Physics 3AB

Motion and Forces Test One 2014

Name:

Mark: / 53

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Time Allowed: 50 minutes

Notes to Students:

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

Question 1 **(4 marks)**

A car moves due west with a speed of 40.0 kmh^{-1} and then turns and accelerates to travel north with a speed of 50.0 kmh^{-1}. With the aid of an appropriate diagram, calculate the change in velocity of the car.

Question 2 **(3 marks)**

A cricket player, attempting to stop a ball from reaching the boundary, slides to a stop on level ground. Using energy considerations, calculate the distance an 85.0 kg player will slide, if his initial speed is 7.00 ms^{-1} and the force of friction against him is a constant 450 N.

Question 3 **(6 marks)**

A projectile is fired from ground level and falls back to ground level.

(a) In the space below, sketch the trajectory of the projectile, assuming there is no air resistance.

(1 mark)

(b) On your sketch above, in **a different coloured pen**, sketch the trajectory of the projectile when in the **presence** of air resistance.

(2 marks)

(c) Select and state **one** feature of the two sketches which is different and explain the difference.

(3 marks)

Question 4 **(7 marks)**

A car travels along the curved exit ramp of a freeway. The radius of the curve is 80.0 m and the curve is not banked. A 70.0 kg passenger experiences a force of 220 N during the turn.

(a) What is the car's speed in kmh^{-1}?

(4 marks)

(b) A passenger in the same car feels as though they are being pushed towards their door. Is this a real force they are experiencing? Explain your reasoning.

(3 marks)

Question 5 **(13 marks)**

A sled weighing 200 N rests on a 15.0° incline. The coefficient of static friction (μ_s) is 0.500.

Given that $F_f = \mu_s F_N$ and $F_f = \mu_k F_N$

(a) Sketch a diagram below showing the forces acting on the sled, including any appropriate resolution of forces.

(4 marks)

(b) Calculate the magnitude of the static friction exerted on the sled.

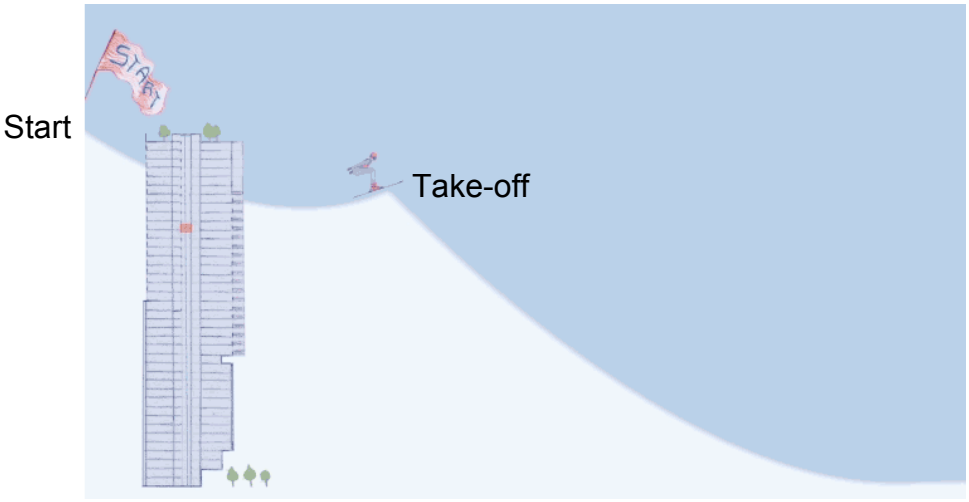
(4 marks)

(c) A child with a weight of 500 N now sits on the sled. If the coefficient of kinetic friction (μ_k) is 0.150, calculate the acceleration of the sled. You may restate the result of derivations from (b).

(5 marks)

Question 6 **(11 marks)**

Ski jumping, recently seen at the Winter Olympics in Sochi, is a sport in which skiers go down a take-off ramp, then jump and attempt to impress judges. From the top of the run, it is a vertical drop of 140 m from their starting position to the landing. This is roughly equivalent to a 40-storey fall.



The ski jumper in the diagram above takes off from the ramp with a speed of 90.0 kmh^{-1} at an angle of 12.0° above the horizontal. Assume the take-off point is 21.0 m below the starting position.

(a) Determine the flight time of the ski jumper from the take-off point.

(4 marks)

(b) Calculate the horizontal displacement of the ski jumper from the take-off point?

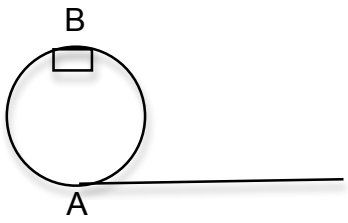
(3 marks)

(c) Calculate the velocity of the ski jumper on landing.

(4 mark)

Question 7 **(9 marks)**

A block slides on a frictionless surface along a loop-the-loop, as shown in the diagram below. The loop-the-loop has a radius of 20.0 cm.



(a) In the area below, sketch and label free body diagrams of the forces acting on the block at point A and at point B.

(2 marks)

(b) If the block was initially released from a point 1.40 m above A, what is the speed of the block at B?

(3 marks)

(c) By making reference to your answer from (b), show that the block will successfully complete the loop-the-loop, (i.e. that it will never lose contact with the track).

(4 marks)