UNIVERSITY OF MANITOBA

October 17, 2013
(7:00 pm – 9:00 pm)

MID-TERM TEST
(+ Formula Sheet)

PAPER NO.: **C**

DEPARTMENT & COURSE NO.: PHYS 1050

TIME: 2 hours

EXAMINATION: Physics 1: Mechanics

EXAMINERS: S. A. Page, J. Mammei, C.-M. Hu

All questions are of equal value. Answer all questions. No marks are subtracted for wrong answers. Scrap paper is provided for your rough work.

Record all answers on the computer score sheet provided. **USE PENCIL ONLY! Mark only <u>one</u> answer for each question!** Select the answer that is closest to yours.

A formula sheet is provided for your use; you may **not** use your own formula sheet or any other materials or notes. Calculators of any type are allowed, but not devices that store text or that can communicate with other such devices.

Be sure your name and student number are printed on the score sheet and the student number correctly coded in the box at the top right-hand side of the sheet.

This is paper **C**. Questions are numbered 81 to 98. Mark the correct answers in rows 81-98 of the ***third*** column of the accompanying IBM sheet in pencil. Also write "Paper **C**" next to your name on the IBM sheet.

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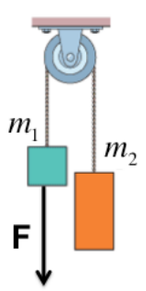
81. A rifle is aimed horizontally and fired at the center of a large target 60 m away. The initial speed of the bullet is 240 m/s. What is the distance from the center of the target to the point where the bullet strikes the target?

a) 48 cm b) 17 cm c) 31 cm d) 69 cm e) 52 cm

82. Kepler's third law of planetary motion relates the period T of a planet's orbit to the orbit radius R and the mass of the sun M, via the equation: $T = \sqrt{4\pi^2 R^3/(\alpha M)}$ where α is a constant. What are the SI units of α ?

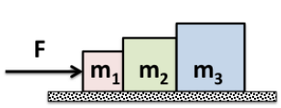
a) m^3/s^2 b) $m^3 s^2/kg$ c) $kg\ s^2/m^3$ d) $deg^2\ m^3/(kg\ s^2)$
e) $m^3/(kg\ s^2)$

83. Two masses are connected via an ideal rope, wound around a massless, frictionless pulley, as shown, and a force $\vec{F}$ is applied to mass m_1. What is the acceleration, if $m_1 = 5.0$ kg, $m_2 = 10$ kg, $F = 49$ N ?



a) zero b) 3.3 m/s^2 c) 4.9 m/s^2 d) 9.8 m/s^2
e) 20 m/s^2

84. Three blocks are sitting on a horizontal, frictionless table. They are pushed from the left by an applied force $F = 10$ N, as shown. How much force does block 3 exert on block 2, if $m_1 = 1\,\text{kg},\ m_2 = 2\,\text{kg},\ m_3 = 3\,\text{kg}$?

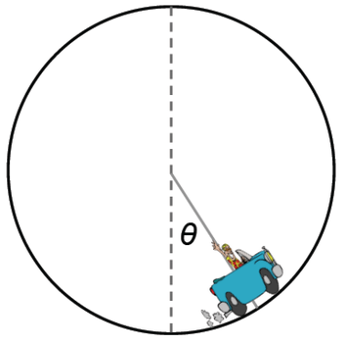


a) 3 N b) 5 N c) 6 N d) 8 N e) 10 N

85. A block of mass $m = 5.0$ kg is sliding down an inclined plane at angle $\theta = 30^\circ$ to the horizontal. The coefficient of kinetic friction is $\mu_k = 0.20$. What is the acceleration of the block?

a) 2.9 m/s² b) 3.2 m/s² c) 4.9 m/s² d) 6.6 m/s² e) 7.5 m/s²

86. A stunt car of mass $m = 1000$ kg travels in a vertical loop of radius $R = 20$ m; its engine keeps the car moving at a constant speed $v = 20$ m/s.



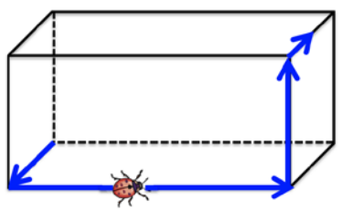
What is the magnitude of the normal force when the car is at angle $\theta = 30^\circ$ to the vertical, as shown in the diagram?

a) 8.5 kN b) 9.8 kN c) 12 kN d) 20 kN e) 28 kN

87. A particle moves along the x axis from x_i to x_f. Which of the following sets of values (x_i, x_f) results in the displacement with the largest magnitude? (All values are in meters.)

a) (4, 6) b) (- 4, - 8) c) (- 4, 2) d) (4, - 2) e) (- 4, 4)

88. A small bug crawls along the edges of a 3d rectangular box. Starting at one corner, he walks along 4 straight line segments from start to finish, so that his total displacement is:
$\Delta \vec{r} = (5.0\hat{i} + 6.0\,\hat{j} + 3.0\hat{k} - 2.0\hat{i})$ cm .



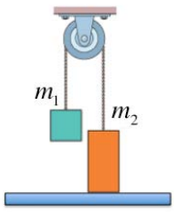
How far from the starting point is the bug at the end of this trip?

a) 16 cm b) 12 cm c) 9.7 cm d) 8.6 cm e) 7.3 cm

89. A car travels in a flat, horizontal circle of radius *R* at constant speed. At a certain instant, the speed of the car is 24 m/s, and the acceleration of the car has components of 2.4 m/s² east and 1.8 m/s² south. What is the radius of the circle?

a) 0.24 km b) 0.19 km c) 0.32 km d) 0.14 km e) 0.27 km

90. Two masses are connected via an ideal rope, wound around a massless, frictionless pulley as shown. What is the magnitude of the normal force between m_2 and the surface beneath it, if $m_1 = 40\ \text{kg},\ m_2 = 100\ \text{kg}$?

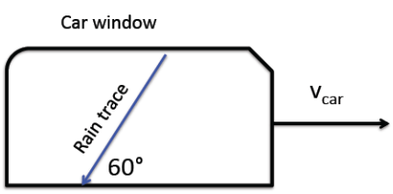


a) 390 N b) 590 N c) 670 N d) 980 N
e) 1380 N

91. An object moving at a constant speed requires 6.0 s to go once around a circle with a diameter of 4.0 m. What is the magnitude of the instantaneous acceleration of the particle during this time?

a) 2.2 m/s^2 b) 2.7 m/s^2 c) 3.3 m/s^2 d) 3.8 m/s^2 e) 4.4 m/s^2

92. A car travels horizontally at a speed of 55 km/h on a rainy day. The traces of rain on the side windows of the car make an angle of 60 degrees with respect to the horizontal. If the rain is falling vertically with respect to the earth, what is the speed of the rain with respect to the earth?



a) 48 km/h b) 95 km/h c) 58 km/h d) 32 km/h e) 80 km/h

93. At t = 0, a particle leaves the origin with a velocity of 5.0 m/s in the positive y direction. Its acceleration is given by $\vec{a} = 3.0\hat{i} - 2.0\hat{j}$ m/s^2.

At the instant the particle reaches its maximum y coordinate, how far is it from the origin?

a) 11 m b) 16 m c) 22 m d) 29 m e) 19 m

94. Two vectors lie with their tails at the same point. When the angle between them is increased by 20°, their scalar product has the same magnitude but changes from positive to negative. The original angle between them was:

a) 0 b) 60° c) 70° d) 80° e) 90°

95. A student in the front of a school bus tosses a ball to another student in the back of the bus while the bus is moving forward at constant velocity.

The *speed* of the ball as seen by a stationary observer in the street:

a) is less than that observed inside the bus.

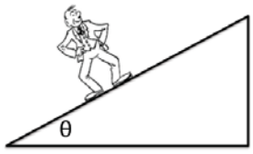
b) is the same as that observed inside the bus.

c) is greater than that observed inside the bus.

d) is always zero.

e) may be either greater, smaller, or equal to that observed inside the bus.

96. A 100 kg man stands on a hill as shown, with $\theta = 30^\circ$. What is the minimum coefficient of static friction between his shoes and the hill in order that he does not slip?

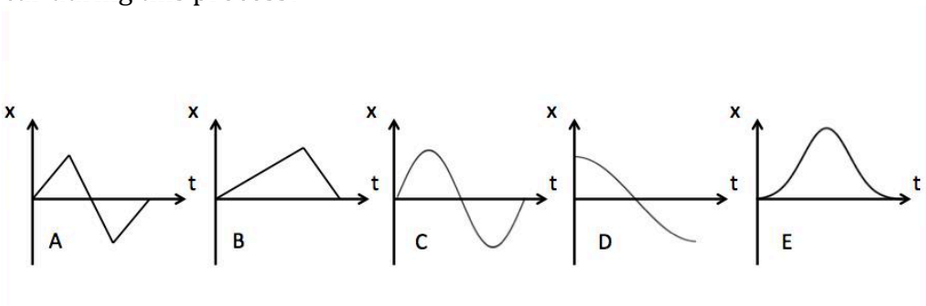


a) 0.29 b) 0.50 c) 0.58 d) 0.87 e) 1.73

97. Two friends, Bob and Sue, are initially 100 m apart and walking towards each other at $t = 0$. Sue walks at constant speed of 1.5 m/s. Bob walks at 1.0 m/s for 10 s and then jogs at 3.0 m/s until he meets Sue. At what time do the two friends meet?

a) 17 s b) 20 s c) 27 s d) 33 s e) 40 s

98. A car accelerates from rest on a straight road. A short time later, it decelerates to a stop and then returns to its original location by first speeding up and then slowing to a stop.
Which of the following five coordinate versus time graphs best describes the motion of the car during this process?



a) A b) B c) C d) D e) E