UNIVERSITY OF GUELPH

PHYS*1080

INTRODUCTORY PHYSICS
FOR THE LIFE SCIENCES II

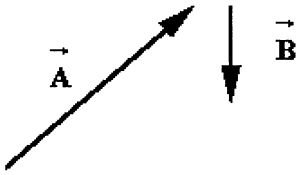
SAMPLE FINAL EXAMINATION 2

PHYS*1080 Final Exam W'2002

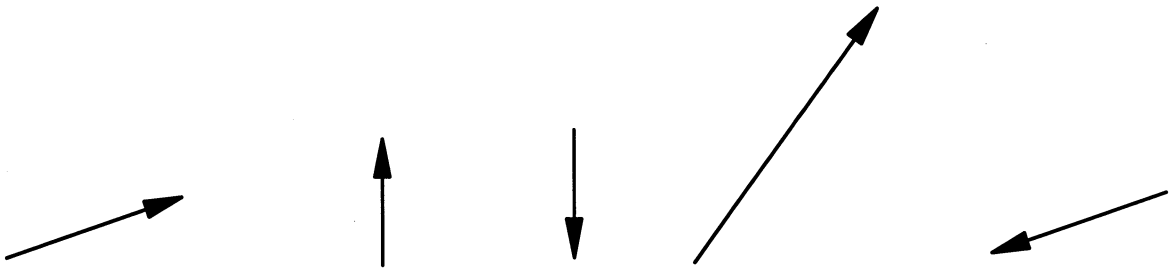
ANSWERS:

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

1. Given two vectors $\vec{A}$ and $\vec{B}$, as pictured here

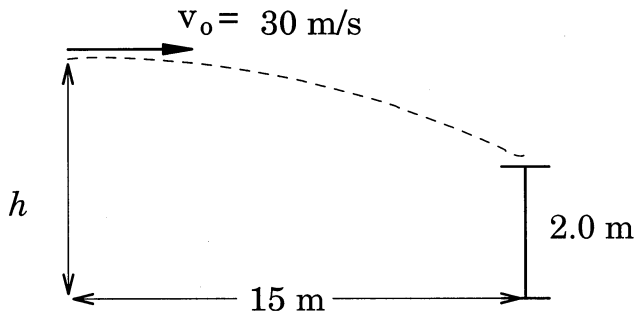


which of the following best represents the vector $\vec{C} = \vec{A} - \vec{B}$?



2. From what height h (as shown) must a ball be thrown horizontally with initial speed $v_o = 30$ m/s to just clear the top of a fence which is 2.0 m high and 15 m away?

(A) 0.4 m
(B) 1.8 m
(C) 2.6 m
(D) 2.8 m
(E) 3.2 m

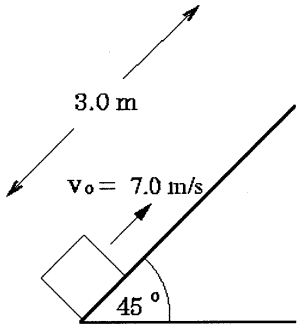


3. Two hockey players are heading for a collision. The first hockey player, of mass 85 kg, is moving toward the east at speed 12 m/s. The other player, of mass 90 kg, is traveling in the direction 45° south of west at speed 15 m/s. Upon colliding, the players become locked together. Just after the collision, with what speed and in what direction are the two players moving?

(A) 4.0 m/s at 20° south of east
(B) 6.5 m/s at 48° south of west
(C) 3.8 m/s at 25° north of east
(D) 5.5 m/s at 86° south of east
(E) 4.6 m/s at 32° east of south

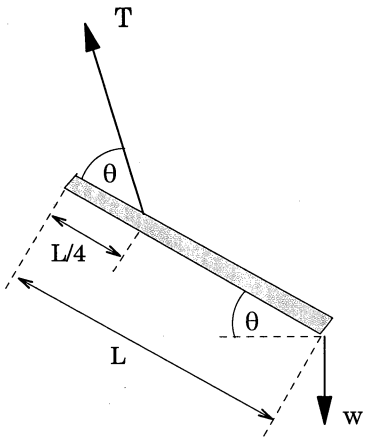
4. A box is kicked so that it slides a distance of 3.0 m up along a ramp inclined at 45° to the horizontal, before coming to rest. The initial speed of the box as it begins to slide up the ramp is v_0 = 7.0 m/s. The coefficient of kinetic friction between the box and the ramp is

(A) 0.10
(B) 0.18
(C) 0.29
(D) 0.46
(E) 0.67



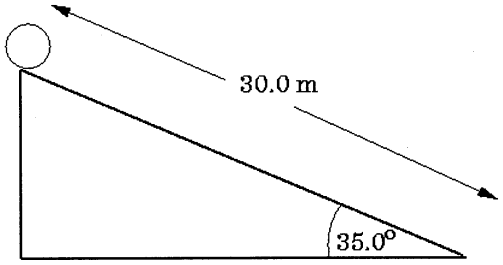
5. A weight w is pulling downward at the end of the forearm of length L, represented by the rod in the accompanying figure. At a distance of $L/4$ from the other end of the forearm, where it is attached to the shoulder blade, a tendon exerts a tension T such that the whole system is in translational and rotational equilibrium. In terms of w, L and the angle θ indicated in the figure, what is the magnitude of the tension T? (Neglect the weight of the forearm itself.)

(A) $T = 4w\tan\theta$
(B) $T = 4w$
(C) $T = \dfrac{4w}{\tan\theta}$
(D) $T = 2Lw\cos\theta$
(E) $T = 4Lw\sin\theta$



6. Starting from rest, a ball of mass m and radius r rolls down a hill of length 30.0 m and inclination angle 35.0°. Using conservation of energy, what will be the ball's speed when it reaches the bottom of the hill? (The moment of inertia of the ball is given by $I = 2mr^2/5$. Note that the result does not depend on the values of m and r.)

(A) 15.5 m/s
(B) 18.3 m/s
(C) 13.0 m/s
(D) 4.95 m/s
(E) 5.87 m/s



7. A figure skater is rotating with an angular velocity ω rad/s. She draws in her arms and her moment of inertia decreases by 40%. Her rotational kinetic energy will

(A) be unchanged
(B) decrease by 40%
(C) increase by 40%
(D) increase by 67%
(E) increase by 33%

8. Two bones, one hollow and one solid, have the same shear modulus and the same length. The hollow bone has an outer radius of 2.0 cm and an inner radius of 1.4 cm. The radius of the solid bone is 1.8 cm. Determine the ratio:

$$\frac{\text{Torque required to twist the hollow bone by } 2.0^\circ}{\text{Torque required to twist the solid bone by } 2.0^\circ}$$

(A) 1.5
(B) 1.1
(C) 0.87
(D) 0.52
(E) 0.26

9. Suppose we were able to develop a "super-pig" in which all linear body dimensions (excluding those of the legs) are 3.0 times those of a normal pig. By what factor would the leg diameter have to increase (comparing the super-pig with a normal pig) in order that the super-pig's legs would experience the same stress as those of a normal pig?

(A) 3.0
(B) 9.0
(C) 5.2
(D) 2.1
(E) 4.5

10. At what height in the atmosphere is the pressure 80% of that at sea-level? (Assume a constant mean temperature of 10°C and a molar mass of 29 grams for a typical "air molecule".)

(A) 1.8 km
(B) 2.7 km
(C) 500 m
(D) 4.1 km
(E) 7.6 km

11. A fluid is flowing in a horizontal tube of varying radius. The viscosity of the fluid is low enough that viscosity can be neglected. As the fluid passes from a wide region of the tube to a narrow region of the tube,

(A) the speed of the fluid increases, and the pressure decreases
(B) the speed of the fluid decreases, and the pressure decreases
(C) the speed of the fluid increases, and the pressure increases
(D) the speed of the fluid decreases, and the pressure increases
(E) the speed of the fluid increases, and the pressure does not change

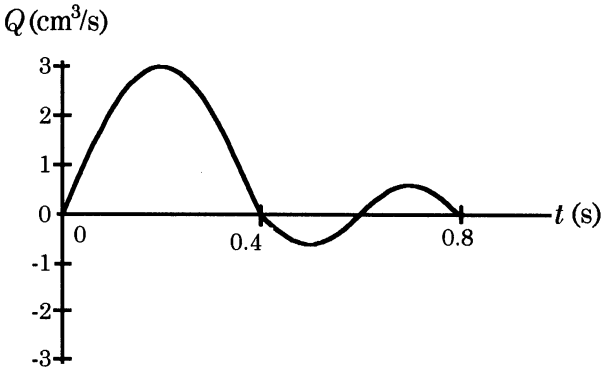
12. The distal thoracic artery of a dog has a diameter of 0.80 cm. What is the tension in the wall of this vessel when the blood pressure is 1.3×10^4 Pa?

(A) 3.7 N/m
(B) 4.3×10^2 N/m
(C) 3.0×10^5 N/m
(D) 4.0×10^{-2} N/m
(E) 52 N/m

13. On a cold breezy day (air temperature of 5°C), a glass of water initially at 20°C cools to 15°C in 10 minutes. How much *longer* will it take to cool to 10°C?

(A) 10 minutes
(B) 12 minutes
(C) 17 minutes
(D) 25 minutes
(E) 32 minutes

14. The graph shows the volume flow rate during one heart beat. The net volume of blood that flows during one beat is closest to:



(A) 0.6 cm^3
(B) 1 cm^3
(C) 2 cm^3
(D) 3 cm^3
(E) 0.3 cm^3

15. On a day when the outside air temperature is –10°C, heat is being lost through a window of area 0.50 m^2 at a rate of 300 W. If the glass is 3.0 mm thick and its thermal conductivity is 0.84 $W \cdot m^{-1} \cdot K^{-1}$, what is the temperature difference from one surface of the window to the other?

(A) 4.6°C
(B) 30°C
(C) 0.62°C
(D) 2.1°C
(E) 7.2°C

16. In Perrin's experiment, tree-resin particles each having mass 5.4×10^{-17} kg and density 1.20×10^3 kg/m^3 were suspended in water. What is the magnitude of the buoyant force on one of these particles?

(A) 6.5×10^{-16} N
(B) 5.1×10^{-16} N
(C) 4.4×10^{-16} N
(D) 3.2×10^{-16} N
(E) 7.6×10^{-16} N

17. Spherical protein molecules of radius 3.0×10^{-9} m are diffusing in water at 20°C. After 1.0 minute, what is the root-mean-square displacement of the protein molecules?

(A) 2.8×10^{-8} m
(B) 2.1×10^{-4} m
(C) 5.7×10^{-3} m
(D) 0 m
(E) 1.6×10^{-4} m

18. Two soap bubbles are floating around in air. One is four times the volume of the other. The excess pressure inside the larger bubble is approximately ____ times that inside the smaller bubble. ("Excess pressure" means the difference between the pressure inside the bubble and that outside the bubble.)

(A) 1.6
(B) 0.63
(C) 0.25
(D) 0.50
(E) 4.0

19. In a horizontal tree branch, a xylem cell of length 1.0 mm and radius 2.0×10^{-5} m is observed to have sap flowing with an average speed of 1.0×10^{-3} m/s. The viscosity of the sap is the same as that of water. What is the pressure *gradient* in the cell?

(A) 1.3×10^{5} N/m^3
(B) 6.4×10^{3} N/m^3
(C) 2.0×10^{4} N/m^3
(D) 2.4×10^{6} N/m^3
(E) 5.2×10^{4} N/m^3

20. A cell is placed in a solution of 0.1 molar NaCl, and the cell's volume does not change. The cell's membrane is impermeable to Na^+ and Cl^- and to the cell's own contents (other than water), but it is permeable to water and to glycerol. The cell contains no glycerol initially. When placed in a solution of 0.2 molar glycerol, the cell will

(A) swell and lyse
(B) swell to twice its original volume
(C) stay at its original volume
(D) shrink so that its volume is one-half of its original volume
(E) shrink until its volume is infinitesimally small

Please check:

- **name & ID # on front page of this exam**
- **ID #, name, Web-CT user ID, and answers bubbled in on computer answer sheet (as well, name and ID # printed on computer answer sheet)**

Best wishes for a pleasant summer!