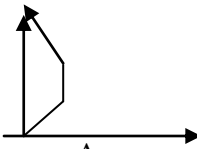
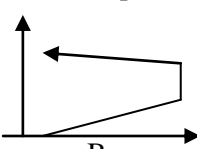


## Special Relativity Review

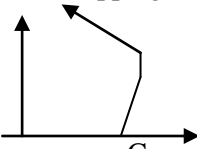
- 1) My keys fell out of my pocket while I rode my bike. They landed on the ground
  - a) ahead of me
  - b) behind me
  - c) beside me
  - d) it depends
- 2) You are at the back of a jet traveling at 400 km/h. You throw a package of peanuts with speed  $v$  toward your friend in first class. At what speed does your friend see the peanuts approaching?
  - a)  $v + 400$  km/h
  - b)  $v - 400$  km/h
  - c)  $v$
  - d)  $v/(v^2 - (400 \text{ km/h})^2)$
- 3) You are at the back of a jet traveling at 400 km/h. You shine a laser toward the front. What speed does your friend on the ground measure for the laser light?
  - a)  $c + 400$  km/h
  - b)  $c - 400$  km/h
  - c)  $c$
  - d)  $c/(c^2 - (400 \text{ km/h})^2)$
- 4) Which of the following shows a ship moving at  $3/5 c$ , stopping and then moving at  $-1/5 c$ ?
 



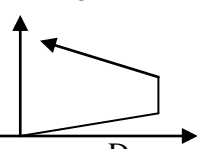
A



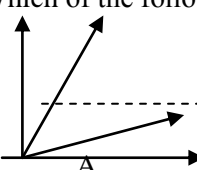
B



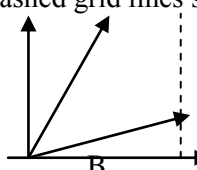
C



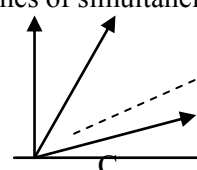
D
- 5) Which of the following dashed grid lines show lines of simultaneity for the 'moving' frame?
 



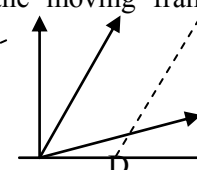
A



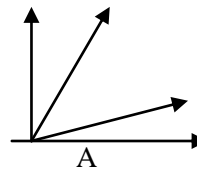
B



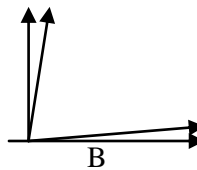
C



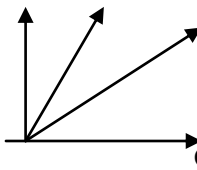
D
- 6) Which of the following show frames moving at  $1/2 c$  relative to each other?
 



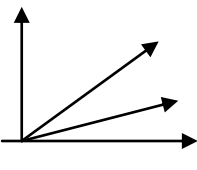
A



B



C



D
- 7) Which of the following remain the same - not relative - when viewed in two different inertial frames?
  - a) speed of light, the number of crew members, rate of separation of the frames
  - b) heart rates, the number of crew members, rate of separation of the frames
  - c) heart rates, the speed of light, rate of separation of the frames
  - d) heart rates, the speed of light, the number of crew members
- 8) Which of the following are relative - not the same - when viewed in two different inertial frames?
  - a) length, time
  - b) colour, time
  - c) colour, length
  - d) all three
- 9) In the twin paradox, the younger twin will be the one who
  - a) travelled faster
  - b) travelled farther
  - c) travelled for less time
  - d) accelerated more
- 10) In the twin paradox, the returning twin has travelled \_\_\_\_\_ in time
  - a) forward
  - b) backward
  - c) back and forth
  - d) forth and back
- 11) Muons formed at the top of the atmosphere manage to get to the earth because
  - a) they see a shortened atmosphere and we see their time running slowly
  - b) they see a shortened atmosphere and they see their time running slowly
  - c) we see a shortened atmosphere and we see their time running slowly
  - d) we see a shortened atmosphere and they see their time running slowly
- 12) Simultaneity is
  - a) dilated
  - b) absolute
  - c) invariant
  - d) relative
- 13) A clock, designed to tick at each second, is moving past you at a uniform speed. You find the clock to be

- a) ticking slowly      b) ticking quickly      c) running backwards      d) accurate
- 14) A pendulum swings with a period  $T$  when at rest. If it is moving at  $3/5 c$ , the observer measures a period of  
a)  $3/5 T$       b)  $5/3 T$       c)  $4/5 T$       d)  $5/4 T$
- 15) Relativity is needed for calculations in which of the following applications?  
a) GPS, LHC      b) GPS, nuclear power      c) nuclear power, LHC      d) all three
- 16) NASA has determined that the clocks aboard the International Space Station run slower. The astronauts on the ISS made similar measurements and found that the Earth's clocks run  
a) more slowly      b) faster      c) at the same rate
- 17) If the speed of light were smaller, then the effects of relativity would be  
a) more noticeable      b) less noticeable      c) the same
- 18) To understand whose time is actually slowing down, Ali has a video camera pointed at her clock. It shoots 20 frames per second and he sends the images immediately to Brenda. Brenda will receive  
a) 20 frames a second      b) 18 frames a second      c) 22 frames a second
- 19) Which equations are just approximations at slow speed?  
a)  $E = mc^2 + 1/2 mv^2$ ,  $p = mv$       b)  $E = mc^2$ ,  $p = mv$       c)  $E = mc^2$ ,  $E = mc^2 + 1/2 mv^2$       d) all three
- 20) The magnetic field of the TRIUMF cyclotron was altered to select particles with the same  
a) charge, speed      b) momentum, speed      c) charge, momentum      d) all three
- 21) The momentum of the particles at the TRIUMF cyclotron can be calculated by  
a)  $mv$ ,  $qBr$ ,      b)  $mv$ ,  $qvB$       c)  $\gamma mv$ ,  $qBr$ ,      d)  $\gamma mv$ ,  $qvB$
- 22) The high momentum particles had lots of pions compared to the low momentum particles because the pions travelled the 4.4 m in comparatively less time in the Earth frame and  
a) the pion frame      b) even less time in the pion frame      c) more time in the pion frame
- 23) Mass is converted to energy in  
a) fusion, decay      b) fission, decay      c) fission, fusion      d) all three
- 24) Energy is released when  
a) large nuclei split or join      b) large nuclei split, small nuclei join      c) small nuclei split, large nuclei join
- 25) Which of the following statements is true?  
a) Fission keeps the Earth's core molten, fusion powers the sun, and decay powers generators  
b) Fusion keeps the Earth's core molten, fission powers the sun, and decay powers generators  
c) Decay keeps the Earth's core molten, fission powers the sun, and fusion powers generators  
d) Decay keeps the Earth's core molten, fusion powers the sun, and fission powers generators
- 26) The time on the GPS satellite runs  $4.4 \times 10^{-10}$  s slower each second. This is  
a) insignificant and can be ignored because it is such a small number  
b) not insignificant for the GPS because it is multiplied by a large number to get distance  
c) not insignificant for the GPS because it is multiplied by a large number each day  
d) not insignificant because it is multiplied by a large speed to get distance and by a large number each day
- 27) The time on the GPS satellite – relative to Earth – runs  
a) slower because of its speed and faster because of the weaker gravity  
b) faster because of its speed and slower because of the weaker gravity  
c) slower because of its speed and the weaker gravity  
d) faster because of its speed and the weaker gravity

28) Relativity makes travel to the stars more feasible because

- a) mass can be converted into energy, mass of the rocket is increased
- b) time on the rocket is slowed, mass of the rocket is increased
- c) time on the rocket is slowed, mass can be converted into energy
- d) all three