PHY2053

PHYSICS
EXAM 1

Name (print, last first): _____ Signature: _____

*On my honor, I have neither given nor received unauthorized aid on this examination.*

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Given Information:

$g = 9.81$ m/s$^2$ $G = 6.67 \times 10^{-11}$ Nm$^2$/kg$^2$ 1 kg = 1000 g 1 m = 100 cm
1 hour = 60 minutes 1 minute = 60 seconds 1 rev = $2\pi$ radians $\pi$ radians = 180°

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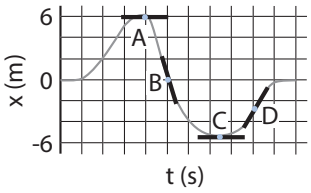
1. Once again, Ash yells, "Pikachu, go!" Again, Pikachu runs 12 m at 45° N of E and then runs 15 m at 20° W of N. This time Psyduck, confused as always, walks 6 m due S. Both Pokemon start out together. How far apart are they now?

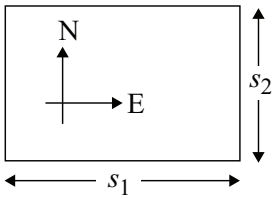
(1) 29 m
(2) 33 m
(3) 32 m
(4) 17 m
(5) None of these.

2. The curved line in the figure shows the position of an object along the x axis as a function of time. The thick straight black lines are the tangents to the curve at the points of the curve labeled A, B, C and D. At what point is the object moving with the greatest speed, and at what point is it moving with positive velocity, respectively (answering in that order)?




(1) B, D (2) A, A (3) B, A (4) A, B (5) C, A

3. Today you are beginning your workout plan. As the commerical said, "Some athletes train to run and some athletes run to train, but all athletes run." You will begin by running around the block shown. The dimensions are $s_1 = 0.35$ mi and $s_2 = 0.20$ mi. Donning your new, very expensive running shoes, you start in the southwest corner of the block (lower left corner in the diagram) head east and run for 1.3 miles in a very respectable 15 minutes. Breathing hard but remembering your physics, you calculate your average velocity for the run.

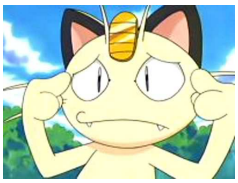



(1) 0.80 mph East (2) 5.2 mph East (3) 0.80 mph North (4) 5.2 mph North (5) None of these.

4. An object is released from rest at $t = 0$ near the surface of an unknown planet (not Earth) and falls 10 meters during the time interval from $t = 0$ s to $t = 2$ s. Ignoring atmospheric resistance, how far does it fall during the time interval from $t = 2$ s to $t = 3$ s?

(1) 12.5 m (2) 30.0 m (3) 52.5 m (4) 24.5 m (5) 102.9 m

5. Meowth slips and falls into a deep well. Jessie and James hear the splash 3.9 seconds later. How deep is the well? The speed of sound is 340 m/s. Assume Meowth falls from rest.



(1) 67 m (2) 75 m (3) 1300 m (4) 86 m (5) None of these.

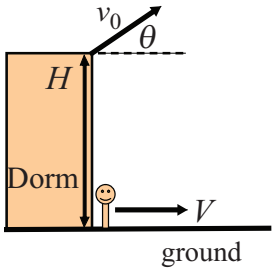
6. Once again, Brock has seen a girl and is immediately in love. She is driving at a constant 20 m/s when she passes him. He starts out after her and catches up to her after traveling 300 m. Assuming Brock starts at the instant she is beside him, what constant acceleration does he need? Assume, also, that Brock was traveling at 5 m/s in the same direction she was traveling when she passed him.

(1) 2.0 m/s$^2$ (2) 2.7 m/s$^2$ (3) 1.5 m/s$^2$ (4) 3.0 m/s$^2$ (5) None of these.

7. From the top of a 14.4 m tall tower, you throw a rock with an unknown velocity directed 40° above the horizontal. The rock hits the ground 45 m from the base of the tower. What is the maximum height of the rock above the ground (not just above the tower)?

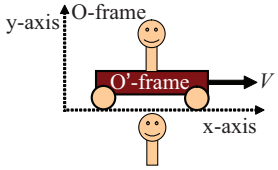
(1) 21 m (2) 23 m (3) 25 m (4) 27 m (5) None of these.

8. A ball is thrown with an initial speed $v_0 = 20$ m/s from a dorm room window a height $H$ above the level ground at an angle $\theta$ with the horizontal as shown in the figure. At that same instant a man begins running from the base of the building at a constant speed $V = 10$ m/s? What positive angle $\theta$ must the ball be thrown such that it will hit the man? Ignore air resistance.



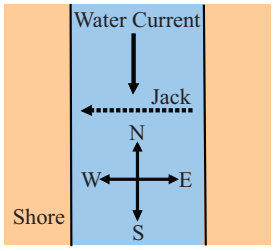

(1) 60.0° (2) 75.5° (3) 41.4° (4) 64.3° (5) 30.0°

9. A train (O'-frame) is moving down the x-axis of the O-frame at speed $V$ as shown in the figure. An observer at rest in the O'-frame throws a stone straight up with speed $v'_y = 4$ m/s (as observed in the O'-frame). If the speed of the stone as observed by an observer at rest in the O-frame is 5 m/s, what is the speed $V$ of the train (in m/s)?




(1) 3 (2) 4 (3) 8 (4) 5 (5) 2

10. Jack wants to row directly across a river from the east shore to a point on the west shore, as shown in the figure. Due to the current he could not aim directly for that point. The width of the river is 500 m and the current flows from north to south at 2.0 m/s. The trip takes Jack 4 minutes. At what speed (in m/s) with respect to the still water is Jack able to row?




(1) 2.89
(2) 2.43
(3) 2.26
(4) 2.08
(5) 1.39

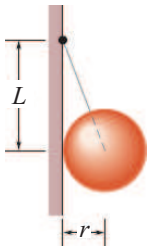
11. While running 4.1 m/s, a 30-kg Raichu slips, falls, and slides to a stop. The coefficient of kinetic friction between Raichu and the level floor is 0.3. For how long did he slide?

(1) 1.4 s (2) 0.42 s (3) 2.2 s (4) 1.0 s (5) None of these.

12. A descending elevator traveling at 6 m/s stops with a uniform deceleration over a distance of 10 m. A woman of mass 55 kg stands on a scale in the elevator. During the deceleration does the scale read higher or lower than her resting weight and what does the scale read (in N)?

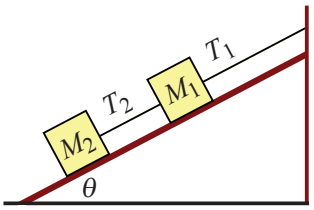
(1) higher, 638 (2) higher, 715 (3) higher, 583 (4) lower, 583 (5) lower, 638

13. In the figure, a uniform sphere with a weight of 6 N and radius $r$ is held in place by a massless rope attached to a frictionless wall a vertical distance $L$ above the center of the sphere. If the magnitude of the force on the sphere from the wall is 2 N, what is the radius $r$ of the ball?



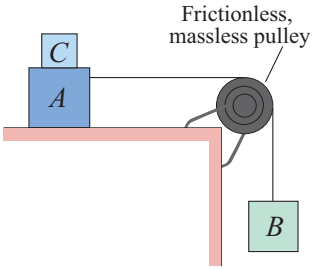

(1) $L/3$
(2) $L/2$
(3) $2L/3$
(4) $3L/4$
(5) $L/4$

14. Near the surface of the Earth, two blocks of mass $M_1$ and $M_2$ are held at rest on a frictionless plane inclined at an angle $\theta$ by a rope attached to the wall, as shown in the figure. The tension in the rope that attaches block 1 to the wall is $T_1$, and the tension in the rope that attaches block 2 to block 1 is $T_2$. If $T_1$ is three times $T_2$ (*i.e.*, . $T_1 = 3T_2$), then what is the mass $M_2$?




(1) $\frac{1}{2}M_1$ (2) $\frac{1}{3}M_1$ (3) $\frac{1}{4}M_1$ (4) $M_1$ (5) $2M_1$

15. In the figure, blocks A and C have a mass of 30 kg and 10 kg, respectively. If the surface of the table is frictionless and the static coefficient of friction, $\mu_s$, between block A and block C is 0.20, what is the maximum mass of block B (in kg) such that, when the system is released from rest, block C will not slip off block A?




(1) 10 (2) 40 (3) 60 (4) 30 (5) 5

16. The acceleration due to gravity ($g$) is proportional to the mass of the Earth and inversely proportional to the square of its radius. The same relationship holds for other planets, but their "$g$" will be different and the same object will have a different weight on a different planet. Snorlax weighs 4510 N on Earth. What is his weight on Jupiter if Jupiter's radius is 11 times the Earth's and Jupiter's mass is 320 times the Earth's?

(1) 12,000 N (2) 130,000 N (3) 3,800,000 N (4) 42,000,000 N (5) None of these.