UNIVERSITY OF MANITOBA

October 27, 2016 MID-TERM TEST
(7:00 pm – 9:00 pm) (+ Formula Sheet)

PAPER NO.: **A** PAGE NO.: 1 of 5

DEPARTMENT & COURSE NO.: PHYS 1020 TIME: 2 hours

EXAMINATION: General Physics 1 EXAMINERS: P. Basnet, J. English, W. Ens

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All questions are of equal value. No marks are subtracted for wrong answers.

Record all answers on the computer score sheet provided. **USE PENCIL ONLY!** Black pen will look good but may not be read reliably by the scoring machine. **Mark only <u>one</u> answer for each question!** Select the answer which is closest to yours.

A formula sheet is provided for your use; you may **not** use your own formula sheet. Calculators should have limited memory capacity and should not be capable of remote communication. No phones or handheld computers (PDAs) or notes are permitted.

Unless the question specifically asks about significant figures, an answer should NOT be considered to be incorrect if the number of significant figures does not match the significant figures supplied in the question.

Be sure your name and 7-digit student number are printed on the score sheet and your student number is correctly coded in the box at the top right-hand side of the sheet.

This is paper **A**. Questions are numbered 1 to 20. Mark the correct answers in rows 1-20 of the accompanying IBM sheet in pencil. Also write "**Paper A**" next to your name on the IBM sheet.

TABLE OF CONSTANTS

$G = 6.673\times10^{-11}$ m^{3}kg^{-1}s^{-2} Mass of the earth = 5.98×10^{24} kg

$g = 9.8$ m/s^2 1 tonne = 10^3 kg

Radius of the earth = 6.38×10^3 km

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1. A physics student adds two displacement vectors with magnitudes of 8.0 km and 6.0 km. Which one of the following statements is true concerning the magnitude of the resultant displacement?

   (a) It must be 14.0 km.
   (b) It could have any value between 2.0 km and 14.0 km depending on how the vectors are oriented.
   (c) It could be equal to zero kilometers, depending on how the vectors are oriented.
   (d) No conclusion can be reached without knowing the directions of the vectors.
   (e) It must be 10.0 km.

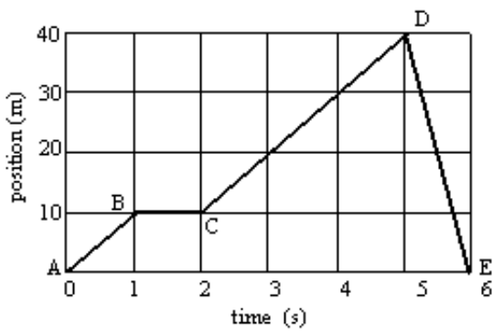
2. A boat radioed a distress call to a Coast Guard station. At the time of the call, a vector $\vec{A}$ from the station to the boat had a magnitude of 45.0 km and was directed 15.0° east of north. A vector from the station to the point where the boat was later found is $\vec{B}$ = 30.0 km, 15.0° north of east. What are the components of the vector from the point where the distress call was made to the point where the boat was found? In other words, what are the components of vector $\vec{C} = \vec{B} - \vec{A}$?

***x* component**	***y* component**
(a) 40.6 km, east	35.7 km, north
(b) 17.3 km, east	35.7 km, south
(c) 35.7 km, west	17.4 km, north
(d) 40.6 km, east	51.2 km, south
(e) 17.3 km, west	51.2 km, south

3. Usain Bolt set a world record for the 100.0-m run with a time of 9.58 s in Berlin this year. If, after reaching the finish line, over the next 221.9 s, Mr. Bolt slowed down to a stop in the next 100 m, and then turned around and walked directly back to his starting point, what is the magnitude of his average velocity for the 400.0 m?

(a) 0 m/s (b) 1.73 m/s (c) 10.1 m/s (d) 1.10 m/s (e) 5.60 m/s

4. An object moves along a straight line. The graph shows the object's position from the starting point as a function of time.



What is the instantaneous velocity of the object at t = 4 s?

(a) +20 m/s (b) +10 m/s
(c) +40 m/s (d) +8 m/s
(e) +6 m/s

5. Neglecting air resistance, what maximum height will be reached by an arrow launched straight upward with an initial speed of 35 m/s?

(a) 63 m (b) 41 m (c) 160 m (d) 18 m (e) 98 m

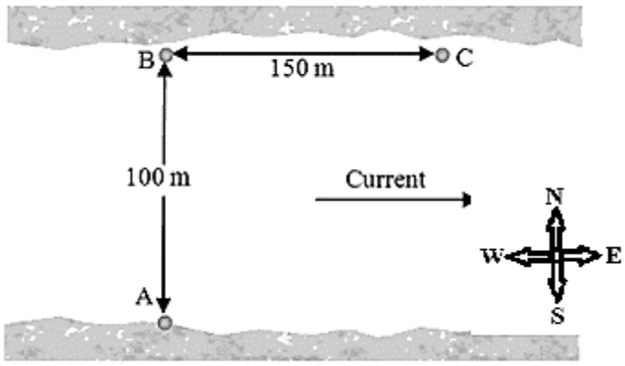
6. An eagle is flying due east at 7.8 m/s carrying a gopher in its talons. The gopher manages to break free at a height of 15 m. What is the magnitude of the gopher's velocity as it reaches the ground? Note: effects of air resistance are not included in this calculation.

(a) 22 m/s (b) 19 m/s (c) 11 m/s (d) 9.8 m/s (e) 7.8 m/s

7. A power boat starting from rest, maintains a constant acceleration. After a certain time t_1, its displacement and velocity are $\vec{r}_1$ and $\vec{v}_1$. At time $t_2 = 5t_1$, what are the new displacement $\vec{r}_2$ and velocity $\vec{v}_2$, assuming the acceleration remains the same.

(a) 5 $\vec{r}_1$ and 5$\vec{v}_1$ (b) 25$\vec{r}_1$ and 5$\vec{v}_1$ (c) (1/5)$\vec{r}_1$ and $\vec{v}_1$
(d) 4$\vec{r}_1$ and 2$\vec{v}_1$ (e) 10$\vec{r}_1$ and 5$\vec{v}_1$

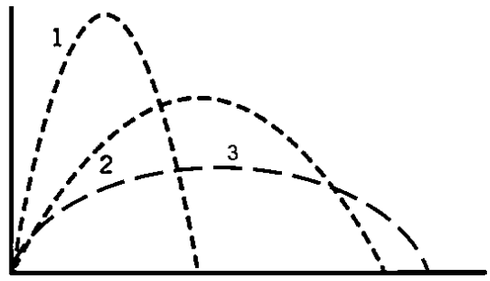
8. A man at point A directs his rowboat due north toward point B, straight across a river of width 100 m. The river current is due east. The man starts across, rowing steadily at 0.50 m/s and reaches the other side of the river at point C, 150 m downstream from his starting point.



What is the speed of the river?

(a) 0.25 m/s (b) 0.45 m/s (c) 0.75 m/s (d) 64.0 m/s (e) 5.0 m/s

9. Three projectiles are fired into the air, and the figure shows their motions. Projectile 1 reaches the greatest height, but the projectile 3 has the greatest range. Which one is in the air for the greatest amount of time?

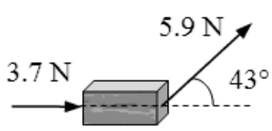


(a) Projectile 3
(b) Projectile 2
(c) Projectile 1
(d) They are all the same.
(e) Projectile 1 and 2 are equal time

10. A 2150-kg truck is traveling along a straight, level road at a constant speed of 55.0 km/h when the driver removes his foot from the accelerator. After 21.0 s, the truck's speed is 33.0 km/h. What is the magnitude of the average net force acting on the truck during the 21.0 s interval?

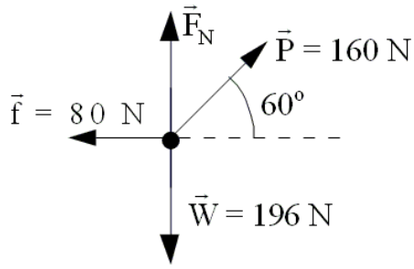
(a) 2250 N (b) 626 N (c) 1890 N (d) 972 N (e) 229 N

11. Two forces act on a 9.0-kg block resting on a frictionless surface as shown. What is the magnitude of the horizontal acceleration of the block?



(a) 0.90 m/s^2 (b) 0.60 m/s^2 (c) 0.41 m/s^2
(d) 1.6 m/s^2 (e) 4.5 m/s^2

12. A force $\vec{P}$ pulls on a crate of mass m that is in contact with a rough surface. The figure shows the magnitudes and directions of the forces that act on the crate in this situation. $\vec{W}$ represents the weight of the crate, $\vec{F}_N$ represents the normal force on the crate, and $\vec{f}$ represents the frictional force.



What is the magnitude of $\vec{F}_N$, the normal force on the crate?

(a) 57.4 N (b) 80.3 N (c) 160 N (d) 196 N (e) 230 N

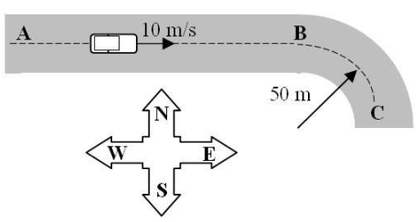
13. Two ice skaters, Harry and John, are each holding on to opposite ends of the same rope. Each pulls the other towards him. The magnitude of Harry's acceleration is 1.75 times greater than the magnitude of John's acceleration. What is the ratio of Harry's mass to John's mass?

(a) 0.80 (b) 0.25 (c) 0.67 (d) 0.57 (e) 1.75

14. A satellite is placed in equatorial orbit above Mars, which has a radius of 3397 km and a mass $M_M = 6.40 \times 1023$ kg. The mission of the satellite is to observe the Martian climate from an altitude of 488 km. What is the orbital period of the satellite?

(a) 9.18×10^2 s (b) 3.62×10^3 s (c) 7.36×10^3 s
(d) 1.08×10^5 s (e) 7.27×10^{12} s

15. A 1800-kg Jeep travels along a straight 500-m portion of highway (from A to B) at a constant speed of 10 m/s. At B, the Jeep encounters a banked curve of radius 50 m. The Jeep follows the road from B to C traveling at a constant speed of 10 m/s while the direction of the Jeep changes from east to south.

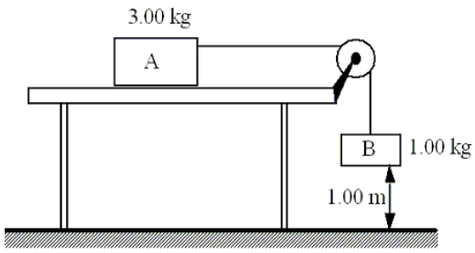


What is the optimum banking angle for this situation so that the friction force does not contribute to the necessary centripetal force?
(a) 4.7° (b) 5.8° (c) 7.9° (d) 10° (e) 12°

16. Mike is cutting the grass using a human-powered lawn mower. He pushes the mower with a force of 45 N directed at an angle of 41° below the horizontal direction. To two significant figures, what is the work that Mike does on the mower each time he pushes it 9.1 m across the yard?

(a) 510 J (b) 260 J (c) 410 J (d) 360 J (e) 310 J

17. Two boxes are connected to each other as shown. The system is released from rest and the 1.00-kg box falls through a distance of 1.00 m. The surface of the table is frictionless. What is the kinetic energy of box B just before it reaches the floor?



(a) 2.45 J (b) 4.90 J (c) 9.80 J
(d) 29.4 J (e) 39.2 J

18. A rock is thrown straight up from the surface of the Earth. Which one of the following statements describes the energy transformation of the rock as it rises? Neglect air resistance.

(a) The total energy of the rock increases.
(b) The kinetic energy increases and the potential energy decreases.
(c) Both the potential energy and the total energy of the rock increase.
(d) The kinetic energy decreases and the potential energy increases.
(e) Both the kinetic energy and the potential energy of the rock remain the same.

19. An automobile approaches a barrier at a speed of 20 m/s along a level road. The driver locks the brakes at a distance of 50 m from the barrier. What minimum coefficient of kinetic friction is required to stop the automobile before it hits the barrier?

(a) 0.4 (b) 0.5 (c) 0.6 (d) 0.7 (e) 0.8

20. A top fuel dragster with a mass of 500.0 kg starts from rest and completes a quarter mile (402 m) race in a time of 5.0 s. The dragster's final speed is 130 m/s. Neglecting friction, what average power was needed to produce this final speed?

(a) 104 kW (b) 560 kW (c) 840 kW (d) 20 MW (e) 630 MW

THE END

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ANSWER KEY

Paper A

1. B
2. B
3. A
4. B
5. A
6. B
7. B
8. C
9. C
10. B
11. A
12. A
13. D
14. C
15. E
16. E
17. A
18. D
19. A
20. C