

Sonic Boom - Due Mon, Apr 9

1. Look up the date when Chuck Yeager broke the “sound barrier”. Oct 14, 1947
 What type of plane was he flying? Named the “Glamorous Glennis”, he flew a Bell X-1 which is in the Smithsonian National Air and Space Museum.

1.5/5

2. What is the speed of sound (in appropriate units)? roughly 767 mph = 343 m/s

2.5/10

3. Explain concisely (2-4 sentences) what a sonic boom is. Use technical language appropriately.

3.5/15

A sonic boom is the “sonic wake” behind a vehicle that is moving faster than the speed of sound through (usually) the air. Since the vehicle is moving faster than the sound it makes, the sound from earlier and later times overlaps on top of itself and an observer hears all of the sound at one single time: as a “boom”.

Sonic Boom - Extra questions

4. When an object that is making noise moves towards you, is the frequency (pitch) higher or lower than when the source is not moving (Chapter 15: Pg 322)?
 Alternate questions:
 (a) What if the source is moving away?
5. Is sound a transverse wave or a longitudinal wave (Chapter 15: Pg 312)? Alternate questions:
 (a) What about a ripple in water?
 (b) Which kind of wave can travel on a slinky?
6. Explain concisely (2-4 sentences) what the Doppler shift is. Use technical language appropriately. (Chapter 15: Pg 322)
7. Chapter 15 problems that you can answer: Questions: 2, 5, 6; Exercise:
8. Chapter 15 problems, that you can probably figure out: Questions: 25, 30; Exercises: 1, 3

Roller Coaster - Due Fri, Apr 13

The Wikipedia page for “g-force” has the following statements

- “The g-force (with g from gravitational) is a measurement of the type of acceleration that causes a perception of weight.”
- “Since g-force accelerations indirectly produce weight, any g-force can be described as a ‘weight per unit mass’ (see the synonym specific weight).”

1. Is “g-force” a force or an acceleration? What units should it be expressed in? $\frac{\text{m}}{\text{s}^2}$

1.5/20

2.5/25

2. Does “g-force” make you heavier (does it “produce weight”)?

3.5/30

3. Find an internet source (Wikipedia is acceptable for this) and list three examples where one might experience “gees” and indicate (a) the source, (b) the activity, and (c) the number of “gees” one would experience.

4. Why do you lift out of your seat when riding a vehicle (or roller coaster) that moves very fast over the crest of a hill?

4.5/35

5. In Chapter 5, Exercise 8, they describe a ferris wheel. For that case, consider the top and bottom of the circular motion.

5.10/45

- After drawing the free-body diagram, compute the normal force the person experiences at the top of the circle.
- After drawing the free-body diagram, compute the normal force the person experiences at the bottom of the circle.
- What is the maximum g-force this person experiences?

Roller Coaster - Extra questions

6. What level of g-force can most people handle?

7. Describe the following terms:

- (a) grey-out (b) tunnel vision (c) blackout (d) pass out (G-LOC)
-

Quicksand - Due Fri, Apr 27

1. Describe how you should try to remove your foot from quicksand, indicate how the physics supports your description.
 - (a) With the foot you want to support yourself, make it as flat as possible (use a snow shoe or ski if available) in order to spread out the weight and reduce the pressure.
 - (b) With the foot you are trying to remove, make it as vertical as possible (point it down) and try to allow for air to get under it so that it does not behave like a suction cup.

1.5/50

2.5/55

2. What kind of ground makes good quicksand? Kind of wet and kind of grainy
-

Quicksand - Extra questions

1. List some liquids that have low viscosity (water, milk, oil) and some liquids that have high viscosity (honey, glue, mayonnaise, molasses).
-

The Northern Lights - Due Fri, Apr 27

1. What are the two names for the auroras and which is which? The northern lights are the Aurora Borealis. The southern lights are the Aurora Australis.
2. Why are the auroras seen at the north and south poles? The Earth's magnetic field directs the particles, which come from the sun, to the poles.

1.5/60

2.5/65

The Northern Lights - Extra questions

1. Describe the make up of an atom. Atoms are made of small, negatively charged electrons orbiting around larger particles (positively charged protons and neutral neutrons) in the nucleus.
2. How large is an atom? Atoms have a radius of about 1×10^{-9} m. How large is a nucleus? Atoms have a radius of about 1×10^{-15} m.
3. Describe the way charged particles move through magnetic fields in general (they move in a helical pattern) and through the magnetic field of the Earth. (They follow the field from the north pole to the south pole and back and forth.)
4. What is a CME? Coronal Mass Ejection

The Sun - Due Fri, Apr 27

1. What is the difference between hydrogen and heavy hydrogen? Hydrogen has a proton in its nucleus. Heavy hydrogen has a proton and a neutron in its nucleus.
2. What is the difference between fusion and fission? Fusion is when two light elements (lighter than iron) combine to become a slightly heavier element (and give off energy). Fission is when a large element (heavier than iron) splits into two smaller elements (and give off energy). Which happens in a star? (fusion) Which happens in a nuclear bomb? (fission)
3. As we did in class, calculate the time it will take Voyager I, which is traveling at 17 km/hr , to reach Proxima Centauri, which is 4 lightyears away. (One light-year is $9.46 \times 10^{12} \text{ km}$.)

1.5/70

2.5/75

3.5/80

$$t = \frac{d}{v} = \frac{4(9.46 \times 10^{12} \text{ km})}{17 \text{ km/s}} = 2.2 \times 10^{12} \text{ s} = 70,534 \text{ yrs} = 2821 \text{ generations}$$

The Sun - Extra questions

1. When stars die, what happens to them? It depends on their initial mass. Small stars become white dwarfs (supported by the electron degeneracy) when they die. Medium-sized stars become neutron stars (supported by the neutron degeneracy) when they die. Large stars become black holes (collapse to a point) when they die.
-

Star Wars - Due Fri, Apr 27

1. List two technologies from Star Wars that are beyond our current technology (i.e., that are “impossible”, *according to Dr. Christensen!*) [Light Sabers](#), [Pod Racing](#), [traveling through worm holes](#), [death stars](#), [artificial gravity without a large shipping ship](#).
-

1.5/85**non-Star-Wars science - Extra questions**

1. How can we create artificial gravity? [By making a spoked wheel that spins](#). If the radius of the wheel is 100 m, then it has to spin $v = 31.62 \text{ m/s}$ in order to create an artificial gravity equal to the gravitational pull of Earth ($1g$).
 2. What is the coriolis force? [Air and fluids resting on a spinning body feel a sideways force when they move across the body](#). On the Earth, this affects the weather patterns and the ocean currents and is the most obvious proof that the Earth itself spins beneath the sun.
 3. What causes a baseball to curve when thrown? [The difference in air pressure on either side of the ball as it spins](#), since the spin causes one side to move through the air faster than the other side. The ball is pushed towards the side that is moving faster.
-