

First Name: _____

Last Name: _____

Physics 20 – Competency Exam – Version 2

The competency test is broken into four sections, with two sections per competency. Each section corresponds to a summative quiz that was written in class. If you show improved knowledge on any of these sections, your teacher will modify your quiz mark to show the same ability (percentage). In short, the competency test acts a reassessment for each of your summative quizzes.

COMPETENCY TEST MARKS → QUIZ REPLACEMENT MARKS

Competency 1 – Motion in 1-Dimension

Interpreting Graphs *Summative Quiz* ___/8 * 1.00 = ___/8

Accelerated Motion *Summative Quiz* ___/10 * 1.20 = ___/12

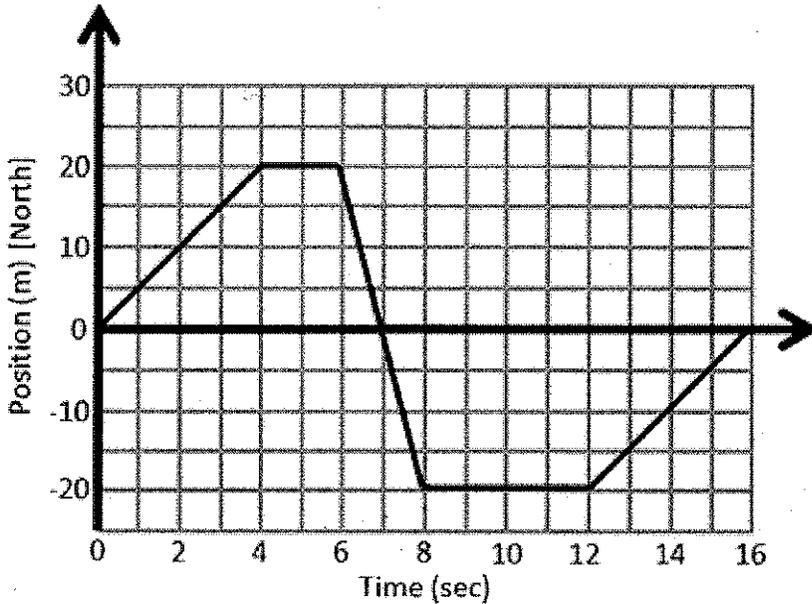
Competency 2 – Motion in 2-Dimensions

Adding Vectors in 2-Dimensions *Summative Quiz* ___/6 * 1.00 = ___/6

Projectile Motion *Summative Quiz* ___/6 * 1.67 = ___/10

Competency 1 – Interpreting Graphs – Version 2

The following is a Position vs. Time graph of a remote control car. Use the graph to answer Q1-4.



Q1: During what time(s) is the remote control car moving South? (1 mark)

6-8 sec

Q2: What is the velocity of the car between 6 and 8 seconds? (1 mark)

$$\vec{v} = \frac{\Delta \vec{d}}{\Delta t} = \frac{-40\text{m}[\text{N}]}{2\text{sec}} = -20\text{m/s}[\text{N}]$$

or
20 m/s [S]

Q3: What is the acceleration of the car between 12 and 16 seconds? (1 mark)

0 m/s² (Constant slope → Constant velocity)

Q4: What is the displacement of the car between 6 and 8 seconds? (1 mark)

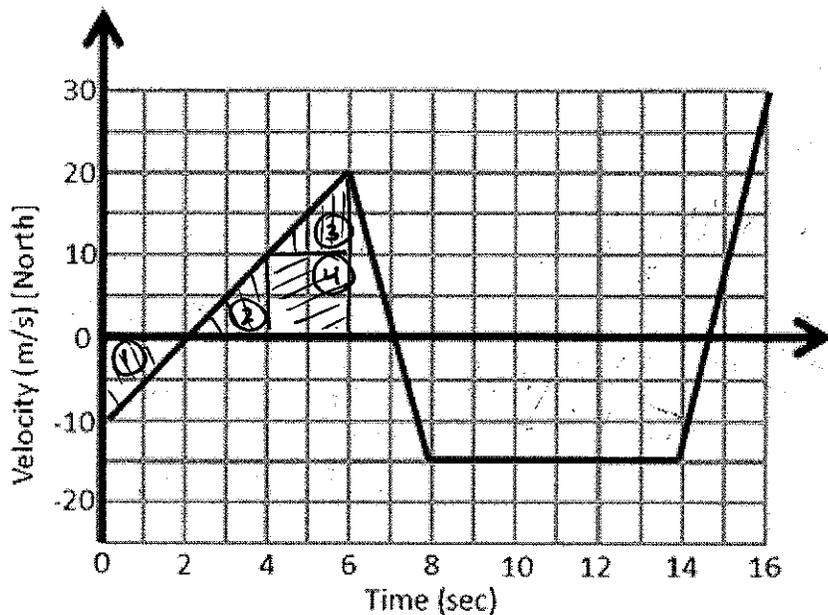
-40m [N]

or

40m [S]

KEY

The following is a Velocity vs. Time graph of a remote control car. Use the graph to answer Q5-8.



Q5: During what time(s) is the remote control car **moving South**? (1 mark)

0-2 sec, 7-14.67 sec

Q6: During what time(s) is the remote controlled car travelling with **uniform motion**? (1 mark)

8-14 sec

Q7: What is the **acceleration** of the car between 6 and 8 seconds? (1 mark)

$$\vec{a} = \frac{\Delta \vec{v}}{\Delta t} = \frac{-35 \text{ m/s} [\text{N}]}{2 \text{ sec}} = -17.5 \text{ m/s}^2 [\text{N}] \quad \text{or} \quad 17.5 \text{ m/s}^2 [\text{S}]$$

Q8: What is the **displacement** of the car between 0 and 6 seconds? (1 mark)

$$A_1 = -10 \text{ m} [\text{N}]$$

$$A_2 = 10 \text{ m} [\text{N}]$$

$$A_3 = 10 \text{ m} [\text{N}]$$

$$A_4 = 20 \text{ m} [\text{N}]$$

$$\hline A_{\text{tot}} = 30 \text{ m} [\text{N}]$$

$$\Delta \vec{s} = 30 \text{ m} [\text{N}]$$

Competency 1 – Accelerated Motion – Version 2

3 Q9: Early Sunday morning Mr. Bayer's two cats decide to fight. Nunzio decides to push David off of a 1.8 meter tall dresser. How fast is David going when he hits the ground? (3 marks)

$$\begin{aligned} v_i &= 0 \text{ m/s} \\ a &= -9.81 \text{ m/s}^2 \\ d &= -1.8 \text{ m} \\ v_f &= ? \end{aligned}$$

$$d = \left(\frac{v_i + v_f}{2} \right) t$$

$$-1.8 \text{ m} = \left(\frac{0 \text{ m/s} + v_f}{2} \right) t$$

$$\begin{aligned} v_f^2 &= v_i^2 + 2ad \\ v_f^2 &= (0 \text{ m/s})^2 + 2(-9.81 \text{ m/s}^2)(-1.8 \text{ m}) \\ v_f^2 &= 35.316 \\ v_f &= 5.94 \text{ m/s} \end{aligned}$$

3 Q10: Later that afternoon Nunzio is walking at 0.8 m/s when Kepler, the hyper dog, decides he also wants to play. Nunzio accelerates to 2.6 m/s after only 2 seconds. How much distance did it take Nunzio to accelerate? (3 marks)

$$\begin{aligned} v_i &= 0.8 \text{ m/s} \\ v_f &= 2.6 \text{ m/s} \\ t &= 2 \text{ s} \\ d &= ? \end{aligned}$$

$$\begin{aligned} d &= \left(\frac{v_i + v_f}{2} \right) t \\ d &= \left(\frac{0.8 \text{ m/s} + 2.6 \text{ m/s}}{2} \right) (2 \text{ sec}) \\ &= \left(\frac{3.4}{2} \right) 2 \end{aligned}$$

$$d = 3.4 \text{ m}$$

KEY

4

Q11: A wild cheetah is resting on the ground when its natural prey, the kangaroo, runs by at a steady 2m/s. If the instant the kangaroo is beside the cheetah the cheetah accelerates at 1.2m/s², how long will it take the cheetah to catch the kangaroo again? (4 marks)

Kangaroo

$$v_x = 2 \text{ m/s}$$

$$d_x = ?$$

$$t = ?$$

$$v_x = \frac{d_x}{t}$$

$$2 \text{ m/s} = \frac{d_x}{t}$$

$$d_x = 2t$$

Cheetah

$$v_{ix} = 0 \text{ m/s}$$

$$a_x = 1.2 \text{ m/s}^2$$

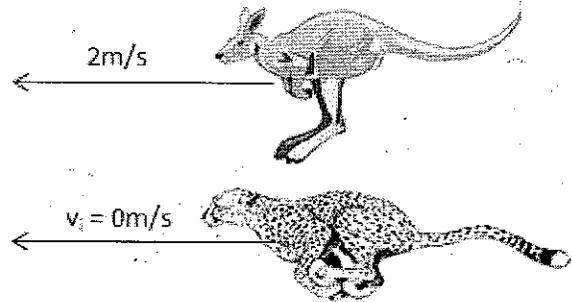
$$d_x = ?$$

$$t = ?$$

$$d_x = v_{ix}t + \frac{1}{2}a_x t^2$$

$$d_x = (0 \text{ m/s})t + \frac{1}{2}(1.2 \text{ m/s}^2)t^2$$

$$d_x = 0.6t^2$$



$$2t = 0.6t^2$$

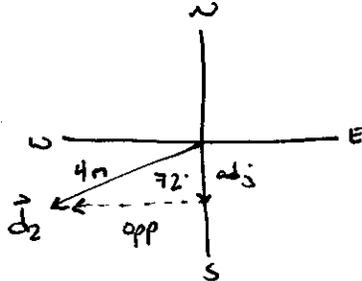
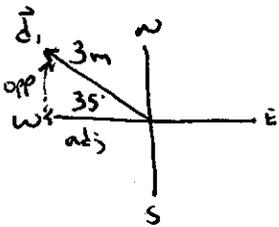
$$2 = 0.6t$$

$$t = 3.33 \text{ sec}$$

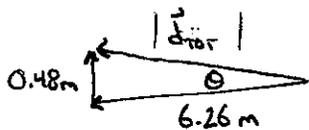
Competency 2 – Adding Vectors in 2-Dimensions Version 2

4

Q12: Mr. Siemens is very busy in FLEX class helping students. First he travels 3m [35° N of W] to help one student, then 4m [72° W of S] to help another. What is Mr. Siemens' total displacement? (4 marks)



	x-comp	y-comp
\vec{d}_1	$\cos \theta = \frac{a}{h}$ $\cos 35^\circ = \frac{d_{1x}}{3}$ $d_{1x} = -2.46\text{m}$	$\sin \theta = \frac{o}{h}$ $\sin 35^\circ = \frac{d_{1y}}{3}$ $d_{1y} = 1.72\text{m}$
\vec{d}_2	$\sin \theta = \frac{o}{h}$ $\sin 72^\circ = \frac{d_{2x}}{4}$ $d_{2x} = -3.80\text{m}$	$\cos \theta = \frac{a}{h}$ $\cos 72^\circ = \frac{d_{2y}}{4}$ $d_{2y} = -1.24\text{m}$
\vec{d}_{TOT}	$d_{\text{TOT}x} = -6.26\text{m}$	$d_{\text{TOT}y} = 0.48\text{m}$



$$a^2 + b^2 = c^2$$

$$0.48^2 + 6.26^2 = |d_{\text{TOT}}|^2$$

$$0.2304 + 39.1876 = |d_{\text{TOT}}|^2$$

$$|d_{\text{TOT}}| = 6.28\text{m}$$

$$\tan \theta = \frac{o}{a}$$

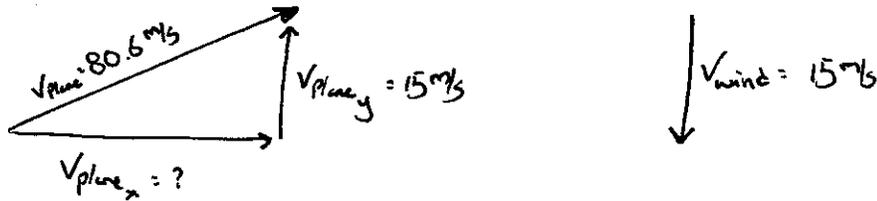
$$\theta = \tan^{-1} \left(\frac{0.48}{6.26} \right)$$

$$\theta = 4.38^\circ$$

$$\boxed{\vec{d}_{\text{TOT}} = 6.28\text{m} [4.38^\circ \text{ N of W}]}$$

KEY

Q13: A Boeing 747 airplane wishes to travel ~~3000m~~ [East], and is capable of travelling at 80.6m/s. If there exists a crosswind of 15m/s [South], and the plane is going to compensate for this, what will be the resultant ground speed of the plane if it weighs ~~442,253kg~~? (2 marks)



	x-comp	y-comp
v_{plane}	79.19 m/s	15 m/s
v_{wind}	0 m/s	-15 m/s
v_{TOT}	79.19 m/s	0 m/s

$$a^2 + b^2 = c^2$$

$$v_{plane,x}^2 + 15^2 = 80.6^2$$

$$v_{plane,x}^2 + 225 = 6496.36$$

$$v_{plane,x} = 79.19 \text{ m/s}$$

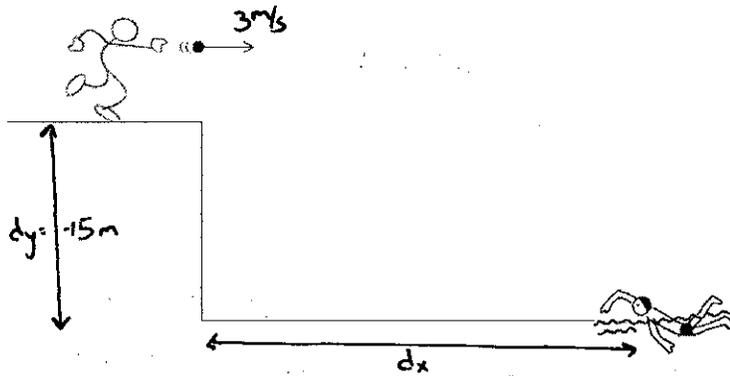
$\vec{v}_{TOT} = \vec{v}_{ground} = 79.19 \text{ m/s [East]}$

Competency 2 – Projectile Motion – Version 2

3

Q14: Mr. Bayer enjoys throwing his pet cats at swimmers. If he throws Nunzio horizontally at 3m/s from a 15m tall cliff, how far away should a swimmer be if Mr. Bayer wants Nunzio to land on their back?

(3 marks)



x-comp

$$v_x = 3\text{m/s}$$

$$d_x = ?$$

$$t = ?$$

y-comp

$$v_{iy} = 0\text{m/s}$$

$$a_y = -9.81\text{m/s}^2$$

$$d_y = -15\text{m}$$

$$t = ?$$

$$d_y = v_{iy}t + \frac{1}{2}a_yt^2$$

$$-15\text{m} = (0\text{m/s})t + \frac{1}{2}(-9.81\text{m/s}^2)t^2$$

$$-15 = -4.905t^2$$

$$t^2 = 3.06$$

$$t = 1.75\text{s}$$

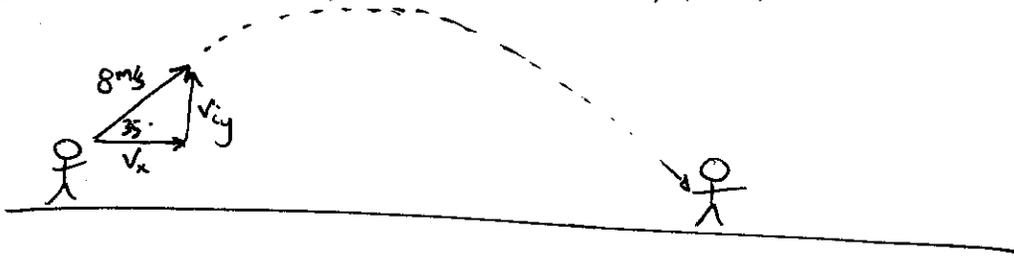
$$v_x = \frac{d_x}{t}$$

$$3\text{m/s} = \frac{d_x}{1.75\text{s}}$$

$$d_x = 5.25\text{m}$$

Mag. Direction 8

Q15: Mr. Siemens throws a ball at 8m/s [35°]. What is the velocity of the ball the instant before it is caught by Mr. Aspenes? Prove your answer mathematically. (3 marks)



x-comp

$$\cos 35^\circ = \frac{v_x}{8}$$

$$v_x = 6.55 \text{ m/s}$$

$$d_x = ?$$

$$t = ?$$

y-comp

$$\sin 35^\circ = \frac{v_{iy}}{8}$$

$$v_{iy} = 4.59 \text{ m/s}$$

$$a_y = -9.81 \text{ m/s}^2$$

$$d_y = 0 \text{ m}$$

$$t = ?$$

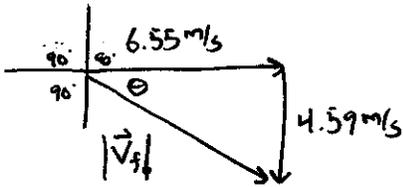
$$v_{fy} = ?$$

$$v_{fy}^2 = v_{iy}^2 + 2a_y d_y$$

$$v_{fy}^2 = (4.59 \text{ m/s})^2 + 2(-9.81 \text{ m/s}^2)(0 \text{ m})$$

$$v_x = 6.55 \text{ m/s}$$

$$v_{fy} = -4.59 \text{ m/s}$$



$$a^2 + b^2 = c^2$$

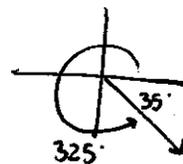
$$6.55^2 + 4.59^2 = c^2$$

$$|\vec{v}_f| = 8 \text{ m/s}$$

$$\tan \theta = \frac{a}{b}$$

$$\theta = \tan^{-1} \left(\frac{4.59}{6.55} \right)$$

$$\theta = 35^\circ$$



$$\vec{v}_f = 8 \text{ m/s } [325^\circ]$$

KEY

The following is a list of the names of the persons who have been named in the above report, together with their addresses and telephone numbers, where known.

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 Mr. G. H. Yellow, 27472 W. 274th St., New York, N. Y. 10011, Tel. 5-678-9012
 Miss I. J. Purple, 27674 E. 276th St., New York, N. Y. 10010, Tel. 6-789-0123
 Mr. K. L. Red, 27876 W. 278th St., New York, N. Y. 10011, Tel. 7-890-1234
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 Mr. M. N. Green, 30704 W. 307th St., New York, N. Y. 10011, Tel. 1-234-5678
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 Mr. Y. Z. Green, 31916 W. 319th St., New York, N. Y. 10011, Tel. 7-890-1234
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 Mrs. Q. R. Purple, 33734 E. 337th St., New York, N. Y. 10010, Tel. 6-789-0123
 Mr. S. T. Red, 33936 W. 339th St., New York, N. Y. 10011, Tel. 7-890-1234
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 Mr. G. H. Green, 37976 W. 379th St., New York, N. Y. 10011, Tel. 7-890-1234
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 Mr. W. X. Yellow, 39592 W. 395th St., New York, N. Y. 10011, Tel. 5-678-9012
 Miss Y. Z. Purple, 39794 E. 397th St., New York, N. Y. 10010, Tel. 6-789-0123
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