Extra-Credit, Take-Home Math Test for Physics 102

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Relax. This test is supposed to be a learning experience. It will be graded generously. It is a multiple-choice test. This is an extra-credit test. You cannot lower your final grade by doing this take-home test. Please print your name and the last four digits of your social-security number on the computer-gradable form.

Question 1

What is $(1 \times 10^3) \,/\, (10 \times 10^2)$?

(a) 0.01, (b) 0.0001, (c) 1, (d) 100, (e) 1000.

Question 2

What is $1/(3R) + 1/(2R)$?

(a) $R/5$, (b) $5/(6R)$, (c) $2/(5R)$, (d) $3/(2R)$, (e) $2/(3R)$.

Question 3

If $1/x = 1/5 + 1/10$, what is x?

(a) 10/3, (b) 3/10, (c) 1/15, (d) 15, (e) 2.

Question 4

If $z = h + vt + (1/2)gt^2$, with $h = 10$ m, $v = 20$ m/s, and $g = -10$ m/s^2, what is z when $t = 3$ s? Here m is short for meters, and s is short for seconds. (And I used 10 instead of 9.8 to simplify the arithmetic.)

(a) -30 m, (b) 10 m, (c) -15 m, (d) 15 m, (e) 25 m.

Question 5

If $y = a + bx + 3c^2$ with $y = 10$, $a = 2$, $x = 4$, and $c = -1$, what is b?

(a) 4 , (b) $-4/5$, (c) 1/6 , (d) $-3i$, (e) 5/4 .

Question 6

If $y = u + 3bt$, what is t?

(a) $by + u$, (b) $3y/(u - b)$, (c) $(y + u)/(3t)$, (d) $(y - u)/(3b)$, (e) $y + u + 3t$.

Question 7

Imagine a flagpole that is 3 m high and that casts a shadow that is 4 m long on the ground. What is the distance from the top of the flagpole to the end of the shadow (the end that is away from the bottom of the flagpole). Assume that the flagpole is straight and vertical, and that the ground is flat and perpendicular to the flagpole.

(a) 4 m, (b) 3 m, (c) $\sqrt{4 + 5}$ m, (d) 7.4 m , (e) 5 m.

Question 8

The energy of an electron at rest is $E = mc^2 = 0.511$ million electron Volts (MeV). When the electron is moving at speed v, its energy is

$$E = \frac{mc^2}{\sqrt{1 - \frac{v^2}{c^2}}}.$$

If the speed of light is $c = 3 \times 10^8$ m/s, what is the energy of an electron moving at $v = 0.9c$?

(a) 0.511 MeV, (b) 2 MeV, (c) 1.17 MeV, (d) 743 MeV , (e) 2 GeV (1 GeV = 1 billion eV).

Question 9

Same as question 8, but assume that $v = 0.99c$:

(a) 0.511 MeV, (b) 2.64 MeV, (c) 9.43 MeV, (d) 3.62 MeV , (e) 4.04 GeV.

Question 10

Same as question 8 but assume that $v = 0.999c$:

(a) 0.511 MeV, (b) 3.45 MeV, (c) 7.80 MeV, (d) 200.3 MeV , (e) 11.43 MeV.