Physics 11 - Dynamic Review Problems (Chapters 2 and 3)

EQUATIONS

average velocity: $v = d/t$

$a = \frac{v_f - v_i}{\Delta t}$

$\Delta d = 1/2(v_i + v_f)\Delta t$

$\Delta d = 1/2\ a\Delta t^2 + v_i \Delta t$

$v_f^2 = 2a\Delta d + v_i^2$

$ax^2 + bx + c = 0$

$x = \frac{- b \pm \sqrt{b^2 - 4ac}}{2a}$

$F_g = mg$

$\sum F = ma$

$F_f = \mu F_N$

$G = 6.67 \times 10^{-11}\ N\ m^2/kg^2$

$g = 9.80\ m/s^2$

Table 1: Planetary Data

Name	Average radius (m)	Mass (kg)	Distance from sun (m)
Sun	696.0×10^6	1.991×10^{30}	---
Mercury	2.43×10^6	3.2×10^{23}	5.80×10^{10}
Venus	6.073×10^6	4.88×10^{24}	1.081×10^{11}
Earth	6.3713×10^6	5.979×10^{24}	1.4957×10^{11}
Mars	3.38×10^6	6.42×10^{23}	2.278×10^{11}
Jupiter	69.8×10^6	1.901×10^{27}	7.781×10^{11}
Saturn	58.2×10^6	5.68×10^{26}	1.427×10^{12}
Uranus	23.5×10^6	8.68×10^{25}	2.870×10^{12}
Neptune	22.7×10^6	1.03×10^{26}	4.500×10^{12}
Pluto	1.15×10^6	1.2×10^{22}	5.9×10^{12}

Table 2: Gravitational Field Strength

Location	g
Earth (average)	9.80 N/kg
New York City	9.80 N/kg
Mount Everest	9.76 N/kg

1. A physics teacher accelerated a 0.250 kg trolley from rest to a speed of 6.00m/s in a time of 0.200s. What was the average force that was applied to the trolley? (neglect friction)

2. Calculate the coefficient of friction between a 22.7 kg garbage can and your driveway if a force of 210N is required to keep it in motion at a constant speed.

3. A 45kg boy on roller skates is given an acceleration of 0.70 m/s^2. How large an unbalanced force was acting upon him?

4. A constant force acts on a 5.0kg scooter and reduces its velocity from 7.0m/s to 3.0m/s in 3.00s. What is the net force on the scooter?

5. A 600.0kg car is moving on a level road at 30.0m/s.
    a. How large a frictional force is required to stop it in a distance of 70.0m?
    b. What is the minimum necessary coefficient of friction between the tires and the roadway?

6. A tow rope will break if the tension in it exceeds 1500N. It is used to tow a 700.0kg car along level ground.
    a. What is the largest acceleration the rope can give the car if the frictional force is 950N?
    b. What would the acceleration be if the tension on the tow rope were 750.0N? Describe the motion of the car in words.

7. A 70.0kg box is pulled along the floor by a 400.0N force. The coefficient of friction between the box and the floor is 0.50. Find the acceleration of the box.

8. A 71.4 kg man stands on a scale on the floor of an elevator. What is the scale reading (in Newtons) if the elevator has an acceleration of (hint - draw a free body diagram, and consider what the scale reading means):
    a. 1.8 m/s^2 up
    b. 1.8 m/s^2 down
    c. 9.8 m/s^2 down
    d. 0.0 m/s^2

9. A 65 kg astronaut weighs herself on the moon where g=1.60 N/kg. What does the scale read (in Newtons)?

10. What is the difference between static and kinetic friction? Which is greater?

11. For each of the following situations, state which of Newton's 3 laws is being demonstrated, and explain the situation in terms of Newton's laws.
    a. A skateboarder experiences pain after hitting a tree.
    b. A librarian easily pushed a cart of books at a constant speed. When he tried to stop the cart he had a great deal of difficulty.
    c. A woman wearing a seat belt and holding her baby in lap in a car was not able to keep hold of the baby when the car came to a sudden stop. (oooooops! No seat belt for the baby!)

12. Explain how walking occurs, with reference to all the forces involved. Include a diagram showing the forces.

13. A box of mass 25.0 kg is pushed horizontally with a pushing force of 255 N and accelerates at a rate of 3.5m/s^2. What is the value of the coefficient of friction between the box and the floor?

14. A 2.50×10^3 kg car is moving at 120.0km/h (speeding!) when the driver sees a deer on the road and slams on the brakes. The car is 65.0 m from the deer when the driver applies the brakes. The deer does not move because it's paralyzed with fear, and the car cannot swerve because the road is too narrow. If the coefficient of friction between the tires and the road is 0.68, will the car hit the deer? Show all work.

15. A man pulls a 130.0N crate up vertically from the ground to a rooftop by pulling on a rope attached to the crate. The man exerts a force of 150.0N on the rope.
    a. What is the magnitude (size) and direction of the reaction force to mans' force on the rope?
    b. Which object exerts the reaction force?
    c. Draw a "free body diagram" for the crate (showing all forces).
    d. What is the net force on the crate?
    e. Calculate the acceleration of the crate.

16. A 3500 kg helicopter accelerates downwards at 2.5 m/s^2. What is the lift force exerted by the air on the propellers?

17. A 45 kg sled slides down a hill. It passes a certain point with a speed of 1.56 m/s and 20.0 s later it's speed is measured at 6.3 m/s. What is the net force acting on the sled?

18. A 1500 kg car is moving at 27.0 m/s when the driver sees a stop sign and applies the brakes. The car is 45.0 m from the stop sign when the driver applies the brakes. What frictional force is required in order to stop the car in 45.0 m?

19. A man drags a 150.0 N crate across the floor by pulling on it with a rope. The man exerts a force of 95 N [West] on the rope, and the coefficient of friction between the crate and the ground is 0.45.
    a. What is the magnitude (size) and direction of the reaction force to mans' force on the rope?
    b. What object exerts the reaction force?
    c. Draw a "free body diagram" for the crate (showing all forces).
    d. What is the net force on the crate?
    e. Calculate the acceleration of the crate.

20. A 55 kg person is standing on a scale in an elevator.
    a. If the elevator is accelerating at 0.98 m/s^2 downwards, what is the scale reading?
    b. If the scale reading is 585N, what is the acceleration of the elevator?
    c. What is the scale reading when the elevator cable breaks and the elevator falls freely?

21. A force of 555N is required to lift a particular rock on Earth.
    a. If the rock were moved to moon, when the gravitational field strength is $1/6^{th}$ that of Earth, what would the rock's mass be?
    b. The rock is then moved to Jupiter, where the gravitational field strength is 10 times that of Earth. What would the rock's weight be on Jupiter?

22. If a $5.50x10^4$ kg rock falls off a cliff and accelerates towards, what is the acceleration of the Earth towards the rock? (mass of Earth is 5.98×10^{24}kg)

23. A 1.3×10^3 kg car experiences air resistance of 2.5×10^3 N, and other frictional forces of 2.2×10^3 N. If the motor is pushing with a force of 7.5×10^3 N, what is the car's acceleration?

24. If the radius of the Earth was tripled and at the same time the mass was doubled, what would be the new value of g?

25. Calculate the force of attraction between a 2.5×10^3 kg elephant and a 20.0 kg bag of peanuts that are 5.0m apart.

26. A young space alien has a mass of 765.0 kg and weighs 4.45×10^3 N on the surface of his home planet, Zork. The radius of Zork is the same as the radius of Mars.
    a. Calculate the gravitational field strength on the surface of Zork.
    b. How much would the alien weigh if he were in a spaceship 3.0×10^5km from the centre of Zork?