FIRST-YEAR PHYSICS EXAM

JANUARY, 1997

DIRECTIONS: Each question is worth 4 points for a total of 100 points. For each statement or question choose the answer which best completes the statement or answers the question and fill in the appropriate blank on the answer form. Make sure you fill the space completely.

CONSTANTS: $g = 10^{m}/sec^2$ $G = 6.673 \times 1^{-11}$ $N\text{-}m^2/Kg^2$ M (earth) = 5.98×10^{24} kg

1. How many significant figures does the number 10.437 have?

   A) 3 B) 4 C) 5 D) 6

2. A car accelerates uniformly from rest, covering a distance of 125 m in 5 sec. What is the car's acceleration in m/s^2?

   A) 25 B) 10 C) 5 D) 50

3. In the preceding question, #2, what is the average speed of the car in m/s over the 5 sec?

   A) 25 B) 10 C) 5 D) 50

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4. The mass of Mars is 6.4×10^{23} kg, and its radius is 3.4×10^{6} m. What is the mean density of Mars in kg/m^3?

   A) 1.9×10^{3} B) 4.7×10^{3} C) 2.1×10^{3} D) 3.9×10^{3}

5. Is the average velocity of an object always equal to the instantaneous velocity?

   A) this is always true B) this is never true

   C) this is the case only when the velocity is constant

   D) this is the case only when the velocity is increasing at a constant rate

6. Can an object have increasing speed while its acceleration is decreasing?

   A) no, this is impossible because of the way in which acceleration is defined

   B) no, because if acceleration is decreasing, the object will be slowing down

   C) yes, an example would be an object released from rest falling in the absence of air friction

   D) yes, an example would be an object released from rest falling in the presence of air friction

7. A ball is thrown straight up with an initial speed of 30 m/s. What will be the speed of the ball in m/s after 4.2 secs?

   A) 72 B) 42 C) 30 D) 12

8. A car traveling at a speed V is able to stop in a distance d. What distance does the car need to stop (assuming the same braking force) when it is traveling twice as fast (2V)?

   A) 4d B) d C) $\sqrt{2}$ d D) 2 d

9. If you wish to cross a flowing river in a motorboat, your time of crossing will be least if you head:

   A) straight across the river B) slightly upstream C) slight downstream

   D) the time will be independent of how you head

10. Which of the following operations will not change a vector?

    A) translate it parallel to itself B) rotate it C) multiply it by a constant factor

    D) add a constant vector to it

11. If the acceleration of an object is directed perpendicular to its velocity:

A) this would not represent a physically possible situation B) the object is turning

C) the object is speeding up D) the object is slowing down

12. A ball thrown horizontally from a point 24 m above the ground strikes the ground after traveling horizontally a distance of 18 m. With what speed was it thrown?

A) 6.10 m/s B) 7.40 m/s C) 8.22 m/s D) 8.96 m/s

13. What is the centripetal acceleration of a point on the perimeter of a bicycle wheel of diameter 0.70 m when the bike is moving at a speed of 8 m/s?

A) 91 m/s^2 B) 183 m/s^2 C) 206 m/s^2 D) 266 m/s^2

14. In the absence of an external force, a moving object will:

A) stop immediately B) slowly slow down and then stop C) go faster and faster

D) move with constant speed

15. A satellite moves in a low circular orbit about a spherical earth that has no atmosphere (the satellite barely skims the surface of the earth). Approximately how long (minutes) will it take the satellite to make one revolution around the earth?

A) 80 min B) 82 min C) 84 min D) 86 min

16. A horizontal force of 5N accelerates a 4 kg mass from rest at a rate of 0.5 m/s^2 in the <u>positive</u> direction. What vector friction force acts on the 4 kg mass?

A) +3N B) -3N C) +2N D) -2N

17. A spring is characterized by a spring constant K = 60 N/m. How much potential energy does it store when stretched by 0.01 m?

A) 0.001 J B) 0.002 J C) 0.003 J D) 0.004 J

18. A pendulum of length 0.5 m is pulled a distance of 0.3 m away from the vertical axis and released from rest. What maximum speed will it reach?

A) 0.50 m/s B) 0.79 m/s C) 1.2 m/s D) 1.4 m/s

19. An object is lifted vertically 3 m and then returned to its original position. How much work was done if the object weights 40 N? (neglect friction)

A) 120 J B) 240 J C) 60 J D) no work was done

20. A toy rocket of mass 0.120 kg achieves a velocity of 40 m/s after 3 seconds when fired vertically from rest. What average acceleration is obtained over the 3 seconds?

A) 10 m/sec^2 B) 13 m/sec^2 C) 16 m/sec^2 D) 20 m/sec^2

21. Compared to yesterday, you did 3 times the work in one-third the time. To do so, your power output must have been:

A) the same as yesterday's power output B) one-third yesterday's power output

C) 3 times yesterday's power output D) 9 times yesterday's power output

22. A 400 N box is pushed up an inclined plane (of length 4 m) to a window ledge 2 m above ground level. Neglecting friction, how much work was done?

A) 800 J B) 100 J C) 1600 J D) none of the preceding

23. The total energy of a system:

A) is equally divided between kinetic energy and potential energy

B) is either all kinetic energy or all potential energy at any one instant

C) can never be negative

D) is constant if only conservative forces act

24. Does the centripetal force acting on an object do work on the object?

A) yes, since a force acts and the object moves, and work is force times distance

B) yes, since it takes energy to turn an object

C) no, because the object has constant speed

D) no, because the force and the displacement of the object are perpendicular

25. On a plot of F vs. x, what represents the work done by the force F?

A) the slope of the curve B) the length of the curve C) the area under the curve

D) the product of the average value of F times the average value of x

SCIENCE LEAGUE

PHYSICS I

ANSWER KEY

MONTH OF JANUARY, 1997

EACH QUESTION IS WORTH 4 POINTS

1 C	9 A	17 C
2 B	10 A	18 D
3 A	11 B	19 D
4 D	12 C	20 B
5 C	13 B	21 D
6 D	14 D	22 A
7 D	15 C	23 D
8 A	16 B	24 D
		25 C