UNISA university of south africa

IMPORTANT INFORMATION : Read it carefully!

DEPARTMENT OF PHYSICS

Mechanics

MODULE CODE : PHY1505

Tutorial Letter 101 for the academic year 2011

SCHEME OF WORK, STUDY RESOURCES AND ASSIGNMENTS

Contents

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1 Word Of Welcome

We, the Physics Department of UNISA, are very pleased to welcome you to this module and hope that you will find it both interesting and rewarding. Throughout the semester we shall do our best to make your study of this module successful. From your side we expect you (i) to try your best to start studying early in the semester and (ii) to complete all your assignments thoroughly and on or before the assigned submission dates.

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

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 at hand when working through the study material, preparing the assignments, preparing for the examination and addressing questions to your module lecturers.

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 **immediately and carefully**, as they always contain important and, sometimes, urgent information.

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

2 Purpose Of This Module

The module **PHY1505** deals with the following aspects of Physics:

- Linear and Rotational Motion
- The Laws of Motion
- Conservation of Mechanical Energy and Momentum
- The Gravitational Field
- Harmonic Motion
- Properties of Fluids

A primary goal of this module is to help you develop a conceptual understanding of these aspects. Physics is often regarded as a collection of equations that can 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.

3 Communicating With UNISA

Communication with the Physics Department and the module leader.

The lecturer responsible for this module will be announced in a follow up tutorial letter and also on the Physics Department's webpage at
http://www.unisa.ac.za/Default.asp?Cmd=ViewContent&ContentID=223

All queries about the academic content of this module should be directed to the module leader, or to the secretary of the Physics Department. 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:

The Module Lecturer PHY1505	Tel : +27+(0)12+429-8027
Department of Physics	Fax : +27+(0)12+429-3643
PO Box 392	E-mail : physics@unisa.ac.za
UNISA 0003	

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

Lecturers are usually available for pre-arranged appointments on weekdays form 08:00 to 15:30.

Communication with the University

All administrative enquiries should be directed to the *Unisa Contact Centre*. Such enquiries will then be channeled to the correct administrative department. The general contact details for the **Unisa Contact Centre** are as follows:

Calls (RSA only)	**:**	**086 167 0411**
International Calls	**:**	**+27 11 670 9000**
Fax Number (RSA)	**:**	**012 429 4150**
Fax Number (International)	**:**	**+27 12 429 4150**
E-mail	**:**	**study-info@unisa.ac.za**

Physical address:	Postal address:
University of South Africa	University of South Africa
Preller street	PO Box 392
Muckleneuk, Pretoria	UNISA 0003
City of Tshwane	

If you need to contact the University about matters that not directly related to the academic content of this module, you may also consult the brochure *My Studies@Unisa*.

4 Student Support System

For information on the various student support systems and services available through Unisa (e.g. student counseling, tutorial classes, language support), please consult the publication *My studies @ Unisa*.

Contact with fellow students

4.1 Study Groups

It si advisable to have contact with fellow students. One way to do this is to form study groups. The addresses of other students in your area may be obtained from the following department by dialling the **Unisa Contact Centre** 086 167 0411 or by writing to:

Directorate: Student Administration and Registration
P. O. Box 392
UNISA
0003

4.2 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**, and then click on the "Login to myUnisa" link on the righthand 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**.

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

5 Study Material

5.1 Inventory letter

At the time of registration, you will receive an inventory letter that will tell you what you have received in your study package and also indicate items that are still outstanding. Also see *My studies @ Unisa*.

Check the study material that you have received against the inventory letter. You should have received all the items listed in the inventory, unless there is a statements like "out of stock" or "not available". If any of the items is missing, follow the instructions at the back of the inventory letter without delay.

PLEASE NOTE Your lecturer cannot help you with missing study material. Please contact the Unisa Contact Centre at 0861 670 411 (RSA only) or +27 11 670 9000 (international calls). Also see section 3 above.

5.2 Study material

The Department of Dispatch should supply you with the following study material for this module:

- Tutorial Letters 101 and 301 at registration and others later.

- Other material that will be announced later.

Apart from Tutorial Letters 101 and 301, you will also receive other tutorial letters during the semester. These tutorial letters will not necessarily be available at the time of registration. Tutorial letters will be dispatched to you as soon as they are available.

If you have access to the internet, you can view the tutorial letters for the modules for which you are registered on the University's online campus, **myUnisa**, at **http://my.unisa.ac.za**

5.3 Prescribed Textbook

The prescribed textbook for this module for this semester is:

Fundamentals of Physics, 8-th Edition, (Wiley, 2008)
by David Halliday, Robert Resnick and Jearl Walker.

You can buy this textbook from local booksellers.

Please consult 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 Contact Centre* at 0861 670 411 (RSA only) or +27 11 670 9000 (international calls).

The content of the module is derived from the first 15 chapters of the prescribed textbook. All sections of each chapter should be studied.

5.4 Recommended books

There are no additional books specifically recommended for this module. However, any first year level Physics textbook you may find in the Unisa library will probably deal with most of the prescribed material. Please contact the Unisa library if you would like to borrow any additional books.

6 How the Assignment System Works

6.1 Assignments and learning

Assignments are seen as part of the learning material for this module. As you do the assignment, study the reading texts, consult other resources, discuss the work with fellow students or tutors or do research, you are actively engaged in learning. Looking at the assessment criteria given for each assignment will help you to understand what is required of you more clearly.

6.2 General remarks

You may submit written assignments and assignments done on mark-reading sheets either by post or electronically via myUnisa. **Assignments may not be submitted by fax or email**. For detailed information and requirements as far as assignments are concerned, see *My studies @ Unisa*, which you received with your study package.

Assignments should be addressed to:

The Registrar
P.O. Box 392
UNISA 0003

To submit an assignment via **myUnisa**:

- Go to **myUnisa**.
- Log in with your **student number** and **password**.
- Select the **module**
- Click on **assignments** in the left menu.
- Click on the **assignment number** you want to submit.
- Follow the instructions on the screen.

PLEASE NOTE Enquiries about assignments (e.g. whether or not the University has received your assignment or the date on which an assignment was returned to you) must be addressed to the Unisa Contact Centre at 0861 670 411 (RSA only) or +27 11 670 9000 (international calls). Also see section 3 above. You might also find information you require on myUnisa website (http://my.unisa.ac.za).

6.3 Feedback on assignments

You will receive the correct answers automatically for multiple-choice questions. For written assignments, markers will comment constructively on your work. However, commentaries on compulsory assignments will be sent to all students registered for this module in a follow-up tutorial letter, and not only to those students who submitted the assignments. The tutorial letter number will be 201, 202, etc.

As soon as you have received the feedback, please go back to your written work and check carefully where you have made mistakes and why. The assignments and the commentaries on these assignments constitute the most important part of your learning and will help you to perform better in the next assignment and the final examination.

6.4 Assignment Submission Dates

Semester 1: you must submit at least one assignment before 5 March and another before 1 April 2011.

Semester 2: you must submit at least one assignment before 13 August and another before 3 Sep 2011.

7 How the Examination System Works

For general information and the requirements for assignments, see My studies @ Unisa.

7.1 Examination admission

You will be admitted to the examination if you have submitted the two compulsory assignments. Your final mark for the module will be made up as follows: 10% from the assignment average and 90% from the final examination (see assignments section below).

7.2 Examination period

This module is offered in a semester period of fifteen weeks. This means that if you are registered for the first semester, you will write the examination in May/June and the supplementary examination will be written in October/November. If you are registered for the second semester you will write the

examination in October/November and the supplementary examination will be written in May/June of the following year.

The examination periods for 2011 are:

- Semester 1: 10 May to 11 June
- Semester 2: 25 Oct to 19 Nov

During the semester, the Examination Section will provide you with information regarding the examination in general, examination venues, examination dates and examination times.

7.3 Tutorial letter with information on the examination

To help you in your preparation for the examination, you will receive a tutorial letter that will explain the format of the examination paper, give you examples of questions that you may expect and set out clearly what material you have to study for examination purposes.

We hope that you will enjoy this module and we wish you success with your studies!

8 Assessment Criteria and Assignment

Consider the following strategies when solving assignment problems.

1. **Analyse the problem**
   (a) indicate the information provided.
   (b) indicate the information required.
   (c) explain the symbols used.
   (d) if necessary, draw a diagram for clarity.
2. **Plan the Solution**
   (a) follow an analogous illustration/example, if any, in the prescribed textbook.
   (b) indicate the principles/laws of classical mechanics involved.
   (c) explain the equations required.
3. **Provide a Solution** with
   (a) systematic and coherent arguments.
   (b) physically reasonable results.
   (c) consistent units.

SEMESTER 1

If you have registered for this module in the first semester, you must submit solutions to ONLY the following two compulsory assignments.

Assignment 01

Due Date : 07 March 2011
Unique Number : 251485

1. The number of significant figures in 15.0 is

   (1) 1
   (2) 2
   (3) 3
   (4) 4
   (5) 5

2. A cubic box with an edge of exactly 1 cm has a volume of

   (1) 10^{-9} m^3
   (2) 10^{-6} m^3
   (3) 10^{-3} m^3
   (4) 10^{3} m^3
   (5) 10^{6} m^3

3. At time $t = 0$ a car has a speed of 16 m/s. It slows down with an acceleration given by -0.50t, in m/s^2 for t in seconds. At the end of 4.0 s it has traveled

   (1) 0
   (2) 12 m
   (3) 14 m
   (4) 25 m
   (5) 59 m

4. An object with an initial velocity of 12 m/s west experiences a constant acceleration of 4 m/s^2 west for 3 seconds. During this time the object travels a distance of

   (1) 12 m
   (2) 24 m
   (3) 36 m
   (4) 54 m
   (5) 144 m

5. A stone is thrown vertically upward with an initial speed of 19.5 m/s. It will rise to a maximum height of

   (1) 4.9 m
   (2) 9.8 m
   (3) 19.4 m
   (4) 38.8 m
   (5) 42.3 m

6. The angle between $\vec{A} = (-25\,\text{m})\hat{i} + (45\,\text{m})\hat{j}$ and the positive x-axis is

   (1) 29°
   (2) 61°
   (3) 119°
   (4) 151°
   (5) 209°

7. Let $\vec{S} = (1\,\text{m})\hat{i} + (2\,\text{m})\hat{j} + (2\,\text{m})\hat{k}$ and $\vec{T} = (3\,\text{m})\hat{i} + (4\,\text{m})\hat{k}$. The angle between these two vectors is given by

   (1) $\cos^{-1}(14/15)$
   (2) $\cos^{-1}(11/225)$
   (3) $\cos^{-1}(104/225)$
   (4) $\cos^{-1}(11/15)$
   (5) cannot be found since $\vec{S}$ and $\vec{T}$ do not lie in the same plane

8. The value of $\hat{k} \cdot (\hat{k} \times \hat{i}\,)$ is

   (1) zero
   (2) +1
   (3) -1
   (4) 3
   (5) $\sqrt{3}$

9. A large cannon is fired from ground level over level ground at an angle of 30° above the horizontal. The muzzle speed is 980 m/s. Neglecting air resistance, the projectile will travel what horizontal distance before striking the ground?

   (1) 4.3 km
   (2) 8.5 km
   (3) 43 km
   (4) 85 km
   (5) 170 km

10. A stone is tied to the end of a string and is swung with constant speed around a horizontal circle with a radius of 1.5 m. If it makes two complete revolutions each second, the magnitude of its acceleration is

   (1) 0.24 m/s^2
   (2) 2.4 m/s^2
   (3) 24 m/s^2
   (4) 240 m/s^2
   (5) 2400 m/s^2

11. A stone is tied to a 0.50 m string and whirled at a constant speed of 4.0 m/s in a vertical circle. Its acceleration at the top of the circle is

   (1) 9.8 m/s^2, up
   (2) 9.8 m/s^2, down
   (3) 8.0 m/s^2, down
   (4) 32 m/s^2, up
   (5) 32 m/s^2, down

12. A 5 kg block is suspended by a rope from the ceiling of an elevator as the elevator accelerates downward at 3.0 m/s^2. The tension force of the rope on the block is

   (1) 15 N, up
   (2) 34 N, up
   (3) 34 N, down
   (4) 64 N, up
   (5) 64 N, down

13. A man weighing 700 Nb is in an elevator that is accelerating upward at 4 m/s^2. The force exerted on him by the elevator floor is

   (1) 71 N
   (2) 290 N
   (3) 410 N
   (4) 700 N
   (5) 990 N

14. When a 25 kg crate is pushed across a frictionless horizontal floor with a force of 200 N, directed 20° below the horizontal, the magnitude of the normal force of the floor on the crate is

    (1) 25 N
    (2) 68 N
    (3) 180 N
    (4) 250 N
    (5) 310 N

15. The coefficient of kinetic friction

    (1) is in the direction of the frictional force
    (2) is in the direction of the normal force
    (3) is the ratio of force to area
    (4) can have units of newtons
    (5) is none of the above

16. A horizontal shove of at least 200 N is required to start moving a 800 N crate initially at rest on a horizontal floor. The coefficient of static friction is

    (1) 0.25
    (2) 0.125
    (3) 0.50
    (4) 4.00
    (5) none of these

17. A 50 N force is applied to a crate on a horizontal rough floor, causing it to move horizontally. If the coefficient of kinetic friction is 0.50, in what direction should the force be applied to obtain the greatest acceleration?

    (1) Horizontal
    (2) 60° above the horizontal
    (3) 30° above the horizontal
    (4) 27° above the horizontal
    (5) 30° below the horizontal

18. An object of mass 1 g is whirled in a horizontal circle of radius 0.5 m at a constant speed of 2 m/s. The work done on the object during one revolution is

    (1) 0
    (2) 1 J
    (3) 2 J
    (4) 4 J
    (5) 16 J

19. A sledge (including load) weighs 5000 N. It is pulled on level snow by a dog team exerting a horizontal force on it. The coefficient of kinetic friction between sledge and snow is 0.05. How much work is done by the dog team pulling the sledge 1000 m at constant speed?

    (1) 2.5×10^4 J
    (2) 2.5×10^5 J
    (3) 5.0×10^5 J
    (4) 2.5×10^6 J
    (5) 5.0×10^6 J

20. Two objects with masses of m_1 and m_2 have the same kinetic energy and are both moving to the right. The same constant force $\vec{F}$ is applied to the left to both masses. If $m_1 = 4\,m_2$, the ratio of the stopping distance of m_1 to that of m_2 is

    (1) 1:4
    (2) 4:1
    (3) 1:2
    (4) 2:1
    (5) 1:1

TOTAL : 100

Assignment 02

Due Date : 07 April 2011

1. A small ball rolls horizontally off the edge a tabletop that is 1.20 m high. It strikes the floor at a point 1.52 m horizontally away from the edge of the table. (a) How long is the ball in the air? (b) What is its speed at the instant it leaves the table edge? [10]

2. An electron with a speed of 1.2×10^7 m/s moves horizontally into a region where a constant vertical force of 4.5×10^{-16} N acts on it. The mass of the electron is 9.11×10^{-31} kg. Determine the vertical distance the electron is deflected during the time it has moved 30 mm horizontally. [10]

3. A 30 g bullet moving at a horizontal velocity of 500 m/s comes to a stop 12 cm within a solid wall. (a) What is the change in the mechanical energy of the bullet? (b) What is the magnitude of the average force from the wall stopping the bullet? [10]

4. A projectile proton with a speed of 500 m/s collides elastically with a target proton initially at rest. The two protons then move along perpendicular paths, with the projectile proton path at 60^o from the original direction. After the collision what are the speeds of (a) the projectile proton and (b) the target proton? [10]

5. During a time interval t the flywheel of a generator turns through the angle $\theta(t) = a\,t + b\,t^3 - c\,t^4$, where a, b and c are constants. Determine the expression for (a) the angular speed and (b) the angular acceleration of the wheel as a function of time. [10]

6. Force $\vec{F} = (3.0\,\mathrm{N})\hat{i} - (3.0\,\mathrm{N})\hat{k}$ acts on a pebble with position vector $\vec{r} = (0.50\,\mathrm{m})\hat{j} - (2.0\,\mathrm{m})\hat{k}$ relative to the origin. In unit vector notation, what is the resulting torque on the pebble about (a) the origin, and (b) the point (2.0 m , 0 , -3.0 m)? [10]

7. A meter stick balances a horizontally on a knife-edge at the 50.0 cm mark. With two 5.0 g coins stacked over the 12.0 cm mark, the stick is found to balance at the 45.5 cm mark. What is the mass of the meter stick? [10]

8. At what altitude above Earth's surface would the gravitational acceleration be 4.9 m/s^2? [10]

9. A cube with a total surface area of 24 m^2 floats upright in water. If the density of water is 4.00 times the density of the cube, how far does the cube sink into the water? [10]

10. A vertical spring stretches 9.6 cm when a 1.3 kg block is hung from its end. (a) Calculate the spring constant. The block is then displaced an additional 5.0 cm downward and released from rest. Find (b) the period, (c) the frequency, (d) the amplitude, and (e) the maximum speed of the simple harmonic motion. [10]

TOTAL : 100

SEMESTER 2

If you have registered for this module in the second semester, you must submit solutions to ONLY the following two compulsory assignments.

Assignment 01

Due Date : 12 August 2011

Unique Number : 168192

1. The number of significant figures in 0.00150 is

   (1) 2
   (2) 3
   (3) 4
   (4) 5
   (5) 6

2. A square with an edge of exactly 1 cm has an area of

   (1) 10^{-6} m^2
   (2) 10^{-4} m^2
   (3) 10^{2} m^2
   (4) 10^{4} m^2
   (5) 10^{6} m^2

3. At time $t = 0$ a car has a speed of 16 m/s. It slows down with an acceleration given by -0.50t, in m/s^2 for t in seconds. By the time it stops it has traveled

   (1) 15 m
   (2) 31 m
   (3) 62 m
   (4) 85 m
   (5) 100 m

4. How far does a car travel in 6 s if its initial speed is 2 m/s and its acceleration is 2 m/s^2 in the forward direction?

   (1) 12 m
   (2) 14 m
   (3) 24 m
   (4) 36 m
   (5) 48 m

5. Neglecting the effect of air resistance a stone dropped off a 175 m high building lands on the ground in

   (1) 3 s
   (2) 4 s
   (3) 6 s
   (4) 18 s
   (5) 36 s

6. The angle between $\vec{A} = (25\,\mathrm{m})\hat{i} + (45\,\mathrm{m})\hat{j}$ and the positive x-axis is

   (1) 29°
   (2) 61°
   (3) 151°
   (4) 209°
   (5) 241°

7. Let $\vec{A} = (2\,\mathrm{m})\hat{i} + (6\,\mathrm{m})\hat{j} - (3\,\mathrm{m})\hat{k}$ and $\vec{B} = (4\,\mathrm{m})\hat{i} + (2\,\mathrm{m})\hat{j} - (1\,\mathrm{m})\hat{k}$. Then $\vec{A} \cdot \vec{B} =$

   (1) $(8\,\mathrm{m})\hat{i} + (12\,\mathrm{m})\hat{j} - (3\,\mathrm{m})\hat{k}$
   (2) $(12\,\mathrm{m})\hat{i} - (14\,\mathrm{m})\hat{j} - (20\,\mathrm{m})\hat{k}$
   (3) 23 m^2
   (4) 17 m^2
   (5) 11 m^2

8. The value of $\hat{i} \cdot (\hat{j} \times \hat{k})$ is

   (1) zero
   (2) +1
   (3) -1
   (4) 3
   (5) $\sqrt{3}$

9. A stone is thrown outward from the top of a 59.4 m high cliff with an upward velocity component of 19.5 m/s. How long is stone in the air?

   (1) 4.00 s
   (2) 5.00 s
   (3) 6.00 s
   (4) 7.00 s
   (5) 8.00 s

10. A girl jogs around a horizontal circle with a constant speed. She travels one fourth of a revolution, a distance of 25 m along the circumference of the circle, in 5.0 s. The magnitude of her acceleration is

    (1) 0.31 m/s^2
    (2) 1.3 m/s^2
    (3) 1.6 m/s^2
    (4) 3.9 m/s^2
    (5) 6.3 m/s^2

11. A stone is tied to a 0.50 m string and whirled at a constant speed of 4.0 m/s in a vertical circle. Its acceleration at the bottom of the circle is

    (1) 9.8 m/s^2, up
    (2) 9.8 m/s^2, down
    (3) 8.0 m/s^2, up
    (4) 32 m/s^2, up
    (5) 32 m/s^2, down

12. A 1000 kg elevator is rising and its speed is increasing at 3 m/s^2. The tension force of the cable on the elevator is

    (1) 6800 N
    (2) 1000 N
    (3) 3000 N
    (4) 9800 N
    (5) 12800 N

13. A car moves horizontally with a constant acceleration of 3 m/s^2. A ball is suspended by a string from the ceiling of the car. The ball does not swing, being at rest with respect to the car. What angle does the string make with the vertical?

    (1) 17°
    (2) 35°
    (3) 52°
    (4) 73°
    (5) Cannot be found without knowing the length of the string

14. A 25 N crate slides down a frictionless incline that is 25° above the horizontal. The magnitude of the normal force of the incline on the crate is

    (1) 11 N
    (2) 23 N
    (3) 25 N
    (4) 100 N
    (5) 220 N

15. When the brakes of an automobile are applied, the road exerts the greatest retarding force

    (1) while the wheels are sliding
    (2) just before the wheels start to slide
    (3) when the automobile is going fastest
    (4) when the acceleration is least
    (5) at the instant when the speed begins to change

16. A 24 N horizontal force is applied to a 40 N block initially at rest on a rough horizontal surface. If the coefficients of friction are $\mu_s = 0.5$ and $\mu_k = 0.4$, the magnitude of the frictional force on the block is

    (1) 8 N
    (2) 12 N
    (3) 16 N
    (4) 20 N
    (5) 400 N

17. A crate resting on a rough horizontal floor is to be moved horizontally. The coefficient of static friction is 0.40. To start the crate moving with the weakest possible applied force, in what direction should the force be applied?

    (1) Horizontal
    (2) 24° below the horizontal
    (3) 22° above the horizontal
    (4) 24° above the horizontal
    (5) 66° below the horizontal

18. The work done by gravity during the descent of a projectile

    (1) is positive
    (2) is negative
    (3) is zero
    (4) depends for its sign on the direction of the y-axis
    (5) depends for its sign on the direction of both the x-axis and y-axes

19. Camping equipment weighing 6000 N is pulled across a frozen lake by means of a horizontal rope. The coefficient of kinetic friction is 0.05. The work done by the campers in pulling the equipment 1000 m at constant velocity is

    (1) 3.1×10^4 J
    (2) 1.5×10^5 J
    (3) 3.0×10^5 J
    (4) 2.9×10^6 J
    (5) 6.0×10^6 J

20. A 4 kg cart starts up an incline with a speed of 3m/s and comes to rest 2 m up the incline. The total work done on the car is

    (1) 6 J
    (2) 8 J
    (3) 12 J
    (4) 18 J
    (5) impossible to calculate without more information

TOTAL : 100

Assignment 02

Due Date : 09 September 2011

1. Snow is falling vertically at a constant speed of 8.0 m/s. At what angle from the vertical do the snowflakes appear to be falling as viewed by the driver of a car traveling on a straight, horizontal road with a speed of 50 km/h? [10]

2. An elevator and its load have a combined mass of 1600 kg. Find the tension in the supporting cable when the elevator, originally moving downward at 12 m/s, is brought to rest with constant acceleration in a distance of 42 m. [10]

3. You push a 2.0 kg block against a horizontal spring, compressing the spring by 15 cm. Then you release the block, and the spring pushes it so that it slides across a tabletop. It stops 75 cm from where you released it. The spring constant is 200 N/m. What is the coefficient of kinetic friction between the block and the table? [10]

4. Two 2.0 kg bodies, A and B, collide. The velocities before the collision are $\vec{v}_A = 15\,\text{m/s})\hat{i} + (30\,\text{m/s})\hat{j}$ and $\vec{v}_B = (-10\,\text{m/s})\hat{i} + (5\,\text{m/s})\hat{j}$. After the collision, $\vec{v}_A' = (-5\,\text{m/s})\hat{i} + (20\,\text{m/s})\hat{j}$. What is (a) the final velocity of B and (b) the change in the total kinetic energy? [10]

5. A wheel rotates with angular acceleration $\alpha(t) = 4\,a\,t^3 - 3\,b\,t^2$, where t is the time and a and b are constants. If the wheel has initial angular speed ω_0, determine the expression for (a) the angular speed and (b) the angular position of the wheel as a function of time. [10]

6. Force $\vec{F} = (-8.0\,\text{N})\hat{i} + (6.0\,\text{N})\hat{j}$ acts on a particle with position vector $\vec{r} = (3.0\,\text{m})\hat{i} + (4.0\,\text{m})\hat{j}$. What are (a) the torque on the particle about the origin, in unit vector notation, and (b) the angle between the directions of $\vec{r}$ and $\vec{F}$? [10]

7. A rope of negligible mass is stretched horizontally between two supports that are 3.44 m apart. When an object of weight 3160 N is hung at the center of the rope, the rope is observed to sag by 35.0 cm. What is the tension in the rope? [10]

8. A satellite travels around planet Mars in an approximately circular orbit of radius 9.4×10^6 m with a period of 7 h 39 min. Calculate the mass of Mars from this information. [10]

9. If a bubble in sparkling water accelerates upward at the rate of 0.225 m/s^2 and has a radius of 0.50 mm, what is its mass? Assume that the drag force on the bubble is negligible. [10]

10. A 4.00 kg block is suspended from a spring with a spring constant 500 N/m. A 50.0 g bullet is fired directly into the block from directly below with a speed of 150 m/s and becomes embedded in the block. (a) Find the amplitude of the resulting simple harmonic motion. (b) What fraction of the original kinetic energy of the bullet is transferred to mechanical energy of the harmonic oscillator? [10]

TOTAL : 100