Year 12 Physics Chapter 6 and 7 Review

1. Fig. 4.1 shows a car of mass 1200 kg, pulling a caravan of mass 400 kg along a horizontal road.

![Car and Caravan Image]

Fig. 4.2 shows the variation with time $t$ of the velocity $v$ of the car as it accelerates from rest.

![Velocity-Time Graph]

a) Calculate the acceleration of the car in the first 20 seconds.

b) Describe how the acceleration changes after the first 20s. Suggest a reason for this change.

2. A boy walk 5km north along a path 53° West of North. Which of the journeys below would result in the same displacement?
   a) 4km north followed by 3 km west
   b) 3km north followed by 2km west
   c) 3km north followed by 4km west
3. During a rugby match, a spectator at A walks to C, the opposite corner of the ground, by walking from A to B to C as shown in the diagram.

![Diagram of a rugby pitch with points A, B, and C marked, and distances 160 m and 70 m indicated.]

a) What is the final displacement of the spectator?

b) If the spectator takes 100s to complete the walk, what was the average velocity?

4. A man, who has walked a certain distance, but not in a straight line, can...
   A have a zero displacement
   B not have a negative displacement
   C have a displacement higher in magnitude to the distance
   D have a displacement equal in magnitude to the distance

5. In which of the following vector diagrams is the resultant of the three vectors zero?

   ![Vector diagrams A, B, C, D, E]
6.

8.) A force $F$ is used to pull a body, which is suspended from a string, to one side as shown in the diagram to the right. The body is in equilibrium. Which of the following vector diagrams represents all the forces acting on the body?

![Diagram of vector options A, B, C, D, E]

7.

Three forces of equal magnitude $F$ act on a body as shown as in the diagram below. The body ...

- A does not accelerate
- B accelerates towards north-west
- C accelerates towards south-east
- D accelerates towards north-east

![Diagram of force vectors]

8.

The pilot of a small aircraft needs to fly from town X to town Y which lies north-east of X. While flying the aircraft will encounter a steady wind blowing from the East, so he draws a velocity - vector diagram to assist in setting his course correctly.

![Diagram of aircraft and wind vectors]

What is the correct label for the vector marked II in the diagram below?

- A Velocity of aircraft relative to air
- B Velocity of aircraft relative to the ground
- C Velocity of air relative to the ground
- D Resultant velocity of aircraft.
9. A picture is hung on the wall in three different ways:

The tension in the string is

A least in i)
B greatest in i)
C greatest in ii)
D least in iii)
E greatest in iii)

10. A tennis player serves a ball from a height of 2.51 m at 18.0 m/s in a horizontal direction. The ball just clears the net which is 1.00 m high. In this question assume that air resistance is negligible.

The figure below shows the ball and its resulting trajectory across the court.

(a) Show that the ball takes approximately 0.6 s to reach the net after being served

(b) (i) Calculate the vertical component of the velocity of the ball as it passes over the net.

(ii) Calculate the overall velocity of the ball as it passes over the net
11. Gliders can be launched with a winch situated on the ground. The winch pulls a rope that is attached to the glider. The diagram below shows the forces acting on the glider at one instant during the launch.

(a) The combined weight of the glider and pilot is 6500 N.

(i) Show that the magnitude of the resultant force acting on the glider is about 6100 N.

(ii) Calculate the angle between this resultant force and the horizontal.

(iii) Calculate the resultant acceleration of the glider in the diagram above.

12. A waiter holds a tray horizontally in one hand between fingers and thumb as shown in the diagram.
$P$, $Q$ and $W$ are the three forces acting on the tray.

(a) (i) State two relationships between the forces that must be satisfied if the tray is to remain horizontal and in equilibrium.

(ii) If the mass of the tray is $0.12$ kg, calculate the magnitude of the force $W$.

(iii) Calculate the magnitudes of forces $P$ and $Q$.

(b) The waiter places a glass on the tray. State and explain where the glass should be positioned on the tray if the force, $P$, is to have the same value as in part (a).

13. The figure below shows a uniform steel girder being held horizontally by a crane. Two cables are attached to the ends of the girder and the tension in each of these cables is $T$.

(a) If the tension, $T$, in each cable is $850$ N, calculate

(i) the horizontal component of the tension in each cable,

(ii) the vertical component of the tension in each cable,

(iii) the weight of the girder.

(b) On the figure draw an arrow to show the line of action of the weight of the girder.

14. After its most recent delivery, the stork announces the good news. If the sign has a mass of $10$ kg, then what is the tensional force in each cable?
15. Suppose that a student pulls with two large forces \( F_1 \) and \( F_2 \) in order to lift a 1-kg book by two cables. If the cables make a 1-degree angle with the horizontal, then what is the tension in the cable?

![Diagram](image)

16. In a castle, overlooking a river, a cannon was once employed to fire at enemy ships. One ship was hit by a cannonball at a horizontal distance of 150 m from the cannon as shown in the figure below. The height of the cannon above the river was 67 m and the cannonball was fired horizontally.

![Diagram](image)

(a) (i) Show that the time taken for the cannonball to reach the water surface after being fired from the cannon was 3.7 s. Assume the air resistance was negligible.

(ii) Calculate the velocity at which the cannonball was fired. Give your answer to an appropriate number of significant figures.

(iii) Calculate the vertical component of velocity just before the cannonball hit the ship.
By calculation or scale drawing, find the magnitude and direction of the velocity of the cannonball just before it hit the ship.

17. The diagram shows the trajectory of a Vortex after it has been thrown with an initial speed of 10.0 m s \(^{-1}\). The Vortex reaches its maximum height at point Q; 4.00 m higher than its starting height.

![Diagram of Vortex trajectory](image)

a) What is the value of the angle \(\theta\) that the initial velocity vector makes with the horizontal?

b) What is the speed of the Vortex at point Q?

c) What is the acceleration of the Vortex at point Q?

18. Two identical tennis balls X and Y are hit horizontally from a point 2.0 m above the ground with different initial speeds: ball X has an initial speed of 5.0 m s\(^{-1}\) while ball Y has an initial speed of 7.5 m s\(^{-1}\).

A) Calculate the time it takes for each ball to strike the ground

B) Calculate the speed of ball X just before it strikes the ground

C) What is the speed of ball Y just before it strikes the ground

D) How much further than ball X does ball Y travel in the horizontal direction before bouncing?

19. During training, an aerial skier takes off from a ramp that is inclined at 40.0° to the horizontal and lands in a pool that is 10.0 m below the end of the ramp. If she takes 1.50 s to reach the highest point of her trajectory, calculate:

A) the speed at which she leaves the ramp

B) the maximum height above the end of the ramp that she reaches

C) the time for which she is in mid-air.
20. Are the following objects in stable or unstable equilibrium?

a)

b)

c)

d)

e)

21. A) will a car with wheelbase 2.5m tip over driving on a road angled at 60 degrees?
Assume its centre of mass is 0.6 m above the ground

b) If the car has a mattress on the roof, raising the centre of gravity by 0.3m, will it topple on the 60 degree road?

22. A shelf (W = 320N) on the bottom of a bookcase is loaded such that the centre of mass of the bookcase is 0.3m from the right hand side of the bookcase and 1m above the floor. The bookcase is 12m high and 2 m at the base. What force would be necessary to topple the bookcase if the force was applied....

a) 10 m from the floor

b) 11m from the top of the bookcase
ANSWERS

1. A) 0.65 m/s² b) acceleration is decreasing, resultant force is less / resistive forces are increasing / driver eases off the accelerator / climbing a hill
2. C
3. A) 175m at 66 degrees east of north b) 1.75m/s
4. A
5. C
6. D
7. C
8. A
9. E
10. A) proof b) 5.4m/s c) 18.8m/s at 17 degrees
11. A) 6083N b) 9.46 degrees c) 9.2m/s² *this is chapter 8 will not be on chapter 6/7 test*
12. A)i) sum of forces in x and y = 0, sum of clockwise and anticlockwise moments = 0  
   ii) W = 1.176N  
   iii) Q = 2.94N P = 1.76N  
   b) above Q
13. A) i) Fx=632N  
   ii) Fy = 569N  
   iii) W = 1136N
14. T = 57N
15. T = 281N
16. A) i) proof  
   ii) 40.5m/s  
   iii) -36.3 m/s  
   iv) 54m/s at 42 degrees above horizontal
17. A) 62.3 degrees b) 4.6m/s c) -9.8m/s
18. A) 0.64s b) 8.0m/s c) 9.8ms d) 1.6m
19. A) 22.9m/s b) 11m c) 3.57s
20. A) Stable b) unstable c) stable d) unstable e)stable
21. A) no b) yes
22. A) F=54N b) not possible.