**YEAR 11 PHYSICS**

**MOVEMENT TEST I**

**TASK 9**

**2019**

**Student name**: \_\_\_\_\_\_\_\_SOLUTIONS\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Marks: / **40**

|  |  |
| --- | --- |
| Teacher:  Mr Boughton □  Mr Dopson G2 □  G3 □    Mrs Munshi □  Dr Pitts □ | [Image result for physics cartoons](https://www.google.com/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&ved=2ahUKEwjX39_39-HjAhWQe30KHXqODXQQjRx6BAgBEAU&url=https%3A%2F%2Fwww.facebook.com%2Fphysicsfootnotes%2Fphotos%2Fcartoons-can-provide-an-excellent-stimulus-for-physics-discussions-forcing-us-to%2F1918504558390316%2F&psig=AOvVaw1MhgsYLGaO0_vXHF3qaBxV&ust=1564757710000104) |

**­**

# **TIME**: 1 Hour

Data sheet supplied

**NOTE:**

1. Calculations must show clear working with answers stated to **three significant figures.**

2. Marks will be allocated for detailed and logical setting out.

3. Place your answer in the designated space under each question.

4.State **assumptions** while attempting open ended type questions.

5. Write in blue/black ink. It is advisable to use a pencil for graphing and diagrams.

**Question 1 (4 marks)**

A very lost goose flies 30.0 km north, then 50.0 km east, then 70.0 km south. Where is the goose now relative to its starting position?

North(positive)

Vertical displacement = 30.0 km north -70.0 km south = - 40.0 km or 40.0 km south

50.0 km east Using Pythagoras, resultant = √(50.02 +40.02) = 64.0

40.0 km south θ = tan-1 (= 38.7o **(1)**

Direction of resultant = 90.0 – 38.7 = 51.3o **(1)**

GRAPHICAL SOLUTION IS ACCEPTABLE

|  |
| --- |
| Answer: 64.0 km, S 51.3o E   1. **+ (1**) |

**Question 2 (8 marks)**

On Willetton SHS’s oval, a student shoots an arrow horizontally at 59.0 m s-1.

1. Draw in and label any acceleration vectors that act on the arrow below.

Note that the arrow is free from the bow and that the arrow is in free flight. Neglect air resistance. *[2 marks]*

**(1 mark for direction and 1 mark for label)**

Acceleration due to gravity

-9.8 m s-2 or gravity accepted but not accurate. Arrow should be at c.g.

1. If the arrow flies horizontally at 59.0 m s-1 and hits a target that brings the arrowhead to

rest in 1.20 ms, determine the average theoretical deceleration of the arrowhead as

it penetrates the target.  *[3 marks]*

\_ +

u = 59.0 m s-1 a =  = = - 4.92 x 104 m s-2

v = 0 **(0.5) (0.5) (1)**

t = 0.0012 s

|  |
| --- |
| Answer  4.92 x 104 m s-2 against the direction  of motion **1 mark for direction**  -4.92 x 104 m s-2 was accepted but not desirable without sign convention |

1. Given that the average deceleration of the arrow is actually - 5.31 x 104 m s-2, determine the theoretical displacement of the arrowhead at t = 0.00126 s after the arrowhead hits the surface of the target.  *[3 marks]*

v2 = u2 +2as **(0.5)** OR s = u t + at2

0 = 59.02 + (2 x -5.31 x 104 x s) **(0.5)** = (59.0 x 0.00126) + (0.5 x -5.31 x 104 x0.001262

= 0.0322 m

s = = 0.0328 m  **(1)**

|  |
| --- |
| Answer  0.0328 or 0.0322 m into the target / forward  **1 for the direction** |

**Question 3 (3 marks)**

A remote control car moves along a straight line. Its displacement from the starting point is shown as a function of time in the graph below.

(a) Determine the displacement of the remote control car at 5.00 s? *[1 mark]*

s = - 2.00 m OR 2.00 m in opposite direction to start **(1)**

Answer

- 2.00 m

1. Which section, or sections, of the graph represents a constant velocity of   
   3.00 m s-1? You must include calculations to justify your answer. *[2 marks]*

Answer

AB

Constant is AB or CD **(1)** gradient = velocity **must have some working for 2 marks**

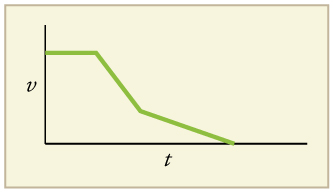
AB = ms-1 CD=  ms-1 so **AB**

1. **mark for working out AB or CD**

**Question 4 (4 marks)**

A graph of velocity versus time of a ship coming into a harbour is shown below.

1. Describe the motion of the ship based on the graph.  *[2 marks]*



D

C

B

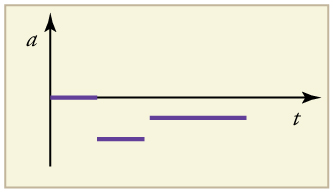
A

(a) The ship **moves at constant velocity** and then begins to **decelerate at a constant rate**. At some point, **its deceleration rate decreases**. It maintains this lower deceleration rate until it **comes to rest. 0.5 for each bold phrase**

(b) What would a graph of the ship’s acceleration versus time graph look like? Draw a sketch in the space provided *[2 marks]*

A graph of acceleration versus time would **start from the origin**, show **zero acceleration in the first leg**, **large and constant negative acceleration in the second leg**, and smaller **constant negative acceleration.**

**0.5 for each bold phrase**



D

C

B

A

**Question 5 (3 marks)**

Dr Pitts is driving her car down South Street and sees the traffic lights turn amber when she is 22.0 m from them. She has a fast reaction time of 0.400 s and is travelling at 17.5 m s-1. Determine through calculation whether she will be able to stop at the traffic lights if the car decelerates at 8.20 m s-2? Tick the box to indicate your answer.

s = 22.0 m

treaction = 0.400 s sreaction = v treaction = 17.5 x 0.400 = 7.00 m **(1)**

v = 17.5 m s-1

sremaining to stop safely= 22.0 – 7.00 = 15.0 m **(0.5)**

a = - 8.20 m s-2

u =17.5 m s-1 t = = = 2.13 s **(0.5)**

v = 0

s travelled during deceleration = ut + at2

= (17.5 x 2.13) –(0.5 x 8.20 2.132) = 18.7 m **(0.5)**

18.7 m >15.0 m so Dr Pitts cannot stop at traffic lights **(0.5)**

OR v2 = u2 +2as

0 = 17.52 – (2 x 8.20 x s)√

s = 18.7 m

|  |  |
| --- | --- |
| **YES,** she will stop in time |  |
| **NO,** she won’t stop in time | **√** |

OR 25.67 m > 22 m

OR -10.2m s-2 > -8.20 m s-2

**Question 6 (7 marks)**

A motorboat heads east at 15.0 m s-1 directly across a 400 m wide river with a current of 7.00 m s-1 south.

(a) Calculate the boat’s velocity while travelling on the river. *[2 marks]*

15.0 m s-1

North(positive)

θ

7.00 m s-1

velocity, v = √(15.02 + 7.002) **0.5 for diagram**

= 16.6 m s-1

θ = tan-1 ( = 25.0o **(0.5)**

|  |
| --- |
| Answer:  16.6 m s-1 S 65O E  **(0.5 + 0.5)** |

(b) Calculate the time it takes for the boat to cross. *[1 mark]*

t = = = 26.7 s

(c) How far downstream will the boat be when it reaches the opposite shore? *[1 mark]*

s = v t = 7.00 x 26.7 =187 m OR tan 25.01 =

(d) Calculate the angle upstream that the boat would have to head in order to end

up directly east of where it started. *[2 marks]*

θ = sin-1() = 27.8o **(1)**

15.0

7.00 Direction = 90 -27.8 = 62.2 o **(0.5)**

|  |
| --- |
| Answer N 62.2 o E or to the shoreline/bank **(0.5)** |

(e) Calculate the boat’s eastward velocity as it heads across at the angle you found in part (d) above.  *[1 mark]*

v = √(15.02 – 7.002) = 13.3 m s-1

OR 15 cos 27.8O = 13.3 m s-1 OR 7 tan 62.2O = 13.3 m s-1

**Question 7 (6 marks)**

Geraldine threw a 2.20kg pumpkin vertically upwards at an initial speed of 3.20ms-1. She caught the pumpkin as it fell back down. Ignore air resistance in this problem.

1. Calculate the maximum height, above Geraldine’s hand, to which the pumpkin rose. *[3 marks]*

u = 3.20 ms-1 0 = 3.202 + (2 x - 9.8 x s) **(1)** +

v = 0 **(0.5)** s = = 0.522 m **(1) \_**

v2 = u2 + 2as **(0.5)**

Answer

0.522 m

1. The pumpkin’s final velocity was its velocity at the instant that it reached Geraldine’s hand again on its downward flight. Determine the magnitude of the pumpkin’s final velocity and justify your answer with calculations.

*[3 marks]*

v2 = u2 + 2as **(0.5)**

u = 0 **(0.5)** v2 = 0 + (2 x - 9.8 x -0.522) **(1)** (-0.5 if not - 0.522)

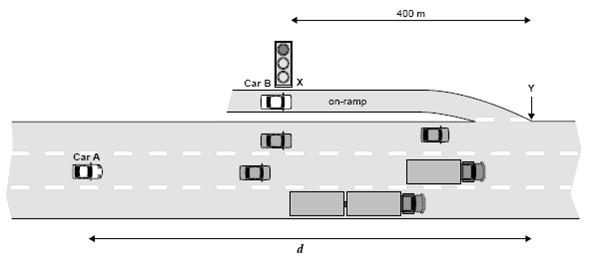
= 10.23

s =- 0.522 m v = √10.23 = 3.20 ms-1 **(1)**

|  |
| --- |
| Answer  3.20 ms-1 |

**Question 8 (5 marks)**

The diagram below shows the merging lane of the on-ramp of a busy freeway. A set of traffic lights is installed at X, 4.00 x 102 m from Y where the cars merge into the traffic flow. The vehicles on the busy freeway are travelling at a constant speed of 90.0 km h–1. When car A, a distance ***d*** along the road from point Y, is at the position shown, the traffic light at X changes to green. Car B, at the traffic light, is then expected to uniformly accelerate to 90.0 km h–1 at Y and merge into traffic beside car A. Calculate the distance ***d***. (You mustshow your working.)

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Answer

**s = 8.00 x 102 m**

For the cars to merge together, their times must be the same.

Car B (accelerating)

u = 0 v2 = u2 + 2as

v = 25.0 m s-1  25.02 = 2 x a x 400

s = 400 m 625 = 800 a

a = 0.78125 ms-2 **(1)**

 **(1)**

 **(1)**

Car A (constant velocity)

v = 25.0 ms-1 s = v t

t = same as car B = 32.0 s = 25.0 x 32.0 **(1)**

= 800 m

**Distance = 8.00 x 102 m** **(1)**