|  |  |
| --- | --- |
| COLOUR_LOGO Aug 2010 | **Year 12 *ATAR* Physics Unit 3** **2017**  ***Test 1 Projectile Motion, 3.0%***  **NAME: ………………………………………………….**  Data: See Data Sheet  Approx. marks shown.  ***(56 marks)*** |

When calculating numerical answers, show your working or reasoning clearly. Give final answers to **three** significant figures and include appropriate units where applicable.

When estimating numerical answers, show your working or reasoning clearly. Give final answers to a maximum of **two** significant figures and include appropriate units where applicable.

1. A person on the tray of a truck travelling at 40.0 kmh–1 in a straight line throws a ball straight up at 8.00 m s–1 and catches it again at the same height. What horizontal displacement does the ball undergo whilst in flight? [4]

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

2. A cannon fires a cannon ball horizontally at speed of 50.0 m s–1 from the top of a bridge that is 100 m above the surface of a lake below. Ignoring air resistance, calculate the velocity of the cannon ball just before it hits the water. [5]

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

3. A cricket ball (hit from near the ground) strikes the ground just over the boundary 110 m from the batsman. A spectator estimates that the ball rose to a maximum height of 25 m.

Use calculations to estimate the velocity with which the ball left the bat. [6]

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

|  |  |
| --- | --- |
| 4. An arrow is fired at 30.0° above the horizontal with a speed of 90.0 m s–1. Neglect air resistance and consider the arrow to be a point mass.  (a) (i) At what instant in time after firing will the arrow be travelling the slowest? [2]  ..................................................................  ..................................................................  ..................................................................  .................................................................. | http://survival-mastery.com/wp-content/uploads/2015/05/Silver-snake-hunting-bow.jpg  **Figure 1** |

..........................................................................................................................................

..........................................................................................................................................

(ii) What is the velocity of the arrow at this instant of time? [2]

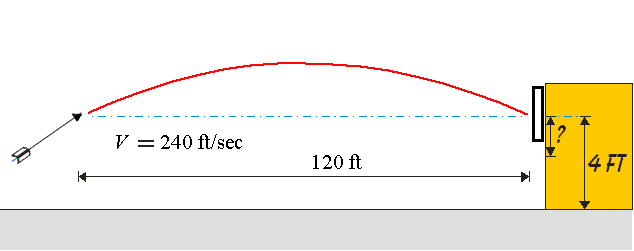
..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

(b) Even though the target is at the same level as the bow when the arrow is released the arrow is not fired directly along the line of sight (the **blue line** in Figure 2 below).

Briefly explain the reason for this. [3]

**Figure 2**

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

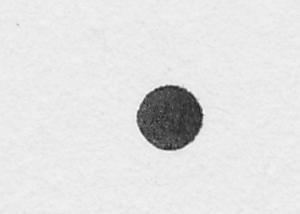
(c) At what different angle could the arrow be fired to achieve the same range? Show the trajectory on **Figure 2**  [2]

..........................................................................................................................................

..........................................................................................................................................

5. On February 6 1971, during the Apollo 14 mission, astronaut Alan Shepard hit a golf ball on the Moon. The golf club launched the ball at an angle of 24° to the ground with an initial speed of 45 m s–1.

(a) Construct a labelled free body diagram below, showing the force(s) acting on the golf ball about halfway between it being struck and its highest point. [2]



(b) Calculate the horizontal and vertical components of the initial velocity. [2]

Answer *uh* …………………m s-1

Answer *uv* …………………m s-1

(c) Assuming the golf ball travelled over a level surface, a horizontal distance of 900 m, calculate

(i) time taken to hit the surface [2]

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

(ii) the value of the acceleration due to gravity on the Moon [4]

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

6. An explosion in a tall building projects window glass outward *and downward* at 40.0 m s–1 at an angle of 20.0° below the horizontal. If the glass strikes the ground 4.50 s later,

(a) how far from the ground was the room in which the explosion occurred, and [3]

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

(b) how far from the base of the building does the glass land? [3]

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

|  |  |
| --- | --- |
| 7. In a football game, a place kicker kicks a football from the ground at a distance of 36.0 m from the goalposts, and the ball must clear the crossbar which is 3.10 m from the ground as shown in the diagram.  When kicked, the ball leaves the foot at 20.0 m s-1 at an angle of 53 0° to the horizontal.   1. How long does the ball take to travel the distance to the goalposts? [3] |  |

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

1. How far above or below the crossbar is the ball when it passes through the goal posts? [4]

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

1. Show on a sketch the path of the football. Include the goalposts in your sketch. Explain why you have drawn the path this way, *showing any necessary working*.

**Label this path P**. [5]

1. On the sketch in (c) above sketch the path of the football would take if air resistance was not negligible.

**Label this path A**. [2]

1. On the sketch in (c) above sketch the path of the football would take if a tail-wind was present and the air resistance was negligible.

**Label this path W**. [2]

End of Test