



St Norbert College

11 ATAR PHYSICS

Unit 2 – Linear Motion and Force

Task 9: Topic Test

Assessment type: Tests and Examinations

Year weighting: 6%

Student name:	
TOTAL	/ 50

Time allowed for this paper

Working time for paper: fifty (50) minutes

Materials required/recommended for this paper

To be provided by the supervisor

This Question/Answer Booklet

Formulae and Data Booklet

To be provided by the candidate

Standard items: pens (blue/black preferred), pencils (including coloured), sharpener, correction tape/fluid, eraser, ruler, highlighters

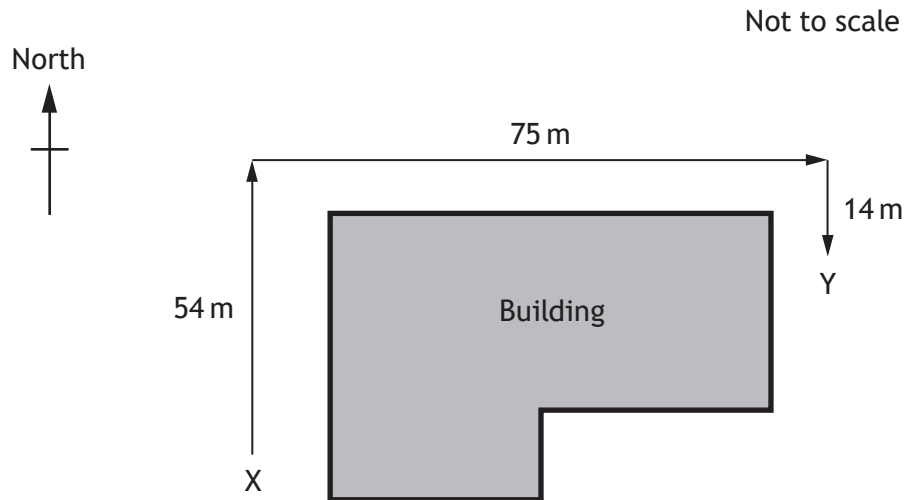
Special items non-programmable calculators approved for use in the WACE examinations, drawing templates, drawing compass and protractor

Important note to candidates

No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have any unauthorised notes or other items of a non-personal nature in the examination room. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

Question 1**(9 marks)**

A student walks around a building from point X to point Y.



(a) Determine:

(i) the magnitude of the displacement of the student from point X to point Y.

(2 marks)

(ii) the direction of displacement of the student from point X to point Y.

(2 marks)

(b) The student takes 68 s to travel from point X to point Y.

(i) Determine the average velocity of the student from point X to point Y.

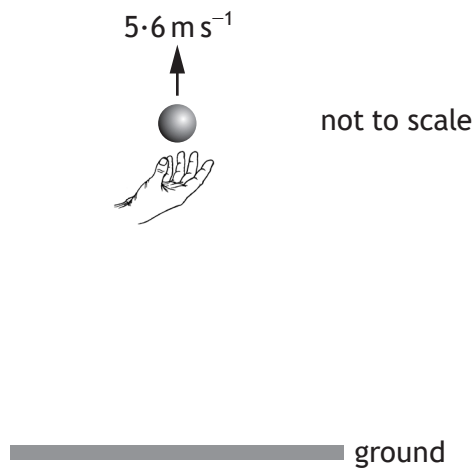
(3 marks)

(ii) The student states that their average speed between point X and point Y is greater than the magnitude of their average velocity between point X and point Y. Explain why the student is correct.

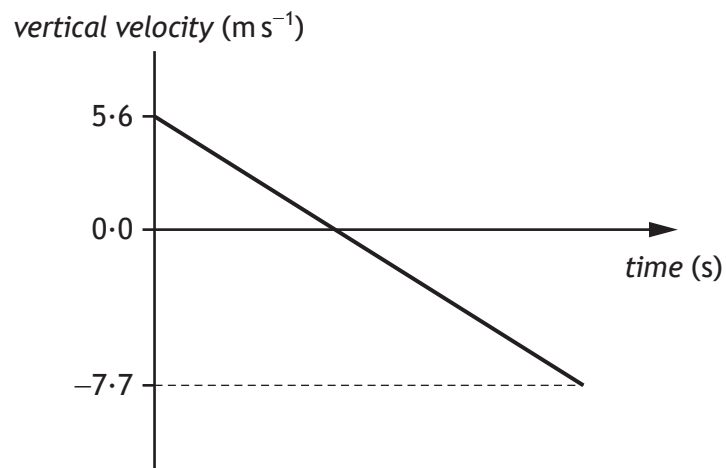
(2 marks)

Question 2**(9 marks)**

A ball is thrown vertically upwards. The ball is above the ground when released.



- (a) The graph shows how the vertical velocity of the ball varies with time from the instant it is released until just before it hits the ground. The effects of air resistance can be ignored.



- (i) Calculate the time taken for the ball to reach its maximum height. (3 marks)

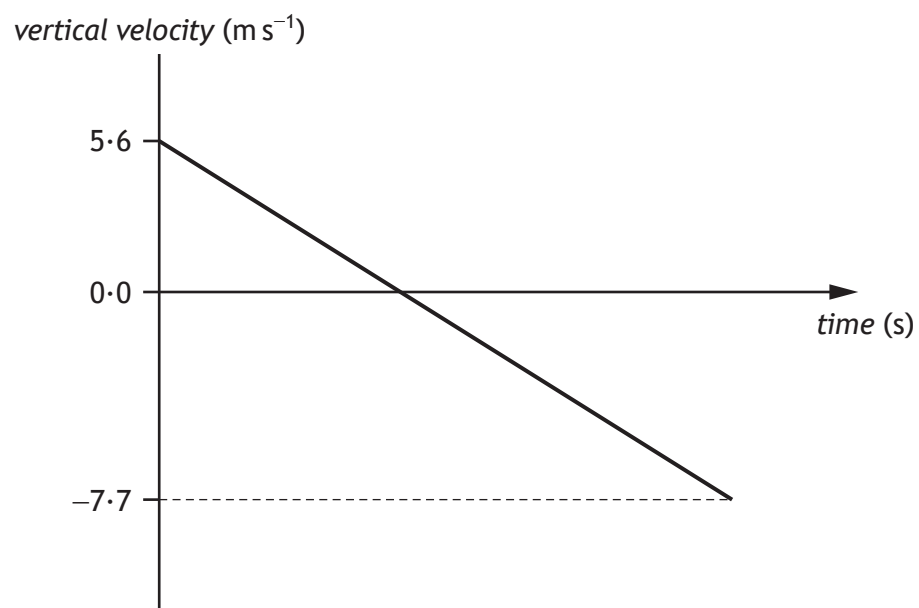
- (ii) Calculate the distance the ball falls from its maximum height to the ground. (3 marks)

- (b) The ball is now thrown vertically upwards from the same height with a greater initial vertical velocity.

Add a line to the graph below to show how the vertical velocity of the ball varies with time from the instant it is released until just before it hits the ground.

The effects of air resistance can be ignored.

Additional numerical values on the axes are not required. (3 marks)



Question 3**(6 marks)**

A weightlifter applies an upwards force of 1176 N to a barbell to hold it in a stationary position as shown.



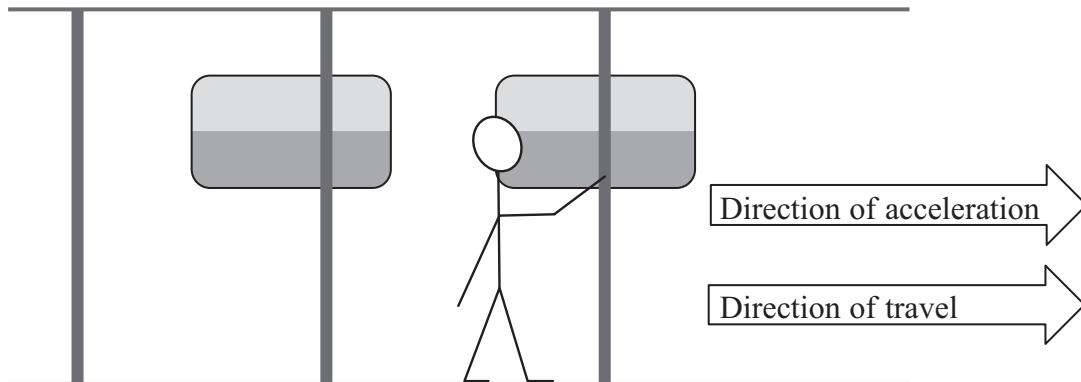
- (a) Describe how the upward force exerted by the weightlifter on the barbell compares to the weight of the barbell. (1 mark)
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- (b) Show that the mass of the barbell is 120 kg. (1 mark)

- (c) The weightlifter increases the upward force on the barbell to 1344 N in order to lift the barbell above their head. Calculate the initial acceleration of the barbell. (4 marks)

Question 4**(5 marks)**

A passenger is standing in a stationary train. As the train leaves the station, the passenger holds on to a vertical support as the train accelerates. This prevents the passenger falling backwards.



With reference to Newton's laws of motion, explain why holding on to a vertical support prevents the passenger falling backwards.

Question 5

(11 marks)

A boy on a board B slides down a slope, as shown in Fig. 5.1.

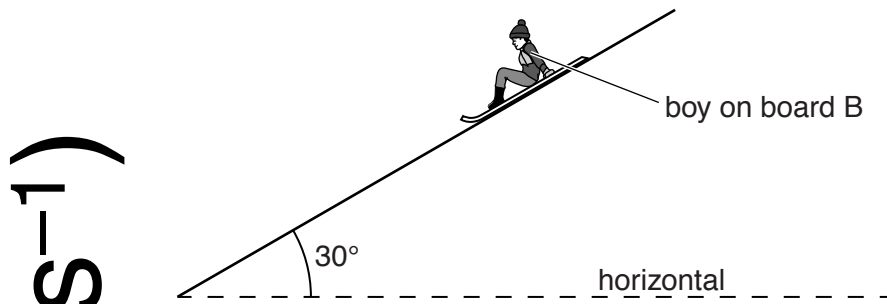


Fig. 5.1.

The angle of the slope to the horizontal is 30° . The total resistive force F acting on B is constant.

The boy and the board B has a total mass of 75 kg and moves with velocity v down the slope. The variation with time t of v is shown in Fig. 5.2.

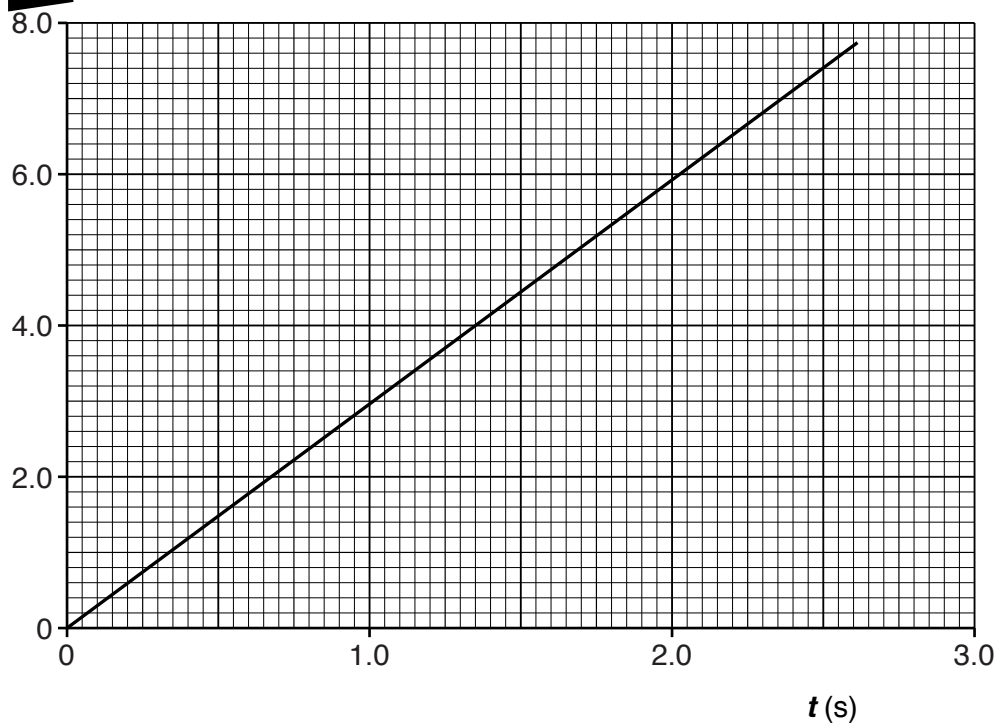


Fig. 5.2.

- (a) For the boy and the board, from $t = 0$ to $t = 2.5\text{s}$, show that the distance moved down the slope is 9.3 m . (2 marks)

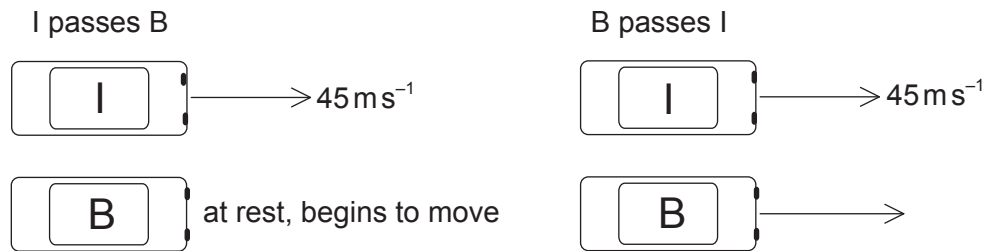
- (b) Calculate the gain in kinetic energy of the boy and board. (3 marks)

- (c) calculate the loss in potential energy of the boy and board. (3 marks)

- (d) calculate the resistive force F . (3 marks)

Question 6**(10 marks)**

Cars I and B are on a straight race track. I is moving at a constant speed of 45 m s^{-1} and B is initially at rest. As I passes B, B starts to move with an acceleration of 3.2 m s^{-2} .



At a later time, B passes I. You may assume that both cars are point particles.

- (a) Show that the time taken for B to pass I is approximately 28 s. (4 marks)

- (b) Calculate the distance travelled by B in this time. (2 marks)

- (c) A third car O with mass 930 kg joins the race. O collides with I from behind, moving along the same straight line as I. Before the collision the speed of I is 45 m s^{-1} and its mass is 850 kg. After the collision, I and O stick together and move in a straight line with an initial combined speed of 52 m s^{-1} .

Calculate the speed of O immediately before the collision.

(2 marks)

- (d) The duration of the collision is 0.45 s. Determine the average force acting on O.

(2 marks)