

1. Acceleration is
- A. change of speed
  - B. change of direction
  - C. change of speed and/or direction
  - D. if its velocity is large.

Answer C (Acceleration is defined as a change in velocity and velocity has both magnitude (speed) and direction. Thus change of speed and/or direction is acceleration).

2. If the mass of an object in **free fall** is tripled, its acceleration
- A. triples
  - B. increases nine times
  - C. stays the same
  - D. is reduced by one third

Answer C (Weight is  $mg$  and it is the force acting on the body. Since the acceleration =  $F/a$ , for falling objects it becomes  $mg/m = g$ )

3. If the net force on a helium balloon is directed straight upward, which way does the acceleration point?
- A. towards the centre of the Earth
  - B. away from the centre of the Earth
  - C. no acceleration
  - D. in the direction of its weight

Answer B (Newton's 2<sup>nd</sup> Law)

4. When you push a parked car that doesn't move, your force is
- A. small and so is absorbed by the car
  - B. canceled by the reaction force of car from the Newton's third law
  - C. canceled by friction of the wheels on the road
  - D. canceled by the weight of the car

Answer C (Newton's 1<sup>st</sup> Law – the car will only move if an unbalanced force acts on it - friction of the wheels on the road opposes your push. Why not B? Well the reaction from the third law acts on YOU not the car!)

5. When you push a sturdy wall and the floor is slippery you slide away from the wall because the force pushing you is
- A. friction between your feet and the ground
  - B. the reaction force of wall from Newton's third law
  - C. the force from your arm muscles
  - D. the pull of Earth's gravity

Answer B (Newton's 3<sup>rd</sup> Law – the wall pushes on you with a force equal to your push. Forces on you in the horizontal direction are (i) friction of the ground on your feet (ii) reaction force of wall from Newton's third law. In slippery conditions (ii) > (i) so you move away from the wall.

6. Your mass is 400N. When the elevator just begins to move upward the balance will read

- A. 400 N
- B. > 400 N
- C. < 400 N
- D. 0 N

Answer B (No matter what the state, your weight is constant – that depends on the gravitation attraction from the earth. To accelerate upward (when the elevator just start to move up) you need an unbalanced **upward** force, so the floor has to push > than your weight. Newton's 2<sup>nd</sup> Law)

7. Your mass is 400N. When the elevator moves upward at constant velocity, the balance will read

- A. 400 N
- B. > 400 N
- C. < 400 N
- D. 0 N

Answer A (No matter what the state, your weight is constant – that depends on the gravitation attraction from the earth. When the elevator moves upward at constant velocity (no acceleration) you need an upward force exactly equal to your weight – Newton's 1<sup>st</sup> Law)

8. Your mass is 400N. When the elevator just begins to slow down while moving upward the balance will read

- A. 400 N
- B. > 400 N
- C. < 400 N
- D. 0 N

Answer C (No matter what the state, your weight is constant – that depends on the gravitation attraction from the earth. To slow down, a negative acceleration (when the elevator just begins to slow down while moving upward) you need an unbalanced **downward** force, so the floor has to push < than your weight. Newton's 2<sup>nd</sup> Law)

9. Your mass is 400N. When the elevator stops moving the balance will read

- A. 400 N
- B. > 400 N
- C. < 400 N
- D. 0 N

Answer A (No matter what the state, your weight is constant – that depends on the gravitation attraction from the earth. When the elevator stops moving (no acceleration) you need an upward force exactly equal to your weight – Newton's 1<sup>st</sup> Law)

10. Your mass is 400N. When the elevator just begins to move down the balance will read

- A. 400 N
- B. > 400 N
- C. < 400 N
- D. 0 N

Answer C (No matter what the state, your weight is constant – that depends on the gravitation attraction from the earth. To accelerate down, (when the elevator just begins to move down) you need an unbalanced **downward** force, so the floor has to push < than your weight. Newton's 2<sup>nd</sup> Law)

11. Your mass is 400N. When the elevator moves downward at constant velocity, the balance will read
- A. 400 N
  - B. > 400 N
  - C. < 400 N
  - D. 0 N

Answer A (No matter what the state, your weight is constant – that depends on the gravitation attraction from the earth. When the elevator moves downward at constant velocity (no acceleration) you need an upward force exactly equal to your weight – Newton's 1<sup>st</sup> Law)

12. Your mass is 400N. When the elevator just begins to slow down while moving downward the balance will read
- A. 400 N
  - B. > 400 N
  - C. < 400 N
  - D. 0 N

Answer B (No matter what the state, your weight is constant – that depends on the gravitation attraction from the earth. To slow down, a negative acceleration (when the elevator just begins to slow down while moving downward) you need an unbalanced upward force, so the floor has to push > than your weight. Newton's 2<sup>nd</sup> Law)

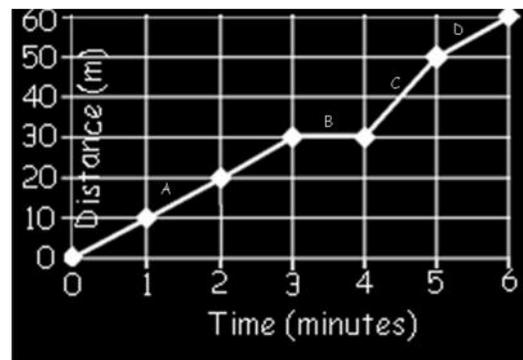
13. Two boats of the same dimensions X and Y face other. Boat X is loaded and its total mass is greater that of Boat Y. A seaman from X pushes on boat Y.



- A. Boat X will slower than Y
- B. Boat X will move faster than X
- C. Boat X and Y will move with same speed
- D. Only boat X will move

Answer A. (Newton's 3<sup>rd</sup> Law – same force on both boats. Newton's 2<sup>nd</sup> Law – increase mass with same force slower acceleration).

14. Distance moved vs time is plotted for a car in traffic jam on a straight level road. Which interval had the greatest velocity?



- A.
- B.
- C.
- D.

Answer C (the slope in a distance time graph is the velocity)

15. After firing a cannon ball, the cannon recoils in the opposite direction from the ball. This is an example of:

- A. Newton's First Law
- B. Newton's Second Law
- C. Newton's Third Law
- D. Newton's Law of Gravitation

Answer C

16. A heavy box sits stationary on the floor. The net force on the box is

- A. zero in all directions
- B. Non-zero and pointing down
- C. Non-zero and pointing left
- D. Non-zero and pointing right

Answer A (no motion – no net force. Newton's 1<sup>st</sup> Law).

17. An object is thrown straight up. What is the net force on the object when it is at the highest point in the path?

- A. It is greater than the weight
- B. It is slightly less than the weight
- C. It is zero
- D. It is equal to the weight

Answer D. (the Earth pulls on an object (weight) even if it is moving – Newton's Gravitation Law).

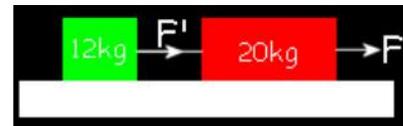
18. An elevator car weighs 6000 N and accelerates upwards at a rate of  $4.0 \text{ ms}^{-2}$ . What is the tension in the support cable?

- A. 1500 N
- B. 2400 N
- C. 24000 N
- D. 6004 N

Answer B ( $m = W/g$ ,  $m = 600\text{kg}$ ,  $F = ma$ ,  $F = 600\text{kg} \times 4.0 \text{ ms}^{-2}$ ,  $F = 2400\text{N}$ ).

19. Two blocks of mass 20kg and 12kg are connected with an inextensible string and pulled on a horizontal frictionless surface. What is the tension on the string?

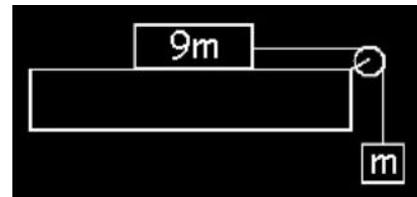
- A.  $1.75F$
- B.  $0.6F$
- C.  $F$
- D.  $0.375F$



Answer D (both blocks move with same acceleration of  $F/(20+12)$ .  $a = F'/12\text{kg}$ ,  $F' = 12\text{kg} \times [F/(20+12)]$ ,  $F' = 0.375F$ ).

20. A block of mass  $m$  is attached to another block of mass  $9m$  on a frictionless table through a pulley. What is the acceleration of the blocks?

- A.  $0.100g$
- B.  $0.375g$
- C.  $9.000g$
- D.  $1.000g$



Answer A. (force on system =  $mg$ .  $F = ma$ ,  $mg = (9m+m)a$ ,  $a = mg/10m$ ,  $a = g/10$ ).

21. A ball of mass  $m$  is hung on two strings, each at an angle  $\theta$  from the vertical. What is the tension on each string?

- A.  $\frac{1}{2} mg \cos \theta$
- B.  $\frac{1}{2} mg \sin \theta$
- C.  $mg/(2 \cos \theta)$ .
- D.  $mg/(2 \sin \theta)$ .

Answer C. (The mass is in equilibrium so downward forces = upward forces)

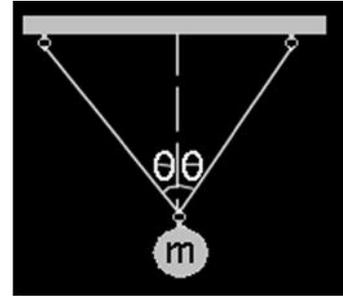
Vertical component on each strings is  $\frac{1}{2}mg$

$\cos \theta = \text{vertical component} / T$

$\cos \theta = (\frac{1}{2}mg)/T$

$T \cos \theta = \frac{1}{2}mg$

$T = mg/(2 \cos \theta)$ .



22. Provided the force acting on an object is constant, as the mass of an object increases, the acceleration of that object

- A. increases
- B. remains the same
- C. decreases
- D. is zero

Answer C

23. An example of balanced forces is

- A. a car accelerating on a level road
- B. a tug-of-war game in which neither side advances
- C. an elevator starting to move upward
- D. a roller coaster going down the first drop

Answer B

24. The motion of a jet aircraft is primarily based on the law of

- A. Newton's 1<sup>st</sup> law
- B. Newton's 2<sup>nd</sup> law
- C. Newton's 3<sup>rd</sup> law
- D. Newton's gravitation law

Answer C

25. According to Newton's Second Law of Motion, if the net force acting on the object increases while the mass of the object remains constant, what happens to the acceleration?

- A. Acceleration decreases.
- B. Acceleration increases.
- C. Acceleration remains the same.
- D. Acceleration is independent of mass.

Answer B