured. The report is concluded with brief and non-technical summary of findings and a reasonable outlook. There are minor omissions in the bibliography.

PGP: This is a very well written report containing all of the expected components. The content of the different section is appropriate and the report possesses a strong underlying logical structure that binds the different parts together. The scientific language, with very minor exception, is excellent and the format used is suitable for a research report. The results are presented in a very good way using plots, diagrams and images. Attempts to quantify the data acquired are present. The Reference section contains a large number of original research sources, which is excellent.

There are some deficiencies mainly in the attempted quantitative interpretation of data which, if rectified, would improve the report:

(1) The last term of Eq. 2 appears to be incorrect. As currently stated, it implies a drag force linear in velocity, while the use of the area and the drag coefficient implies a quadratic dependence
(2) The value of the drag coefficient (0.47) assumes hight Reynolds numbers, exceeding 10000, while the data from Fig.4 suggest Re ~ 400, which would result in drag

coefficient 0.66. At low Re, Stokes formula is to be recovered, which makes the drag coefficient velocity-dependent; there are interpolation formulae describing this.

(3) The above points ((1) and (2)) hold for a solid sphere moving through a Newtonian liquid. However the bubble differs from a solid sphere due to the lateral mobility of the oil-water interface. In fluid dynamics terms, whilst for a sphere a no-slip boundary condition should hold, for an oil bubble the boundary condition should be derived from the continuity of the tangential component of the stress tensor, This would affect the value of the drag coefficient and the quantitative interpretation of the data.

(4) It is not entirely clear how the results presented in Figs. 5 and 6 were calculated. What was measured experimentally, the velocity, acceleration or perhaps the terminal velocity? This makes it difficult to understand, for example, the negative values for the acceleration in Fig. 6. Contrary to the statements in the text, buoyancy force is constant and does not depend on the distance to the surface (provided the bubble is entirely submersed in water).

(5) Section 5.1 states that "larger bubbles generally exhibit faster rising rates", but this is not evident from Fig. 4.

(6) I suggest error analysis and discussion be relegated to an appendix. It would be good to see some Schlieren images of rising bubbles in the Results section. The photographs in Fig. 1 are not necessary, the setup is explained much more clearly using the diagram in Fig. 2. Reference to turbulence are not appropriate as the onset of turbulence is at much higher *Re* than achieved in these experiments.

Scientific and Technical Attainment __36____ (50 max)

COMMENTS (What improvements could the student have made to improve their mark?):

AS: Yolia performed an interesting experiment using Schlierent imaging to detect the motion of oil bubbles in water. However, the methods of analysis may be flawed. Eq(2) assumes that buoyancy drives the mass of oil in the bubble. This neglects the fluid-mechanical phenomenon known as added mass. Eq(4) seems to assume turbulent regime of viscous drag; I would expect Stokes' formula to be applicable instead. This may explain the strange phenomenon of negative accelerations.

PGP: This is a non-trivial experiment demanding knowledge from different areas of physics (optics, fluid dynamics, interfacial science) and requires a high degree of dedication. The volume and quality of results reported are very good, with appropriate interpretations and attempts at quantitative conclusions. This, together with the large number of research sources, demonstrates a high level of engagement and understanding. This work would give a good basis for an extended investigation, should such be undertaken in the future. Some additional work would have been necessary, such as a more precise modelling of the drag

force of the rising bubble, as well as alternative ways to compare experimental results with the model.

TOTAL AGREED MARKS for REPORT __68___ (100 max)

Signed ……A.Shytov……
……P.G.Petrov……

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Report

Marks (maximum 50) are given for the coverage, content, presentation of the report. The expected components in the report include: introduction, aims, background; theory; design, planning; description of project work; discussion of results; conclusions; suggestions for future work; and references and bibliography. Material that has already been assessed (*e.g.* from the introductory report) should not be reproduced in its entirety in the final report, although a brief summary of such material may be included if appropriate.

(a) Report	
Mark Range	*Assessors look for: completeness of all expected components; logical coherence and structure of material; high-quality and scientific and literary accuracy of the text and figures; consistent and thorough referencing; skilled use of diagrams to enhance the clarity of the text and provide evidence for the conclusions.*
43-50	Exceptional. A report that is difficult to fault. This work is of publishable quality, with only very minor amendments, and would be likely to receive that judgement if submitted to a high-quality peer-reviewed journal.
35-42	Excellent. No significant deficiencies, but a number of minor errors. Clear text and diagrams with a well defined focus, reflecting a thorough knowledge of material and a very high-level of competence in its critical assessment.
31-34	Very good. Consistently very good level of knowledge or ability, with no more than one significant deficiency. The report components demonstrate consistently good knowledge of material and a generally high level of competence in its critical assessment.
27-30	Focal level. Only one or two significant deficiencies. Expected components present, with good content, structure and presentation.
23-26	No major flaws, but a number of significant deficiencies. Expected components present in an acceptable form.
20-22	Threshold level. Only one or two major flaws. Expected components present in a recognisable form.
10-19	A number of major flaws. Lacking in overall structure. Evidence of a lack of basic knowledge and critical ability.
0-9	Nothing approaching an acceptable report.

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Technical and Scientific Attainment

Marks (maximum 50) are given to reflect the student's attainment, as demonstrated by the scientific quality of aspects of the project over which the student has some ownership.

(b) SCIENTIFIC AND TECHNICAL ATTAINMENT	
Mark Range	*Assessors look for evidence in the report of: advanced practical / technical skills; finesse; consistency checks and validation of results; independent input to the project; innovative creative approach; self-detection and self-correction of errors; identification and follow-up of interesting results; independent use of the literature; refinement / optimisation / adaptation of existing methods; a well-judged and strategic approach.*
43-50	Exceptional. A command of all relevant aspects that is difficult to fault. The project makes a novel contribution to its research field and is at the level expected of work reported in a high-quality peer-reviewed journal.
35-42	Excellent. A command of most relevant aspects that is difficult to fault. Some minor deficiencies. The report will be a useful technical reference for others working in the field.
31-34	Very good. A consistently very good command of most relevant aspects. The student has the ability to produce experiments (or software, etc.) that consistently produce reliable results.
27-30	Focal level. A command of most relevant aspects in some depth. The student has the ability to produce experiments (or software, etc.) that work well.
23-26	An adequate command of most relevant aspects. The student has the ability to produce experiments (or software, *etc*.) that work adequately.
20-22	Threshold level. A command of most relevant aspects at a relatively superficial level. The student has the ability to produce experiments (or software, *etc*.) that work to some extent.
10-19	Little evidence of technical ability or relevant skills. Experiments (or software, *etc*.) unlikely to work.
0-9	No evidence of technical ability or relevant skills.