TRENT UNIVERSITY
Department: Physics & Astronomy
Course: PHYS 1000H: *Introductory Physics*
Instructor: Rayf Shiell

NAME (PRINT):_____ _____

STUDENT NUMBER: _____

****** READ BEFORE STARTING ******

1) DO **NOT** TURN THIS PAGE UNTIL INSTRUCTED TO DO SO.

2) PLACE YOUR TRENT STUDENT ID CARD ON YOUR DESK. PLACE BOOKS, BAGS, PURSES, BACKPACKS, ETC. AT THE FRONT OF THE ROOM.

3) THE **ONLY** ALLOWED AIDS ARE THE FORMULA SHEET GIVEN TO YOU IN THE EXAM AND YOUR CALCULATOR. **NO** COMMUNICATION DEVICES SUCH AS CELLPHONES, WATCHES, ETC. PERMITTED

4) WRITE YOUR NAME AND STUDENT NUMBER IN THE SPACE ABOVE, **AND** ON YOUR SCANTRON ANSWER SHEET. THE DEPARTMENT IS **PHYS**; COURSE CODE NUMBER IS **1000**.

5) **AFTER THE EXAM STARTS** INDICATE ON YOUR ANSWER SHEET THE **TEST VERSION** (DISPLAYED ON PAGE 2). YOU THEN HAVE THREE HOURS TO COMPLETE THE EXAM.

6) THE TEST CONTAINS **15 MULTIPLE CHOICE QUESTIONS**. READ EACH QUESTION CAREFULLY.

7) SCRIBBLE/DOODLE IN YOUR ANSWER BOOKLET, BUT YOU MUST **FILL IN YOUR ANSWERS ON YOUR ANSWER SHEET**. USE A PENCIL TO RECORD YOUR RESPONSES. IF YOU WISH TO ERASE A RESPONSE, DO SO CAREFULLY!

8) ENSURE YOU PUT YOUR RESPONSE IN THE CORRECT BUBBLE ON YOUR ANSWER SHEET. THERE IS ONLY ONE CORRECT ANSWER PER QUESTION. DO NOT MAKE ANY OTHER MARKS ON THE ANSWER SHEET (DO NOT "X" OUT MISTAKES ON BUBBLES). **SHADE IN EACH BUBBLE CAREFULLY – STAY INSIDE THE CIRCLE!**

9) WHEN YOU HAVE COMPLETED THE EXAM CAREFULLY CHECK YOUR ANSWERS

10) BEFORE YOU LEAVE YOU **MUST** HAND IN YOUR COMPLETED ANSWER SHEET **AND** YOUR ANSWER BOOKLET **AND** THIS QUESTION PAPER.

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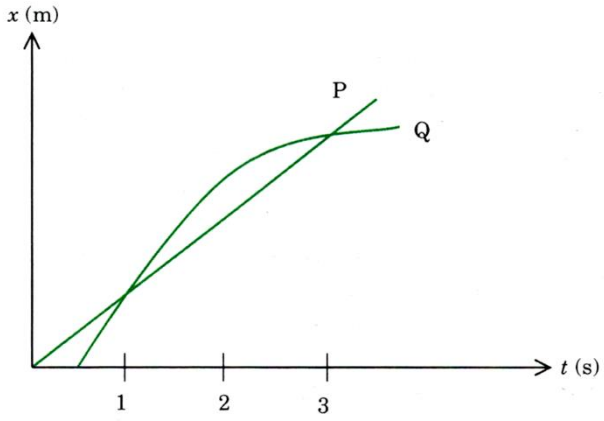
VERSION C

1) A soccer ball is thrown straight up a distance of 5.0 m and returns to your hand. Neglecting air resistance, you know that:

A. the ball took longer to go up than come down.
B. the acceleration was upward on the way up and downward on the way down.
C. the acceleration was constant throughout its motion.
D. the speed was zero at the maximum height, but the velocity was never zero.
E. the velocity was constant except at the moment it turned around.

2) The motions of two cheetahs, represented by P and Q, are described by the position-time graphs shown. Do the two cheetahs ever have the same *velocity*?



A. P and Q have the same velocity at around 2 s.
B. P and Q have the same velocity at 3 s.
C. P and Q have the same velocity at 1 s, 2 s, and 3 s.
D. P and Q have the same velocity at 1 s and 3 s.
E. P and Q never have the same velocity.

3) A muscle tendon with a circular cross-section of diameter d and length L_0 is stretched by an amount ΔL by a steady force F. How much stretch would an equal force produce in a similar tendon of diameter $2d$ and length $2L_0$?

A. $\Delta L/8$ **B.** $\Delta L/4$ **C.** ΔL **D.** $\Delta L/2$ **E.** $4\Delta L$

4) Which of the following best describes the second of Eqs. (7.2) from the formula sheet?

A. The potential energy due to gravity within an object-Earth system is the mass of the object multiplied by the gravitational acceleration of the Earth multiplied by the height above any reference point near the Earth's surface

B. The potential energy due to gravity within an object-Earth system is the mass of the Earth multiplied by the gravitational acceleration of the Earth multiplied by the height from the surface of the Earth

C. The potential energy due to gravity within an object-Earth system is the mass of the Earth multiplied by the gravitational acceleration of the Earth multiplied by the height above any reference point near the Earth's surface

D. The potential energy due to gravity within an object-Earth system is the mass of the object multiplied by the gravitational acceleration of the Earth multiplied by the height above sea level

E. The potential energy due to gravity within an object-Earth system is equal to the mass of the object and the Earth multiplied by the gravitational acceleration of the Earth together multiplied by the height above the Earth's surface

5) In a recent television broadcast, an astronaut was shown to be 'weightless' while on a visit to the International Space Station (ISS) which orbits Earth. This can be explained by the fact that

A. the force of gravity exerted on the astronaut by Earth is balanced by the force of gravity exerted on the astronaut by the Sun.
B. the astronaut and the ISS are both in free fall.
C. the ISS is going so fast that the force of gravity exerted on the astronaut by Earth is negligible.
D. the force of gravity exerted on the astronaut by Earth is balanced by the force of gravity exerted on the astronaut by the ISS.
E. the force of gravity exerted on the astronaut by Earth is essentially zero.

6) A ball travelling horizontally is caught in a well-padded mitt. Take the direction of the motion of the ball to be the positive direction. If the acceleration of the ball is $-1.9\times10^{4}\ \text{m/s}^2$, and $1.8\ \text{ms}$ elapses from the time the ball first touches the mitt until it comes to rest, what was the initial velocity of the ball?

A. 34.2 m/s **B.** 32.5 m/s **C.** 28.5 m/s **D.** 16.1 m/s **E.** 10.5 m/s

7) A goalkeeper can kick a soccer ball at a speed of $22\ \text{m/s}$. Suppose a soccer ball is kicked at this speed at an angle of $39°$ above the horizontal on a level field. How far does the ball travel? Treat the effect of air resistance to be negligible. Include units as appropriate.

A. 49.4 m **B.** 48.3 m **C.** 42.1 m **D.** 38.3 m **E.** 36.9 m

8) A strong, but inept, shot putter putts the shot straight upwards from a height of $2.2\ \text{m}$ above the ground with an initial speed of $10.8\ \text{m/s}$. How long does he have to get out of the way after the shot was released if he is $1.8\ \text{m}$ tall? Treat the effect of air resistance to be negligible.

A. 4.2 s **B.** 3.7 s **C.** 3.2 s **D.** 2.7 s **E.** 2.2 s

9) Which of the following best describes Eq. (7.1) from the formula sheet?

A. The work done on a system by an external force is a scalar quantity and is equal to the magnitude of the force multiplied by the magnitude of the displacement of the point of application of the force multiplied by the cosine of the angle between them.

B. The work done on a system is the energy lost when an object is moved due to an external force and is given by the distance moved by the object multiplied by the cosine of the angle to the horizontal.

C. The work done on a system is a scalar quantity and is equal to the magnitude of the normal force multiplied by the magnitude of the displacement of the system multiplied by the cosine of the angle between them.

D. The work done on a system is a vector quantity and is equal to the magnitude of the external force multiplied by the magnitude of the displacement of the system multiplied by the cosine of the angle between them.

E. The work done on a system is a scalar quantity and is equal to the magnitude of an internal force, F, in the system multiplied by the magnitude of the point of application of the force multiplied by the cosine of the angle between them.

10) The Moon orbits the Earth with an orbital radius of $384{,}000\ \text{km}$ and a period of $27.3\ \text{days}$ .Given this, what would you calculate to be the orbital radius of a satellite that orbits the Earth with a period of $0.9\ \text{h}$?

A. 310 km **B.** 1700 km **C.** 2200 km **D.** 3100 km **E.** 4700 km

11) Near the end of a marathon race, the first two runners are separated by a distance of $53\ \text{m}$. The front runner has a velocity of $3.2\ \text{m/s}$, and the second a velocity of $4.8\ \text{m/s}$. Treat the forward direction as positive. Which of the following is the velocity of the second runner relative to the first?

A. +1.2 m/s **B.** +1.1 m/s **C.** +1.5 m/s **D.** +1.7 m/s **E.** +1.6 m/s

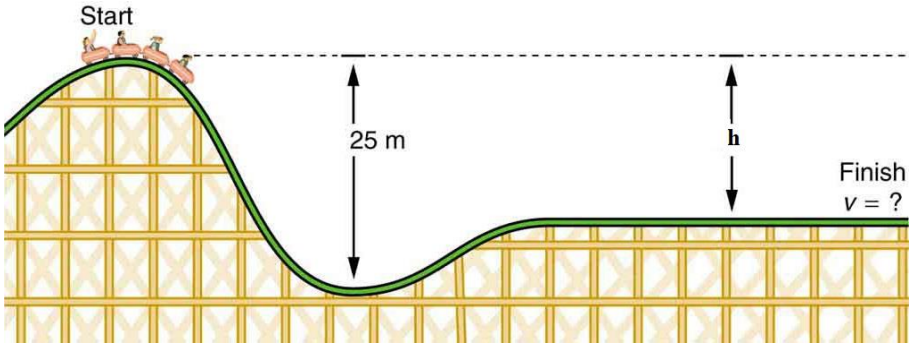
12) A trapezist of mass $70\ \text{kg}$ balances on the middle of a tightrope. What is the tension in the wire supporting the trapezist if the tightrope is at an angle of $\theta = 11°$ below the horizontal?

A. 1600 N **B.** 1800 N **C.** 2000 N **D.** 2200 N **E.** 2400 N

13) A car of mass $900\ \text{kg}$ negotiates a $550\ \text{m}$ radius flat curve at $72\ \text{km/h}$. Treat the effect of air resistance to be negligible. What is the centripetal force exerted on the car?

A. 655 N **B.** 635 N **C.** 615 N **D.** 605 N **E.** 595 N

14) A roller coaster crests the top of a hill that is $19\ \text{m}$ above the final, flat section of track as shown in the following figure. Treat effect of friction to be negligible.



What is the final speed of the roller coaster if its speed at the top of the hill is $4\ \text{m/s}$?

A. 20 m/s **B.** 22 m/s **C.** 24 m/s **D.** 26 m/s **E.** 28 m/s

15) A child drives a bumper car with total mass $200\ \text{kg}$ head-on into a side rail at $2.4\ \text{m/s}$, which exerts a force of $-3600\ \text{N}$ on the car for $0.2\ \text{s}$. Treat the initial direction of motion to be positive and the effect of friction to be negligible. What is the final velocity of the bumper car?

A. –0.8 m/s **B.** –1.0 m/s **C.** –1.2 m/s **D.** –1.4 m/s **E.** –1.6 m/s