PHYS 100 Midterm examination #1 (vers. 1B)

Spet. 30, 2005 Name Key

Time: 50 minutes Student No.

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Part I (Multiple choice questions). For each of the following five questions, please circle one answer only.

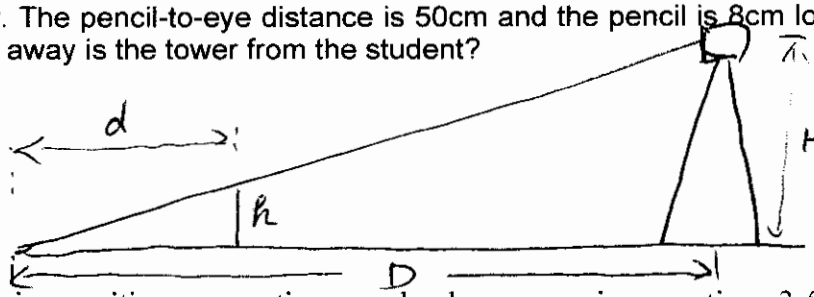
1 (2/20). The moon travels about 2.4×10^6 km in 28 days in one rotation around the earth. Express its speed in meters per second.

A) 9.9×10^5 m/s
B) 5.8×10^{15} m/s
(C)) 9.9×10^2 m/s
D) 5.8×10^{12} m/s
E) 8.5×10^4 m/s

$$\frac{2.4\times10^6\ km}{28\ day}\cdot\frac{1000\ m}{1\ km}\cdot\frac{1\ day}{24\ h}\cdot\frac{1\ h}{3600\ s} = 9.9\times10^2\ m/s$$

2 (2/20). A student holds a pencil vertically at arm's length. The pencil just obscures the student's view of a distant water tower. The pencil-to-eye distance is 50cm and the pencil is 8cm long. If the tower is 80 meters high, how far away is the tower from the student?

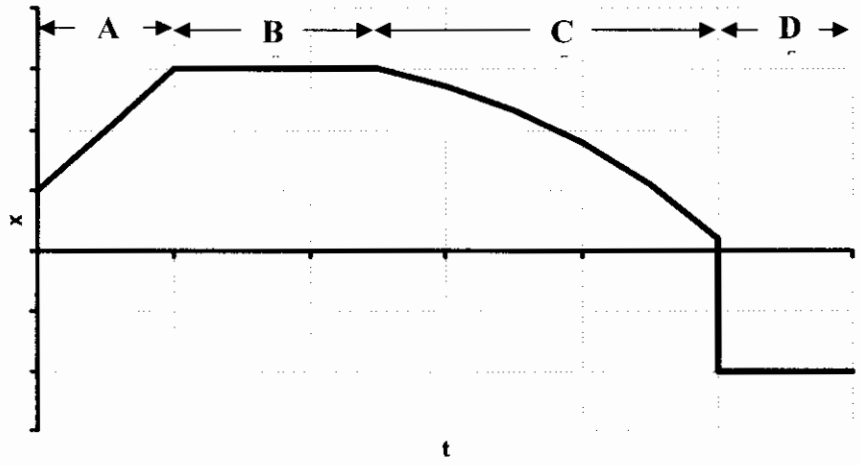
A) 500 m
B) 50 m
C) 128 m
D) 1280 m
E) 5000 m



$$\frac{D}{d}=\frac{H}{h}$$

$$D=\frac{H}{h}\cdot d = \frac{80\ m}{0.08\ m}\cdot 0.5\ m = 500\ m$$

Please refer to the following position-versus-time graph when answering questions 3-5:



3 (2/20). The displacement that occurs in time interval D is

A) Positive
(B)) 0
C) Increasing
D) Negative
E) Equal to the instantaneous velocity

$\Delta x = 0$

4 (2/20). The average velocity in time interval A is

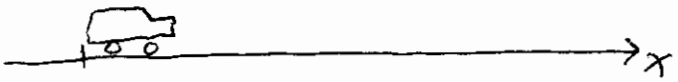
F) Increasing
G) 0
(H) Positive $\Delta x > 0$ $v_{av} = \frac{\Delta x}{\Delta t} > 0$
I) Negative
J) Decreasing

5 (2/20). During time interval C the instantaneous velocity is
K) Positive
L) 0
M) Increasing $\Delta x < 0$. $v_{av} = \frac{\Delta x}{\Delta t} < 0$.
(N) Negative
O) Equal to the average velocity

Part II (Full solution questions). For questions 6 and 7, please show complete solutions and explain your reasoning, stating any principles that you have used.

6 (5/20). You are driving through town at 12.0 m/s when suddenly a ball rolls out in front of you. You apply the brakes and begin slowing down at 4.00 m/s^2.
a) How far do you travel before stopping?
b) What is your speed when you have traveled only half the distance ?

[Solution]: Setup coordinate system:



Given: $v_0 = 12.0$ m/s, $a = -4.00$ m/s^2

$x_0 = 0$ (choose origin at x_0)

a). $\Delta x = \frac{v_f^2 - v_0^2}{2a} = \frac{0^2 - (12.0)^2}{2(-4.00)} = 18.0$ m

(OR: $\Delta t = \frac{\Delta v}{a} = \frac{0 - 12.0}{-4.00} = 3.00$ s.

$\Delta x = v_0(\Delta t) + \frac{1}{2} a (\Delta t)^2 = (12.0)(3.00) + \frac{1}{2}(-4.00)(3.00)^2$

$= 18.0$ m)

b). $\Delta x = \frac{1}{2} \cdot (18.0\text{m}) = 9.00$ m.

$v_f^2 = 2 \cdot a(\Delta x) + v_0^2 = 2 \cdot (-4.00)(9.00) + (12.0)^2 = 72.0$ m^2/s^2.

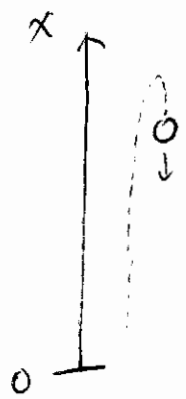
$v_f = \sqrt{72.0} = 8.49$ m/s

7 (5/20). A boy throws a small ball upward into the air with an initial velocity of 10.0 m/s.

a) Find the maximum height that the ball reaches?

b) How long, in seconds, is the ball in the air before it comes back to the boy's hand?

[Solution]. Set up coordinate system.



Given: $v_0 = 10.0\ m/s$. $a = -g = -9.8\ m/s^2$

$x_0 = 0$

a) at Max height, $x = x_M$, $v_M = 0$.

$$x_M = (\Delta x)_M = \frac{v_M^2 - v_0^2}{2a}$$

$$= \frac{0^2 - (10.0)^2}{2(-9.8)}$$

$$= 5.10\ m.$$

OR: $\Delta t = \frac{\Delta v}{a} = \frac{0 - 10.0\ m/s}{-9.8\ m/s^2} = 1.02\ s$

$$x_M = (\Delta x)_M = v_0(\Delta t) + \frac{1}{2}a(\Delta t)^2 = (10.0)(1.02) + \frac{1}{2}(-9.8)(1.02)^2$$

$$= 5.10\ m.$$

b). When the ball comes back to the boy's hand, $x = 0$, $\Delta x = 0$

$$0 = v_0(\Delta t) + \frac{1}{2}a(\Delta t)^2$$

$$0 = \Delta t\left[v_0 - \frac{1}{2}a(\Delta t)\right]$$

Solve for Δt: $\Delta t = 0$ rejected.

OR: $\Delta t = -\frac{2v_0}{a} = -\frac{2(10.0\ m/s)}{-9.8\ m/s^2} = 2.04\ (s)$.