Tutorial Letter 101/3/2018

Elementary Physics
PHY 1501

Semesters 1 and 2

Department of Physics

This tutorial letter contains important information about your module.
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Dear Student

1 INTRODUCTION

The Department of Physics at UNISA is very pleased to welcome you to this module (PHY1501) and we hope that you will find it both interesting and rewarding. Throughout the year we shall do our best to make you succeed in this module. From your side we expect you (i) to try your best to start studying early in the semester/year and (ii) to complete all your assignments thoroughly and on time.

During the Semester you will receive a number of tutorial letters. Tutorial letters are our main way of communicating with you about teaching, learning and assessment.

Tutorial matters

Tutorial Letter 101 contains important information about the scheme of work, resources and assignments for this module. We urge you to read it carefully and to keep it close at hand when working through the study material, preparing the assignment(s), preparing for the examination and addressing questions to your module leader.

Please read Tutorial Letter 301 in combination with Tutorial Letter 101, as it gives you an idea of generally important information when studying at a distance through the Department of Physics.

In Tutorial Letter 101, you will find the assignments and assessment criteria as well as instructions on the preparation and submission of the assignments. This tutorial letter also provides all the information you need with regard to the prescribed study material and other resources and how to obtain it. Please study this information carefully and make sure that you obtain the prescribed material as soon as possible.

We have also included certain general and administrative information about this module. Please study this section of the tutorial letter carefully.

Right from the start we would like to point out that you must read all the tutorial letters you receive during the semester/year immediately and carefully.

We hope that you will really enjoy this module and wish you all the best!

2 PURPOSE AND OUTCOMES

2.1 Purpose

The primary goal of this module (PHY1501) is to help you develop a conceptual understanding of the following aspects of Physics:

- Introduction to Physics
- One-Dimensional Kinematics
- Vectors in Physics
- Two-Dimensional Kinematics
- Forces and Newton’s laws of motion
- Application of Newton’s Laws of Motion
• Work and Kinetic Energy
• Potential Energy and Conservation of Energy
• Linear Momentum and Collisions
• Rotational Kinematics and Energy
• Rotational Dynamics and Static Equilibrium
• Oscillations about Equilibrium and Elasticity
• Fluids

For Engineering Qualifications

• The basics of applied mechanics – Units and basic terms, Method of problem solution and workmanship, Numerical accuracy and significant figures, algebraic and simultaneous equations, trigonometry and geometry
• Forces, vectors, and resultants – Vectors, Force Types, Force characteristics and units, Resultants
• Moments and Couples – Moments of a force, Couples
• Equilibrium – Free-Body Diagrams and Conventions, Equations of Equilibrium, Two-Force Members, Coplanar Force Systems
• Structures and Members – Method of Joints, Method of Sections, Method of Members
• Friction – Friction Laws, Coefficients of Friction, Angle of Friction
• Centroids and Centre of Gravity – Centroids of Simple Areas, Centroids of Composite Areas, Centroids of Lines
• Moments of Inertia – Moment of Inertia of an Area, Parallel Axis Theorem, Moment of Inertia of Composite Areas, Radius of Gyration, Mass Moment of Inertia, Mass Moment of Inertia of Composite Bodies, Radius of Gyration of Bodies
• Stress Analysis – Stress, Strain, Modulus of Elasticity, Factor of Safety, and Hooke’s Law
• Hydrostatics – Density, Specific Weight, Pressure, Resultant Hydrostatic Force on Immersed Plane Surfaces
• Flow of fluids and Bernoulli’s Equation

Physics is often regarded as a collection of equations that can only be used blindly to solve problems. A good problem solving technique does NOT begin with equations. It starts with a firm grasp of the concepts and how they fit together to provide a coherent description of the physical world. We trust that you will inculcate the latter approach in studying this module.

2.2 Outcomes

At the end of this module you should be able to apply the concepts learned to solve simple real-life problems related to the module’s scope.

NOTE: Engineering students are expected to be familiar with the concepts in the syllabus for Non-Engineering Qualifications.

3 LECTURER(S) AND CONTACT DETAILS

3.1 Lecturer(s)

The lecturers for this module will be announced in a follow up tutorial letter and also on the Physics department website:

http://www.unisa.ac.za/Default.asp?Cmd=ViewContent&ContentID=223

PLEASE NOTE: Letters to the module leader must not be enclosed with assignments.

Lecturers are usually available for pre-arranged appointments on weekdays from 08:00 to 15:30. All queries about the academic content should be directed to the module leader, or to the
3.2 Department

Communication with the Physics Department and the module leader

When contacting us please have your student number, module code and study material ready. Whenever you send us an e-mail or letter, please include your student number and the appropriate module code. Our general contact information is as follows:

Dr MJ Sithole
Department of Physics (UNISA)
Private Bag X06
Florida, Roodepoort
1710

Tel: +27 (0)11 670-9074
Fax: +27 (0)11 471-2988
E-mail: sithomj@unisa.ac.za

3.3 University

All administrative enquiries to the university may be directed by post as follows:

Physical address: Postal address:
University of South Africa University of South Africa
Cnr. Christiaan de Wet Street & Private Bag X06
Pioneer Avenue Florida, Roodepoort
Florida Park 1710
Roodepoort
1709

Consult the brochure My studies @ Unisa to find other details if you need to contact the University about matters which are not directly related to the academic content of this module.

4 RESOURCES

4.1 Prescribed books

(a) Non-Engineering Qualifications

The prescribed textbook is:

PHYSICS: Technology Update, 4th Edition PNIE by James S. Walker (ISBN: 978-1-29202-100-3) Published by Pearson Education (2014). There is NO study guide for this textbook. Please refer to the list of official booksellers and their addresses listed in My studies @ Unisa. If you have any difficulties in obtaining books from these bookshops, please contact the Unisa Prescribed Book Section at Tel: +27 (0) 12 429-4152 or email vospresp@unisa.ac.za.

(b) Engineering Qualifications

The prescribed textbook is:

Please refer to the list of official booksellers and their addresses listed in *My studies @ Unisa*. If you have any difficulties in obtaining books from these bookshops, please contact the Unisa Prescribed Book Section at Tel: +27 (0) 12 429-4152 or email vospresc@unisa.ac.za

4.2 Recommended books

The recommended book for students pursuing Engineering Qualifications is:


4.3 Electronic reserves (e-reserves)

There are no e-Reserves for this module.

4.4 Library services and resources information

For brief information, go to [www.unisa.ac.za/brochures/studies](http://www.unisa.ac.za/brochures/studies)

For detailed information, go to [http://www.unisa.ac.za/library](http://www.unisa.ac.za/library). For research support and services of personal librarians, click on "Research support".

The library has compiled a number of library guides:

- finding recommended reading in the print collection and e-reserves – [http://libguides.unisa.ac.za/request/undergrad](http://libguides.unisa.ac.za/request/undergrad)
- requesting material – [http://libguides.unisa.ac.za/request/request](http://libguides.unisa.ac.za/request/request)
- postgraduate information services – [http://libguides.unisa.ac.za/request/postgrad](http://libguides.unisa.ac.za/request/postgrad)
- finding, obtaining and using library resources and tools to assist in doing research – [http://libguides.unisa.ac.za/Research_Skills](http://libguides.unisa.ac.za/Research_Skills)
- how to contact the library/finding us on social media/frequently asked questions – [http://libguides.unisa.ac.za/ask](http://libguides.unisa.ac.za/ask)

5 STUDENT SUPPORT SERVICES

For information on the various student support systems and services available at Unisa (e.g. student counselling, tutorial classes, language support), please consult the publication *MyStudies @ Unisa* that you received with your study material.

**Contact with fellow students**

a) **Study groups**

It is advisable to have contact with fellow students. One way to do this is to form study groups. The addresses of students in your area may be obtained from the following department by writing to:

**Directorate: Student Administration and Registration**
PO Box 392
UNISA
0003
Please note: Although there is nothing stopping you from working together on assignments, you should always write out and submit your own individual assignment. Even though you must submit only the answers to the multiple-choice questions (on a mark reading sheet), it is in your best interest to generate your own ideas and to keep a written record of these and your attempts at solving the assignment problems. It is unacceptable for a group of students to submit identical assignments on the basis that they worked together. That is copying (a form of plagiarism), for which you may be penalized or subjected to disciplinary proceedings by the University.

b) myUnisa

If you have access to a computer that is linked to the internet, you can quickly access resources and information at the University. The myUnisa learning management system is Unisa's online campus that will help you to communicate with your lecturers, with other students and with the administrative departments of Unisa – all through the computer and the internet.

To go to the myUnisa website, start at the main Unisa website, [http://www.unisa.ac.za](http://www.unisa.ac.za) and then click on the “Login to myUnisa” link on the right-hand side of the screen. This should take you to the myUnisa website. You can also go there directly by typing in [http://my.unisa.ac.za](http://my.unisa.ac.za)

For more information on myUnisa, please consult My studies @ Unisa.

c) Group Discussions

You will receive information with dates, venues and times for group discussions for this module on the module’s website on myUnisa portal. The groups discussions(popularly referred to as Discussion Classes) will be facilitated by the Module Leader/Lecturer. You are therefore advised to keep your contact details updated and to keep your mylife email active. Visit this website regularly.

For information on the various student support systems and services available at Unisa (e.g. student counselling, tutorial classes, language support), please consult the publication MyStudies @ Unisa that you received with your study material.

6 STUDY PLAN

This is a semester module. The semester period is roughly seventeen (17) weeks only. We therefore encourage you to work as fast as you can through the prescribed work. You are advised to go through the prescribed work before you attempt to do any assignments. In your studies for the semester you should take into account the following: In order to remain an active student you must have submitted:

Semester 1: at least one assignment by 3rd April 2018

Semester 2: at least one assignment by 06th of September 2018

7 PRACTICAL WORK AND WORK-INTEGRATED LEARNING

There are no practical sessions for this module per se. However, if you are doing this module and
registered for the engineering stream make sure that you are also registered for one of the practical modules such as MCAPRAC1.

8 ASSESSMENT

8.1 Assessment criteria
The students will show evidence of the ability to make the calculations correctly; the demonstration of how it was done is excellent, coherent, detailed and very well explained, showing great command and understanding of the methods involved.

8.2 Assessment plan
There are mainly two types of assessment for this module.

(a) Continuous Assessment - Assignments.

(b) Summative Assessment - Final Examination at the end of each semester.

There are three (3) compulsory assignments for each semester. The assignments are numbered 01, 02, and 03 as can be seen in this tutorial letter. An additional assignment for further practice may be posted on the module website on myUnisa at a later stage. Therefore it is vital that you check the myUnisa website from time to time.

The questions for the assignments are given in this Tutorial letter as follows:

- For Semester 1 Non-Engineering Qualifications: See pages 11-20
- For Semester 2 Non-Engineering Qualifications: See pages 21-30
- For Semester 1 Engineering Qualifications: See pages 31-41
- For Semester 2 Engineering Qualifications: See pages 42-52

The questions and problems are taken from various sources, but mainly from the prescribed textbooks and the recommended textbooks.

Please make sure that you answer the assignments for the semester for which you are registered. If you answer questions for the semester for which you are not registered your assignment will not be marked and you will get zero mark and if you answer questions for the qualification for which you are not registered you will get zero marks.

The average of the percentage marks obtained in your assignments will contribute 20% toward your final mark.

8.3 Assignment numbers

8.3.1 General assignment numbers
There are three (3) assignments that you are required to do for this module: Assignment 1, Assignment 2 and Assignment 3. Assignments 1 and 2 consist of ten (10) questions each and you are required to submit written solutions to the questions for assessment. Assignment 3 consist of twenty five (25) Multiple Choice Questions (MCQ) and each question caries four (4) marks.

8.3.2 Unique assignment numbers
Each assignment is allocated a unique assignment number. Note that each assignment has its own unique number which must be written on the cover of your assignment upon submission. The unique assignment numbers for this module are as follows:
8.4 Assignment due dates

The due dates for the assignments for both semester 1 and semester 2 are as follows:

<table>
<thead>
<tr>
<th>Assignment Number</th>
<th>Unique Assignment Number</th>
<th>Due Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>737225</td>
<td>26 February 2018</td>
</tr>
<tr>
<td>02</td>
<td>863324</td>
<td>26 March 2018</td>
</tr>
<tr>
<td>03</td>
<td>775803</td>
<td>23 April 2018</td>
</tr>
<tr>
<td>01</td>
<td>847425</td>
<td>20 August 2018</td>
</tr>
<tr>
<td>02</td>
<td>687822</td>
<td>10 September 2018</td>
</tr>
<tr>
<td>03</td>
<td>771221</td>
<td>05 October 2018</td>
</tr>
</tbody>
</table>

8.5 Submission of assignments

You may submit written assignments and assignments completed on mark-reading sheets either by post or electronically via the myUnisa portal. Consult the brochure My studies @ Unisa for details on how to do this. **Assignments may NOT be submitted by fax or e-mail.**

You will receive the solutions (keys) for each of the assignments from Unisa a few weeks after the
due dates of the assignments. These solutions will be posted on the module website for you to download.

8.6 The assignments

The assignments section starts from page 11. Please choose the correct assignments which correspond with the qualification that you are pursuing. The “chapters to read” referred to in the assignments section are from your prescribed book.

8.7 Other assessment methods

There are no other assessment methods for this module. However, we urge you to visit the website link: http://www.compadre.org/osp, which has a plethora of simulations exercises that may help you understand Physics concepts much better. Please send the feedback on your experience with the use of this website to M J Sithole (sithomj@unisa.ac.za)

8.8 The examination

To be admitted to the examination you need to submit at least one compulsory assignment. A two-hour examination is written at the end of each semester. The examination contributes 80% toward your final mark.

9 FREQUENTLY ASKED QUESTIONS

For any other study information see the brochure My Studies @ Unisa.

10 SOURCES CONSULTED

To be successful in your studies this semester you are required to consult the prescribed and recommended textbooks and the accompanying study guides if available and the myUnisa website.

11 IN CLOSING

We hope that this tutorial letter will greatly help you in planning and managing your studies. We would like to emphasize, once again, that late assignments WILL NOT be considered, you are therefore required to adhere to assignment due dates.

12 ADDENDUM

No addendum.
SEMESTER 1 ASSIGNMENTS FOR NON-ENGINEERING STUDENTS

(The assignments that follow are for students registered for the FIRST SEMESTER for Non-Engineering Qualifications ONLY)
A. NON-ENGINEERING STUDENTS

The following assignments should be done by students who are pursuing Non-Engineering Qualifications ONLY.

<table>
<thead>
<tr>
<th>Question</th>
<th>Problems to solve</th>
<th>Book Chapters to read</th>
<th>Marks to be awarded</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>57 page 55</td>
<td>2</td>
<td>[10]</td>
</tr>
<tr>
<td>2</td>
<td>90 page 58</td>
<td>2</td>
<td>[10]</td>
</tr>
<tr>
<td>3</td>
<td>40 page 86</td>
<td>3</td>
<td>[10]</td>
</tr>
<tr>
<td>4</td>
<td>53 page 87</td>
<td>3</td>
<td>[10]</td>
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<tr>
<td>5</td>
<td>43 page 118</td>
<td>4</td>
<td>[10]</td>
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<tr>
<td>6</td>
<td>77 page 120</td>
<td>4</td>
<td>[10]</td>
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<tr>
<td>7</td>
<td>30 page 156</td>
<td>5</td>
<td>[10]</td>
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<tr>
<td>8</td>
<td>40 page 157</td>
<td>5</td>
<td>[10]</td>
</tr>
<tr>
<td>9</td>
<td>80 page 202</td>
<td>6</td>
<td>[10]</td>
</tr>
<tr>
<td>10</td>
<td>81 page 202</td>
<td>6</td>
<td>[10]</td>
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</tbody>
</table>

These problems are taken from your prescribed book
Assignment 02 – Semester 1  
Unique No: 863324  
Due date: 26 March 2018  

*(Total: 100 marks. Contribution to year mark: 30%)*

<table>
<thead>
<tr>
<th>Question</th>
<th>Problems to solve</th>
<th>Book Chapters to read</th>
<th>Marks to be awarded</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>11 page 235</td>
<td>7</td>
<td>[10]</td>
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<tr>
<td>2</td>
<td>72 page 239</td>
<td>7</td>
<td>[10]</td>
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<tr>
<td>3</td>
<td>47 page 277</td>
<td>8</td>
<td>[10]</td>
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<tr>
<td>4</td>
<td>97 page 280</td>
<td>8</td>
<td>[10]</td>
</tr>
<tr>
<td>5</td>
<td>27 page 327</td>
<td>9</td>
<td>[10]</td>
</tr>
<tr>
<td>6</td>
<td>75 page 331</td>
<td>9</td>
<td>[10]</td>
</tr>
<tr>
<td>7</td>
<td>24 page 364</td>
<td>10</td>
<td>[10]</td>
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<tr>
<td>8</td>
<td>51 page 366</td>
<td>10</td>
<td>[10]</td>
</tr>
<tr>
<td>9</td>
<td>37 page 412</td>
<td>11</td>
<td>[10]</td>
</tr>
<tr>
<td>10(a)</td>
<td>69 page 501</td>
<td>13</td>
<td>[10]</td>
</tr>
<tr>
<td>(b)</td>
<td>47 page 596</td>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>

These problems are taken from your prescribed book
1) In addition to $1 \text{ m} = 39.37 \text{ in.}$, the following exact conversion equivalents are given: 
1 mile = 5280 ft, 1 ft = 12 in, 1 hour = 60 min, and 1 min = 60 s. If a particle has a velocity of 8.4 miles per hour, its velocity, in m/s, is closest to

1) 3.8 m/s.  
2) 3.0 m/s.  
3) 3.4 m/s.  
4) 4.1 m/s.  
5) 4.5 m/s.

2) The shortest wavelength of visible light is approximately 400 nm. Express this wavelength in centimeters.

1) $4 \times 10^{-5} \text{ cm}$  
2) $4 \times 10^{-7} \text{ cm}$  
3) $4 \times 10^{-9} \text{ cm}$  
4) $4 \times 10^{-11} \text{ cm}$  
5) $400 \times 10^{-11} \text{ cm}$

3) The figure shows the graph of the position $x$ as a function of time for an object moving in the straight line (the $x$-axis). Which of the following graphs best describes the velocity along the $x$-axis as a function of time for this object?
4) Two objects are dropped from a bridge, an interval of 1.0 s apart, and experience no appreciable air resistance. As time progresses, the DIFFERENCE in their speeds

1) increases.
2) remains constant.
3) decreases.
4) increases at first, but then stays constant.
5) decreases at first, but then stays constant.

5) Vectors $\vec{A}$ and $\vec{B}$ are shown in the figure. Vector $\vec{C}$ is given by $\vec{C} = \vec{B} - \vec{A}$. The magnitude of vector $\vec{A}$ is 16.0 units, and the magnitude of vector $\vec{B}$ is 7.00 units. What is the magnitude of vector $\vec{C}$?
6) An airplane undergoes the following displacements: First, it flies 66 km in a direction 30° east of north. Next, it flies 49 km due south. Finally, it flies 100 km 30° north of west. Using vector components, determine how far the airplane ends up from its starting point.

1) 79 km
2) 81 km
3) 82 km
4) 78 km
5) 76 km

7) A ball is thrown at a 60.0° angle above the horizontal across level ground. It is thrown from a height of 2.00 m above the ground with a speed of 20.0 m/s and experiences no appreciable air resistance. The time the ball remains in the air before striking the ground is closest to

1) 16.2 s.
2) 3.07 s.
3) 3.32 s.
4) 3.53 s.
5) 3.64 s.

8) A plane flying at 70.0 m/s suddenly stalls. If the acceleration during the stall is 9.8 m/s² directly downward, the stall lasts 5.0 s, and the plane was originally climbing at 25° to the horizontal, what is the velocity after the stall?
1) 66 m/s at 17° below the horizontal
2) 66 m/s at 17° above the horizontal
3) 80 m/s at 37° below the horizontal
4) 80 m/s at 37° above the horizontal
5) None of the above

9) A 7.0-kg object is acted on by two forces. One of the forces is 10.0 N acting toward the east. Which of the following forces is the other force if the acceleration of the object is 1.0 m/s² toward the east?

1) 6.0 N east
2) 3.0 N west
3) 12 N east
4) 9.0 N west
5) 7.0 N west
Answer: 2

10) The figure shows two forces, each of magnitude 4.6 N, acting on an object. The angle between these forces is 40°, and they make equal angles above and below the horizontal. What third force will cause the object to be in equilibrium (acceleration equals zero)?

1) 8.6 N pointing to the right
2) 7.0 N pointing to the right
3) 4.3 N pointing to the right
4) 3.5 N pointing to the right
5) None of the above

11) Two objects, each of weight W, hang vertically by spring scales as shown in the figure. The pulleys and the strings attached to the objects have negligible weight, and there is no appreciable friction in the pulleys. The reading in each scale is

1) W.
2) more than W, but not quite twice as much.
3) less than W.
4) 2W.
5) more than 2W.
12) A 60.0-kg person rides in elevator while standing on a scale. The elevator is traveling downward but slowing down at a rate of 2.00 m/s². The reading on the scale is closest to

1) 589 N.
2) 708 N.
3) 469 N.
4) 120 N.
5) 349 N.

13) A 200 g hockey puck is launched up a metal ramp that is inclined at a 30° angle. The coefficients of static and kinetic friction between the hockey puck and the metal ramp are \( \mu_s = 0.40 \) and \( \mu_k = 0.30 \), respectively. The puck's initial speed is 63 m/s. What vertical height does the puck reach above its starting point?

1) 130 m
2) 270 m
3) 200 m
4) 66 m
5) None of the above

14) In the figure, a block of mass \( M \) hangs at rest. The rope that is fastened to the wall is horizontal and has a tension of 52 N. The rope that is fastened to the ceiling has a tension of 91 N, and makes an angle \( \theta \) with the ceiling. What is the angle \( \theta \)?

![Diagram of a block hanging at rest with ropes tensioned towards the ceiling and the wall.](image)

1) 55°
2) 35°
3) 30°
4) 63°
5) 45°
15) Two objects having masses $m_1$ and $m_2$ are connected to each other as shown in the figure and are released from rest. There is no friction on the table surface or in the pulley. The masses of the pulley and the string connecting the objects are completely negligible. What must be true about the tension $T$ in the string just after the objects are released?

1) $T = m_2g$
2) $T > m_2g$
3) $T < m_2g$
4) $T = m_1g$
5) $T > m_1g$

16) A 6.00-kg block is in contact with a 4.00-kg block on a horizontal frictionless surface as shown in the figure. The 6.00-kg block is being pushed by a horizontal 20.0-N force as shown. What is the magnitude of the force that the 6.00-kg block exerts on the 4.00-kg block?

1) 6.00 N
2) 20.0 N
3) 8.00 N
4) 4.00 N
5) 10.0 N

17) A car travels at a steady 40.0 m/s around a horizontal curve of radius 200 m. What is the minimum coefficient of static friction between the road and the car’s tires that will allow the car to travel at this speed without sliding?

1) 1.23
2) 0.816
3) 0.736
4) 0.952
5) 0.662
18) A firecracker breaks up into several pieces, one of which has a mass of 200 g and flies off along the x-axis with a speed of 82.0 m/s. A second piece has a mass of 300 g and flies off along the y-axis with a speed of 45.0 m/s. What are the magnitude and direction of the total momentum of these two pieces?

1) 361 kg·m/s at 56.3° from the x-axis
2) 93.5 kg·m/s at 28.8° from the x-axis
3) 21.2 kg·m/s at 39.5° from the x-axis
4) 361 kg·m/s at 0.983° from the x-axis
5) 21.2 kg·m/s at 56.3° from the x-axis

19) A 1.2-kg spring-activated toy bomb slides on a smooth surface along the x-axis with a speed of 0.50 m/s. At the origin 0, the bomb explodes into two fragments. Fragment 1 has a mass of 0.40 kg and a speed of 0.90 m/s along the negative y-axis. In the figure, the angle \( \theta \), made by the velocity vector of fragment 2 and the x-axis, is closest to

![Diagram of bomb explosion](image)

1) 31°.
2) 37°.
3) 38°.
4) 53°.
5) 59°.

20) During the time a compact disc (CD) accelerates from rest to a constant rotational speed of 477 rev/min, it rotates through an angular displacement of 0.250 rev. What is the angular acceleration of the CD?

1) 358 rad/s²
2) 126 rad/s²
3) 901 rad/s²
4) 866 rad/s²
5) 794 rad/s²

21) A constant force of 25 N is applied as shown to a block which undergoes a displacement of 7.5 m to the right along a frictionless surface while the force acts. What is the work done by the force?
1) zero joules
2) +94 J
3) −94 J
4) +160 J
5) −160 J

22) A roller coaster starts from rest at the top of an 18-m hill as shown. The car travels to the bottom of the hill and continues up the next hill that is 10.0 m high.

How fast is the car moving at the top of the 10.0-m hill, if friction is ignored?

1) 6.4 m/s
2) 8.1 m/s
3) 13 m/s
4) 18 m/s
5) 27 m/s

23) Which one of the following statements concerning kinetic energy is true?
1) Kinetic energy can be measured in watts.
2) Kinetic energy is always equal to the potential energy.
3) Kinetic energy is always positive.
4) Kinetic energy is a quantitative measure of inertia.
5) Kinetic energy is directly proportional to velocity.

24) A u-shaped tube is connected to a flexible tube that has a membrane-covered funnel on the opposite end as shown in the drawing. Justin finds that no matter which way he orients to membrane, the height of the liquid in the u-shaped tube does not change. Which of the following choices best describes this behavior?
1) Archimedes' principle
2) Bernoulli's principle
3) continuity equation
4) irrotational flow
5) Pascal's principle

25) A balloon inflated with helium gas (density = 0.2 kg/m\(^3\)) has a volume of 6 \times 10^{-3} \text{ m}^3. If the density of air is 1.3 kg/m\(^3\), what is the buoyant force exerted on the balloon?

1) 0.01 N
2) 0.08 N
3) 0.8 N
4) 1.3 N
5) 7.8 N
SEMESTER 2 ASSIGNMENTS FOR NON-ENGINEERING STUDENTS

(The assignments that follow are for students registered for the SECOND SEMESTER for Non-Engineering Qualifications ONLY)
Assignment 01 – Semester 2  
Unique No: 847425  
Due date: 20 August 2018

(Total: 100 marks. Contribution to year mark: 30%)

<table>
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<td>10</td>
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These problems are taken from your prescribed book.
Assignment 02 – Semester 2
Unique No: 687822
Due date: 10 September 2018

(Total: 100 marks. Contribution to year mark: 30%)

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<td>10(a)</td>
<td>73 page 501</td>
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<td>(b)</td>
<td>48 page 596</td>
<td>15</td>
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</tbody>
</table>

These problems are taken from your prescribed book.
1) How many nanoseconds does it take for a computer to perform one calculation if it performs $6.7 \times 10^7$ calculations per second?

1) 15 ns
2) 67 ns
3) 11 ns
4) 65 ns
5) None of the above

2) The position $x$, in meters, of an object is given by the equation $x = A + Bt + Ct^2$, where $t$ represents time in seconds. What are the SI units of $A$, $B$, and $C$?

1) m, m, m
2) m, s, s
3) m, s, s^2
4) m, m/s, m/s^2
5) m/s, m/s^2, m/s^3

3) A runner maintains constant acceleration after starting from rest as she runs a distance of 60.0 m. The runner's speed at the end of the 60.0 m is 9.00 m/s. How much time did it take the runner to complete the 60.0 m distance?

1) 6.67 s
2) 15.0 s
3) 9.80 s
4) 10.2 s
5) 13.3 s
4) A teacher sends her students on a treasure hunt. She gives the following instructions:

1. Walk 300 m north
2. Walk 400 m northwest
3. Walk 700 m east-southeast and the treasure is buried there.

As all the other students walk off following the instructions, Jane physics student quickly adds the displacements and walks in a straight line to find the treasure. How far and in what direction does Jane need to walk?

1) 187 m in a direction 67.3° north of east
2) 481 m in a direction 40.9° north of east
3) 399 m in a direction 52.5° north of east
4) 284 m in a direction 28.2° west of north
5) The treasure position cannot be reached in one straight walk.

5) If \( \mathbf{A} > \mathbf{B} \), under what condition is \( |\mathbf{A} - \mathbf{B}| = \mathbf{A} - \mathbf{B}? \)

1) The statement is never true.
2) Vectors \( \mathbf{A} \) and \( \mathbf{B} \) are in opposite directions.
3) Vectors \( \mathbf{A} \) and \( \mathbf{B} \) are in the same direction.
4) Vectors \( \mathbf{A} \) and \( \mathbf{B} \) are in perpendicular directions.
5) The statement is always true.

6) Vectors \( \mathbf{A} \) and \( \mathbf{B} \) are shown in the figure. Vector \( \mathbf{C} \) is given by \( \mathbf{C} = \mathbf{B} - \mathbf{A} \). The magnitude of vector \( \mathbf{A} \) is 16.0 units, and the magnitude of vector \( \mathbf{B} \) is 7.00 units. What is the angle of vector \( \mathbf{C} \), measured counterclockwise from the +x-axis?

![Diagram of vectors A, B, and C](image)

1) 16.9°
2) 22.4°
3) 73.1°
4) 287°
5) 292°
7) The components of vector $\vec{B}$ are $B_x = -3.5$ and $B_y = -9.7$, and the components of vector $\vec{C}$ are $C_x = -6$ and $C_y = +8.1$. What is the angle (less than 180 degrees) between vectors $\vec{B}$ and $\vec{C}$?

1) 124°
2) 56°
3) 17°
4) 163°
5) 106°

8) A hockey puck slides off the edge of a table with an initial velocity of 28.0 m/s and experiences no air resistance. The height of the tabletop above the ground is 2.00 m. What is the angle below the horizontal of the velocity of the puck just before it hits the ground?

1) 77.2°
2) 72.6°
3) 12.8°
4) 12.6°
5) 31.8°

9) A ball is thrown at a 60.0° angle above the horizontal across level ground. It is thrown from a height of 2.00 m above the ground with a speed of 20.0 m/s and experiences no appreciable air resistance. The time the ball remains in the air before striking the ground is closest to

1) 16.2 s.
2) 3.07 s.
3) 3.32 s.
4) 3.53 s.
5) 3.64 s.

10) A plane has an eastward heading at a speed of 156 m/s (relative to the air). A 20.0 m/s wind is blowing southward while the plane is flying. The velocity of the plane relative to the ground is

1) 157 m/s at an angle 7.31° south of east.
2) 157 m/s at an angle 7.31° east of south.
3) 155 m/s at an angle 7.36° south of east.
4) 155 m/s at an angle 7.36° east of south.
5) 157 m/s at an angle 7.36° south of east.

11) A ball is tossed vertically upward. When it reaches its highest point (before falling back downward)
1) the velocity is zero, the acceleration is directed downward, and the force of gravity acting on the ball is directed downward.
2) the velocity is zero, the acceleration is zero, and the force of gravity acting on the ball is zero.
3) the velocity is zero, the acceleration is zero, and the force of gravity acting on the ball is directed downward.
4) the velocity and acceleration reverse direction, but the force of gravity on the ball remains downward.
5) the velocity, acceleration, and the force of gravity on the ball all reverse direction.

12) A 7.0-kg object is acted on by two forces. One of the forces is 10.0 N acting toward the east. Which of the following forces is the other force if the acceleration of the object is 1.0 m/s\(^2\) toward the east?

1) 6.0 N east
2) 3.0 N west
3) 12 N east
4) 9.0 N west
5) 7.0 N west

13) An object weighing 4.00 N falls from rest subject to a frictional drag force given by \(F_{\text{drag}} = bv^2\), where \(v\) is the speed of the object and \(b = 3.00 \text{ N} \cdot \text{s}^2/\text{m}^2\). What terminal speed will this object approach?

1) 1.78 m/s
2) 3.42 m/s
3) 1.15 m/s
4) 2.25 m/s
5) 0.75 m/s

14) When a parachutist jumps from an airplane, he eventually reaches a constant speed, called the terminal speed. Once he has reached terminal speed

1) his acceleration is equal to \(g\).
2) the force of air drag on him is equal to zero.
3) the force of air drag on him is equal to \(g\).
4) his speed is equal to \(g\).
5) the force of air drag on him is equal to his weight.

15) A 60.0-kg person rides in elevator while standing on a scale. The elevator is traveling downward but slowing down at a rate of 2.00 m/s\(^2\). The reading on the scale is closest to

1) 589 N.
2) 708 N.
3) 469 N.
4) 120 N.
5) 349 N.

16) You swing a bat and hit a heavy box with a force of 1500 N. The force the box exerts on the bat is
1) exactly 1500 N only if the box does not move.
2) exactly 1500 N whether or not the box moves.
3) greater than 1500 N if the box moves.
4) less than 1500 N if the box moves.
5) greater than 1500 N if the bat bounces back.

17) A series of weights connected by very light cords are given an upward acceleration of 4.00 m/s\(^2\) by a pull \(P\), as shown in the figure. \(A\), \(B\), and \(C\) are the tensions in the connecting cords. The pull \(P\) is closest to

1) 690 N.
2) 490 N.
3) 290 N.
4) 200 N.
5) 50 N.

18) A 600-kg car traveling at 30.0 m/s is going around a curve having a radius of 120 m that is banked at an angle of 25.0°. The coefficient of static friction between the car’s tires and the road is 0.300. What is the magnitude of the force exerted by friction on the car?

1) 1590 N
2) 3430 N
3) 7240 N
4) 7820 N
5) 795 N
19) Two objects of the same mass move along the same line in opposite directions. The first mass is moving with speed \( v \). The objects collide, stick together, and move with speed \( 0.100v \) in the direction of the velocity of the first mass before the collision. What was the speed of the second mass before the collision?

1) \( 1.20v \)  
2) \( 10.0v \)  
3) \( 0.900v \)  
4) \( 0.800v \)  
5) \( 0.00v \)

20) A string is tied to a doorknob 0.72 m from the hinge as illustrated in the figure. At the instant shown, the force applied to the string is 5.0 N. What is the magnitude of the torque on the door?

![Torque Diagram](image)

1) \( 2.1 \text{ N} \cdot \text{m} \)  
2) \( 3.0 \text{ N} \cdot \text{m} \)  
3) \( 1.0 \text{ N} \cdot \text{m} \)  
4) \( 0.78 \text{ N} \cdot \text{m} \)  
5) \( 0.60 \text{ N} \cdot \text{m} \)

21) The drawing shows the top view of a door that is 1.68 m wide. Two forces are applied to the door as indicated. What is the magnitude of the net torque on the door with respect to the hinge?

![Torque Diagram](image)

1) \( 0 \text{ N} \cdot \text{m} \)  
2) \( 4.4 \text{ N} \cdot \text{m} \)  
3) \( 8.3 \text{ N} \cdot \text{m} \)  
4) \( 9.1 \text{ N} \cdot \text{m} \)  
5) \( 11 \text{ N} \cdot \text{m} \)
22) A ping-pong ball weighs 0.025 N. The ball is placed inside a cup that sits on top of a vertical spring. If the spring is compressed 0.055 m and released, the maximum height above the compressed position that the ball reaches is 2.84 m. Neglect air resistance and determine the spring constant.

![Spring Diagram]

1) 47 N/m  
2) 24 N/m  
3) 11 N/m  
4) 5.2 N/m  
5) 2.6 N/m

23) Complete the following statement: In order to calculate the "stress" on the box, in addition to the information given, one must also know

1) the mass of the box.  
2) the bulk modulus of the material from which the box is made.  
3) the shear modulus of the material from which the box is made.  
4) the Young's modulus of the material from which the box is made.  
5) the bulk modulus of the liquid.

24) Complete the following statement: In general, the term stress refers to

1) a change in volume.  
2) a change in length.  
3) a force per unit area.  
4) a fractional change in length.  
5) a force per unit length.

25) The brick shown in the drawing is glued to the floor. A 3500-N force is applied to the top surface of the brick as shown. If the brick has a shear modulus of 5.4 \times 10^9 N/m^2, how far to the right does the top face move relative to the stationary bottom face?

![Brick Diagram]

1) 5.8 \times 10^{-6} m  
2) 2.6 \times 10^{-6} m  
3) 1.1 \times 10^{-6} m  
4) 6.5 \times 10^{-7} m  
5) 3.4 \times 10^{-7} m
SEMESTER 1 ASSIGNMENTS FOR ENGINEERING STUDENTS

(The assignments that follow are for students registered for the FIRST SEMESTER in Engineering ONLY)
B. ENGINEERING STUDENTS

The following assignments should be done by students who are pursuing Engineering Qualifications ONLY.

Assignment 01 – Semester 1

Unique No: 737225

Due date: 26 February 2018

(Total: 100 marks. Contribution to year mark: 30%)

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These problems are taken from your prescribed book
Questions 1-6 are taken from your prescribed book

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**Question 7**

A 2.0-m-long, 1.0-mm-diameter wire is suspended from the ceiling. Hanging a 4.5-kg mass from the wire stretches the wire’s length by 1.0-mm. What is Young’s modulus for this wire? Can you identify the material?  

[10]
Question 8

8.1 Define the terms ‘tensile stress’, ‘tensile strain’ and ‘Young Modulus’, and state the S.I. units of each term.

8.2 Two materials, A and B, are used to make cables of identical cross section and length, to lift identical loads. If A has a greater Young’s Modulus than B, which cable will stretch the most when loaded?

8.3 A student is given a wire made of an unknown metal and asked to determine its Young’s Modulus. The student uses a vernier scale to measure the wire’s extension under a range of loads. Results are shown below.

<table>
<thead>
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<th>Load (N)</th>
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<td>0.9</td>
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<td>1.6</td>
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<td>2.2</td>
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<tr>
<td>30.0</td>
<td>4.0</td>
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</tbody>
</table>

(i) Plot a graph of load against extension.
(ii) Given that the wire’s diameter is 1.12 mm and its unstretched length is 2.060 m, find the Young’s Modulus of the metal.

[10]

Question 9

Suppose a 60.0-kg woman floats in freshwater with 97.0% of her volume submerged when her lungs are full of air. What is her average density?

[10]

Question 10

The tank shown in Fig. 4.8 contains a lubricating oil with a specific gravity of 0.91. A rectangular gate with the dimensions B=1.4 m and H=0.8 m is placed in the inclined wall of the tank (θ=60°). The centroid of the gate is at a depth of 1.6 m from the surface of the oil. Calculate (a) the magnitude of the resultant force \( \mathbf{F}_R \) on the gate and (b) the location of the center of pressure.
Fig. 4.8
Assignment 03 – Semester 1
Unique No: 775803
Due date: 23 April 2018

(Total: 100 marks. Contribution to year mark: 40%)

1) In addition to 1 m = 39.37 in., the following exact conversion equivalents are given: 1 mile = 5280 ft, 1 ft = 12 in, 1 hour = 60 min, and 1 min = 60 s. If a particle has a velocity of 8.4 miles per hour, its velocity, in m/s, is closest to

1) 3.8 m/s.
2) 3.0 m/s.
3) 3.4 m/s.
4) 4.1 m/s.
5) 4.5 m/s.

2) The shortest wavelength of visible light is approximately 400 nm. Express this wavelength in centimeters.

1) 4 \times 10^{-5} \text{ cm}
2) 4 \times 10^{-7} \text{ cm}
3) 4 \times 10^{-9} \text{ cm}
4) 4 \times 10^{-11} \text{ cm}
5) 400 \times 10^{-11} \text{ cm}
3) The figure shows the graph of the position $x$ as a function of time for an object moving in the straight line (the $x$-axis). Which of the following graphs best describes the velocity along the $x$-axis as a function of time for this object?
4) Two objects are dropped from a bridge, an interval of 1.0 s apart, and experience no appreciable air resistance. As time progresses, the DIFFERENCE in their speeds

1) increases.
2) remains constant.
3) decreases.
4) increases at first, but then stays constant.
5) decreases at first, but then stays constant.

5) Vectors \( \vec{A} \) and \( \vec{B} \) are shown in the figure. Vector \( \vec{C} \) is given by \( \vec{C} = \vec{B} - \vec{A} \). The magnitude of vector \( \vec{A} \) is 16.0 units, and the magnitude of vector \( \vec{B} \) is 7.00 units. What is the magnitude of vector \( \vec{C} \)?

![Vector Diagram](image)

1) 9.00
2) 9.53
3) 15.5
4) 16.2
5) 17.5

6) An airplane undergoes the following displacements: First, it flies 66 km in a direction 30° east of north. Next, it flies 49 km due south. Finally, it flies 100 km 30° north of west. Using vector components, determine how far the airplane ends up from its starting point.

1) 79 km
2) 81 km
3) 82 km
4) 78 km
5) 76 km
7) A ball is thrown at a 60.0° angle above the horizontal across level ground. It is thrown from a height of 2.00 m above the ground with a speed of 20.0 m/s and experiences no appreciable air resistance. The time the ball remains in the air before striking the ground is closest to

1) 16.2 s.
2) 3.07 s.
3) 3.32 s.
4) 3.53 s.
5) 3.64 s.

8) A plane flying at 70.0 m/s suddenly stalls. If the acceleration during the stall is 9.8 m/s² directly downward, the stall lasts 5.0 s, and the plane was originally climbing at 25° to the horizontal, what is the velocity after the stall?

1) 66 m/s at 17° below the horizontal
2) 66 m/s at 17° above the horizontal
3) 80 m/s at 37° below the horizontal
4) 80 m/s at 37° above the horizontal
5) None of the above

9) A 7.0-kg object is acted on by two forces. One of the forces is 10.0 N acting toward the east. Which of the following forces is the other force if the acceleration of the object is 1.0 m/s² toward the east?

1) 6.0 N east
2) 3.0 N west
3) 12 N east
4) 9.0 N west
5) 7.0 N west
Answer: 2

10) The figure shows two forces, each of magnitude 4.6 N, acting on an object. The angle between these forces is 40°, and they make equal angles above and below the horizontal. What third force will cause the object to be in equilibrium (acceleration equals zero)?

1) 8.6 N pointing to the right
2) 7.0 N pointing to the right
3) 4.3 N pointing to the right
4) 3.5 N pointing to the right
5) None of the above
11) Two objects, each of weight $W$, hang vertically by spring scales as shown in the figure. The pulleys and the strings attached to the objects have negligible weight, and there is no appreciable friction in the pulleys. The reading in each scale is

1) $W$.
2) more than $W$, but not quite twice as much.
3) less than $W$.
4) $2W$.
5) more than $2W$.

12) A 60.0-kg person rides in elevator while standing on a scale. The elevator is traveling downward but slowing down at a rate of $2.00 \text{ m/s}^2$. The reading on the scale is closest to

1) 589 N.
2) 708 N.
3) 469 N.
4) 120 N.
5) 349 N.

13) A 200 g hockey puck is launched up a metal ramp that is inclined at a 30° angle. The coefficients of static and kinetic friction between the hockey puck and the metal ramp are $\mu_s = 0.40$ and $\mu_k = 0.30$, respectively. The puck's initial speed is 63 m/s. What vertical height does the puck reach above its starting point?

1) 130 m
2) 270 m
3) 200 m
4) 66 m
5) None of the above
14) In the figure, a block of mass $M$ hangs at rest. The rope that is fastened to the wall is horizontal and has a tension of 52 N. The rope that is fastened to the ceiling has a tension of 91 N, and makes an angle $\theta$ with the ceiling. What is the angle $\theta$?

1) $55^\circ$
2) $35^\circ$
3) $30^\circ$
4) $63^\circ$
5) $45^\circ$

15) Two objects having masses $m_1$ and $m_2$ are connected to each other as shown in the figure and are released from rest. There is no friction on the table surface or in the pulley. The masses of the pulley and the string connecting the objects are completely negligible. What must be true about the tension $T$ in the string just after the objects are released?

1) $T = m_2g$
2) $T > m_2g$
3) $T < m_2g$
4) $T = m_1g$
5) $T > m_1g$
16) A 6.00-kg block is in contact with a 4.00-kg block on a horizontal frictionless surface as shown in the figure. The 6.00-kg block is being pushed by a horizontal 20.0-N force as shown. What is the magnitude of the force that the 6.00-kg block exerts on the 4.00-kg block?

1) 6.00 N
2) 20.0 N
3) 8.00 N
4) 4.00 N
5) 10.0 N

17) A car travels at a steady 40.0 m/s around a horizontal curve of radius 200 m. What is the minimum coefficient of static friction between the road and the car's tires that will allow the car to travel at this speed without sliding?

1) 1.23
2) 0.816
3) 0.736
4) 0.952
5) 0.662

18) A firecracker breaks up into several pieces, one of which has a mass of 200 g and flies off along the x-axis with a speed of 82.0 m/s. A second piece has a mass of 300 g and flies off along the y-axis with a speed of 45.0 m/s. What are the magnitude and direction of the total momentum of these two pieces?

1) 361 kg·m/s at 56.3° from the x-axis
2) 93.5 kg·m/s at 28.8° from the x-axis
3) 21.2 kg·m/s at 39.5° from the x-axis
4) 361 kg·m/s at 0.983° from the x-axis
5) 21.2 kg·m/s at 56.3° from the x-axis

19) A 1.2-kg spring-activated toy bomb slides on a smooth surface along the x-axis with a speed of 0.50 m/s. At the origin 0, the bomb explodes into two fragments. Fragment 1 has a mass of 0.40 kg and a speed of 0.90 m/s along the negative y-axis. In the figure, the angle θ, made by the velocity vector of fragment 2 and the x-axis, is closest to
1) $31^\circ$.
2) $37^\circ$.
3) $38^\circ$.
4) $53^\circ$.
5) $59^\circ$.

20) During the time a compact disc (CD) accelerates from rest to a constant rotational speed of 477 rev/min, it rotates through an angular displacement of 0.250 rev. What is the angular acceleration of the CD?

1) $358 \text{ rad/s}^2$
2) $126 \text{ rad/s}^2$
3) $901 \text{ rad/s}^2$
4) $866 \text{ rad/s}^2$
5) $794 \text{ rad/s}^2$

21) A constant force of 25 N is applied as shown to a block which undergoes a displacement of 7.5 m to the right along a frictionless surface while the force acts. What is the work done by the force?

1) zero joules
2) $+94 \text{ J}$
3) $-94 \text{ J}$
4) $+160 \text{ J}$
5) $-160 \text{ J}$

22) A roller coaster starts from rest at the top of an 18-m hill as shown. The car travels to the bottom of the hill and continues up the next hill that is 10.0 m high.

How fast is the car moving at the top of the 10.0-m hill, if friction is ignored?

1) 6.4 m/s
2) 8.1 m/s
3) 13 m/s
4) 18 m/s
5) 27 m/s
23) Which one of the following statements concerning kinetic energy is true?

1) Kinetic energy can be measured in watts.
2) Kinetic energy is always equal to the potential energy.
3) Kinetic energy is always positive.
4) Kinetic energy is a quantitative measure of inertia.
5) Kinetic energy is directly proportional to velocity.

24) A u-shaped tube is connected to a flexible tube that has a membrane-covered funnel on the opposite end as shown in the drawing. Justin finds that no matter which way he orients to membrane, the height of the liquid in the u-shaped tube does not change. Which of the following choices best describes this behavior?

1) Archimedes' principle
2) Bernoulli's principle
3) continuity equation
4) irrotational flow
5) Pascal's principle

25) A balloon inflated with helium gas (density = 0.2 kg/m$^3$) has a volume of $6 \times 10^{-3}$ m$^3$. If the density of air is 1.3 kg/m$^3$, what is the buoyant force exerted on the balloon?

1) 0.01 N
2) 0.08 N
3) 0.8 N
4) 1.3 N
5) 7.8 N
SEMESTER 2 ASSIGNMENTS
FOR ENGINEERING STUDENTS

(The assignments that follow are for students registered for the SECOND SEMESTER in Engineering ONLY)
Assignment 01 – Semester 2
Unique No: 847425
Due date: 20 August 2018

(Total: 100 marks. Contribution to year mark: 30%)

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These problems are taken from your prescribed book
Questions 1-6 are taken from your prescribed book

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Question 7
What diameter of a steel rod is required to support a tension load of 60 kN? Assume that the allowable stress for the steel is 180 N/mm²

[10]

Question 8
Human bones are rigid but when one stands on his leg it shortens. Calculate the change in length of the femur when an 80 kg man supports 72.0 kg of his mass on it, assuming the femur to be equivalent to a uniform rod that is 40 cm long and 2.00 cm in radius.

[10]
Question 9

For the oil tank shown below, compute the magnitude of the resultant force on the indicated area and the location of the centre of pressure.

[Diagram of an oil tank with dimensions and oil level]

Question 10

A buoy is a solid cylinder 0.3 m in diameter and 1.2 m long. It is made of a material with a specific weight of 7.9 kN/m³. If it floats upright, how much of its length is above the water?
1) How many nanoseconds does it take for a computer to perform one calculation if it performs \(6.7 \times 10^7\) calculations per second?

1) 15 ns  
2) 67 ns  
3) 11 ns  
4) 65 ns  
5) None of the above

2) The position \(x\), in meters, of an object is given by the equation \(x = A + Bt + Ct^2\), where \(t\) represents time in seconds. What are the SI units of \(A\), \(B\), and \(C\)?

1) m, m, m  
2) m, s, s  
3) m, s, s^2  
4) m, m/s, m/s^2  
5) m/s, m/s^2, m/s^3

3) A runner maintains constant acceleration after starting from rest as she runs a distance of 60.0 m. The runner's speed at the end of the 60.0 m is 9.00 m/s. How much time did it take the runner to complete the 60.0 m distance?

1) 6.67 s  
2) 15.0 s  
3) 9.80 s  
4) 10.2 s  
5) 13.3 s
4) A teacher sends her students on a treasure hunt. She gives the following instructions:

1. Walk 300 m north
2. Walk 400 m northwest
3. Walk 700 m east-southeast and the treasure is buried there.

As all the other students walk off following the instructions, Jane physics student quickly adds the displacements and walks in a straight line to find the treasure. How far and in what direction does Jane need to walk?

1) 187 m in a direction 67.3° north of east
2) 481 m in a direction 40.9° north of east
3) 399 m in a direction 52.5° north of east
4) 284 m in a direction 28.2° west of north
5) The treasure position cannot be reached in one straight walk.

5) If $\vec{A} > \vec{B}$, under what condition is $|\vec{A} - \vec{B}| = |\vec{A} - \vec{B}|$?

1) The statement is never true.
2) Vectors $\vec{A}$ and $\vec{B}$ are in opposite directions.
3) Vectors $\vec{A}$ and $\vec{B}$ are in the same direction.
4) Vectors $\vec{A}$ and $\vec{B}$ are in perpendicular directions.
5) The statement is always true.

6) Vectors $\vec{A}$ and $\vec{B}$ are shown in the figure. Vector $\vec{C}$ is given by $\vec{C} = \vec{B} - \vec{A}$. The magnitude of vector $\vec{A}$ is 16.0 units, and the magnitude of vector $\vec{B}$ is 7.00 units. What is the angle of vector $\vec{C}$, measured counterclockwise from the $+x$-axis?
1) 16.9°
2) 22.4°
3) 73.1°
4) 287°
5) 292°

7) The components of vector $\vec{B}$ are $B_x = -3.5$ and $B_y = -9.7$, and the components of vector $\vec{C}$ are $C_x = -6$ and $C_y = +8.1$. What is the angle (less than 180 degrees) between vectors $\vec{B}$ and $\vec{C}$?

1) 124°
2) 56°
3) 17°
4) 163°
5) 106°

8) A hockey puck slides off the edge of a table with an initial velocity of 28.0 m/s. and experiences no air resistance. The height of the tabletop above the ground is 2.00 m. What is the angle below the horizontal of the velocity of the puck just before it hits the ground?

1) 77.2°
2) 72.6°
3) 12.8°
4) 12.6°
5) 31.8°

9) A ball is thrown at a 60.0° angle above the horizontal across level ground. It is thrown from a height of 2.00 m above the ground with a speed of 20.0 m/s and experiences no appreciable air resistance. The time the ball remains in the air before striking the ground is closest to

1) 16.2 s.
2) 3.07 s.
3) 3.32 s.
4) 3.53 s.
5) 3.64 s.

10) A plane has an eastward heading at a speed of 156 m/s (relative to the air). A 20.0 m/s wind is blowing southward while the plane is flying. The velocity of the plane relative to the ground is

1) 157 m/s at an angle 7.31° south of east.
2) 157 m/s at an angle 7.31° east of south.
3) 155 m/s at an angle 7.36° south of east.
4) 155 m/s at an angle 7.36° east of south.
5) 157 m/s at an angle 7.36° south of east.
11) A ball is tossed vertically upward. When it reaches its highest point (before falling back downward)

1) the velocity is zero, the acceleration is directed downward, and the force of gravity acting on
the ball is directed downward.
2) the velocity is zero, the acceleration is zero, and the force of gravity acting on the ball is zero.
3) the velocity is zero, the acceleration is zero, and the force of gravity acting on the ball is
directed downward.
4) the velocity and acceleration reverse direction, but the force of gravity on the ball remains
downward.
5) the velocity, acceleration, and the force of gravity on the ball all reverse direction.

12) A 7.0-kg object is acted on by two forces. One of the forces is 10.0 N acting toward the east. Which of the following forces is the other force if the acceleration of the object is 1.0 m/s^2 toward the east?

1) 6.0 N east
2) 3.0 N west
3) 12 N east
4) 9.0 N west
5) 7.0 N west

13) An object weighing 4.00 N falls from rest subject to a frictional drag force given by \( F_{\text{drag}} = bv^2 \), where \( v \) is the speed of the object and \( b = 3.00 \text{ N} \cdot \text{s}^2/\text{m}^2 \). What terminal speed will this object approach?

1) 1.78 m/s
2) 3.42 m/s
3) 1.15 m/s
4) 2.25 m/s
5) 0.75 m/s

14) When a parachutist jumps from an airplane, he eventually reaches a constant speed, called the terminal speed. Once he has reached terminal speed

1) his acceleration is equal to \( g \).
2) the force of air drag on him is equal to zero.
3) the force of air drag on him is equal to \( g \).
4) his speed is equal to \( g \).
5) the force of air drag on him is equal to his weight.

15) A 60.0-kg person rides in elevator while standing on a scale. The elevator is traveling downward but slowing down at a rate of 2.00 m/s^2. The reading on the scale is closest to

1) 589 N.
2) 708 N.
3) 469 N.
4) 120 N.
5) 349 N.
16) You swing a bat and hit a heavy box with a force of 1500 N. The force the box exerts on the bat is

1) exactly 1500 N only if the box does not move.
2) exactly 1500 N whether or not the box moves.
3) greater than 1500 N if the box moves.
4) less than 1500 N if the box moves.
5) greater than 1500 N if the bat bounces back.

17) A series of weights connected by very light cords are given an upward acceleration of 4.00 m/s² by a pull $P$, as shown in the figure. $A$, $B$, and $C$ are the tensions in the connecting cords. The pull $P$ is closest to

![Diagram of weights](image)

1) 690 N.
2) 490 N.
3) 290 N.
4) 200 N.
5) 50 N.

18) A 600-kg car traveling at 30.0 m/s is going around a curve having a radius of 120 m that is banked at an angle of 25.0°. The coefficient of static friction between the car’s tires and the road is 0.300. What is the magnitude of the force exerted by friction on the car?
1) 1590 N  
2) 3430 N  
3) 7240 N  
4) 7820 N  
5) 795 N

19) Two objects of the same mass move along the same line in opposite directions. The first mass is moving with speed \( v \). The objects collide, stick together, and move with speed \( 0.100v \) in the direction of the velocity of the first mass before the collision. What was the speed of the second mass before the collision?

1) \( 1.20v \)  
2) \( 10.0v \)  
3) \( 0.900v \)  
4) \( 0.800v \)  
5) \( 0.00v \)

20) A string is tied to a doorknob 0.72 m from the hinge as illustrated in the figure. At the instant shown, the force applied to the string is 5.0 N. What is the magnitude of the torque on the door?

![Diagram](image)

1) \( 2.1 \text{ N} \cdot \text{m} \)  
2) \( 3.0 \text{ N} \cdot \text{m} \)  
3) \( 1.0 \text{ N} \cdot \text{m} \)  
4) \( 0.78 \text{ N} \cdot \text{m} \)  
5) \( 0.60 \text{ N} \cdot \text{m} \)

21) The drawing shows the top view of a door that is 1.68 m wide. Two forces are applied to the door as indicated. What is the magnitude of the net torque on the door with respect to the hinge?

![Diagram](image)
1) 0 N \cdot m
2) 4.4 N \cdot m
3) 8.3 N \cdot m
4) 9.1 N \cdot m
5) 11 N \cdot m

22) A ping-pong ball weighs 0.025 N. The ball is placed inside a cup that sits on top of a vertical spring. If the spring is compressed 0.055 m and released, the maximum height above the compressed position that the ball reaches is 2.84 m. Neglect air resistance and determine the spring constant.

1) 47 N/m
2) 24 N/m
3) 11 N/m
4) 5.2 N/m
5) 2.6 N/m

23) Complete the following statement: In order to calculate the "stress" on the box, in addition to the information given, one must also know

1) the mass of the box.
2) the bulk modulus of the material from which the box is made.
3) the shear modulus of the material from which the box is made.
4) the Young's modulus of the material from which the box is made.
5) the bulk modulus of the liquid.

24) Complete the following statement: In general, the term stress refers to

1) a change in volume.
2) a change in length.
3) a force per unit area.
4) a fractional change in length.
5) a force per unit length.
25) The brick shown in the drawing is glued to the floor. A 3500-N force is applied to the top surface of the brick as shown. If the brick has a shear modulus of $5.4 \times 10^9$ N/m$^2$, how far to the right does the top face move relative to the stationary bottom face?

1) $5.8 \times 10^{-6}$ m
2) $2.6 \times 10^{-6}$ m
3) $1.1 \times 10^{-6}$ m
4) $6.5 \times 10^{-7}$ m
5) $3.4 \times 10^{-7}$ m