

Family Name (Please **print**
in **BLOCK LETTERS**)

Given Name(s)
as on student card

Student Number

Practical Group
Code (eg. FxA)

PHY131H1F

Term Test —version 1

Tuesday, October 2, 2012

Duration: 80 minutes

Aids allowed: A pocket calculator with no communication ability. A single original handwritten aid-sheet prepared by the student, no larger than 8.5”x11”, written on both sides.

- **Turn off** any communication device (phone, pager, PDA, iPod, etc.) you may have and place it at the front or back of the test room.
- **DO NOT separate the sheets of your question paper.** You can, however, “carefully” tear off the blank page at the end, as it does not have to be handed in.
- Before starting, please **PRINT IN BLOCK LETTERS your name, student number, and practical group code** at the top of this page **and** on the answer sheet.
- Check that the test-version numbers under the shaded circle at the top right of the answer sheet and in the title of your test paper match. If they do not, call an invigilator; if they do, **do not write anything on or near the circles.**

Scanned Area of the Answer Sheet:

1. Use a **dark-black, soft-lead pencil or a black pen.**
2. Mark in your student number by shading the circles in the student number area.
3. Indicate your answer to a multiple-choice question by **thoroughly** filling the appropriate circle on the answer sheet and also by recording your answer on the test paper.
4. If you wish to modify an answer, erase your pencil mark thoroughly, or use dry tape white-out sparingly.
5. **Do not write anything else on the answer sheet.** Use the blank sheets at the end or the back of the question sheets for rough work.

The test consists of **8** multiple-choice questions, worth 3 points each, or altogether **24** points. The test also has a set of free-form questions worth **16** points, for which fully worked solutions are required. The total possible number of points is **40**.

Multiple-choice questions:

- Each question has five possible answers, only one of which is correct.
- Blank or incorrect answers are worth zero point.
- Multiple answers for the same question are marked as incorrect.

Free-form Questions: To be awarded maximum credit, you must provide fully worked solutions to all parts of the free-form questions. In addition to showing your work, please put your answer(s) for each part in the boxes provided. You can use the back-side of the sheets and the blank pages at the end for your rough work which will not be graded or taken into account.

When the invigilators declare the test ended, **stop any writing or filling of circles** on the answer sheet immediately. Please put your answer sheet **inside your test paper** and have the paper ready for an invigilator to pick up.

Good luck!

Possibly helpful information for this test:

$\pi = 3.14159$ is the ratio of the circumference to the diameter of a circle

$g = 9.80 \text{ m/s}^2$ is the acceleration due to gravity near the Earth's surface.

Common Prefixes: k = "kilo-" = 10^3 c = "centi-" = 10^{-2}

μ = "micro-" = 10^{-6} n = "nano-" = 10^{-9}

m = "milli-" = 10^{-3}

The quadratic equation: If $ax^2 + bx + c = 0$, then $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Air resistance may be neglected in all questions.

MULTIPLE CHOICE (24 points total)

Question 1

Below is a motion diagram for an object with smooth motion and a constant value of acceleration. We define positive displacements as being toward the right. Note the dots are not numbered, so it is not known whether the object has positive or negative velocity. What can you say about the sign of the acceleration and whether the object is speeding up or slowing down?

- (A) The acceleration must be negative, and the object must be slowing down.
- (B) The acceleration must be positive, and the object must be speeding up.
- (C) The acceleration must be positive, and the object may be speeding up or slowing down.
- (D) The acceleration may be positive or negative, and the object must be speeding up.
- (E) The acceleration may be positive or negative, and the object may be speeding up or slowing down.



Question 2

The standard kilogram is a polished platinum-iridium cylinder stored in Paris. Imagine a system of units in which the volume of this standard kilogram is defined to be exactly 1 "ford". Note that the density of platinum-iridium is $21,500 \text{ kg/m}^3$, and the density of ice is 919 kg/m^3 . What is the density of ice in kg/ford?

- (A) 4.65×10^{-5} (B) 1.09×10^{-3} (C) 4.27×10^{-2} (D) 23.4 (E) 919

Question 3

You wish to measure the average speed of cars driving down St. George St. Over a distance of $125 \pm 2 \text{ m}$ you measure an average travel time of 11.3 ± 1.2 seconds. From these measurements you conclude that the average speed of cars is 11.1 m/s . What is the error in this value?

- (A) 0.11 m/s (B) 1.2 m/s (C) 1.6 m/s (D) 2 m/s (E) 2.3 m/s

Question 4

An extremely accurate digital thermometer gives a reading of 37.2°C when placed in a tissue sample. Repeated measurements give the same value of 37.2°C . What is the error in this value?

- (A) The error is 0.0°C (B) The error is 0.05°C (C) The error is 0.1°C
(D) There is no scatter in the measurements, so no error can be reported.
(E) In this situation you should take more measurements until you have a large enough sample to compute a standard deviation.

Question 5

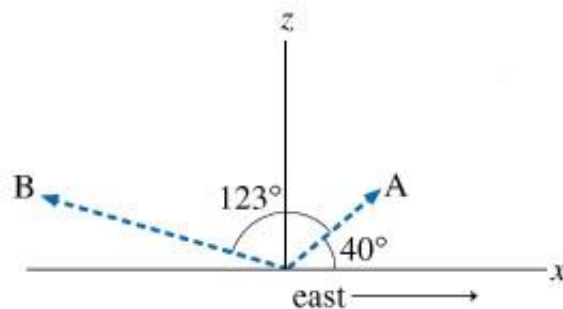
A ball is dropped from rest and another ball is dropped from rest a short time later. At the instant the second ball is dropped, the distance between the two balls is d . What is the distance between the balls at a time t after the second ball was dropped?

- (A) d (B) $d - \frac{1}{2}gt^2$ (C) $d + \frac{1}{2}gt^2$ (D) $d - t\sqrt{2dg}$ (E) $d + t\sqrt{2dg}$

Question 6

A radar station, located at the origin of xz plane, as shown in the figure below, detects an airplane coming straight at the station from the east. When the airplane is first observed, its position relative to the origin is \vec{R}_A . The position vector \vec{R}_A has a magnitude of 445 m and is located at exactly 40.0° above the horizon. The airplane is tracked for another 123° in the vertical east-west plane, until it has passed directly over the station and reached point B. The position of point B relative to the origin is \vec{R}_B (the magnitude of \vec{R}_B is 908 m). The position vectors are shown in the diagram, where the x axis represents the ground and the positive z direction is upward. What is the magnitude of the airplane's displacement $|\vec{R}_B - \vec{R}_A|$?

- (A) 20.6 m
(B) 763 m
(C) 1.10×10^3 m
(D) 1210 m
(E) 1330 m



Question 7

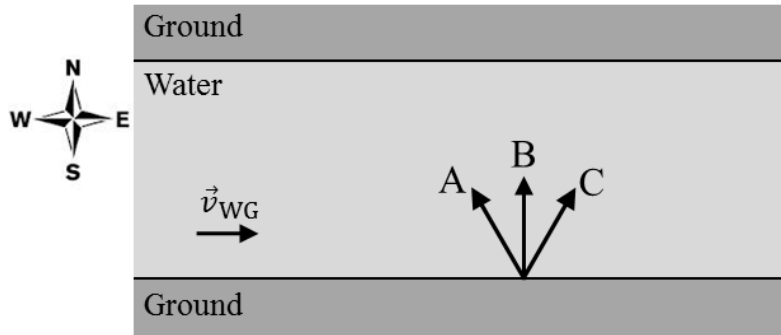
An object is dropped and freely falls to the ground with an acceleration of magnitude $1 g$. (Assume air resistance is negligible and the object is near the surface of the Earth.) If, instead, it is thrown upward at an angle from the same initial location, after the object leaves your hand its acceleration will be

- (A) $0 g$. (B) $1 g$ downward. (C) $1 g$ upward. (D) Larger than g .
(E) Smaller than g , but not zero.

Question 8

A river runs from west to east. The velocity of the Water relative to the Ground has a constant value of \vec{v}_{WG} . A Swimmer can swim at some maximum constant speed relative to the water v_{SW} . The Swimmer chooses the direction of his velocity so he crosses the river from the south bank to the north bank in the minimum amount of time. Which of the three labeled arrows on the diagram best indicates the direction of the velocity of the Swimmer relative to the Ground, \vec{v}_{SG} ?

- (A) A.
- (B) B.
- (C) C.
- (D) While crossing the river, the direction of \vec{v}_{SG} starts as C, but then curves toward B.
- (E) While crossing the river, the direction of \vec{v}_{SG} starts as A, but then curves toward B.

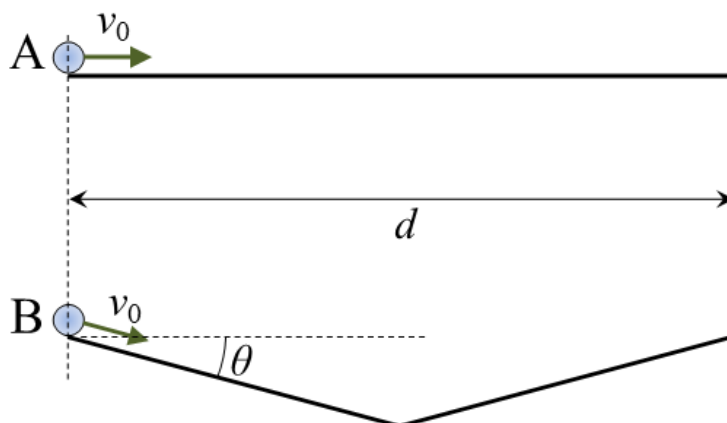


FREE-FORM IN TWO UNRELATED PARTS (16 points total)

Clearly show your reasoning and work as some part marks may be awarded. Write your final answers in the boxes provided.

PART A

Two balls roll on frictionless tracks, both starting with the same initial speed $v_0 = 1.40$ m/s. Ball A rolls on a straight, horizontal track a distance $d = 2.20$ m. Ball B rolls down a straight track which is angled at $\theta = 10.0^\circ$ below the horizontal. Half-way along the track, the track for ball B turns upward at an angle of $\theta = 10.0^\circ$ above the horizontal, so that the two tracks reach the same height at the end. At the instant Ball B encounters the sharp upward turn half-way along its track, assume it changes its direction without changing its speed. The *horizontal* distance that ball B travels is $d = 2.20$ m.



A1. [3 points] How much time does it take Ball A to roll the distance $d = 2.20$ m? [Please express your answer to the correct number of significant figures, with units in the box provided.]

$t_A =$

PART A – Continued from previous page

A2. [5 points] How much time does it take Ball B to roll the full length of its track, a total *horizontal* distance of $d = 2.20$ m? [Please express your answer to the correct number of significant figures, with units in the box provided.]

$t_B =$

A3. [1 point] Which ball reaches the end of its track first? [Circle the letter of the best answer below]

- (A) Ball A (B) Ball B (C) both balls reach the end at the same time

PART B [7 points]

You're driving down the highway late one night at speed v_0 when a deer jumps onto the road a distance d in front of you. Your reaction time before stepping on the brakes is t_1 . While stepping on the brakes, your car slows down, and the maximum magnitude of the car's acceleration during this time is a . What is the minimum value of the distance d so that you come to a stop before hitting the deer? [Please express your answer in the box provided using any or all of the following: v_0 , t_1 , a and any numerical constants necessary.]

$d_{\min} =$

ROUGH WORK (not marked)

A large, empty rectangular box with a thin black border, occupying most of the page. It is intended for students to write their rough work, which is not marked.