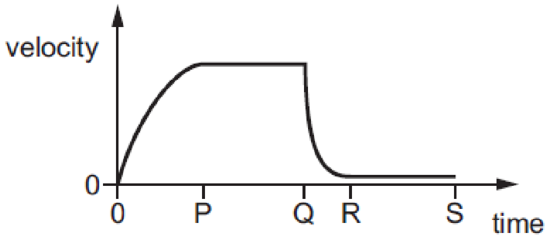
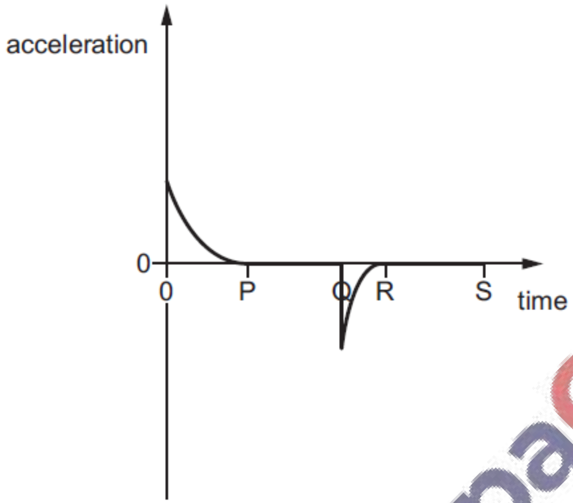
1. Nov/2023/Paper_ 9702/11/No.5

A parachutist falls from a stationary balloon at time $t = 0$. The velocity–time graph for the parachutist from time $t = 0$ until the time when he is just above the ground is shown.

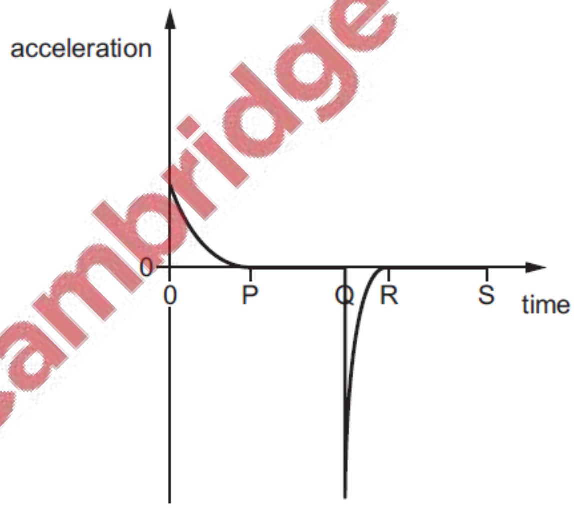


Which graph best shows the variation with time of the acceleration of the parachutist?

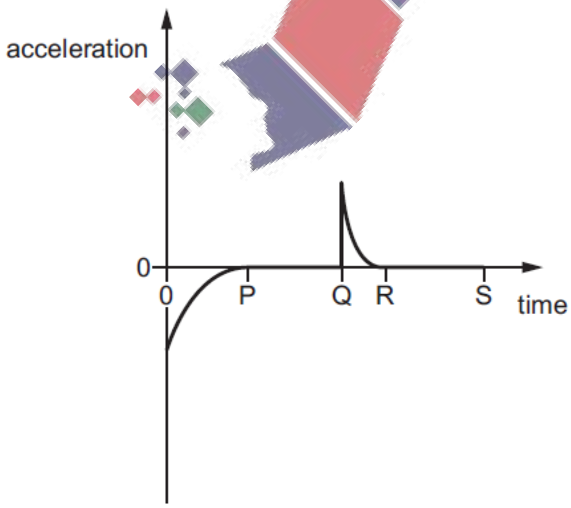
A



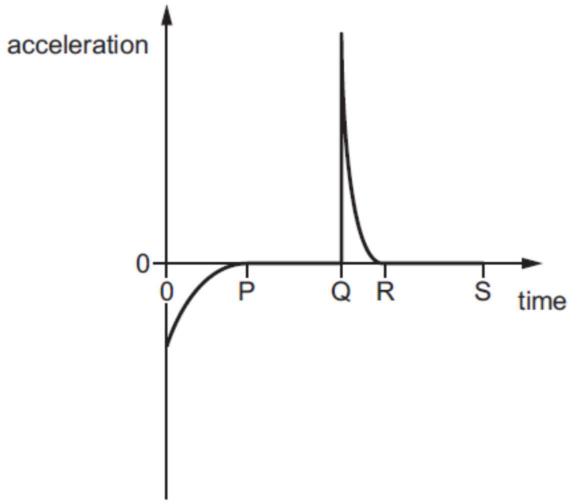
B



C

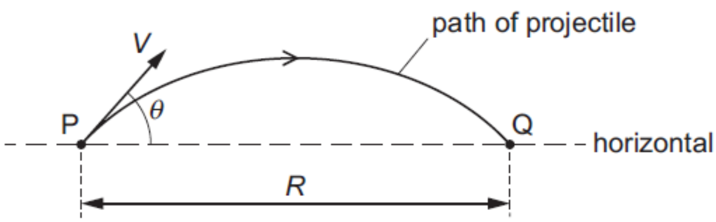


D



2. Nov/2023/Paper_ 9702/11/No.6

A projectile is fired from point P with velocity V at an angle θ to the horizontal. It lands at point Q, a horizontal distance R from P, after time T.



The acceleration of free fall is g. Air resistance is negligible.

Which equation is correct?

A $R = VT\cos\theta$

B $R = VT\sin\theta$

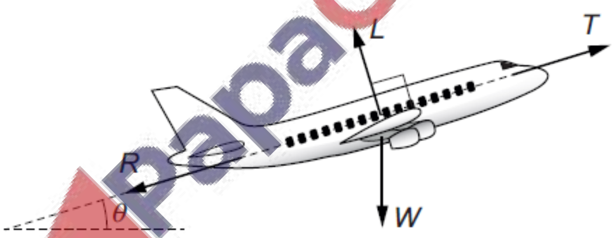
C $R = VT\cos\theta - \frac{1}{2}gT^2$

D $R = VT\sin\theta - \frac{1}{2}gT^2$

3. Nov/2023/Paper_ 9702/12/No.4

An aeroplane is moving at a constant speed in a straight line at an angle θ to the horizontal.

Four forces act on the aeroplane: thrust force T, weight W, lift force L and resistive force R.



Which two equations must be correct?

A $L = W\cos\theta$ and $T = R + W\sin\theta$

B $L = W\sin\theta$ and $T = R + W\cos\theta$

C $L = W\cos\theta$ and $T = R - W\sin\theta$

D $L = W\sin\theta$ and $T = R - W\cos\theta$

4. Nov/2023/Paper_ 9702/12/No.5

What is the definition of acceleration?

A the rate of change of displacement

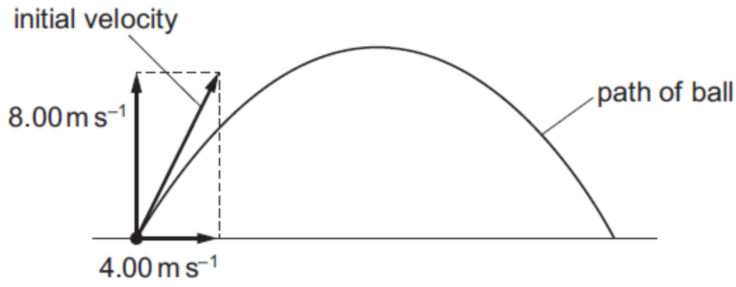
B the rate of change of kinetic energy

C the rate of change of momentum

D the rate of change of velocity

5. Nov/2023/Paper_ 9702/12/No.6

An astronaut on the Moon, where there is no air resistance, throws a ball. The ball's initial velocity has a vertical component of $8.00\,m\,s^{-1}$ and a horizontal component of $4.00\,m\,s^{-1}$, as shown.



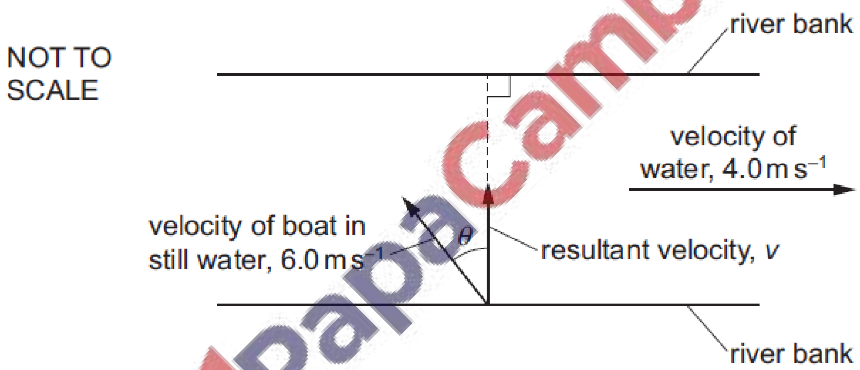
The acceleration of free fall on the Moon is $1.62\,m\,s^{-2}$.

What is the speed of the ball 9.00 s after being thrown?

A $6.58\,m\,s^{-1}$ **B** $7.70\,m\,s^{-1}$ **C** $10.6\,m\,s^{-1}$ **D** $14.6\,m\,s^{-1}$

6. Nov/2023/Paper_ 9702/13/No.4

A boat is crossing a river in which the water is moving at a speed of $4.0\,m\,s^{-1}$ from left to right.



In still water, the speed of the boat is $6.0\,m\,s^{-1}$. The boat is directed at an angle θ to a line perpendicular to the river banks. The resultant velocity v of the boat is in a direction perpendicular to the river banks.

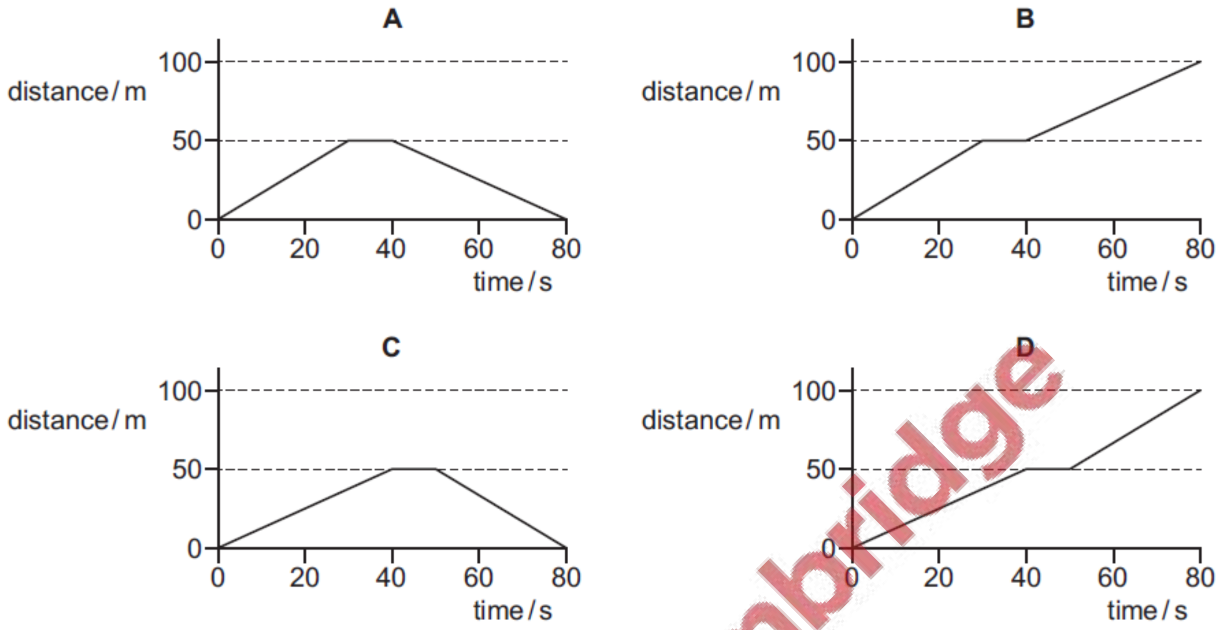
What are the values of θ and v?

	θ / °	v / $m\,s^{-1}$
A	42	4.5
B	42	7.2
C	48	4.5
D	48	7.2

7. Nov/2023/Paper_ 9702/13/No.5

A student walks at a constant speed for a distance of 50 m in a time of 40 s. The student rests for a time of 10 s and then walks back to the starting point at a constant speed in a time of 30 s.

What is the distance–time graph for the motion of the student?



8. Nov/2023/Paper_ 9702/21/No.2(b)

A hot-air balloon floats just above the ground. The balloon is stationary and is held in place by a vertical rope, as shown in Fig. 2.1.

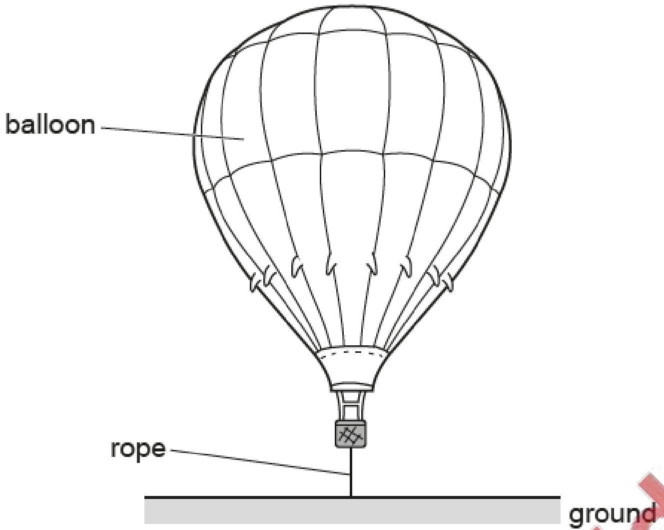


Fig. 2.1

The balloon has a weight W of 3.39×10^4 N. The tension T in the rope is 4.00×10^2 N.
Upthrust U acts on the balloon.
The density of the surrounding air is $1.23\,kg\,m^{-3}$.

(b) The balloon is stationary at a height of 500 m above the ground. A tennis ball is released from rest and falls vertically from the balloon.

A passenger in the balloon uses the equation $v^2 = u^2 + 2as$ to calculate that the ball will be travelling at a speed of approximately $100\,m\,s^{-1}$ when it hits the ground.

Explain why the actual speed of the ball will be much lower than $100\,m\,s^{-1}$ when it hits the ground.

....

....

....

.... [3]

9. Nov/2023/Paper_ 9702/22/No.1(b, c)

(b) Under certain conditions, the distance s moved in a straight line by an object in time t is given by

$$s = \frac{1}{2}at^2$$

where a is the acceleration of the object.

State **two** conditions under which the above expression applies to the motion of the object.

1 ....

2 ....

[2]

(c) The variation with time t of the velocity v of a car that is moving in a straight line is shown in Fig. 1.1.

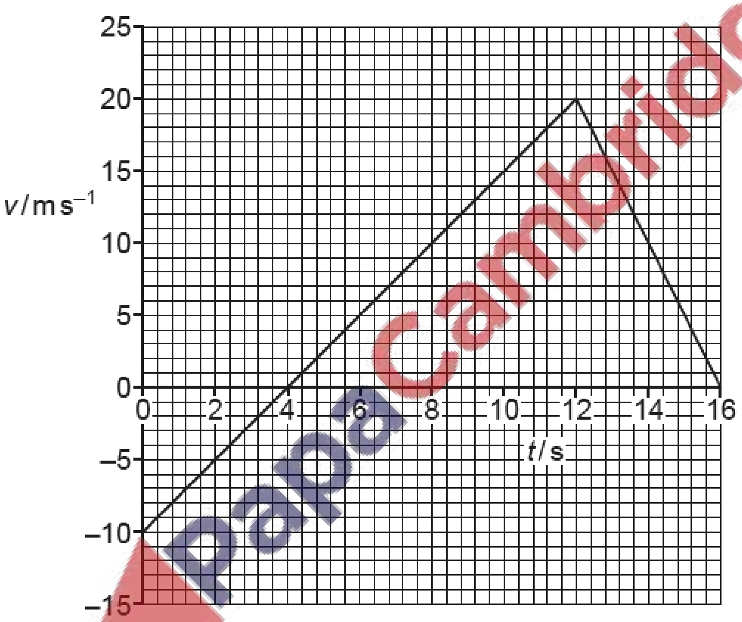


Fig. 1.1

(i) Compare, qualitatively, the acceleration of the car at time $t = 8.0\,s$ and at time $t = 14.0\,s$ in terms of:

- magnitude

....

....

- direction.

....

....
[2]

(ii) Determine the magnitude of the acceleration of the car at time $t = 4.0\,s$.

acceleration = ... $m\,s^{-2}$ [2]

(iii) The car is at point X at time $t = 0$.

Determine the magnitude of the displacement of the car from X at time $t = 12.0\,s$.

displacement = ...m [2]

10. Nov/2023/Paper_ 9702/23/No.2

A ball on horizontal ground is kicked towards a vertical wall. Fig. 2.1 shows the path of the ball.

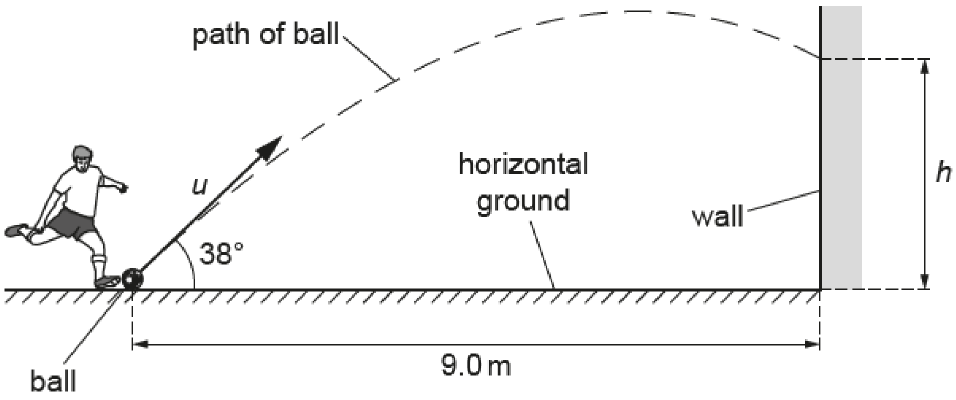


Fig. 2.1 (not to scale)

The ball has an initial velocity u at an angle of 38° to the ground. The ball travels a horizontal distance of 9.0 m before striking the wall at a height h above the ground. The horizontal component u_H of the initial velocity of the ball is 9.5 m s^{-1}.

Air resistance is negligible.

(a) **(i)** Show that the time t for the ball to reach the wall is 0.95 s.

[1]

(ii) Calculate the vertical component u_V of the initial velocity of the ball.

u_V = ... m s^{-1} [2]

(iii) Determine h.

h = ... m [2]

(b) The speed of the ball just after striking the wall is less than its speed just before striking the wall.

State what this indicates about the nature of the collision of the ball with the wall.

....

.... [1]

[Total: 6]