Physics ATAR - Year 12

Gravity and Motion
Test 1
2019

Name:	Mark: / 59
	= %

Teacher: HKR   JRM
(please circle)

Time Allowed: 50 Minutes

Notes to Students:

1. You must include **all** working to be awarded full marks for a question.
2. Marks will be deducted for incorrect or absent units and answers stated to an incorrect number of significant figures.
3. **No** graphics calculators are permitted – scientific calculators only.

Question 1   **(9 marks)**

A rescue plan wants to drop supplies to isolated mountain climbers on a rocky ridge 215 m below. The plane is travelling at 72.4 ms^{-1} horizontally.

215 m

(a)   Calculate the distance 'x' that that plane must drop the supplies in advance in order for them to reach the climbers.

x
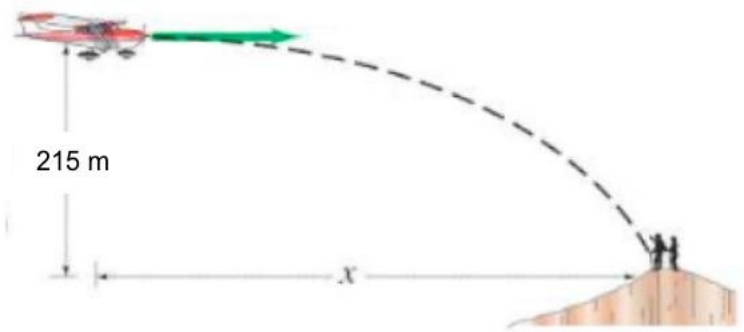
                                                       (4 marks)

(b)   Suppose instead, the plane (while still travelling 72.4 ms^{-1} horizontally) releases the supplies a horizontal distance of 425 m in advance of the climbers. Calculate the vertical velocity (up or down) that the supplies should be given in order for them to reach the climbers.

                                                       (5 marks)

Question 2   **(8 marks)**

A "fuzzy dice" is hanging by a string from the rearview mirror of a car. The car enters a corner and travels at a constant speed of 20.0 ms^{-1} throughout. The driver observes that the string makes an angle of 10.0° to the vertical.

(a)   Calculate the radius of curvature of the corner.

                                                                              (5 marks)

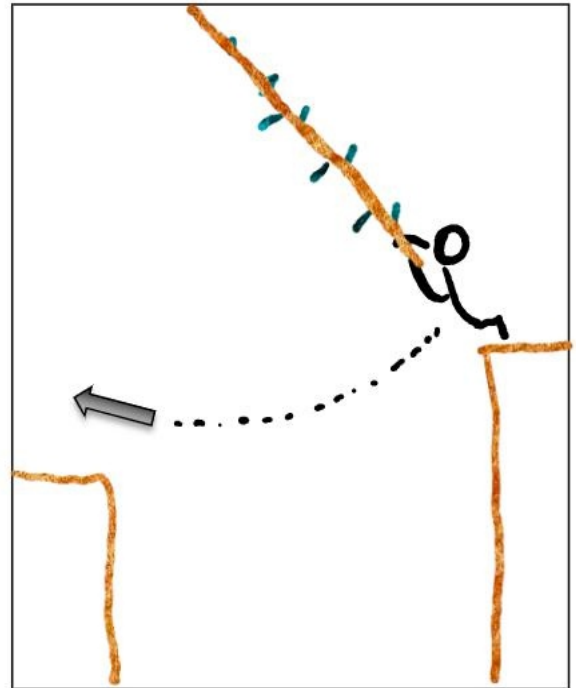(b)   Calculate the centripetal acceleration of the car as it turns the corner.

                                                                              (3 marks)

Question 3   (7 marks)

Tarzan plans to cross a gorge by swinging in an arc from a 7.40 m hanging vine. The tension in the vine can withstand a maximum force of 1400 N before it breaks and his mass is 85.0 kg.

(a)   Calculate the maximum speed the vine can support at the lowest point of his swing.

(4 marks)

(b)   Explain the effect (if any) that shortening the vine would have on the maximum speed that Tarzan could swing at the lowest point.

(4 marks)

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Question 4   **(9 marks)**

A roller coaster of mass 1250 kg falls from point A with an initial speed of 4.00 ms^{-1}. It falls a height 'h' and then enters a loop of radius 'R'.

(a)   Using concepts of conservation of energy, produce an equation for the total mechanical energy in terms of 'h'.

                                                 (3 marks)
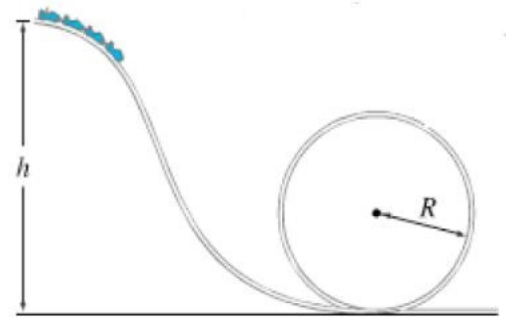
(b)   Given that h = 13.0 m and R = 4.40 m, Calculate the speed of the rollercoaster as it reaches the top of the loop.

                                                 (3 marks)

(c)   Hence, calculate the reaction force that the track exerts on the rollercoaster. (If you could not complete (b), use v = 11.0 ms^{-1})

                                                 (3 marks)

Question 5   **(7 marks)**

A recent addition to the Big Bash League Cricket commentary is to discuss the "air time" of a big hit. Commentators in the 2018/19 season have commented the longest "air-time" of a 6 (where the ball is struck out of the field) was 5.50 seconds. The ball was struck at an angle of 60.0 degrees above horizontal and a height of 1.10 m above the ground, it was caught by a lucky fan in the crowd a height of 8.50 m above the ground.
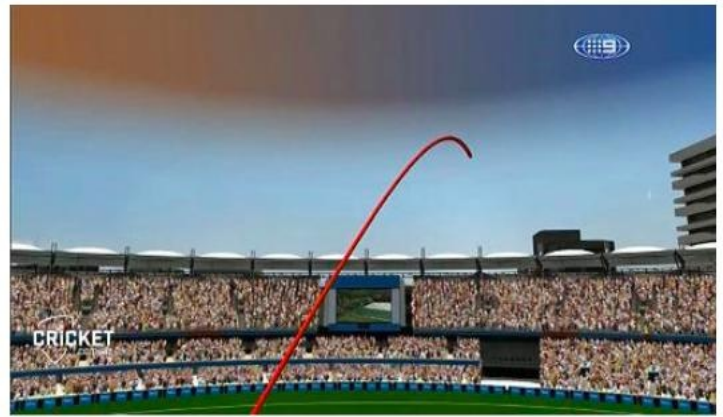
Wide World of Sports, Channel 9 Australia

(a)   Calculate the velocity that the ball leaves the cricket bat with if the ball had an air time of 5.50 seconds.

                                                                              (4 marks)

(b)   Calculate the horizontal distance the lucky fan is from the batsman.

                                                                              (3 marks)

Question 6   **(9 marks)**

A cannon ball is fired at 102 ms^{-1} at an angle of 46.0° above the horizontal towards a tall vertical cliff-face located horizontally 839 meters away.

(a)   Calculate the time taken for the cannon ball to strike the cliff.

                                                                        (3 marks)

(b)   Calculate the distance up the cliff-face that the cannon ball strikes.

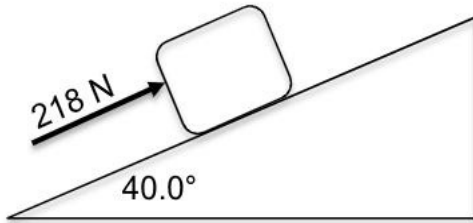   (3 marks)

(c)   Show, via a suitable equation, whether the cannonball strikes the cliff-face travelling in an upwards direction or a downwards direction.

                                                                            (3 marks)

Question 7   (5 marks)

A force of 218 N is applied to a 25.0 kg box up an incline of 40.0°, as shown in the diagram. The acceleration of the box is measured to be 0.750 ms^{-2} up the incline. Calculate the co-efficient of kinetic friction between the box and the slope given that $F_F = \mu_k F_N$.

Question 8   **(5 marks)**

Two children are playing on a piece of playground equipment which rotates in a counter clockwise direction when viewed from above. As the equipment rotates, the child on the left of the diagram lets go.
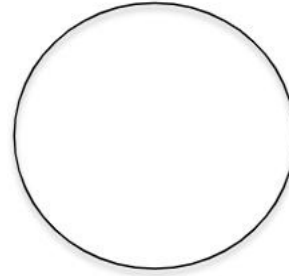
(a)   On the overhead view to the right, sketch the horizontal path of the child after she lets go.

(1 mark)

(b)   Ignoring any vertical effects due to gravity, explain why the child takes this path.

(4 marks)

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END OF TEST