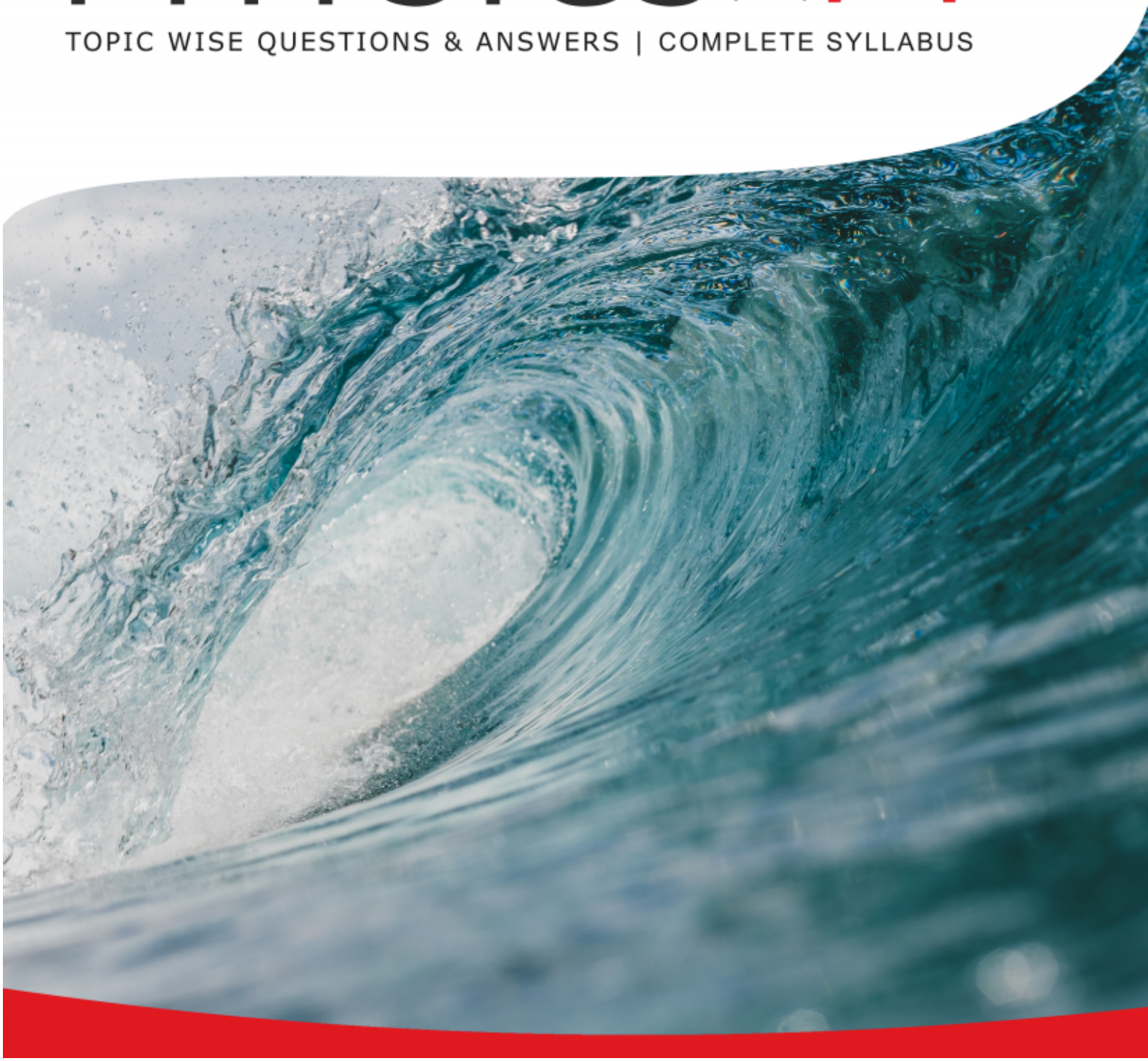
Cambridge International AS & A Level

PHYSICS (9702) P1

TOPIC WISE QUESTIONS & ANSWERS | COMPLETE SYLLABUS



PapaCambridge

Chapter 3

Kinematics

3.1 Equations of motion

173. 9702_m20_qp_12 Q: 7

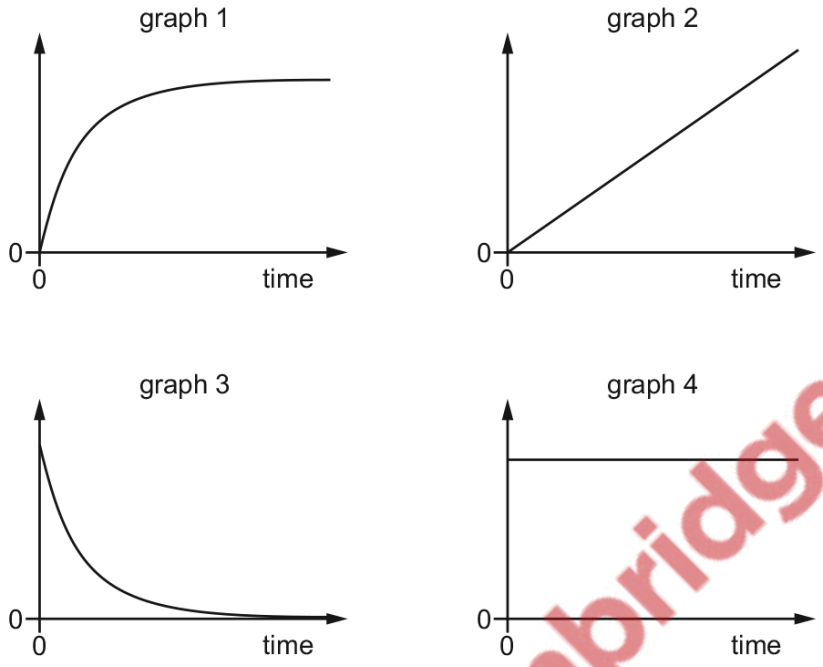
A car moves with uniform acceleration along a straight road. Oil leaks from the car at the rate of one drop every two seconds. The diagram shows the distances between three successive oil drops on the road.

What is the acceleration of the car?

A $0.75\,m\,s^{-2}$ **B** $1.5\,m\,s^{-2}$ **C** $3.0\,m\,s^{-2}$ **D** $6.0\,m\,s^{-2}$

174. 9702_m20_qp_12 Q: 9

The diagram shows graphs of various quantities plotted against time for an object dropped from a stationary balloon high in the atmosphere.



Which statement could be correct?

A Graph 1 is acceleration against time and graph 3 is resultant force against time.

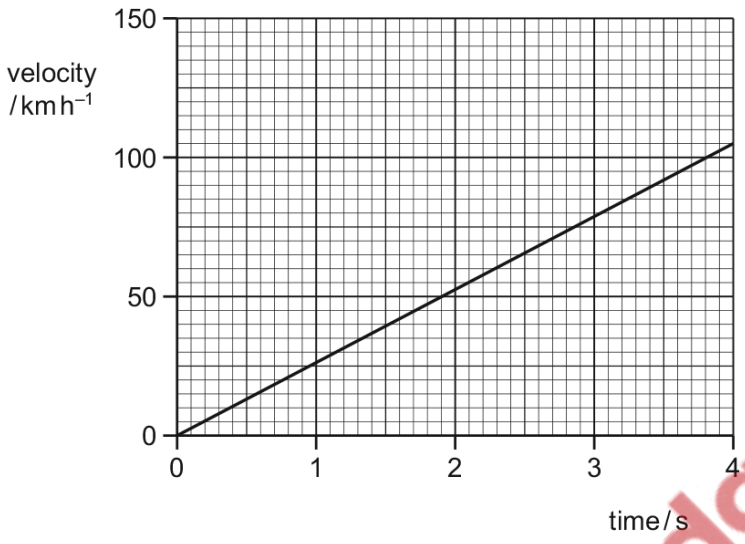
B Graph 1 is acceleration against time and graph 4 is resultant force against time.

C Graph 3 is acceleration against time and graph 1 is velocity against time.

D Graph 3 is acceleration against time and graph 2 is velocity against time.

175. 9702_s20_qp_11 Q: 6

The velocity of an electric car changes as shown.



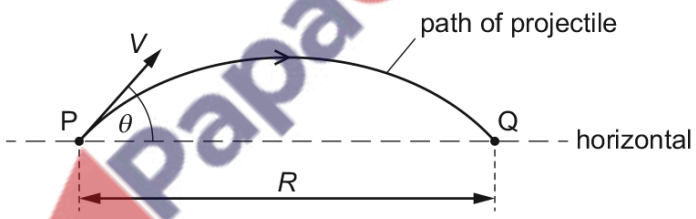
What is the acceleration of the car?

A 210 m s^{-2} **B** 58 m s^{-2} **C** 26 m s^{-2} **D** 7.3 m s^{-2}

---

176. 9702_s20_qp_11 Q: 7

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 $R = VT\sin\theta$

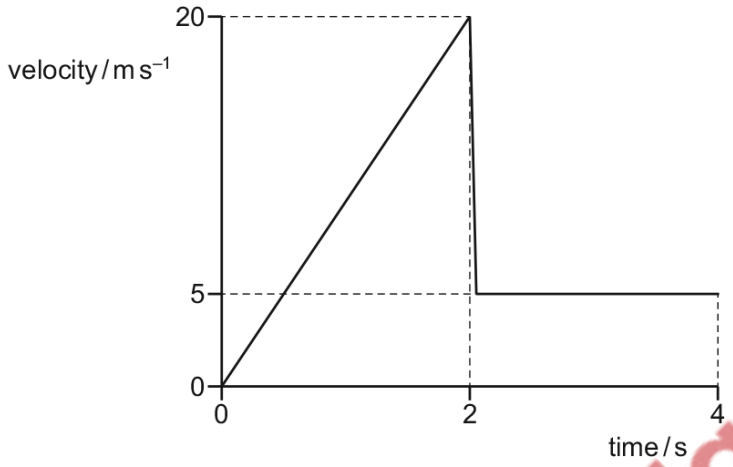
C $R = VT\cos\theta - \frac{1}{2}gT^2$

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

---

177. 9702_s20_qp_12 Q: 5

A stone is dropped from a height of 20 m above water. The graph shows the variation with time of the velocity of the stone.



Which statement describes the approximate position of the stone four seconds after it is dropped?

A It is at a distance of 10 m above the surface of the water.

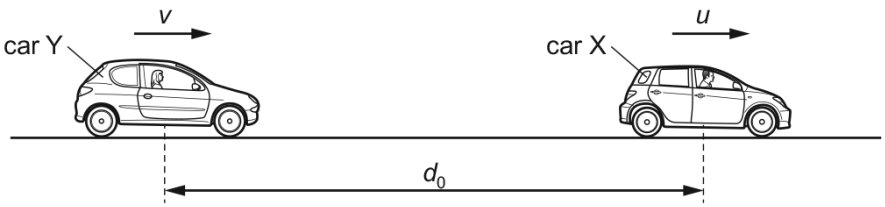
B It is at a distance of 10 m below the surface of the water.

C It is at a distance of 20 m below the surface of the water.

D It is at a distance of 30 m below the surface of the water.

178. 9702_s20_qp_12 Q: 6

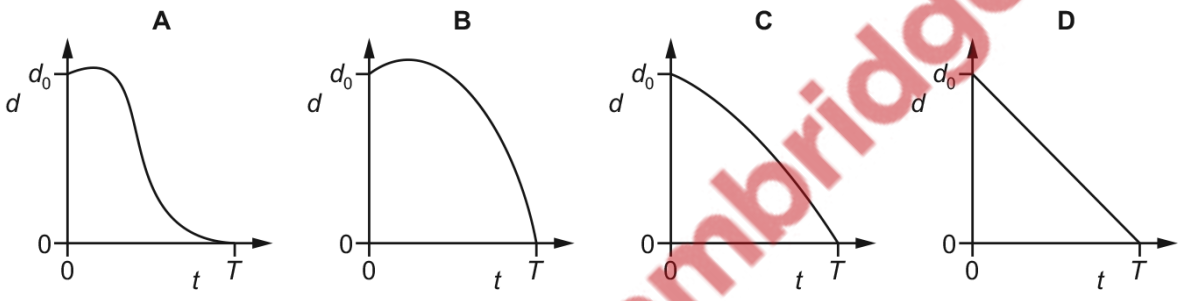
A car X is travelling at a constant speed u along a straight road. At time $t = 0$ a second car Y is a distance d_0 behind car X and travelling at a speed v in the same direction. Speed v is less than speed u.



At time $t = 0$ car Y begins to accelerate with a constant acceleration.

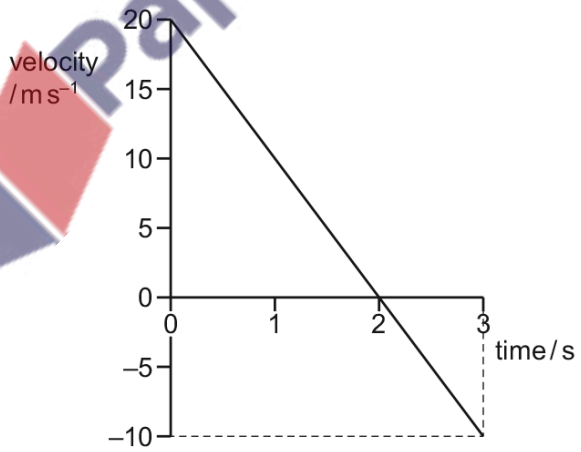
Car Y overtakes car X at time $t = T$.

Which graph could best show the variation with time t of the distance d between the cars?



179. 9702_s20_qp_13 Q: 6

The graph shows how the velocity of a ball varies with time from the moment it is hit vertically upwards from the ground.



What is the displacement of the ball from the ground after a time of 3.0 s?

A 15 m **B** 25 m **C** 30 m **D** 45 m

180. 9702_s20_qp_13 Q: 7

Two students each throw a ball horizontally from the top of a tower. The two balls are released at the same time.

The first student throws her ball with a speed of $20\,m\,s^{-1}$ and the second student throws his ball with a speed of $10\,m\,s^{-1}$.

Assume air resistance is negligible and that the balls land on horizontal ground.

Which row describes the horizontal distances travelled and the landing times of the two balls on the ground?

	horizontal distances	landing times
A	same	same
B	same	different
C	different	same
D	different	different

---

181. 9702_m19_qp_12 Q: 3

The speed of an aircraft in still air is $200\,km\,h^{-1}$. The wind blows from the west at a speed of $85.0\,km\,h^{-1}$.

In which direction must the pilot steer the aircraft in order to fly due north?

A 23.0° east of north

B 23.0° west of north

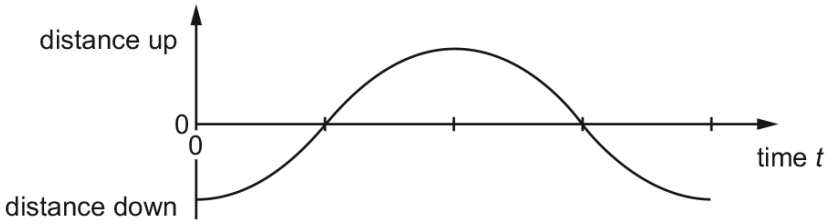
C 25.2° east of north

D 25.2° west of north

---

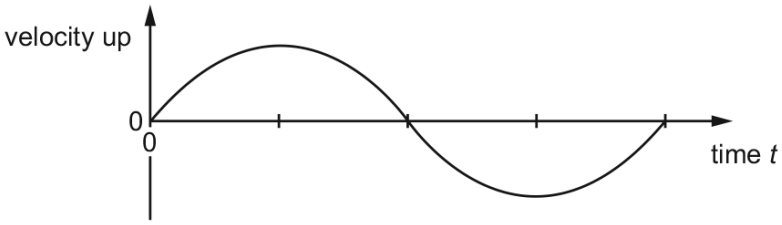
182. 9702_m19_qp_12 Q: 6

A mass on the end of a spring bounces up and down as shown, after being released at time $t = 0$.

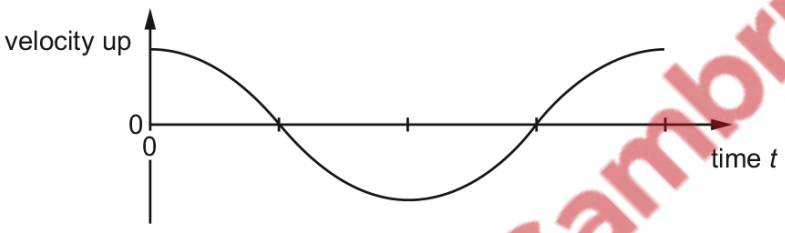


Which graph shows how the velocity varies with time?

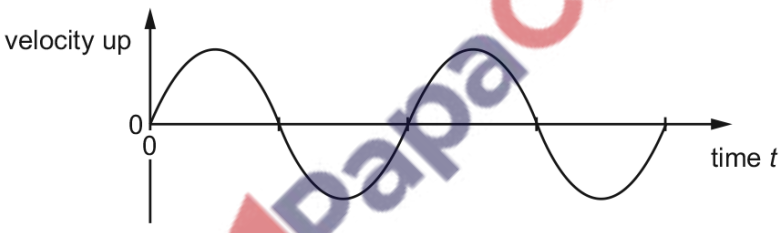
A



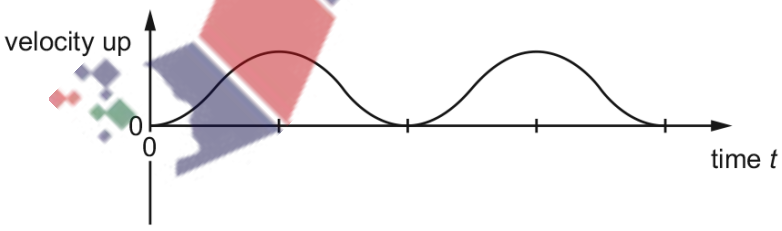
B



C



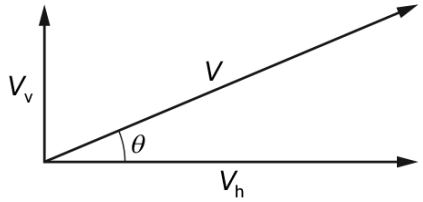
D



183. 9702_s19_qp_11 Q: 3

A particle has velocity V at an angle θ to the horizontal.

The components of the particle's velocity are V_v upwards in the vertical direction and V_h to the right in the horizontal direction, as shown.

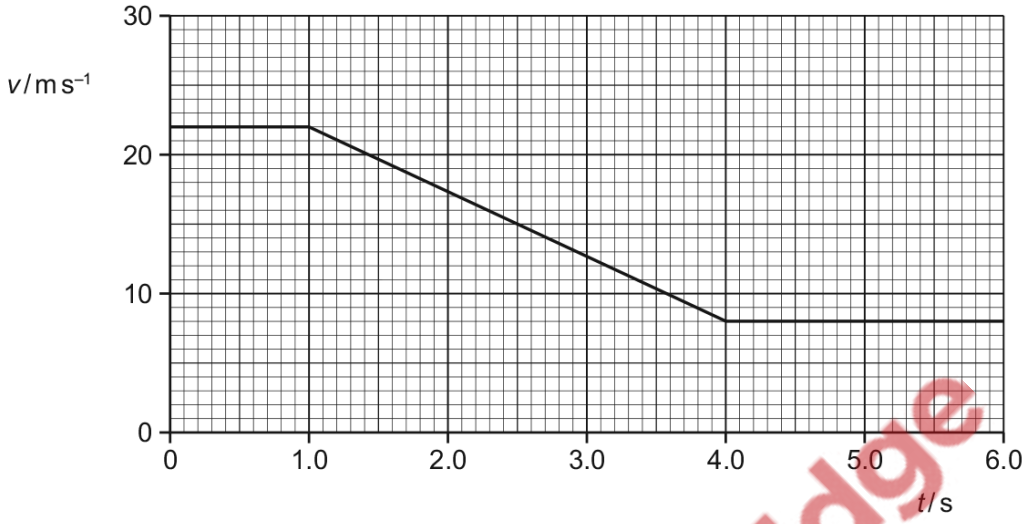


What are expressions for the magnitude of V and for the angle θ?

	magnitude of V	θ
A	$\sqrt{(V_v^2 + V_h^2)}$	$\tan^{-1}\left(\frac{V_h}{V_v}\right)$
B	$\sqrt{(V_v^2 + V_h^2)}$	$\tan^{-1}\left(\frac{V_v}{V_h}\right)$
C	$\sqrt{(V_v^2 - V_h^2)}$	$\tan^{-1}\left(\frac{V_h}{V_v}\right)$
D	$\sqrt{(V_v^2 - V_h^2)}$	$\tan^{-1}\left(\frac{V_v}{V_h}\right)$

184. 9702_s19_qp_11 Q: 6

A car travels along a straight horizontal road. The graph shows the variation of the velocity v of the car with time t for 6.0 s of its journey.



The brakes of the car are applied from t = 1.0 s to t = 4.0 s.

How far does the car travel while the brakes are applied?

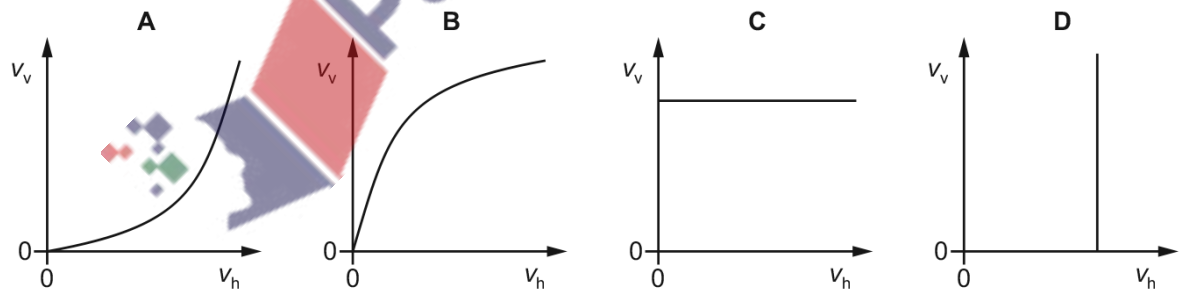
A 21 m **B** 45 m **C** 67 m **D** 83 m

---

185. 9702_s19_qp_11 Q: 7

A stone is thrown horizontally from the top of a cliff and falls into the sea some time later. Air resistance is negligible.

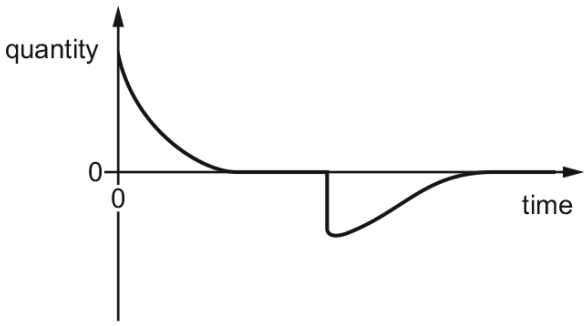
Which graph shows how the vertical component v_v of velocity of this stone varies with its horizontal component v_h of velocity as it moves through the air?



---

186. 9702_s19_qp_12 Q: 8

The graph shows how a physical quantity varies with time.



Which event could best be represented by the graph?

A the acceleration of a firework rising to a maximum height and falling to the ground

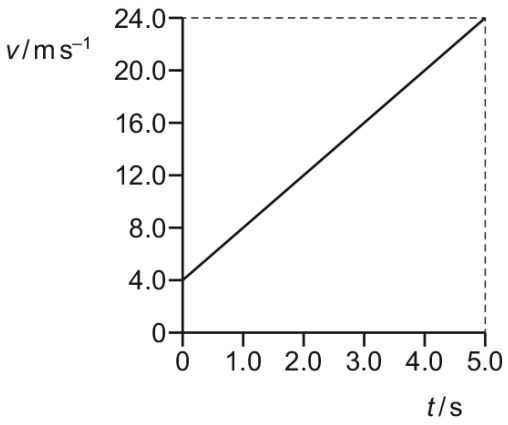
B the acceleration of a skydiver leaving an aircraft, falling, opening a parachute and falling to the ground

C the speed of a javelin as it leaves an athlete's hand, falls and sinks into the ground

D the speed of a high jump athlete leaving the ground, jumping over a bar and descending to the ground

187. 9702_s19_qp_13 Q: 7

The graph shows the variation of velocity v with time t for an object.



The object passes a fixed point at time $t = 0$.

What is the displacement of the object from the fixed point at time $t = 5.0\,s$ and what is the acceleration of the object?

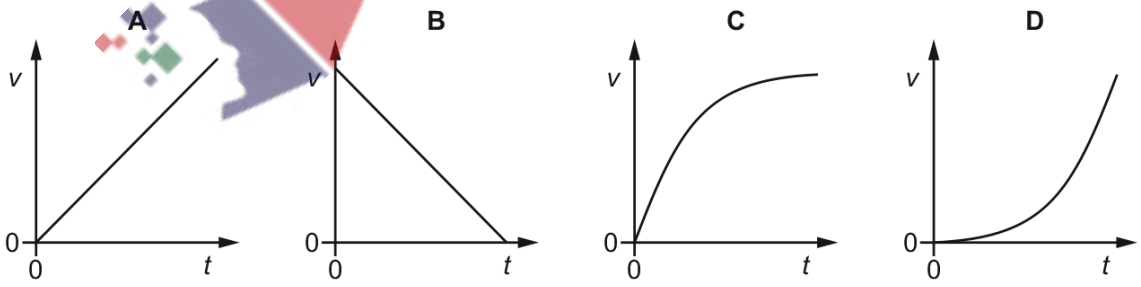
	displacement / m	acceleration / m s^{-2}
A	60	4.0
B	70	4.0
C	60	4.8
D	70	4.8

---

188. 9702_s19_qp_13 Q: 8

A skydiver jumps from an aeroplane and falls vertically through the air.

Which graph shows the variation with time t of the skydiver's vertical velocity v?



---

189. 9702_w19_qp_11 Q: 9

A skydiver falls from an aircraft that is moving horizontally.

The vertical component of the velocity of the skydiver is *v*.

The vertical component of the acceleration of the skydiver is *a*.

Which row describes *v* and *a* during the first few seconds after the skydiver leaves the aircraft?

	v	*a*
A	constant	constant
B	constant	decreasing
C	increasing	constant
D	increasing	decreasing

---

190. 9702_w19_qp_12 Q: 6

A ball is thrown vertically upwards from ground level and reaches a maximum height of 12.7 m before falling back to ground level.

Assume air resistance is negligible.

What is the total time for which the ball is in the air?

A 1.61 s **B** 3.22 s **C** 3.88 s **D** 5.18 s

---

191. 9702_w19_qp_13 Q: 6

A lead sphere is released from rest at point X, a long way above the surface of a planet. The sphere falls in a vacuum. After a time of 4.0 s, it has fallen through a vertical distance of 3.0 m. Assume the acceleration of free fall is constant.

How far will the sphere have fallen from point X at a time of 20 s after its release?

A 15 m **B** 75 m **C** 80 m **D** 2000 m

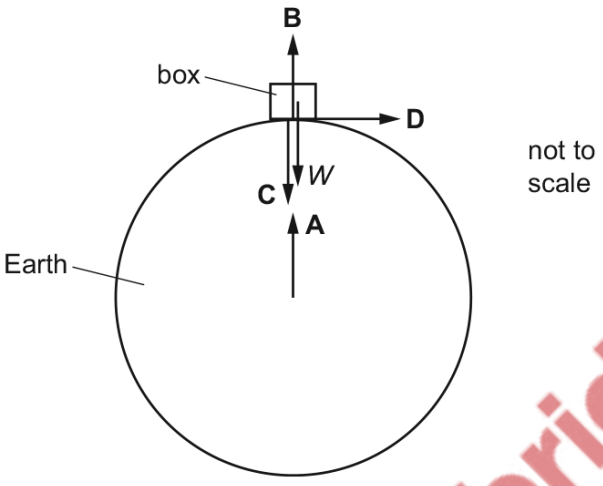
---

192. 9702_w19_qp_13 Q: 7

A box rests on the Earth, as shown.

Newton's third law describes how forces of the same type act in pairs. One of the forces of a pair is the weight *W* of the box.

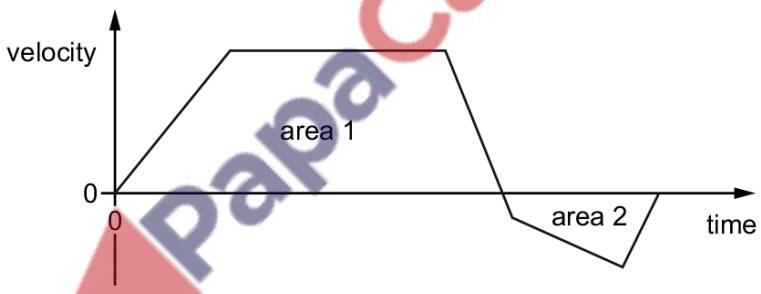
Which arrow represents the other force of this pair?



---

193. 9702_m18_qp_12 Q: 8

The velocity-time graph for an object is shown.



How can the total displacement of the object be determined?

A area 1 – area 2

B $\frac{(\text{area 1} + \text{area 2})}{2}$

C area 1 + area 2

D area 2 – area 1

---

194. 9702_m18_qp_12 Q: 9

A girl throws a ball vertically upwards. It takes a time of 3.20 s to return to her hand.

Assume air resistance is negligible.

What is the initial speed with which the ball is thrown?

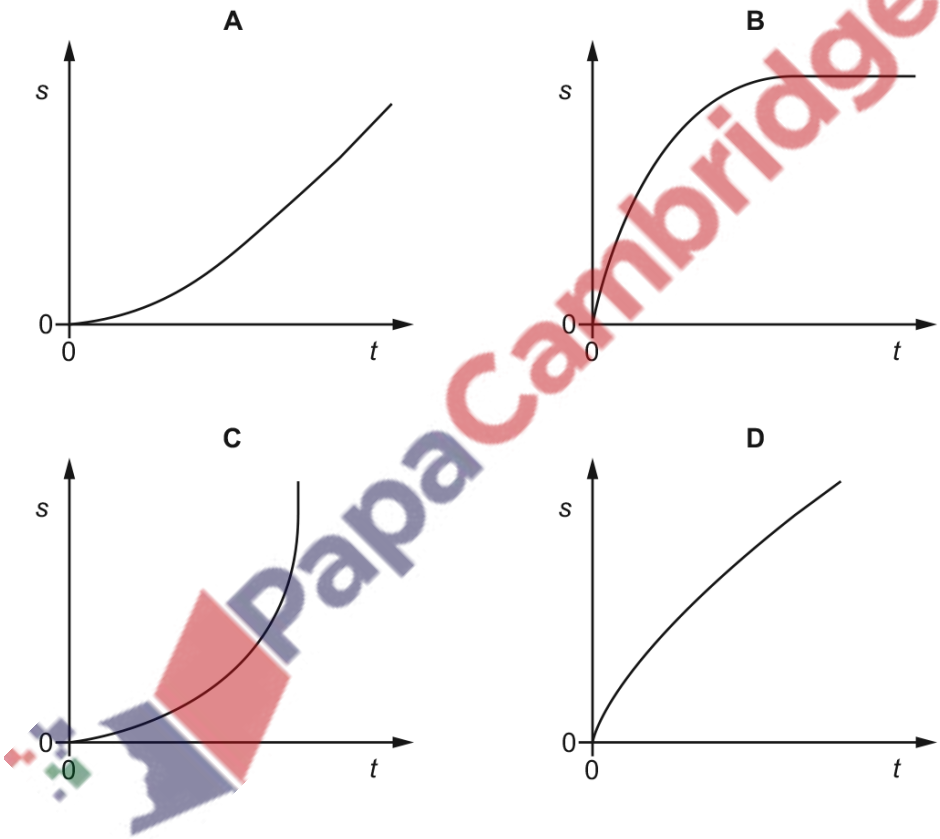
A $3.07\,m\,s^{-1}$ **B** $7.85\,m\,s^{-1}$ **C** $15.7\,m\,s^{-1}$ **D** $31.4\,m\,s^{-1}$

---

195. 9702_s18_qp_11 Q: 6

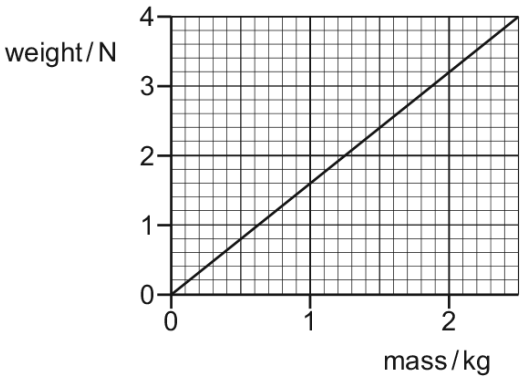
A tennis ball falls freely, in air, from the top of a tall building.

Which graph best represents the variation with time *t* of the distance *s* fallen?



196. 9702_s18_qp_11 Q: 7

The graph shows the variation with mass of the weight of objects on a particular planet.

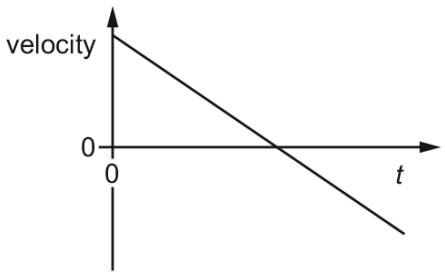


What is the value of the acceleration of free fall on the planet?

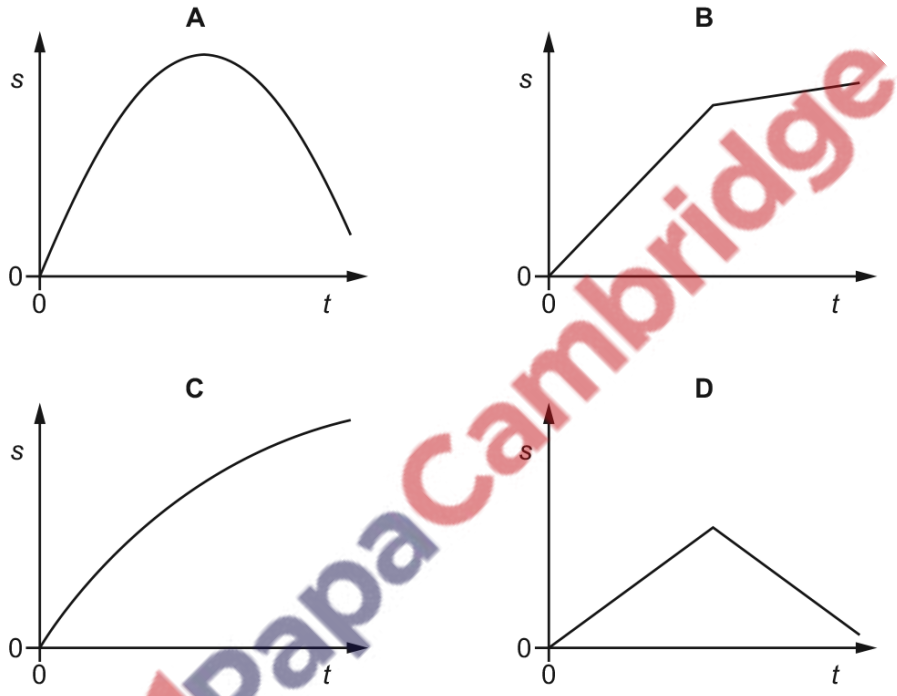
A $0.63\,ms^{-2}$ **B** $1.6\,ms^{-2}$ **C** $3.2\,ms^{-2}$ **D** $9.8\,ms^{-2}$

197. 9702_s18_qp_12 Q: 5

The velocity of an object changes with time *t* as shown.

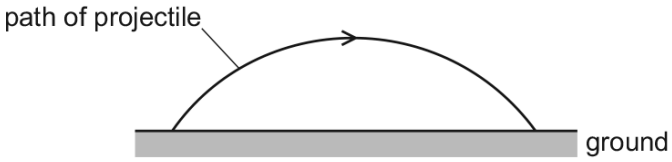


Which graph best shows the variation with time *t* of the displacement *s* of the object?



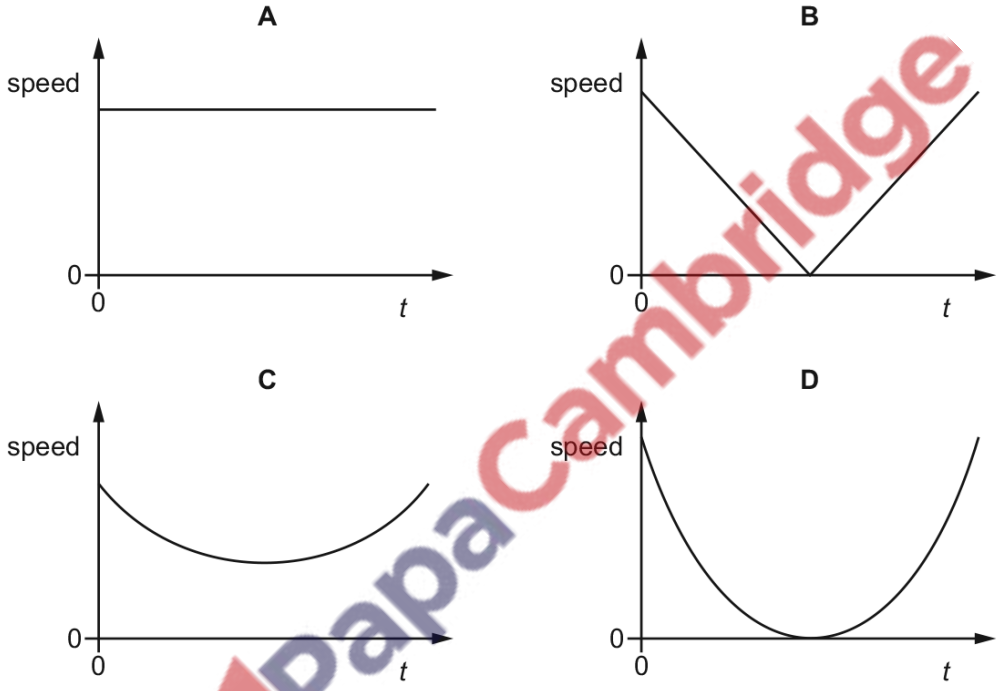
198. 9702_s18_qp_12 Q: 6

A projectile is launched at an angle to the horizontal at time $t = 0$. It travels over horizontal ground, as shown.



Assume that air resistance is negligible.

Which graph best shows the variation with t of the speed of the projectile from when it is launched to when it lands on the ground?



199. 9702_s18_qp_13 Q: 6

A rock on the surface of Mars is projected vertically upwards with an initial speed of $9.4\,m\,s^{-1}$. The rock rises to a height of 12 m above the surface.

Assume there is no atmosphere on Mars.

What is the acceleration of free fall near the surface of Mars?

A $0.39\,m\,s^{-2}$ **B** $3.7\,m\,s^{-2}$ **C** $7.4\,m\,s^{-2}$ **D** $9.8\,m\,s^{-2}$

200. 9702_w18_qp_11 Q: 6

A tennis ball is thrown horizontally in air from the top of a tall building.

The effect of air resistance is **not** negligible.

What happens to the horizontal and to the vertical components of the ball's velocity?

	horizontal component of velocity	vertical component of velocity
A	constant	constant
B	constant	increases at a constant rate
C	decreases to zero	increases at a constant rate
D	decreases to zero	increases to a maximum value

---

201. 9702_w18_qp_12 Q: 6

A sprinter runs a 100 m race. The sprinter has a constant acceleration from rest of $2.5\,m\,s^{-2}$ until reaching a speed of $10\,m\,s^{-1}$. The speed then remains constant until the end of the race.

Which time does it take the sprinter to run the race?

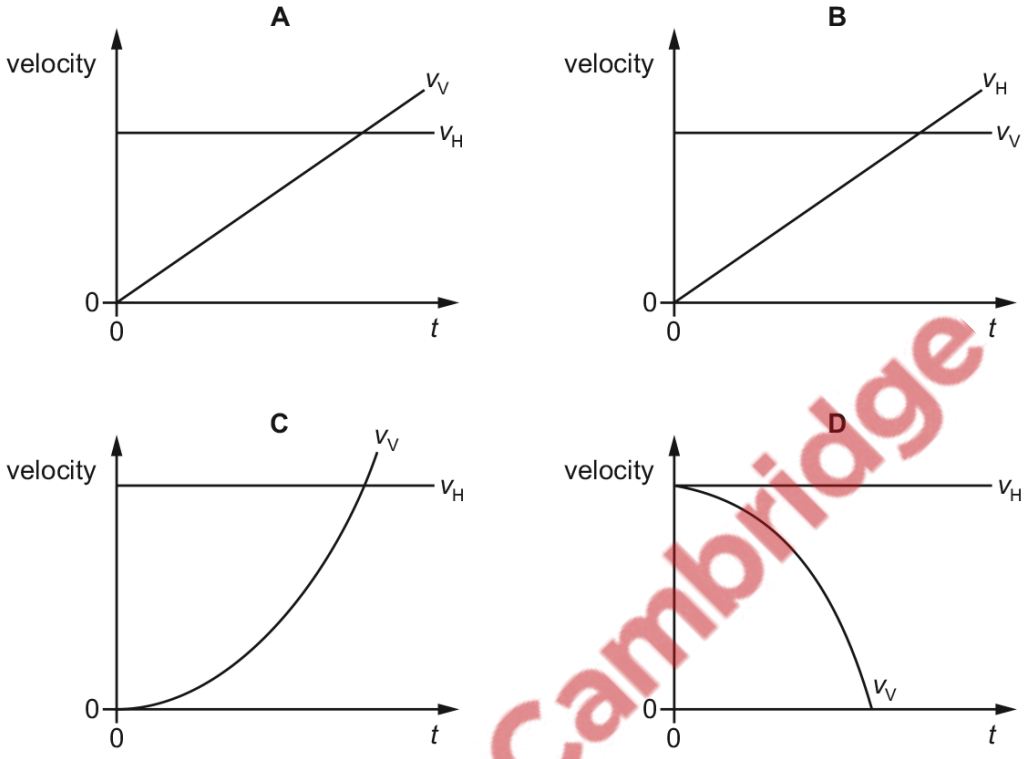
A 8.9 s **B** 10 s **C** 12 s **D** 14 s

---

202. 9702_w18_qp_13 Q: 6

A stone is projected horizontally at time $t = 0$ and falls. Air resistance is negligible. The stone has a horizontal component of velocity v_H and a vertical component of velocity v_V.

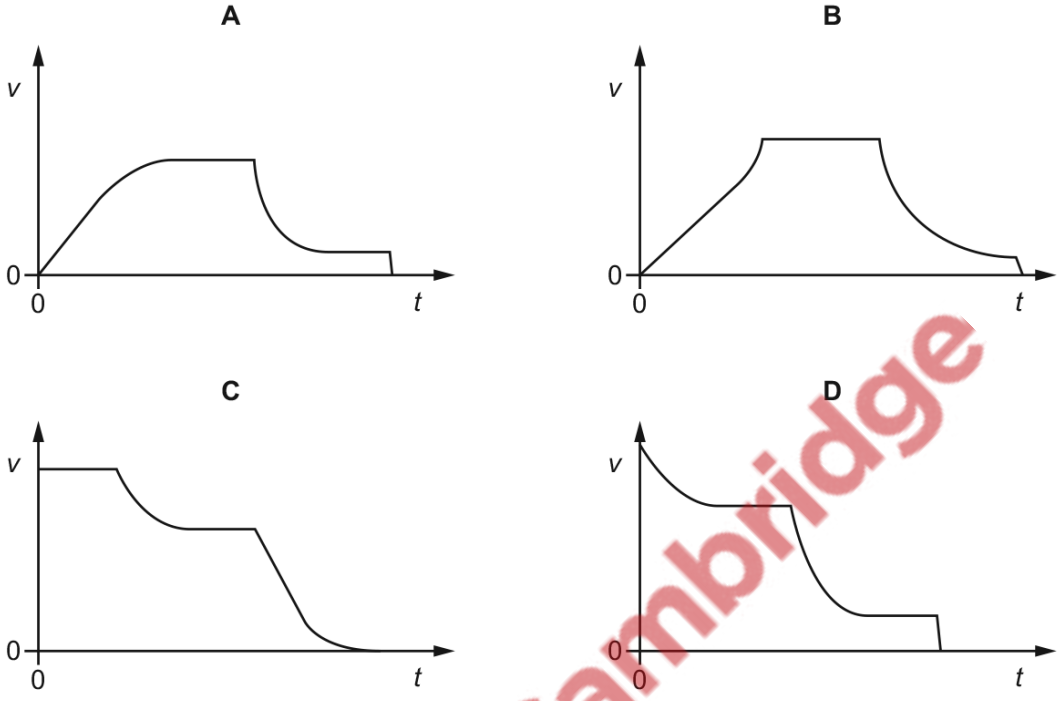
Which graph shows how v_H and v_V vary with time t?



203. 9702_w18_qp_13 Q: 9

A parachutist falls vertically from rest at time $t = 0$ from a hot-air balloon. She falls for some distance before opening her parachute.

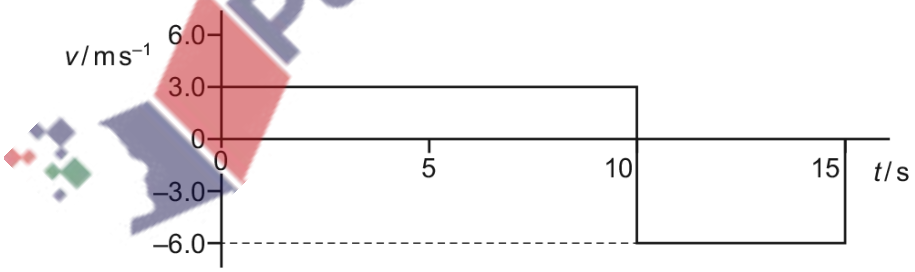
Which graph best shows the variation with time t of the speed v of the parachutist?



204. 9702_m17_qp_12 Q: 6

A radio-controlled toy car travels along a straight line for a time of 15 s.

The variation with time t of the velocity v of the car is shown.



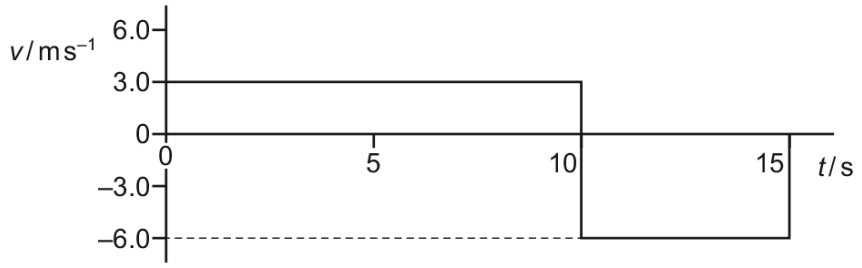
What is the average velocity of the toy car for the journey shown by the graph?

A $-1.5\,m\,s^{-1}$ **B** $0.0\,m\,s^{-1}$ **C** $4.0\,m\,s^{-1}$ **D** $4.5\,m\,s^{-1}$

205. 9702_m17_qp_12 Q: 7

A radio-controlled toy car travels along a straight line for a time of 15 s.

The variation with time t of the velocity v of the car is shown.



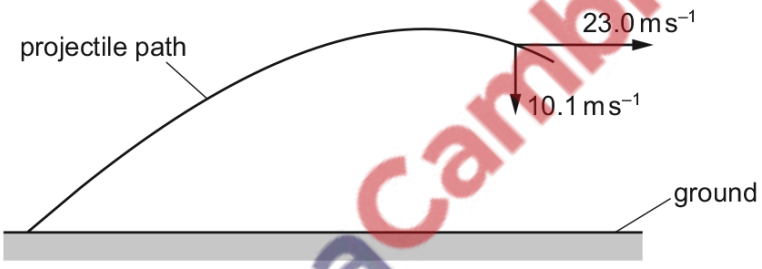
What is the average velocity of the toy car for the journey shown by the graph?

A $-1.5\,m\,s^{-1}$ **B** $0.0\,m\,s^{-1}$ **C** $4.0\,m\,s^{-1}$ **D** $4.5\,m\,s^{-1}$

---

206. 9702_m17_qp_12 Q: 18

A projectile is thrown at an angle to the ground.



At a certain time, the projectile has a horizontal velocity of $23.0\,m\,s^{-1}$ and a vertical velocity of $-10.1\,m\,s^{-1}$.

What is the speed of the projectile at this time?

A $12.9\,m\,s^{-1}$ **B** $20.7\,m\,s^{-1}$ **C** $25.1\,m\,s^{-1}$ **D** $33.1\,m\,s^{-1}$

---

207. 9702_s17_qp_11 Q: 4

The values of displacement, velocity and acceleration of a vehicle can be deduced from graphs representing its motion. Often the areas under these graphs, or the gradients of the graphs, are used.

What would **not** give a value for a displacement, a velocity or an acceleration?

A area under a velocity-time graph

B gradient of a displacement-time graph

C gradient of a velocity-time graph

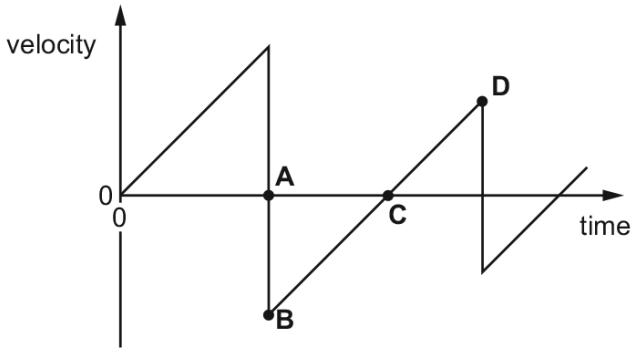
D gradient of an acceleration-time graph

---

208. 9702_s17_qp_11 Q: 5

A ball is released from rest above a hard, horizontal surface. The graph shows how the velocity of the bouncing ball varies with time.

At which point on the graph does the ball reach its maximum height after the first bounce?



---

209. 9702_s17_qp_11 Q: 6

A ball is kicked upwards at an angle of 45° to horizontal ground. After a short flight, the ball returns to the ground.

It may be assumed that air resistance is negligible.

What is **never** zero during the flight of the ball?

A the horizontal component of the ball's acceleration

B the horizontal component of the ball's velocity

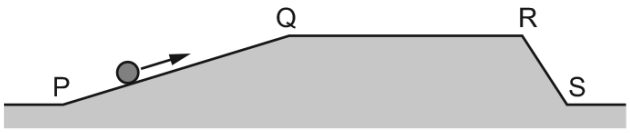
C the vertical component of the ball's momentum

D the vertical component of the ball's velocity

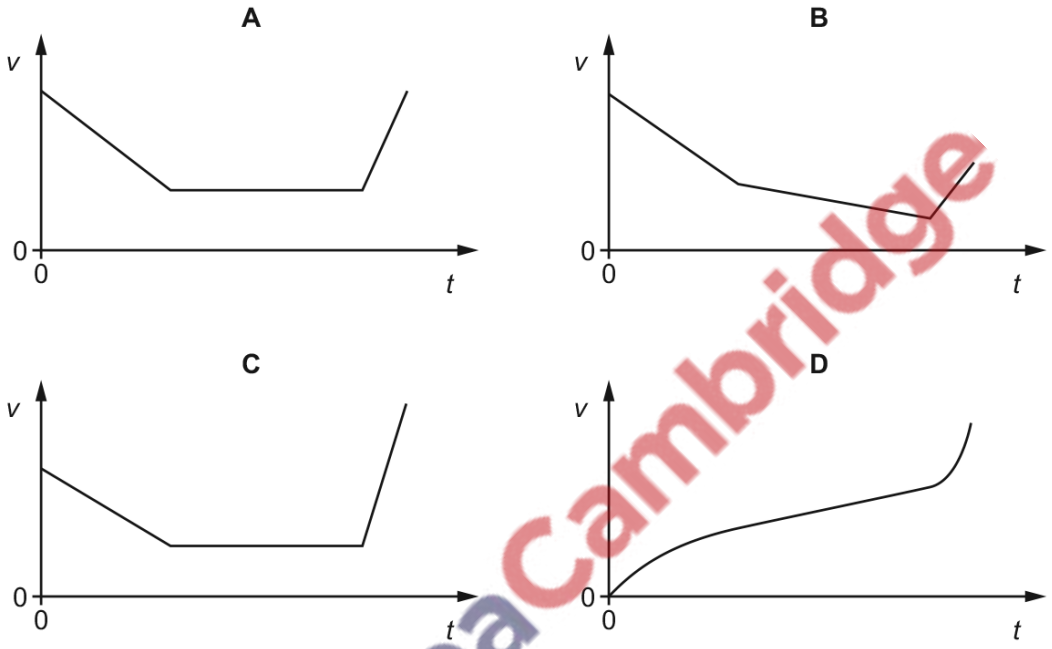
---

210. 9702_s17_qp_12 Q: 6

A ball is set in motion at P on a frictionless surface. It moves up slope PQ, along the horizontal surface QR and finally descends slope RS.



Which graph could represent the variation with time t of the ball's speed v as the ball moves from P to S?



---

211. 9702_s17_qp_13 Q: 5

On a planet, a vertically-launched projectile takes 12.5 s to return to its starting position. The projectile gains a maximum height of 170 m. The planet does not have an atmosphere.

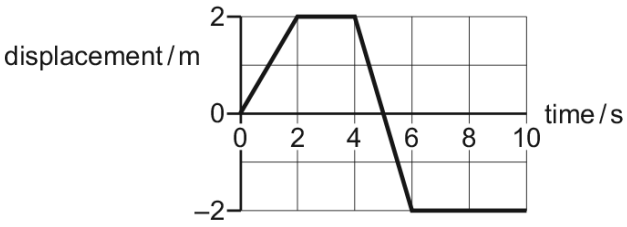
What is the acceleration of free fall on this planet?

A $2.2\,m\,s^{-2}$ **B** $8.7\,m\,s^{-2}$ **C** $27\,m\,s^{-2}$ **D** $54\,m\,s^{-2}$

---

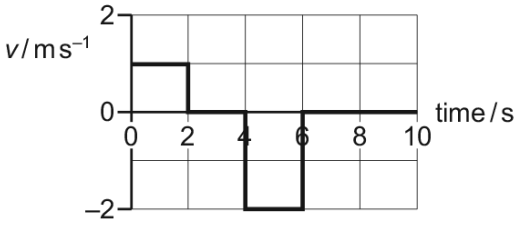
212. 9702_s17_qp_13 Q: 6

A displacement-time graph for a toy car is shown.

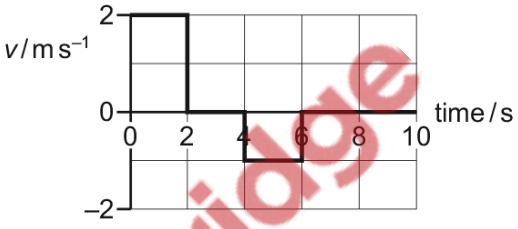


Which graph shows the variation with time of the velocity v of the car?

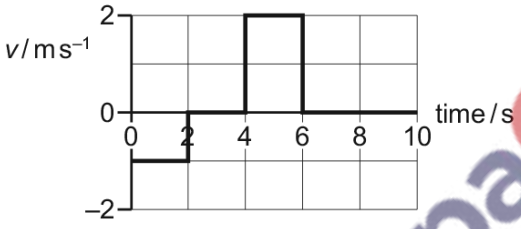
A



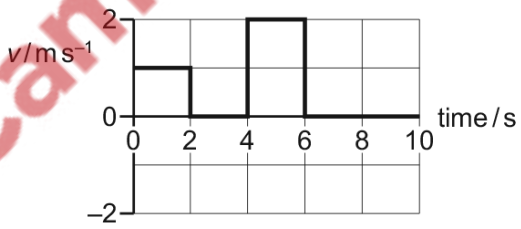
B



C

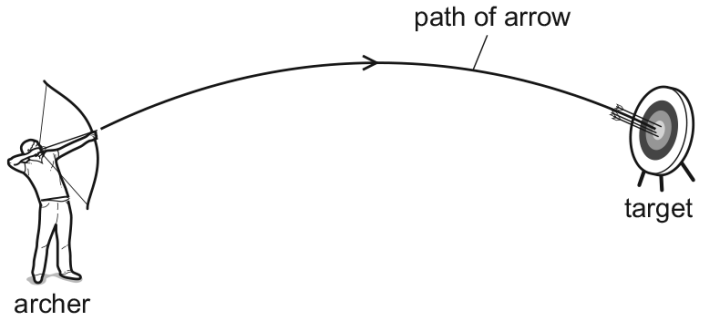


D



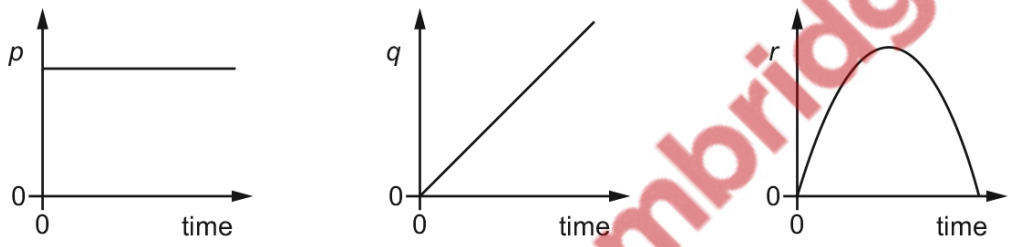
213. 9702_w17_qp_11 Q: 7

An archer shoots an arrow at a target. The diagram shows the path of the arrow.



Air resistance is assumed to be negligible.

The graphs show how three different quantities p, q and r, relating to the motion of the arrow, vary with time.



Which quantity is the horizontal component of displacement and which quantity is the vertical component of displacement of the arrow?

	horizontal component of displacement	vertical component of displacement
A	p	q
B	q	r
C	r	p
D	r	q

---

214. 9702_w17_qp_12 Q: 6

A hot-air balloon is moving vertically upwards with a constant speed of $3.00\,\text{m}\,\text{s}^{-1}$. A sandbag is dropped from the balloon. It takes 5.00 s for the sandbag to fall to the ground.

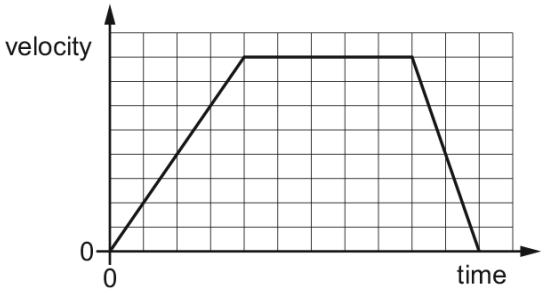
What was the height of the balloon when the sandbag was released?

A 29 m **B** 108 m **C** 123 m **D** 138 m

---

215. 9702_w17_qp_12 Q: 7

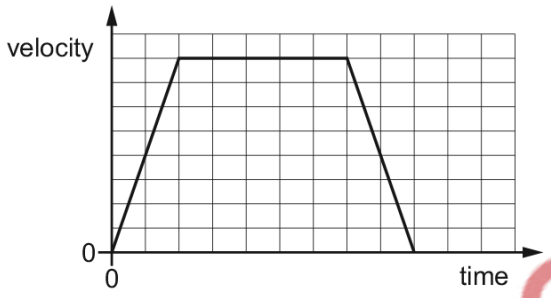
The velocity-time graph for a train starting at one station and stopping at the next is shown.



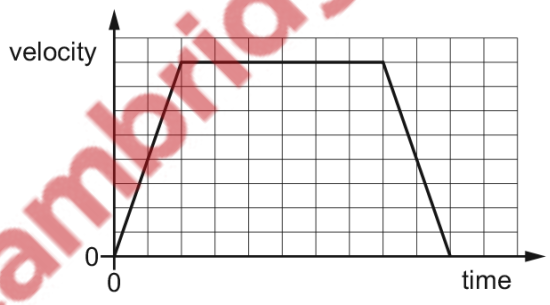
Another train has double the acceleration but the same maximum speed and the same deceleration.

Which velocity-time graph, on the same scale, shows the motion of this train between the same stations?

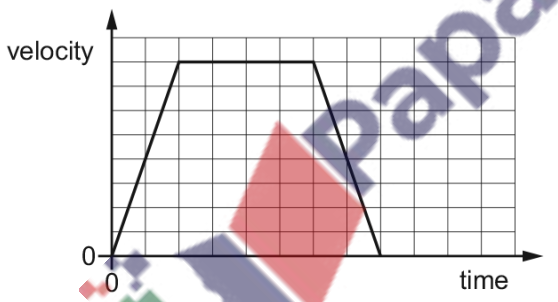
A



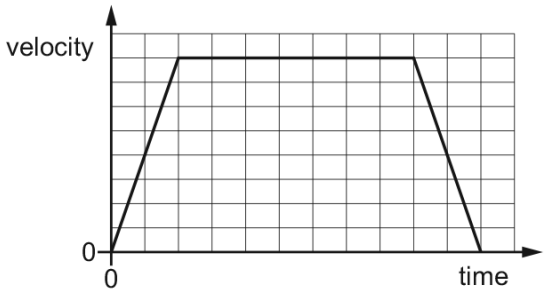
B



C



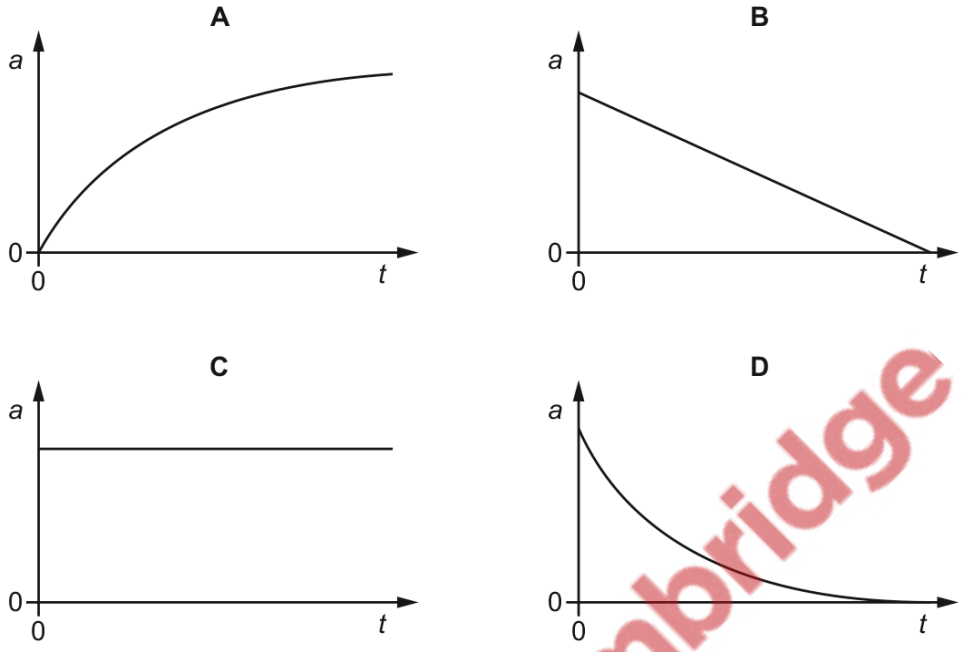
D



216. 9702_w17_qp_12 Q: 8

A stone is released from rest and falls a long distance in air.

Which graph could show the variation with time *t* of the acceleration *a* of the stone?

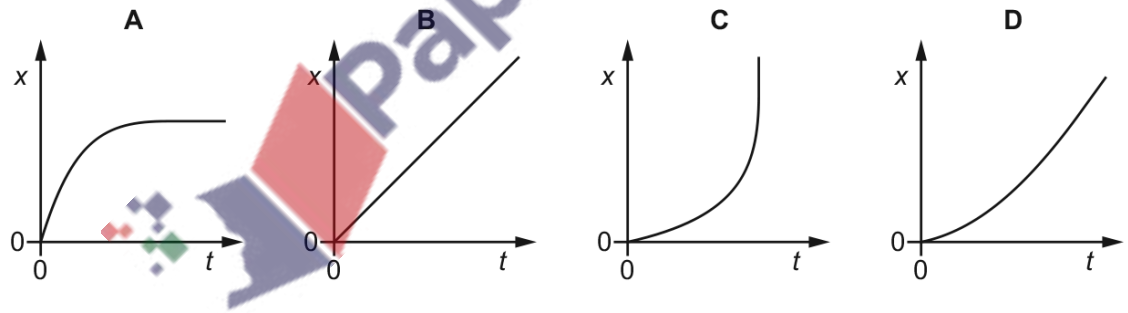


---

217. 9702_w17_qp_13 Q: 6

A football falls from the top of a tall building.

Which graph best represents the way in which the distance *x* fallen varies with time *t*?

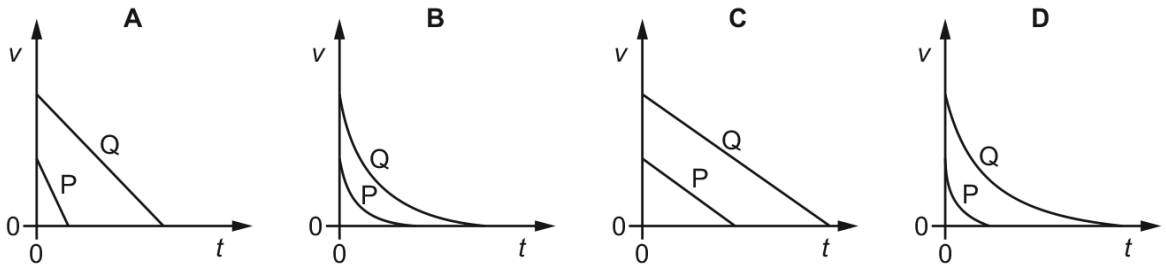


---

218. 9702_w17_qp_13 Q: 7

Two identical cars P and Q are travelling along a straight road. Car Q is travelling at twice the speed of car P. The brakes are applied to both cars, producing the same constant deceleration.

Which graph shows how the velocity v of each car varies with time t?



---

219. 9702_m16_qp_12 Q: 6

An object has an initial velocity u and an acceleration a. The object moves in a straight line through a displacement s and has final velocity v.

The above quantities are related by the equation shown.

$$v^2 = u^2 + 2as$$

Which condition **must** be satisfied in order for this equation to apply to the motion of the object?

A The direction of a is constant and the direction of a is the same as the direction of s.

B The direction of a is constant and the direction of a is the same as the direction of u.

C The magnitude of a is constant and the direction of a is constant.

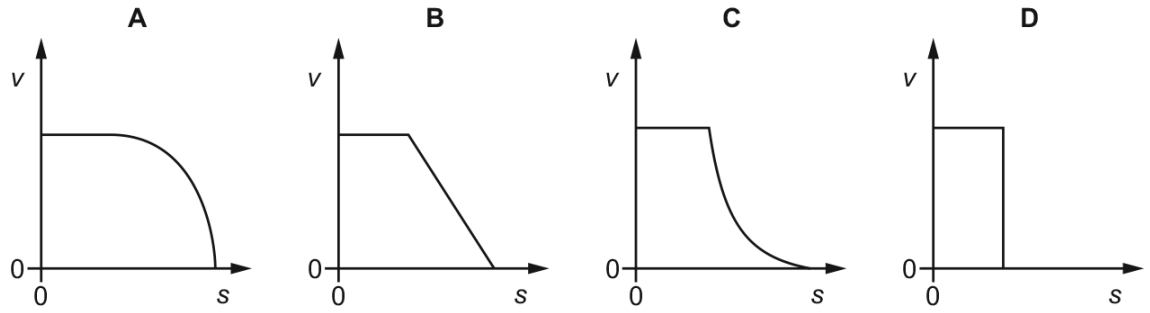
D The magnitude of a is constant and the direction of a is the same as the direction of v.

---

220. 9702_m16_qp_12 Q: 7

A car is travelling at constant velocity. Its brakes are then applied, causing uniform deceleration.

Which graph shows the variation with distance *s* of the velocity *v* of the car?



---

221. 9702_m16_qp_12 Q: 8

A ball is thrown across a flat field.

Which statement describes the motion of the ball, when the effects of air resistance are ignored?

A The ball lands with the same velocity at which it is thrown.

B The horizontal component of acceleration is constant throughout the motion.

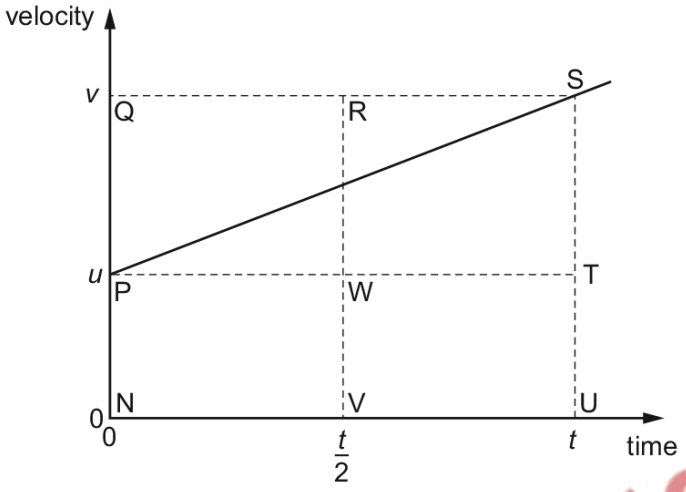
C The horizontal and vertical components of acceleration are both zero at the highest point of the motion.

D The horizontal and vertical components of velocity are both zero at the highest point of the motion.

---

222. 9702_s16_qp_11 Q: 6

A car accelerates uniformly from velocity u to velocity v in time t.



On the graph, which area equals the distance travelled by the car in time t?

A NPTU + PQST

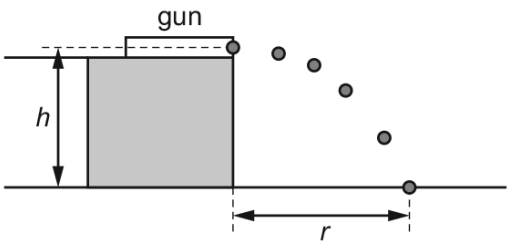
B NPWV + VRSU

C NPWV + WRST

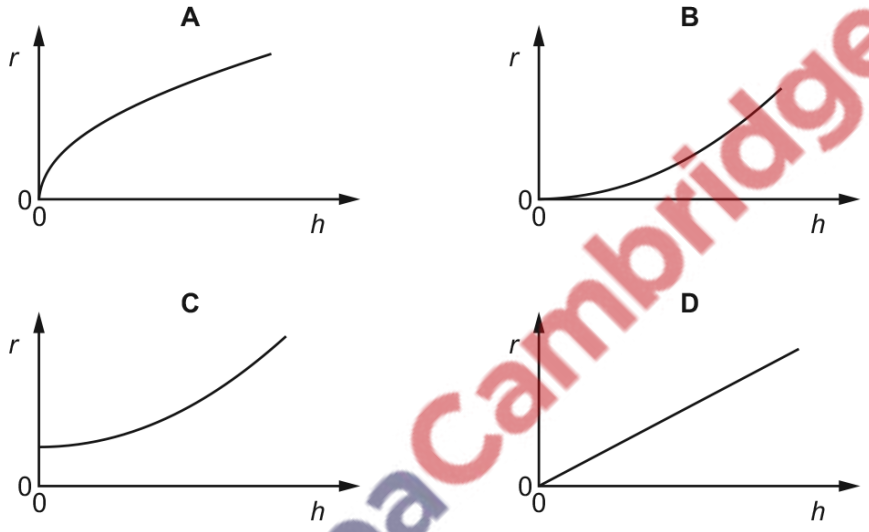
D PST + PQS

223. 9702_s16_qp_11 Q: 7

A student uses a spring gun to launch a steel ball with a constant horizontal velocity. He varies the height h of the gun and measures the horizontal displacement r of the ball when it hits the ground.



Which graph shows the variation with height h of the horizontal displacement r?

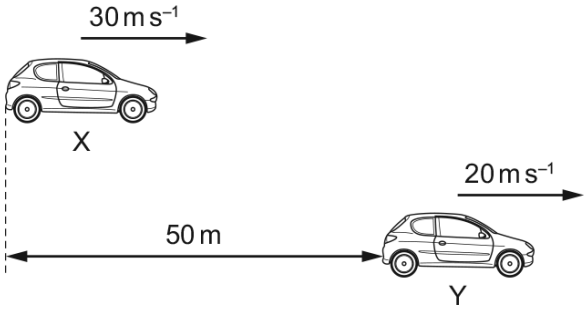


224. 9702_s16_qp_11 Q: 8

Two cars X and Y are positioned as shown at time $t = 0$.

They are travelling in the same direction.

X is 50 m behind Y and has a constant velocity of 30 m s^{-1}. Y has a constant velocity of 20 m s^{-1}.



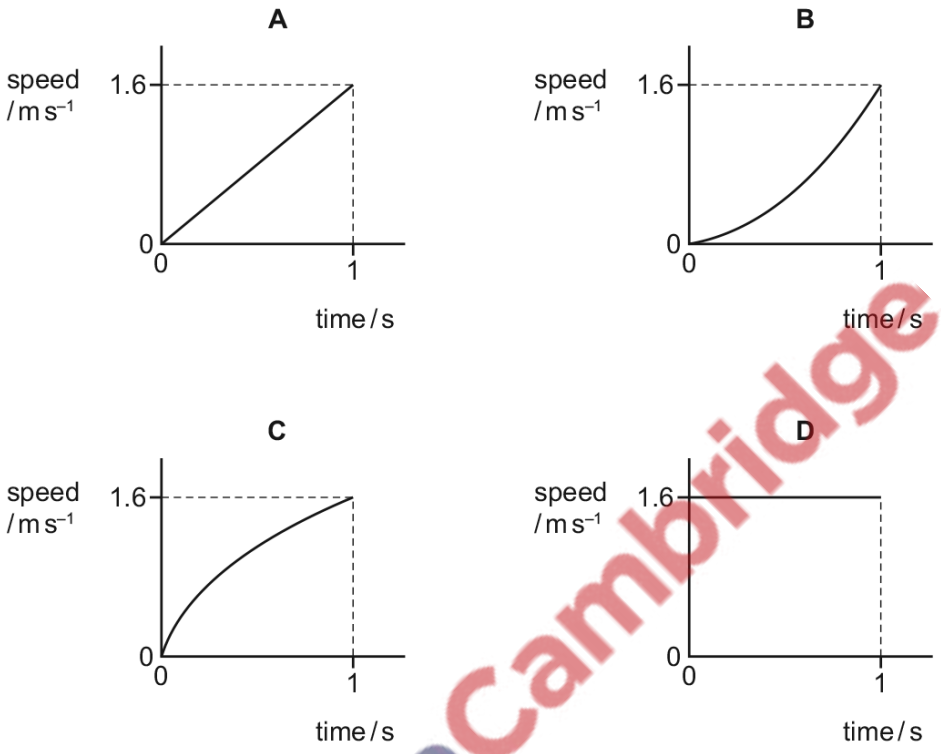
What is the value of t when X is level with Y?

A 1.0 s **B** 1.7 s **C** 2.5 s **D** 5.0 s

225. 9702_s16_qp_12 Q: 6

The acceleration of free fall on the Moon is $1.6\,m\,s^{-2}$. The Moon has no atmosphere. An astronaut standing on the surface of the Moon drops a feather.

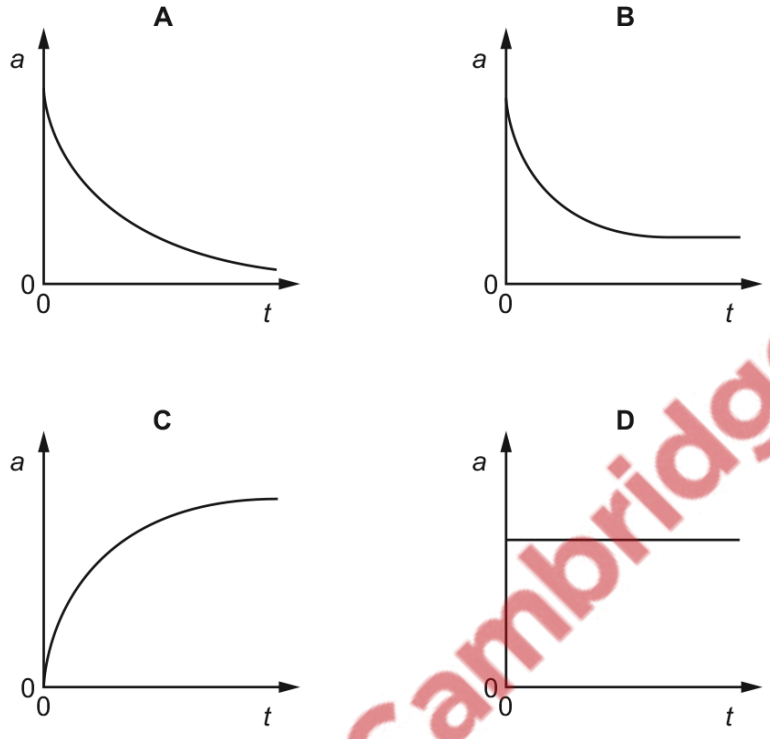
Which graph shows the variation with time of the speed of the feather during the first second of its fall?



226. 9702_s16_qp_12 Q: 7

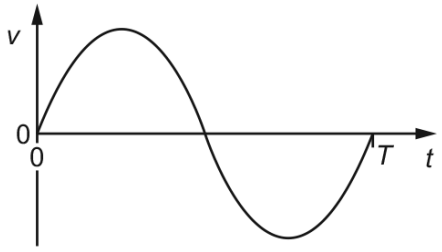
A tennis ball is released from rest at the top of a tall building.

Which graph best represents the variation with time t of the acceleration a of the ball as it falls, assuming that the effect of air resistance is **not** negligible?



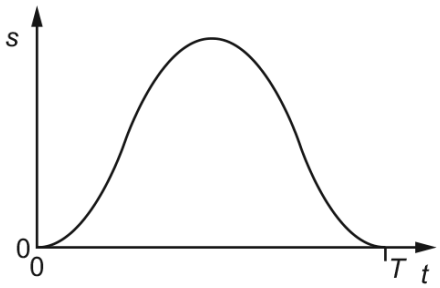
227. 9702_s16_qp_12 Q: 8

The graph shows how the velocity v of an object moving in a straight line varies with time t from $t = 0$ to $t = T$.

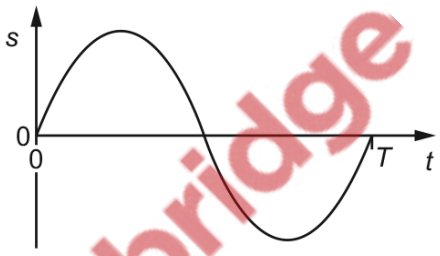


Which graph represents the displacement s of the object in the time $t = 0$ to $t = T$?

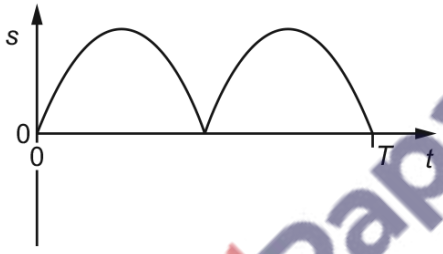
A



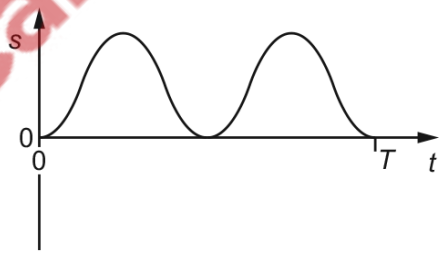
B



C



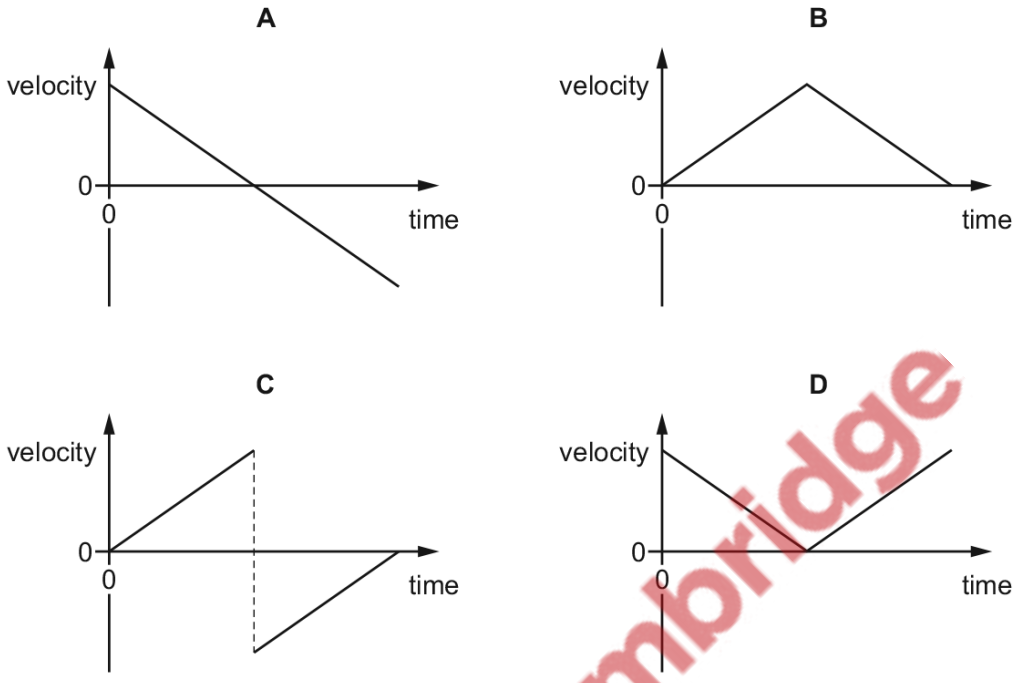
D



228. 9702_s16_qp_13 Q: 6

A ball rolls in a straight line up a ramp and then back down the ramp along its original path.

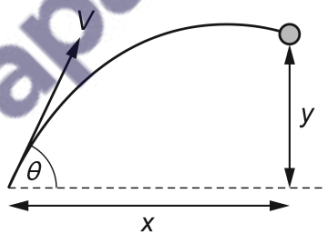
Which graph shows the variation with time of the ball's velocity?



---

229. 9702_s16_qp_13 Q: 7

A ball is thrown with velocity V at an angle θ to the horizontal.



The acceleration of free fall is g. Assume that air resistance is negligible.

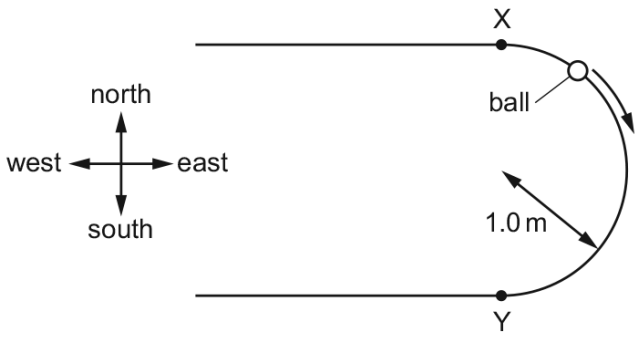
What are the horizontal displacement x and the vertical displacement y after time t?

	x	y
A	$Vt\cos\theta$	$Vt\sin\theta + \frac{1}{2}gt^2$
B	$Vt\cos\theta$	$Vt\sin\theta - \frac{1}{2}gt^2$
C	$Vt\sin\theta$	$Vt\cos\theta + \frac{1}{2}gt^2$
D	$Vt\sin\theta$	$Vt\cos\theta - \frac{1}{2}gt^2$

---

230. 9702_s16_qp_13 Q: 8

A ball travels from point X to point Y around a semi-circular track of radius 1.0 m as shown.



What is the displacement of the ball from X to Y?

A 2.0 m

B 2.0 m due south

C 3.1 m

D 3.1 m due south

---

231. 9702_s16_qp_13 Q: 9

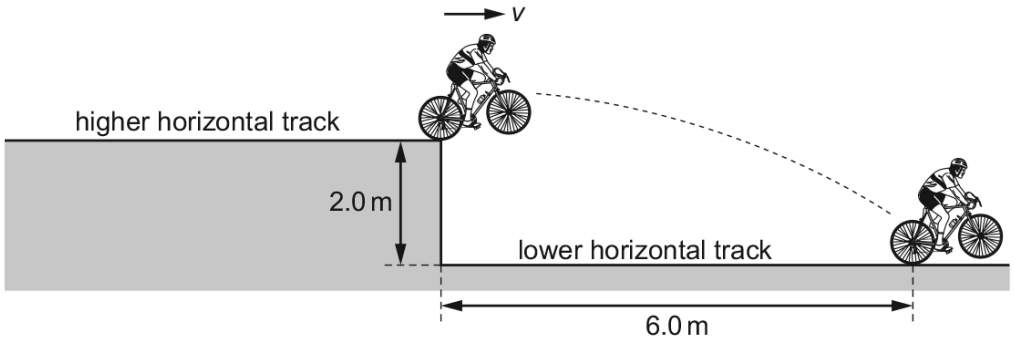
Which row in the table gives the quantities that are conserved in a perfectly elastic collision between two gas molecules?

	total momentum	total kinetic energy
A	conserved	conserved
B	conserved	not conserved
C	not conserved	conserved
D	not conserved	not conserved

---

232. 9702_w16_qp_11 Q: 6

A cyclist pedals along a raised horizontal track. At the end of the track, he travels horizontally into the air and onto a track that is vertically 2.0 m lower.



The cyclist travels a horizontal distance of 6.0 m in the air. Air resistance is negligible.

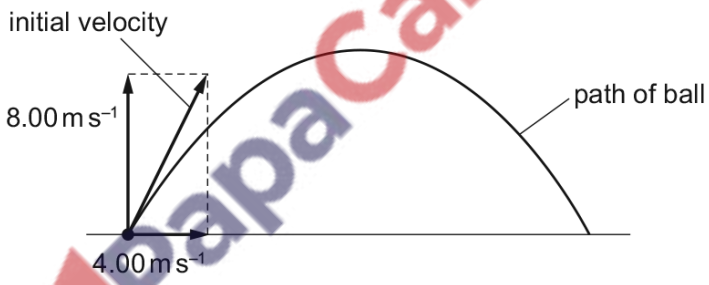
What is the horizontal velocity v of the cyclist at the end of the higher track?

A $6.3\,m\,s^{-1}$ **B** $9.4\,m\,s^{-1}$ **C** $9.9\,m\,s^{-1}$ **D** $15\,m\,s^{-1}$

---

233. 9702_w16_qp_11 Q: 7

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 $1.62\,m\,s^{-2}$.

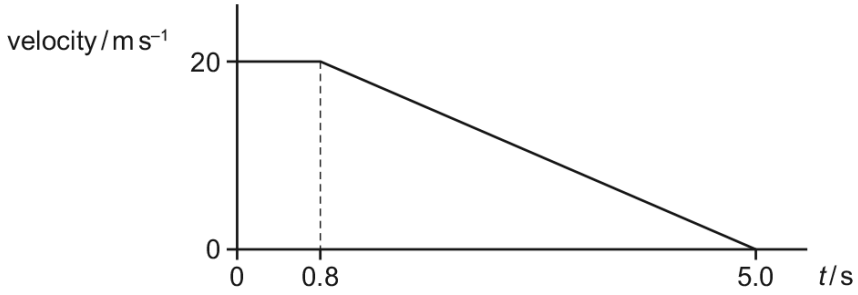
What will be the speed of the ball 9.00 s after being thrown?

A $6.6\,m\,s^{-1}$ **B** $7.7\,m\,s^{-1}$ **C** $10.6\,m\,s^{-1}$ **D** $14.6\,m\,s^{-1}$

---

234. 9702_w16_qp_11 Q: 8

A car is travelling at constant velocity. At time t = 0, the driver of the car sees an obstacle in the road and then brakes to a halt. The graph shows the variation with t of the velocity of the car.



How far does the car travel in the 5.0 s after the driver sees the obstacle?

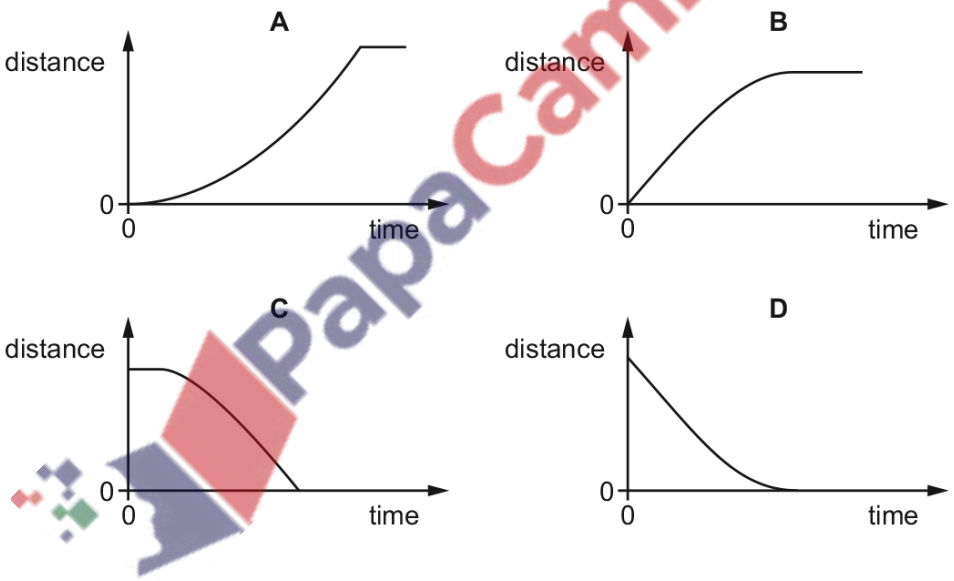
A 16 m **B** 42 m **C** 58 m **D** 84 m

---

235. 9702_w16_qp_12 Q: 7

A lorry travels at a constant speed and then decelerates until it stops.

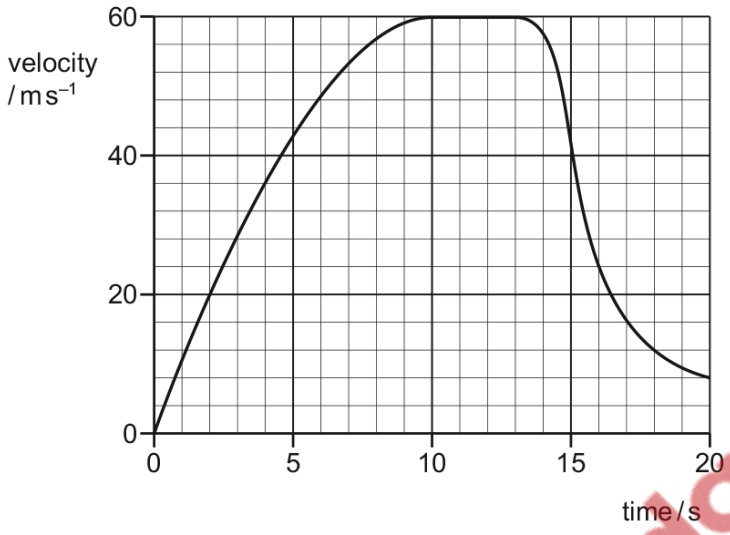
Which graph shows the variation with time of the distance travelled by the lorry?



---

236. 9702_w16_qp_12 Q: 8

The graph shows the vertical velocity of a parachutist during the first 20 s of her jump.



Approximately how far does she fall **before** opening the parachute?

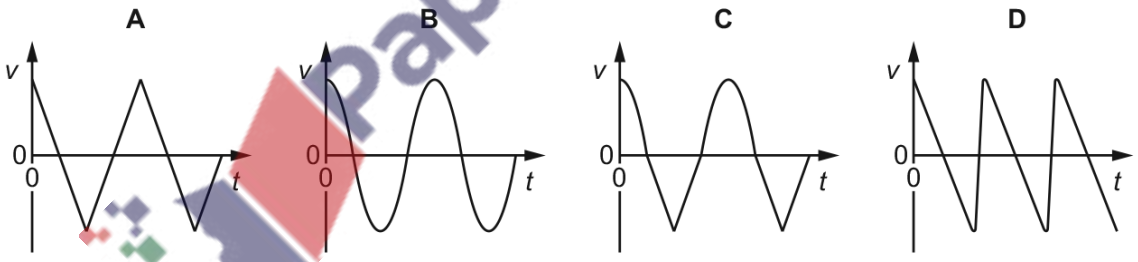
A 390 m **B** 570 m **C** 710 m **D** 770 m

---

237. 9702_w16_qp_12 Q: 9

A girl is jumping on a trampoline.

Which graph shows the variation of the girl's velocity v with time t?



---

238. 9702_w16_qp_12 Q: 10

In order that a train can stop safely, it will always pass a signal showing a yellow light before it reaches a signal showing a red light. Drivers apply the brake at the yellow light and this results in a uniform deceleration to stop exactly at the red light.

The distance between the red and yellow lights is x.

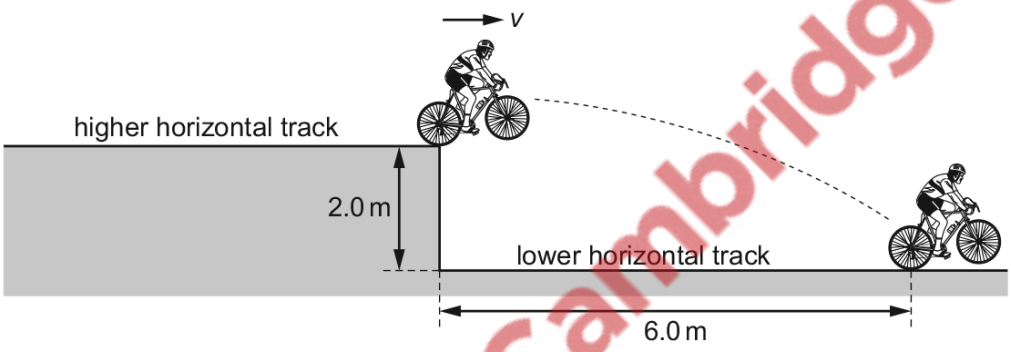
If the speed of the train is increased by 20%, without changing the deceleration of the train, what must be the minimum distance between the lights?

A $1.20x$ **B** $1.25x$ **C** $1.44x$ **D** $1.56x$

---

239. 9702_w16_qp_13 Q: 6

A cyclist pedals along a raised horizontal track. At the end of the track, he travels horizontally into the air and onto a track that is vertically 2.0 m lower.



The cyclist travels a horizontal distance of 6.0 m in the air. Air resistance is negligible.

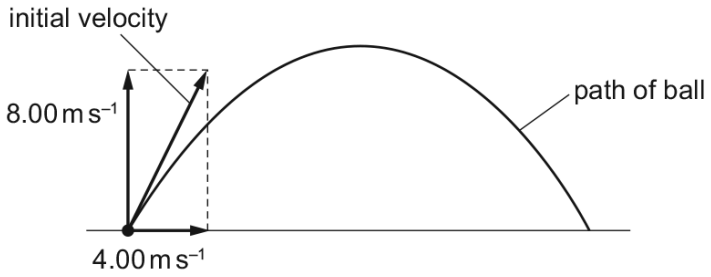
What is the horizontal velocity v of the cyclist at the end of the higher track?

A $6.3\,m\,s^{-1}$ **B** $9.4\,m\,s^{-1}$ **C** $9.9\,m\,s^{-1}$ **D** $15\,m\,s^{-1}$

---

240. 9702_w16_qp_13 Q: 7

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}.

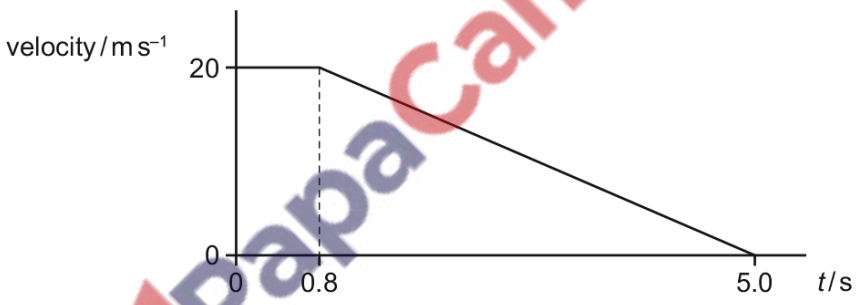
What will be the speed of the ball 9.00 s after being thrown?

A 6.6 m s^{-1} **B** 7.7 m s^{-1} **C** 10.6 m s^{-1} **D** 14.6 m s^{-1}

---

241. 9702_w16_qp_13 Q: 8

A car is travelling at constant velocity. At time t = 0, the driver of the car sees an obstacle in the road and then brakes to a halt. The graph shows the variation with t of the velocity of the car.



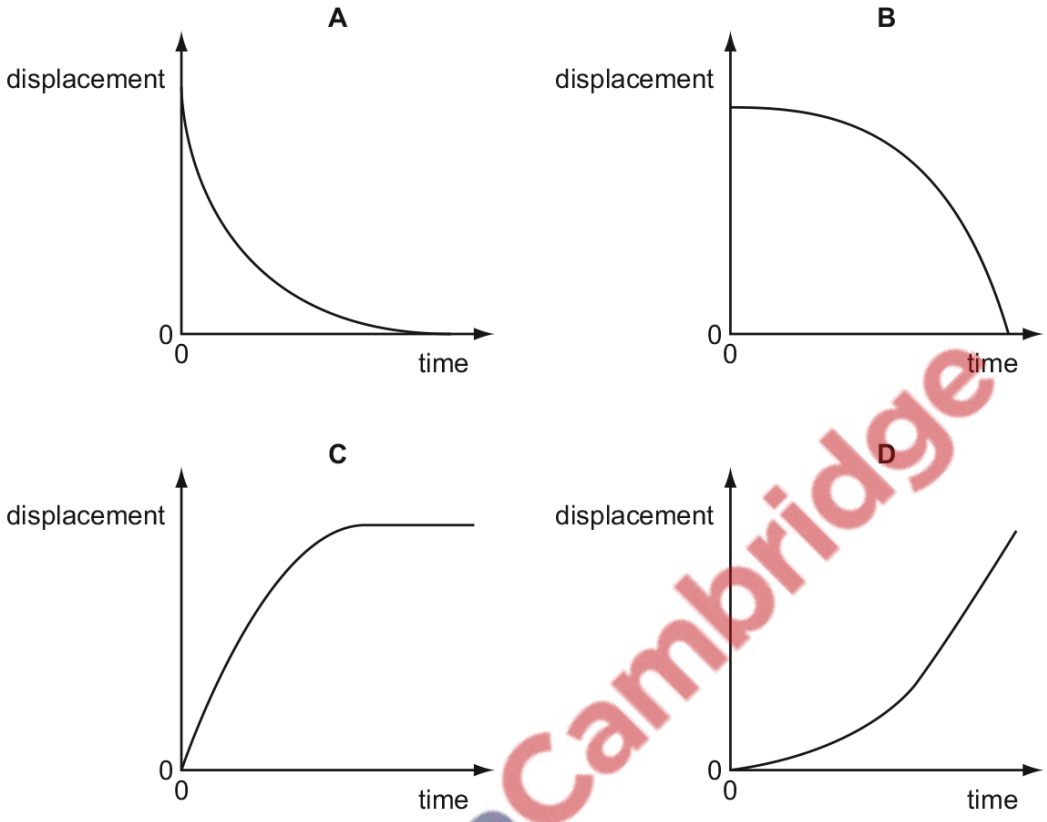
How far does the car travel in the 5.0 s after the driver sees the obstacle?

A 16 m **B** 42 m **C** 58 m **D** 84 m

---

242. 9702_s15_qp_11 Q: 7

A sphere is released and falls. Its initial acceleration reduces until it eventually begins to travel at constant terminal velocity. Which displacement-time graph best represents the motion of the sphere?



243. 9702_s15_qp_11 Q: 8

An insect jumps with an initial vertical velocity of $1.0\,m\,s^{-1}$, reaching a maximum height of $3.5 \times 10^{-2}\,m$. Assume the deceleration is uniform.

What is the magnitude of the deceleration?

A $3.6\,m\,s^{-2}$ **B** $9.8\,m\,s^{-2}$ **C** $14\,m\,s^{-2}$ **D** $29\,m\,s^{-2}$

244. 9702_s15_qp_11 Q: 9

A body having uniform acceleration a increases its velocity from u to v in time t.

Which expression would **not** give a correct value for the body's displacement during time t?

A $ut + \frac{1}{2}at^2$

B $vt - \frac{1}{2}at^2$

C $\frac{(v+u)(v-u)}{2a}$

D $\frac{(v-u)t}{2}$

---

245. 9702_s15_qp_12 Q: 7

In an experiment to determine the acceleration of free fall g, a ball bearing is held by an electromagnet. When the current to the electromagnet is switched off, a clock starts and the ball bearing falls. After falling a distance h, the ball bearing strikes a switch to stop the clock which measures the time t of the fall.

If systematic errors cause t and h to be measured incorrectly, which error **must** cause g to appear greater than $9.81\,\text{m}\,\text{s}^{-2}$?

A h measured as being **smaller** than it actually is and t is measured correctly

B h measured as being **smaller** than it actually is and t measured as being **larger** than it actually is

C h measured as being **larger** than it actually is and t measured as being **larger** than it actually is

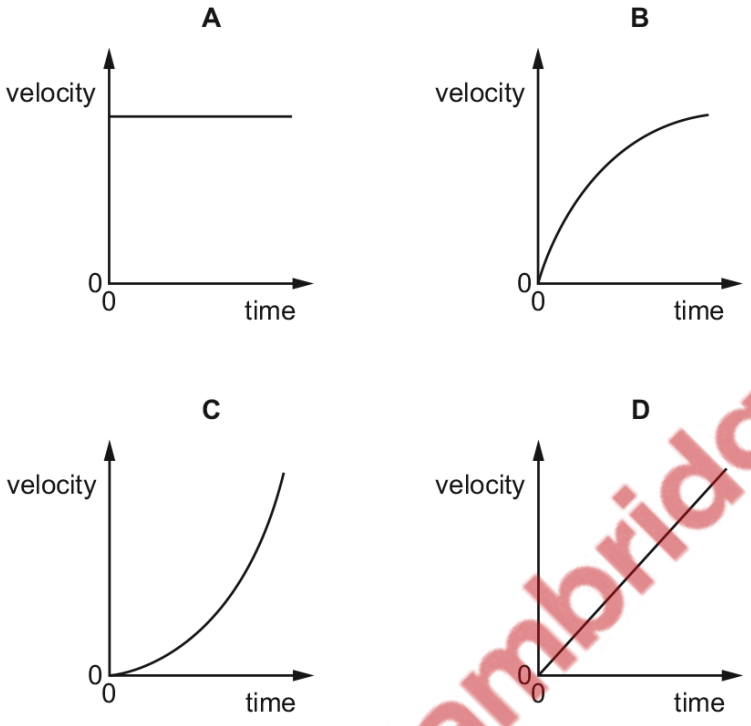
D h is measured correctly and t measured as being **smaller** than it actually is

---

246. 9702_s15_qp_12 Q: 8

A stone is thrown horizontally from the top of a cliff. Air resistance is negligible.

Which graph shows the variation with time of the vertical component of the stone's velocity?



247. 9702_s15_qp_12 Q: 9

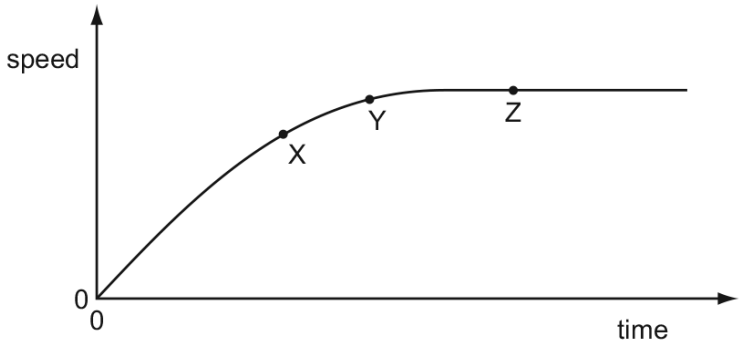
A sprinter runs a 100 m race in a straight line. He accelerates from the starting block at a constant acceleration of 2.5 $m s^{-2}$ to reach his maximum speed of 10 $m s^{-1}$. He maintains this speed until he crosses the finish line.

Which time does it take the sprinter to run the race?

A 4 s **B** 10 s **C** 12 s **D** 20 s

248. 9702_s15_qp_13 Q: 7

A raindrop falls vertically from rest in air. The variation with time of the speed of the raindrop is shown in the graph.



Which statement about the raindrop is correct?

A At point X, the raindrop has an acceleration of $9.81\,m\,s^{-2}$.

B At point Z, the force on the raindrop due to air resistance has reached its maximum value and so the acceleration of the raindrop has also reached its maximum value.

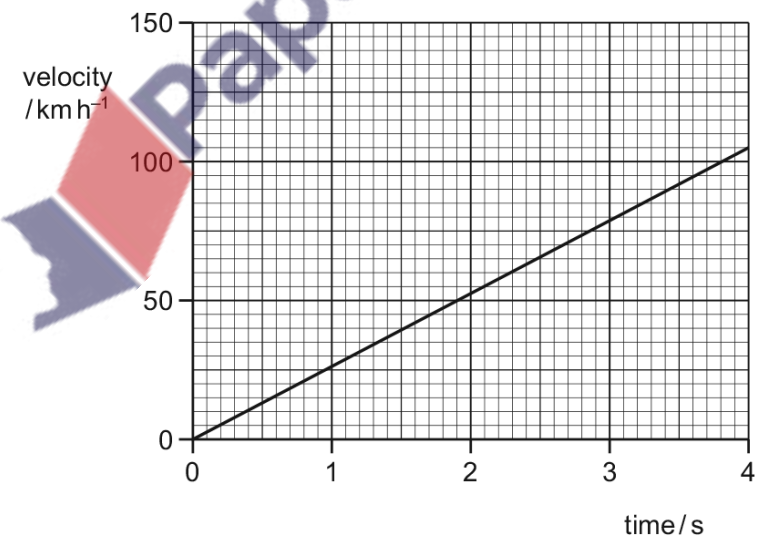
C At point Z, the force due to air resistance is equal and opposite to the weight of the raindrop and so the speed of the raindrop is zero.

D The resultant force on the raindrop at point Y is less than the resultant force on the raindrop at point X.

---

249. 9702_s15_qp_13 Q: 8

The velocity of an electric car changes as shown.



What is the acceleration of the car?

A $210\,m\,s^{-2}$ **B** $58\,m\,s^{-2}$ **C** $26\,m\,s^{-2}$ **D** $7.3\,m\,s^{-2}$

---

250. 9702_s15_qp_13 Q: 9

A body falling in a uniform gravitational field encounters air resistance. The air resistance increases until terminal velocity is reached.

Which factor does **not** affect its terminal velocity?

A the density of the air

B the height from which the body falls

C the mass of the body

D the shape of the body