Henderson Key

Physics Spring Final Exam Review 2021

These questions will help you prepare for the final exam. The review is worth up to +10 bonus on the exam! You will get the same formula chart on the exam that I am giving you for this review.

Work and Power

1. What is the unit used to measure work, kinetic energy, and potential energy?

Joules

2. If a group of workers can apply a force of 1000 Newtons to move a crate 20 meters, what amount of work will they have accomplished?

$W = 1000\,N \times 20\,m =$ **20,000 J**

3. If 68 Joules of work were necessary to move a 4 Newton crate, how far was the crate moved?

$d = \frac{W}{F} = \frac{68\,J}{4\,N} =$ **17 m**

4. A 75.0 kg man pushes on a 500,000 ton wall for 250 s but it does not move. How much work does he do on the wall?

$W = 0\,J$ no work b/c $d = 0$!

5. Calculate the power expended when a 500 N barbell is lifted 2.2 m in 2 s.

$P = \frac{W}{t} = \frac{500 \times 2.2\,m}{2\,s} =$ **550 J/s**

Energy

6. Contrast Potential and Kinetic energy.

Potential: energy possessed by position above a base level

Kinetic: energy of motion

7. A 10 000 kg airplane lands, descending a vertical distance of 10 km while travelling 100 km measured along the ground. What is the plane's potential energy at the start of the descent? As it descends, what happens to the potential energy value? → It decreases as it descends b/c the height value is lower.

$PE = 10{,}000\,kg \times 9.8\,m/s^2 \times 10\,km$

$=$ **980,000 J**

8. Calculate the kinetic energy of a .045 kg golf ball travelling at 18 m/s.

$KE = \frac{1}{2} \times 0.045 \times 18^2 =$ **7.29 J**

9. a) Determine the kinetic energy of a 500-kg roller coaster car that is moving with a speed of 20 m/s.

$KE = \frac{1}{2} \times 500\ kg \times 20^2 =$ **100,000 J**

(b) If the roller coaster car were moving with twice the speed, then what would be its new kinetic energy? ~~Twice~~ 4 x as much (400,000 J)

10. Missy Diwater, the former platform diver for the Ringling Brother's Circus, had a kinetic energy of 12000 J just prior to hitting the bucket of water. If Missy's mass is 40 kg, then what is her speed?

$V = \sqrt{\frac{12{,}000\ J}{\frac{1}{2} \times 40 kg}} =$ **24.5 m/s**

11. In a perfect machine, the work input would equal the work output. However, there aren't any perfect machines in our everyday world. A cell phone charger uses 4.83 joules per second when plugged into an outlet, but only 1.31 joules per second actually goes into the cell phone battery. The remaining joules are lost as heat. That's why the battery feels warm after it has been charging for a while. How efficient is the charger?

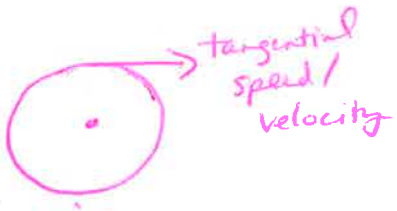
$\frac{1.31}{4.83} =$ **27%**

<u>Circular Motion</u>

12. Contrast revolution and rotation. → spinning

↓ going around a center point

13. What does an object's tangential speed represent?



It's linear speed at a given moment in circular motion.

14. Explain rotational inertia.

The property of an object to resist changes to its circular motion.

15. How does mass affect an object's rotational inertia? (increase or decrease)

More mass = Increase in inertia

16. The greater the distance between the object's mass concentration and axis, the ___greater___ the inertia.

17. The rotational counterpart of force that causes rotational acceleration is called ___torque___.

18. Mary the Mechanic has to loosen a bolt on a tire. She applies a perpendicular force of 30 N on the wrench that is 0.5 m long. How much Torque is she applying?

$T = F \times d = 30N \times 0.5m$

$= 15\ N \cdot m$

19. A waterwheel built in Hamah, Syria, has a radius of 20.0 m. If the tangential velocity at the wheel's edge is 7.85 m/s, what is the centripetal acceleration of the wheel?

$a_c = \frac{(7.85\ m/s)^2}{20\ m} = 3.08\ m/s^2$

20. An astronomer at the equator measures the Doppler shift of sunlight at sunset. From this, she calculates that Earth's tangential velocity at the equator is 465 m/s. The centripetal acceleration at the equator is 3.41×10^{-2} m/s^2. Use this data to calculate Earth's radius. -2

$\frac{r \times a_c}{a_c} = \frac{v^2}{a_c}$ $\quad r = \frac{v^2}{a_c} = \frac{465^2}{3.41 \times 10^{-2}} =$

6,340,909 m ~~634 m~~

21. A 615kg racing car completes one lap in 14.3 s around a circular track with a radius of 50m. The car moves with a constant speed. What is this speed (velocity)?

$V = \frac{2\pi \times 50}{14.3\ s} = 21.97\ m/s$

22. What is centripetal force?

The force that keeps something on a circular path.
Force toward the center.

23. A 2500 kg car enters a curve with a radius of 45 m. If the car is moving at a speed of 35 m/s, what is the centripetal force that maintains the car's circular motion through the curve?

$$F_c = \frac{2500\ kg \times 35^2}{45} = 68055.6\ N$$

Temperature and Heat

24. As temperature increases, does matter contract or expand? Expand

25. What is the lowest possible temperature? Absolute zero

26. As temperature increases, how does the kinetic energy respond? KE increases

27. Heat is energy that transfers from one object to another.

28. A 0.5 kg piece of aluminum increases its temperature 7°C when heat energy is added. How much heat energy produced this change in temperature? (calculate for Q)

$$Q = 0.5 \times 900 \times 7 = 3150\ J$$

29. Oil has a specific heat of 1,900 j/kg°C. If 4,900 J of heat energy is added to it, the temperature increases from 20°C to 30°C. What is the mass of the oil?

$$m = \frac{Q}{C \times \Delta T} = \frac{4900}{1900 \times 10} = 0.26\ kg$$

19,000

30. Look up the specific heats of Clay and Copper. Which substance would heat up faster sitting out in the sunlight? Copper

31. Why is water a useful cooling agent? It has a high specific heat.

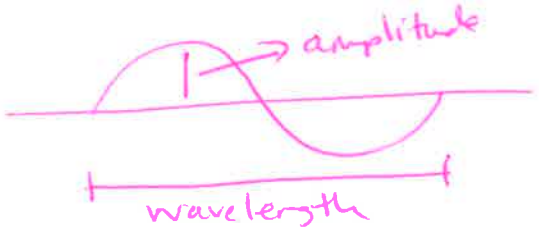
32. Read the following situations and write if it is heat transfer by conduction, convection, or radiation.
    a. Hot air balloon rises Convection

b. Microwaving leftover fajitas from T. Blanco's Radiation

c. The reason why you may be hot when sleeping on the top bunk, while your sibling/friend is fine at the bottom. Convection

d. Using a curling iron on your hair conduction

33. Draw a transverse wave and label the amplitude and wavelength.



34. Which one has more energy: a wave with a high frequency or wave with a low frequency?

wave w/ high frequency

35. Which one has more energy: a wave with a low amplitude or a wave with a high amplitude?

high amplitude

36. A wave has a frequency of 6 Hz and a wavelength of 22 m. What is the speed of the wave?

$V = 22m \times 6 =$ **132 m/s**

37. A wave with a frequency of 500 Hz is traveling at a speed of 200 m/s. What is the wavelength?

$\lambda = \frac{V}{f} = \frac{200}{500} =$ **0.4 m**

38. Contrast constructive and destructive interference.

↓ when waves combine to make a larger wave

↓ when waves combine to make a smaller wave.

39. Contrast diffraction and refraction. Be sure you can look at a picture and recognize which is which.

↓ change in direction as they pass into a different medium

Diffraction - when a wave encounters an obstacle or opening and they bend around a ~~corner~~ corner or through the opening

40. Because of the Doppler Effect, as a sound wave source approaches how does the frequency compare to when the sound source is leaving?

It is higher when approaching

lower when it leaves.