KEY

1st Semester Exam Review

Conceptual Ideas:

1 **Select** the quantity that has changed—velocity or speed—for a car that travels north at 88 km/h and then turns east while continuing to move at 88 km/h.
-Explain your answer.

2. **Explain** how you can use a speedometer and a clock to tell how far you have traveled in a car if the car's odometer is not working.

3. **Calculate** the distance a plane flies on a 7.95-hour flight from Chicago to London. Assume a constant speed of 800.0 km/h

4. **Determine** a skier's velocity in kilometers per hour if it takes her 1.7 minutes to ski down a 1.67 km slope.

5. **Calculate** the average acceleration of a car that changes speed from 0 m/s to 15 m/s in 5 s.

6. **Calculate** how long it takes for a stone falling from a to hit the water. The stone starts from rest and hits the water with a velocity of 12.3 m/s.

7. **Identify** the straight-line accelerations below as either speeding up or slowing down.
   a. $0.75\ m/s^2$
   b. $24.8\ m/s^2$
   c. $-3.9\ m/s^2$

8. **Identify** the following examples of friction as unwanted or necessary.
   a. friction between a cast-iron pan and the food in the pan
   b. friction between bones in a joint
   c. friction between tires and the road
   d. friction inside a car engine

9. **Explain** what happens whenever a net force acts on an object.

10. **Analyze** the following situations, and indicate whether the forces are balanced or unbalanced.
   a. a skydiver accelerating downward
   b. a cannonball fired parallel to the ground
   c. a motorboat coasting at a constant speed
   d. a bike leaning against a tree

11. **Interpret** the following situations to determine whether an object's velocity is being altered by an applied force (answer *Yes* or *No*).
   a. A batter hits a baseball upward into right field.
   b. A satellite orbits Earth at a constant speed of 7,000 m/s.
   c. A submarine moves due east at a constant speed of 45 m/s.
   d. A falling book lands on the floor with a pre-collision speed of 9 m/s.

12. **Calculate** the acceleration of an 82 kg couch that is pushed across the floor with an unbalanced force of 21 N.
13. **Determine** the force needed to accelerate a 1,357 kg car forward at 8.0 m/s^2.
14. **Use** the concept of inertia to illustrate why volleyball is not played with a ball that has a mass similar to a bowling ball.
15. **Predict** the path of a cannonball. To do this, draw a line in the direction of the cannonball's flight. Also draw and label the horizontal and vertical components of the cannonball's projectile motion. What is the shape of this path?
16. **Calculate** the mass in kg of an object that weighs 1,225 N on Earth.
17. **Identify** which of Newton's three laws of motion specifically applies in each of the following situations:
    a. You feel a force against the sole of your foot as you take a step forward.
    b. A meteor moving in a straight path changes direction when it flies by Earth.
    c. A full grocery cart that is pushed starts moving and increases speed, but the same push increases its speed even more when the cart is empty.
    d. A skateboard moves faster in the same direction it is pushed.
18. **Apply** Newton's third law of motion to explain how two billiard balls, moving toward each other at the same speed, collide and move away from each other at the same speed as before.
19. **Apply** the concept of momentum to compare the mass and velocity of a slow-moving train and of a high-speed bullet.
20. **Indicate** which of the following has the greatest momentum: a 500 kg car moving at 64 km/h, a 250 kg cart moving at 128 km/h, or a 1,000 kg truck moving at 32 km/h. Explain your answer.
21. **Identify** what can be inferred about the velocity of a car that is moving with a constant momentum.
22. **Define** each of the following terms, and write the equation for each.
    a. work
    b. power
    c. mechanical advantage
23. **Explain** the relationship between work and power.
24. **Explain** how machines make work easier if they still require that the same amount of work be done.
25. **Calculate** the amount of work done when a grocery store stocker uses 120 N of force to lift a sack of flour 1.5 m onto a shelf.
26. **Calculate** the average power in kilowatts required to pull a car up a ramp if the amount

of work is 250 kJ over a period of 45 s.

27. **Calculate** the mechanical advantage of a group of pulleys used to raise an engine from a car. The engine is raised 1.2 m with the pulleys when 4.8 m of rope is pulled through the pulleys.
28. **Name** an example of each of the following types of simple machines:
    a. lever
    b. wedge
    c. pulley
    d. wheel and axle
    e. inclined plane
    f. screw
29. **Define** the following terms:
    a. kinetic energy
    b. potential energy
    c. mechanical energy
30. **Calculate** the gravitational potential energy of a 95 kg rock at the top of a 45 m cliff. The acceleration due to gravity is 9.8 m/s^2.
31. **Calculate** the kinetic energy of a bicyclist traveling at 11 m/s. The total mass of the cyclist and the bike is 74 kg.
32. **Identify** the type of energy stored in a stretched bungee cord.
33. **Explain** how the kinetic energy of an object changes when the speed of the object doubles.
34. **Contrast** chemical energy with mechanical energy.
35. **Define** the term *efficiency*.
36. **List** two ways mechanical energy can be transformed into non-mechanical energy.
37. **Calculate** the efficiency of the following machines:
    a. A lever is used to lift a 45 N rock. The applied force is 75 N.
    b. A pulley system raises a 39 N log with an applied force of 45 N.
    c. You do 425 J of work to push a 75 N box up a ramp until the box is 2.5 m above the ground.
38. **Explain** why the height of a bouncing ball decreases after each bounce.
39. **Describe** why a high-efficiency machine is more desirable than a low-efficiency machine.
40. **Explain** how a skier, gliding down a hill, illustrates the conservation of energy.
41. **Define** temperature in terms of kinetic energy.

42. **Predict** what will happen if a block of hot iron is placed in a glass of cool water.
43. **Evaluate** the following newspaper headline. Is it realistic? Explain your answer.
Scientists Create a Thermometer to Measure Temperatures Below 0 Kelvin
44. **Explain** why a metal door should not be built to fit tightly to the frame of a door, especially in a region where the weather gets hot.
45. **Explain** why a ceramic bowl will keep oatmeal hot longer than a stainless steel bowl.
46. **Explain** which method of heat transfer can take place if two objects at different temperatures are placed without touching each other in a vacuum. **Example?**
47. **Calculate** how much energy must be transferred as heat in each of the following situations. Use the following equation:
    a. A 100 kg tank of water is warmed from 10°C to 25°C; specific heat = 4,180 J/kg • K
    b. 100 kg of steam is raised from 120°C to 135°C; specific heat = 1,870 J/kg • K
48. **Describe** the method of heat transfer involved when you mix hot water with cold water to make lukewarm water.
49. **Describe** the first law of thermodynamics.
50. **Describe** the second law of thermodynamics.
51. **Identify** what causes usable energy to be lost when you heat your house.
52. **Predict** what type of heat transfer will occur during the following processes:
    a. evaporation
    b. condensation
53. **Explain** what the Law of Conservation of Energy means.
55. **Apply Concepts:** A runner runs a 1,500 m race on a circular track. The runner stops 100 m from the starting point. What are the distance and displacement traveled by the runner?
56. **Describe** what happens to an object when an unbalanced force acts on it?
57. **Calculate:** A baseball accelerates downward at 9.8 m/s_2. The force pulling the ball downward is 1.4 N. What is the mass of the baseball?
58. **Identify** what two kinds of motion combine to produce projectile motion?
59. **Apply Concepts:** A certain machine changes a large input force into a smaller output force. How does the machine affect the distance over which the force is applied? Explain your answer.
60. **Compare:** How is temperature related to heat?

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Concepts

① Velocity: it's a vector quantity

② Speedometer will tell your speed & clock how long you've been driving. $d = vt$

③ $t = 7.95\ hr$ $v = 800\ km/hr$ $d = vt = 6360\ miles$

④ $t = 1.7\ min = 0.028\ hr$ $d = 1.67\ km$ $v = \frac{d}{t} = 58.94\ km/hr$

⑤ $v_i = 0\ m/s$ $v_f = 15\ m/s$ $t = 5\ s$ $a = \frac{v_f - v_i}{t} = 3\ m/s^2$

⑥ $v_f = 12.3\ m/s$ $t = \frac{v_f}{g} = 1.26\ s$

⑦ a) ↑ b) ↑ c) ↓

⑧ a) N b) U c) N d) U

⑨ If $F_{net} \neq 0$ an object will accelerate

⑩ a) U b) U c) B d) B

⑪ a) Y b) Y c) N d) Y

(12) $M = 82kg$ $F = 21N$ $a = \frac{F}{M} = 0.26 m/s^2$

(13) $M = 1357 kg$ $A = 8 m/s^2$ $F = Ma = 10,856 N$

(14) More mass = More Inertia. A bowling ball would not fly as freely. It doesn't want it's motion to change

(15) 

(16) $F_w = 1225N$ $M = \frac{F_w}{g} = 125 kg$

(17) a) 1st b) 1st, 2nd c) 1st d) 2nd

(18) For every <u>action</u> force there is an <u>equal</u> & <u>opposite</u> <u>reaction</u> force. They have the same mass so they will effect each other the same.

(19) - (21) Don't Do

(22) a) Force over a distance [$W = Fd$]

b) Time it takes to do work [$P = \frac{W}{t}$]

c) The machines ability to decrease the input force [$MA = \frac{F_L}{F_E} = \frac{d_E}{d_L}$]

(23) They increase the effort distance while keeping the amount of work done the same.

(25) The more work you do in a short time period the more power you exert

(26) $F = 120\ N$ $d = 1.5\ m$ $w = Fd = 180\ J$

(26) $w = 250\ kJ$ $t = 45\ s$ $p = \frac{w}{t} = 5.56\ kW$

(27) $d_r = 1.2\ m$ $d_e = 4.8\ m$ $MA = \frac{d_e}{d_r} = 4$

(28) a) Crowbar b) axe c) Crane d) Car
e) ramp F) screw

(29) a) Energy of motion b) Stored energy c) KE + PE

(30) $m = 95\ kg$ $h = 43\ m$ $PE = mgh = 41,895\ J$

(31) $v = 11\ m/s$ $m = 74\ kg$ $KE = \frac{1}{2}mv^2 = 4477\ J$

(32) Elastic potential energy

(33) When speed doubles, KE quadruples

(34) Chemical Energy has to do with the position of atoms & can be converted into ME

(35) How much energy is lost between work input vs work output

(36) Sound energy & light energy

(37) a) $\frac{45}{75} = 0.6$ b) $\frac{39}{45} = 0.87$ c) $\frac{187.5}{425} = 0.441$

(38) Some of the ME is converted into NON-ME

(39) HE allows for less energy dissipation

(40) PE is converted to KE

(41) Temp is the average KE of the molecules in an object

(42) The heat of the iron will transfer to the water, cooling the iron & heating the water

(43) No 0 K is lowest possible temp

(44) Metal expands in heat & contracts in cool

(45) Ceramic is an insulator; doesn't dissipate heat

(46) Most conductors requires touch
Convection Needs a medium

(47a) $Q = MC\Delta T = (100)(4180)(15) = 6270000$ J

b) $Q = MC\Delta T = (100)(1870)(15) = 2805000$ J

(48) Convection: heat flows in a current

(49) 1st Law: Energy can't be created or destroyed

(50) 2nd Law: Heat Flows from warm to cold

(51) Leaks in seals

(52) a) conduction
b) Convection

(53) Energy has to come from somewhere & go somewhere

(54) dist: 1,400m disp: 160m

(56) It accelerates

(57) $M = \frac{F_w}{g} = 6.4$ kg

(58) Vertical & Horizontal

(59) The distance will increase. If you reduce the force required you must increase distance. Work Must remain the same

Math Problem:

1. Like the polar bear, the walrus is a strong swimmer, although it does not have the same endurance. For short periods of time, a walrus can swim at an average speed of 9.7 m/s. How far would a walrus swim at this speed in 3.4 minutes?

2. A baseball is pitched at a speed of 35.0 m/s. How long does it take the ball to travel 18.4 m from the pitcher's mound to home plate?

3. The cheetah, the fastest of land animals, can run 274 m in 8.65 s at its top speed. What is the cheetah's top speed?

4. A freight train, traveling at a speed of 18.0 m/s, begins braking as it approaches a train yard. The train's acceleration while braking is $-0.33\ m/s^2$. What is the train's speed after 23 s?

5. A child sleds down a steep, snow-covered hill with an acceleration of $2.82\ m/s^2$. If her initial speed is 0.0 m/s and her final speed is 15.5 m/s, how long does it take her to travel from the top of the hill to the bottom?

6. A fighter jet lands on the flight deck of an aircraft carrier that has a length of 300.0 m. The jet must reduce its speed from about 153 km/h to exactly 0 km/h in 2.0 s. What is the jet's acceleration?

7. A 214 kg boat is sinking in the ocean. The force of gravity that draws the boat down is partially offset by the buoyant force of the water, so the net unbalanced force on the boat is –1,310 N. What is the acceleration of the boat?

8. A house is lifted from its foundations onto a truck for relocation. The unbalanced force lifting the house is 2,850 N. This force causes the house to move from rest to an upward speed of 0.15 m/s in 5.0 s. What is the mass of the house?

9. In drag racing, acceleration is more important than speed, and therefore drag racers are designed to provide high accelerations. Suppose a drag racer has a mass of 1,250 kg and accelerates at a constant rate of $16.5\ m/s^2$. How large is the unbalanced force acting on the racer?

10. You must exert a force of 4.5 N on a book to slide it across a table. If you do 2.7 J of work in the process, how far have you moved the book?

11. A child pulls a sled up a snow-covered hill. In the process, the child does 405 J of work on the sled. If she walks a distance of 15 m up the hill, how large a force does she exert on the sled?

12. After the house has been set on the truck bed, the truck accelerates until it reaches a constant speed. If the force required to move the house horizontally a distance of 75.5 m is 3,150 N, how much work has been done on the house?

13. A ship's diesel engine has a power output of 130,000 W. How much work is done by this engine in 15.0 min?

14. Suppose a weightlifter's power output is 178 W during the time he does 3,310 J of work on the weights. How long does it take the weightlifter to raise the weights?

15. A certain steam turbine is designed to be used as both a power generator and as a pump. When used as a generator, the turbine provides enough power to do 300,000,000 J of work in 1 min. What is the power output of the turbine?

16. A wheelbarrow has a mechanical advantage of 2.2. The output distance extends from the load's center of mass to the wheel, and the input distance is from the handles to the wheel. For an output distance of 0.45 m, what is the input distance?

17. A lever and fulcrum are used to raise a heavy rock, which has a weight of 445 N. If the lever has a mechanical advantage of 9.50, what must the input force on the lever be in order to just begin lifting the rock?

18. A mover uses a ramp to load a crate of nails onto a truck. The crate, which must be lifted 1.4 m from the street to the bed of the truck, is pushed along the length of the ramp. If the ramp is 4.6 m long and friction between the ramp and crate can be ignored, what is the mechanical advantage of the ramp?

19. When a 65 kg skydiver jumps from a plane, her speed steadily increases until air resistance provides a force that balances the force due to free fall. How fast is the skydiver falling if her kinetic energy at the moment is 704,000 J?

20. A cheetah can run briefly with a speed of 31 m/s. Suppose a cheetah with a mass of 47 kg runs at this speed. What is the cheetah's kinetic energy?

21. An automobile to be transported by ship is raised 7.0 m above the dock. If its gravitational potential energy is 66,000 J, what is the automobile's mass?

22. What is the gravitational potential energy associated with a 75 kg tourist at the top floor of the Empire State Building, with respect to the street 404 m below?

23. An inclined plane allows you to do 280 J of useful work on a refrigerator that you are sliding upward along the plane. If the work that you have to do is 760 J, what is the efficiency of the plane?

24. Lithium has the highest specific heat of any pure metal. The temperature of a 25.00 g sample of lithium will increase by 7.69 K when 684.4 J of energy is added. What is the specific heat?

25. The cup's mass is 0.75 kg, and its specific heat is 1,860 J/kg • K. If the temperature of the cup increases from 20.0°C to 36.5°C, what is the amount of energy that has been transferred by heat into the cup?

26. A wave with a frequency of 60.0 Hz travels through vulcanized rubber with a wavelength of 0.90 m. What is the speed of this wave?

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Math

(1) $v = 9.7$ m/s
$t = 3.4$ min $= 204$ s $d = vt$ 1977.6 m

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(2) $v = 35$ m/s
$d = 18.11$ m $t = \frac{d}{v} = 0.535$ s

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(3) $d = 274$ m
$t = 8.65$ s $v = \frac{d}{t} = 31.68$ m/s

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(4) $v_i = 18$ m/s
$a = -0.33$ m/s^2
$t = 23$ s $v_f = v_i + at = 10.41$ m/s

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(5) $a = 2.82$ m/s^2
$v_i = 0$ m/s
$v_F = 17.5$ m/s $t = \frac{v_f - v_i}{a} = 5.5$ s

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(6) $d = 300$ m
$v_i = 153 \frac{km}{hr} = 42.5$ m/s $a = \frac{v_f - v_i}{t} = \frac{-42.5}{2} = \boxed{-21.25 \text{ m/s}^2}$
$v_F = 0$ m/s
$t = 2$ s

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(7) $m = 214$ kg
$F_{net} = 1310$ N $a = \frac{F}{m} = 6.12$ m/s to the left

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(8) $F_{net} = 2850$ N $a = \frac{v_f - v_i}{t} = 0.03$ m/s^2
$v_i = 0$ m/s
$v_f = 0.15$ m/s $m = \frac{F}{a} = 95000$ kg
$t = 5$ s

(9) $m = 1250\,kg$ $F = ma = 20{,}625\,N$
$a = 16.5\,m/s^2$

(10) $F = 4.5\,N$ $d = \frac{w}{F} = 0.6\,m$
$w = 2.7\,J$

(11) $w = 405\,J$ $F = \frac{w}{d} = 27\,N$
$d = 15\,m$

(12) $d = 75.5\,m$ $w = Fd = 23{,}782.5\,J$
$F = 315\,N$

(13) $P = 130{,}000\,W$ $w = Pt = 1.17 \times 10^8\,J$
$t = 15\,min = 900\,s$

(14) $P = 178\,W$ $t = \frac{w}{P} = 18.6\,s$
$w = 3310\,J$

(15) $w = 3 \times 10^8\,J$ $P = \frac{w}{t} = 5 \times 10^6\,W$
$t = 60\,s$

(16) $MA = 2.2$ $d_r = 0.45\,m$ $d_e = MA\,d_r = 1\,m$

(17) $F_r = 445\,N$ $F_e = \frac{F_r}{MA} = 46.84\,N$
$MA = 9.5$

(18) $d_r = 1.4\,m$ $MA = \frac{d_e}{d_r} = 3.29$
$d_e = 4.6\,m$

(19) $m = 65\,kg$ $KE = 704{,}000\,J$ $v = \sqrt{\frac{2KE}{m}} = 147.18\ m/s$

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(20) $v = 31\ m/s$ $m = 47\,kg$ $KE = \frac{1}{2}mv^2 = 22{,}583.5\,J$

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(21) $d = 7\,m$ $PE = 66{,}000\,J$ $m = \frac{PE}{gh} = 960.1\,kg$

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(22) $m = 75\,kg$ $h = 404$ $PE = mgh = 296940\,J$

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(23) $W_{out} = 280\,J$ $W_{in} = 760$ $e = \frac{W_o}{W_i} = 0.37$

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(24) $m = 25g = 0.025\,kg$ $\Delta T = 7.69\,K$ $Q = 684.45$ $c = \frac{Q}{m\Delta T} = 3559.95\ \frac{J}{kg}$

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(25) $m = 0.75\,kg$ $c = 1{,}860\ \frac{J}{kgK}$ $\Delta T = 16.5\,K$ $Q = mc\Delta T = 23017.5\ J$

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(26) $f = 60\,Hz$ $\lambda = 0.9\,m$ $v = f\lambda = 54\ m/s$