ADDITIONAL PROBLEM SHEET **SPRING 2021-2022**

1.[Chap 4 - problem 7]: An ion's position vector is initially $\vec{r} = 5\,\hat{\imath} - 6\hat{\jmath} + 2\,\hat{k}$, and 10 s later it is $\vec{r} = -2\,\hat{\imath} + 8\hat{\jmath} - 2\,\hat{k}$, all in meters. In unitvector notation, what is its $\vec{v}_{avg}$ during the 10 s?

2. [Chap 4 - problem 11]: The position of a particle moving in an r xy plane is given by $\vec{r} = (5t^3 - 5t)\hat{\imath} + (6 - 7t^4\hat{\jmath})$, with $\vec{r}$ in meters and t in seconds. In unit-vector notation, calculate (a) $\vec{r}$, (b) $\vec{v}$, and (c) $\vec{a}$ for t = 2.00 s.

3. [Chap 4 - problem 27]: A certain airplane has a speed of 290.0 km/h and is diving at an angle of 30.0° below the horizontal when the pilot releases a radar decoy (Fig. 4-33). The horizontal distance between the release point and the point where the decoy strikes the ground is d = 700 m. (a) How long is the decoy in the air? (b) How high was the release point?

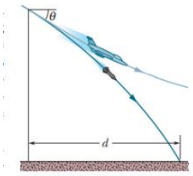

Figure 4-33 Problem 27.

4. [Chap 4 - problem 29]: A projectile's launch speed is five times its speed at maximum height. Find launch angle θ_0 .

5. [Chap 4 - problem 97]: A rifle is aimed horizontally at a target 30 m away. The bullet hits the target 1.9 cm below the aiming point. What are (a) the bullet's time of flight and (b) its speed as it emerges from the rifle?

6. [Chap 5 - problem 8]: A 2.00 kg object is subjected to three forces that give it an acceleration $\vec{a} = -8\,\hat{\imath} + 6\hat{\jmath}$. If two of the three forces are $\overrightarrow{F_1} = 3\,\hat{\imath} + 16\hat{\jmath}$ and $\overrightarrow{F_2} = -12\,\hat{\imath} + 8\hat{\jmath}$ find the third force.

7. [Chap 5 - problem 39]: A sphere of mass 3×10^{-4} kg is suspended from a cord. A steady horizontal breeze pushes the sphere so that the cord makes a constant angle of 37^0 with the vertical. Find (a) the push magnitude and (b) the tension in the cord.

8. [Chap 5 - problem 45]: An elevator cab that weighs 27.8 kN moves upward. What is the tension in the cable if the cab's speed is (a) increasing at a rate of 1.22 m/s^2 and (b) decreasing at a rate of 1.22 m/s^2?

9. [Chap 6 - example 6.2]: Calculate the typical stopping distances for a car sliding to a stop from an initial speed of 10.0 m/s on a dry horizontal road, an icy horizontal road, and (everyone's favorite) an icy hill.) if the coefficient of kinetic friction is $\mu_k = 0.60$, which is typical of regular tires on dry pavement and that with ice μ_k = 0.10? For the car sliding down an icy hill the inclination is $\theta = 5^0$.

10.[Chap 7 - problem 2]: If a Saturn V rocket with an Apollo spacecraft attached had a combined mass of 2.9 X 10^5 kg and reached a speed of 11.2 km/s, how much kinetic energy would it then have?

11. [Chap 7 - problem 8]: A ice block floating in a river is pushed through a displacement $\vec{d} = (15\ m)\hat{\imath} - (12\ m)\hat{\jmath}$ along a straight embankment by rushing water, which exerts a force

$\vec{F} = (210\ N)\hat{\imath} - (150\ N)\hat{\jmath}$ on the block. How much work does the force do on the block during the displacement?

12. [Chap 7 - problem 10]: A coin slides over a frictionless plane and across an xy coordinate system from the origin to a point with xy coordinates (3.0 m, 4.0 m) while a constant force acts on it. The force has magnitude 2.0 N and is directed at a counterclockwise angle of 100^0 from the positive direction of the x axis. How much work is done by the force on the coin during the displacement?

13. [Chap 7 - problem 39]: A force $\vec{F} = (cx - 3x^2)\hat{\imath}$ acts on a particle as the particle moves along an x axis, with F in newtons, x in meters, and c a constant. At x = 0, the particle's kinetic energy is 20.0 J; at x = 3.00 m, it is 11.0 J. Find c.

14.[Chap 7 - problem 40]: A can of sardines is made to move along an x axis from x = 0.25 m to x = 1.25 m by a force with a magnitude given by F = exp(-4x^2), with x in meters and F in newtons. (Here exp is the exponential function.) How much work is done on the can by the force?

15. [Chap 7 - problem 41]: A single force acts on a 3.0 kg particle-like object whose position is given by $x = 3.0\ t - 4.0\ t^2 + 1.0\ t^3$, with x in meters and t in seconds. Find the work done by the force from t = 0 to t = 4.0 s.

16. [Chap 8 - problem 1]: What is the spring constant of a spring that stores 25 J of elastic potential energy when compressed by 7.5 cm?

17. [Chap 9 - problem 19]: A 2100 kg truck traveling north at 41 km/h turns east and accelerates to 51 km/h. (a) What is the change in the truck's kinetic energy? What are the (b) magnitude and (c) direction of the change in its momentum?

18. [Chap 9 - problem 39]: A 91 kg man lying on a surface of negligible friction shoves a 68 g stone away from himself, giving it a speed of 4.0 m/s. What speed does the man acquire as a result?

19.[Chap 10 - problem 2]: What is the angular speed of (a) the second hand, (b) the minute hand, and (c) the hour hand of a smoothly running analog watch? Answer in radians per second.

20.[Chap 10 - problem 4]: The angular position of a point on a rotating wheel is given by $\theta = 2.0 + 4.0t^2 + 2.0t^3$, where θ is in radians and t is in seconds. At t = 0, what are (a) the point's angular position and (b) its angular velocity? (c) What is its angular velocity at t = 4.0 s? (d) Calculate its angular acceleration at t = 2.0 s. (e) Is its angular acceleration constant?