LAST NAME as on student card	First Name(s) **as on student card**	Student Number	Practical Group Code

PHY132H1S
Term Test —version B
Tuesday, February 4, 2014
Duration: 80 minutes

Aids allowed: A pocket calculator with no communication ability. A single aid-sheet prepared by the student, no larger than 8.5"x11", written on both sides. A Hard-copy English translation dictionary. A ruler.

- **Completely turn off** any communication device you may have and leave it with your belongings at the front of the 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.

Locate your test version number in the header at the top of the page and fill in the circle with the corresponding version code on your answer sheet in the "Form Code" box. Mark in your student number by shading the circles at the top-right of the sheet, starting with a 0 if the first digit is a 9. It is not required to bubble in your surname on the lower half of the sheet.

Scanned Area of the Answer Sheet:

1. **Use a dark-black, soft-lead pencil or a black pen.**
2. 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.
3. If you wish to modify an answer, erase your pencil mark thoroughly.
4. **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:

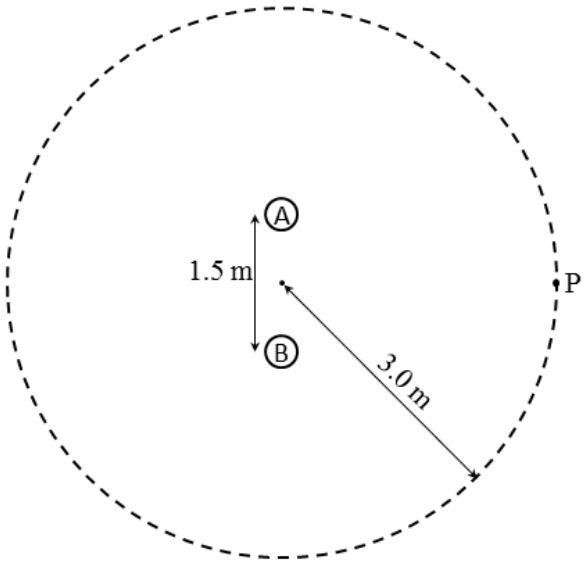
- Please choose the best answer.
- Blank or incorrect answers are worth zero points.
- Multiple answers for the same question result in zero points for that question.

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.

Possibly helpful information for this test:
π = 3.14159 is the ratio of the circumference to the diameter of a circle
The speed of sound in air may be assumed to be 343 m/s, unless otherwise stated.
Coulomb's law constant is $K = 8.99 \times 10^9$ N m^2/C^2
Common Prefixes: k = "kilo-" = 10^3 c = "centi-" = 10^{-2} m = "milli-" = 10^{-3}
μ = "micro-" = 10^{-6} n = "nano-" = 10^{-9}

Question 1
Two speakers, A and B, sit 1.5 m apart in the centre of a large field. They both emit a pure note, in phase, with a wavelength of 0.50 m. A large circle is traced out around them, centred on the point between the two speakers, with a radius of 3 m. If an observer begins at point P where the interference is maximum, and then walks counterclockwise around the circle one time, how many times will the observed sound intensity reach a minimum?



(A) 10 (B) 12 (C) 6
(D) 15 (E) 8

Question 2
Two positively charged particles q_1 and $q_2 = 2q_1$ lie on the x-axis. q_1 is at $x = 0$, and q_2 is at $x = d$, where d is a positive distance. At which of the following positions could a third charge be placed so as to experience little or no net force?

(A) 0.414 d (B) $d/2$ (C) $-d$ (D) 2.414 d (E) $d/3$

Question 3
Ocean waves with a wavelength of 120 m are moving East at a speed of 16 m/s relative to the shore. A boat is traveling West with a speed of 4 m/s relative to the shore. What is the frequency of waves as observed by a person on the boat?

(A) 6 waves per minute. (B) 10 waves per minute. (C) 0.1 waves per minute.
(D) 11 waves per minute. (E) 2 waves per minute.

Question 4

An object with a height y_o is held a distance $2f$ in front of a lens of positive focal length f. What is the height of the image, y_i? [Positive values correspond to an erect image, negative values correspond to an inverted image.]

(A) $-\frac{y_o}{2}$ (B) $-2y_o$ (C) $2y_o$ (D) $-y_o$

(E) No real image is formed in this case.

Question 5

A trumpet player stands on a rolling platform, which moves at a constant velocity towards a large stationary brick wall. He blows into the trumpet, producing a sound with constant frequency of $f_0 = 256$ Hz, as measured when the trumpet and an observer are both at rest. The trumpet player hears the emitted sound as well as the echo of the sound which is reflected from the wall. He hears a beat frequency of $f_{\text{beat}} = 3.0$ Hz. What is the speed of the trumpet player?

(A) 2.0 m/s (B) 4.0 m/s (C) 0.25 m/s (D) 343 m/s (E) 0.50 m/s

Question 6

After running a plastic comb through you hair several, times you hold it near a metal can, which is lying on its side on a table. The can rolls toward the comb. Why does this happen?

(A) The can has an overall negative electric charge.
(B) The comb becomes polarized.
(C) The can becomes magnetic.
(D) This is very unlikely to happen, because in most cases the can should roll away from the comb.
(E) The can becomes polarized.

Question 7

When one person shouts at a football game, the sound intensity level at the centre of the field is 60 dB. When all the people shout together, the intensity level increases to 100 dB. Assuming that each person generates the same sound intensity at the centre of the field, approximately how many people are at the game?

(A) 10,000 (B) 20,000 (C) 40 (D) 40,000 (E) 400

Question 8

Ramon has eyeglasses with the prescription −1.0 D. What eye condition does Ramon have, and what is his far point without the glasses?

(A) Myopia, 10 m (B) Hyperopia, 1.0 m (C) Myopia, 1.0 m
(D) Hyperopia, 0.25 m (E) Myopia, 2.0 cm

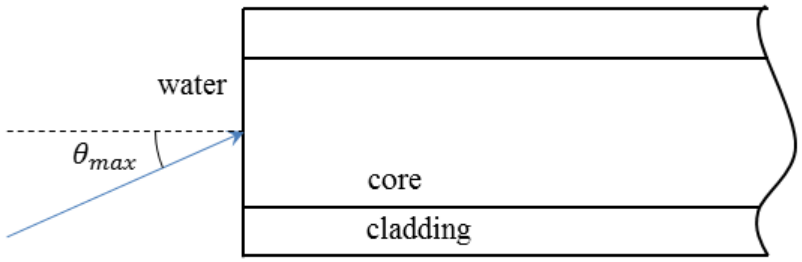
FREE-FORM PART (16 points total)
Clearly show your reasoning and work as some part marks may be awarded. Write your final answers in the boxes provided.

PART A [8 points]
The high "E-note" string on a guitar has a linear mass density of μ. It is tightened between two fixed points a distance L apart to a tension of T. A performer on a stage plays this E-note at the same time as a fast spectator rushes toward the stage at high speed. What is the minimum speed the spectator must go so that the frequency he observes is above the human range of hearing, f_{max}? Please express your answer in terms of numerical constants and any of the following: μ, L, T, f_{max} and the speed of sound in air, v.

$v_{\text{min}} =$

PART B [8 points]

Consider an optical fibre whose core has an index of refraction of $n_{core} = 1.62$ and cladding has an index of refraction of $n_{cladding} = 1.52$. When immersed in water ($n_{water} = 1.33$), what is the maximum angle θ_{max} that a ray can be incident upon the centre of the tip of the fibre so that, when in the fibre and incident on the core/cladding interface, it will undergo total internal reflection?



θ_{max} =

ROUGH WORK (not marked)