Mechanics

(Equation of Motion)

TOPIC QUESTIONS (1)

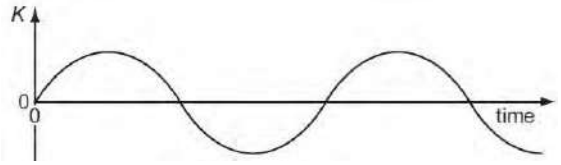
Level	A Level
Subject	Physics
Exam Board	CIE
Paper Type	Multiple Choice

Time Allowed : 50 Min

1. The symbol g represents the acceleration of free fall.Which of these statements is correct?

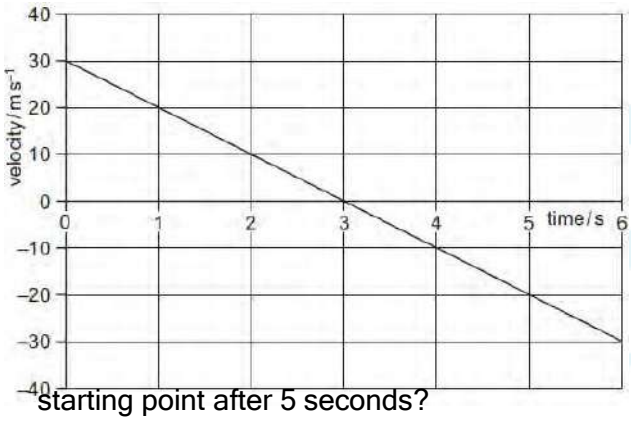
A g is gravity. B g is reduced by air resistance.
C g is the ratio weight / mass. D g is the weight of an object.

2. A particle moves along a straight line. A particular property Kof the particle's motion is plotted against time.



At any time, the slope of the graph is the acceleration of theparticle. What is the property K?
A the displacement of the particle
B the distance travelled by the particleC the speed of the particle
D the velocity of the particle

3. A stone is thrown vertically upwards. A student plots thevariation with time of its velocity.



WWh at is the vertical displacement of the stone from its starting point after 5 seconds?
A 20 m B 25 m C 45 m D 65 m

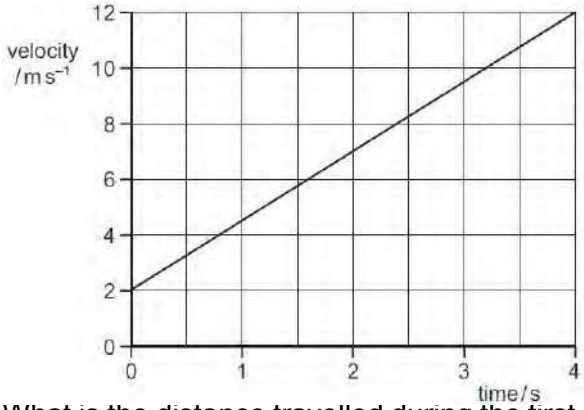
June 08

4. An object accelerates in a direction that is always perpendicular to its motion. What is the effect, if any, of theacceleration on the object's speed and direction?

	speed	direction
A	changes	changes
B	changes	constant
C	constant	changes
D	constant	constant

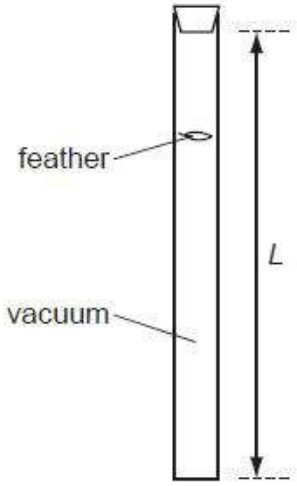
Nov. 08

5. The diagram shows a velocity-time graph for a car.



What is the distance travelled during the first 4.0 s?
A 2.5 m B 3.0 m C 20 m D 28 m

6. The diagram shows a laboratory experiment in which a feather falls from rest in a long evacuated vertical tube of length *L*.

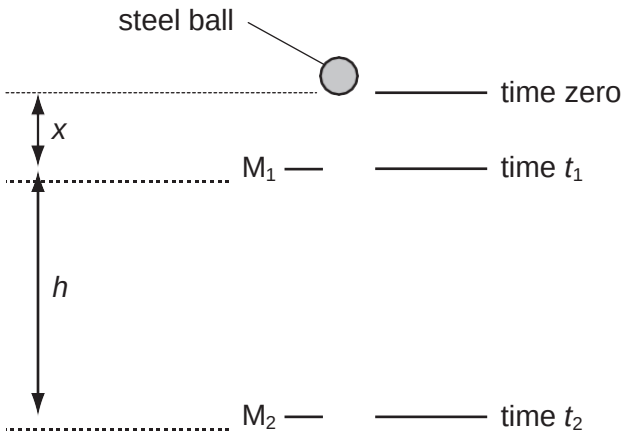


The feather takes time *T* to fall from the top to the bottom of the tube.

How far will the feather have fallen from the top of the tube in time 0.50 *T*?

A 0.13 *L* **B** 0.25 *L* **C** 0.38 *L* **D** 0.50 *L*

7. Two markers M_1 and M_2 are set up a vertical distance *h* apart.



A steel ball is released at time zero from a point a distance *x* above M_1. The ball reaches M_1 at time t_1 and reaches M_2 at time t_2. The acceleration of the ball is constant.

Which expression gives the acceleration of the ball?

A $\frac{2h}{t_2^2}$

B $\frac{2h}{(t_2 + t_1)}$

C $\frac{2h}{(t_2 - t_1)^2}$

D $\frac{2h}{(t_2^2 - t_1^2)}$

8. A bullet is fired horizontally with speed v from a rifle. For a short time t after leaving the rifle, theonly force affecting its motion is gravity. The acceleration of free fall is g.

Which expression gives the value of $\frac{\text{the horizontal distance travelled in time } t}{\text{the vertical distance travelled in time } t}$?

A $\frac{vt}{g}$ B $\frac{v}{gt}$ C $\frac{2vt}{g}$ D $\frac{2v}{gt}$

9. 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.

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

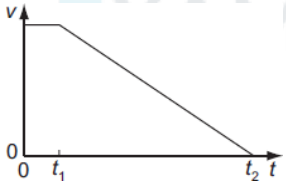
A 1.20 x B 1.25 x C 1.44 x D 1.56 x

10. A moving body undergoes uniform acceleration while travelling in a straight line between points X, Y and Z. The distances XY and YZ are both 40 m. The time to travel from X to Y is 12 s and from Y to Z is 6.0 s.

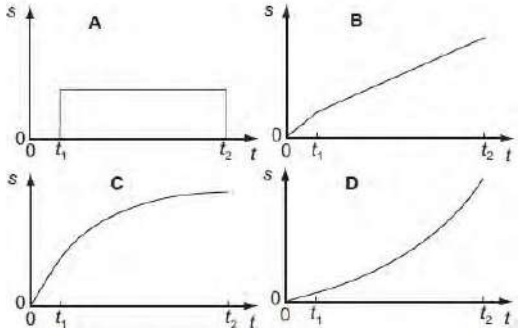
What is the acceleration of the body?

A 0.37 $m s^{-2}$ B 0.49 $m s^{-2}$ C 0.56 $m s^{-2}$ D 1.1 $m s^{-2}$

11. When a car driver sees a hazard ahead, she applies the brakes as soon as she can and brings the car to rest. The graph shows how the speed v of the car varies with time t after the hazard is seen.



Which graph represents the variation with time t of the distances travelled by the car after the hazard has been seen?



12. An object falls 10.0 m from rest before entering some water. Assuming negligible air resistance, what is the time taken to reach the water and the speed with which the object reaches thewater?

	time / ms	speed / ms^{-1}
A	1.02	10.0
B	1.02	14.0
C	1.43	10.0
D	1.43	14.0

June 05

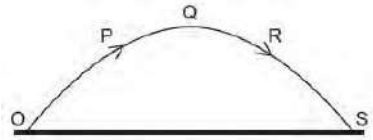
13. Which feature of a graph allows acceleration to bedetermined?

A the area under a displacement-time graphB the area under a velocity-time graph
C the slope of a displacement-time graphD the slope of a velocity-time graph

14. A boy throws a ball vertically upwards. It rises to a maximumheight, where it is momentarily at rest, and falls back to his hands. Which of the following gives the acceleration of the ball at various stages in its motion? Take vertically upwards as positive. Neglect air resistance.

	rising	at maximum height	falling
A	$-9.81\,ms^{-2}$	0	$+9.81\,ms^{-2}$
B	$-9.81\,ms^{-2}$	$-9.81\,ms^{-2}$	$-9.81\,ms^{-2}$
C	$+9.81\,ms^{-2}$	$+9.81\,ms^{-2}$	$+9.81\,ms^{-2}$
D	$+9.81\,ms^{-2}$	0	$-9.81\,ms^{-2}$

15. A projectile is launched at point O and follows the pathOPQRS, as shown. Air resistance may be neglected.



Which statement is true for the projectile when it is at the highestpoint Q of its path?

A The horizontal component of the projectile's acceleration iszero.
B The horizontal component of the projectile's velocity is zero.
C The kinetic energy of the projectile is zero.
D The momentum of the projectile is zero. The diagram shows avelocity-time graph for a car

16. An object falls 10.0 m from rest before entering some water.

Assuming negligible air resistance, what is the time taken to reach the water and the speed with which the object reaches the water?

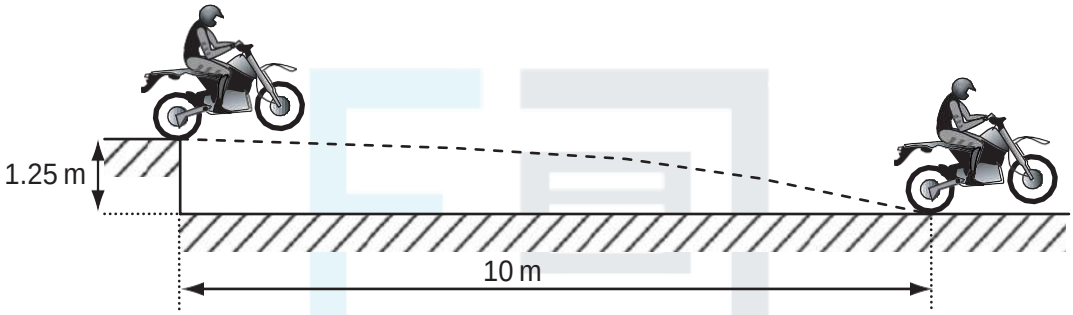
	time / ms	spe / ms^{-1}
A	1.02	10.0
B	1.02	14.0
C	1.43	10.0
D	1.43	14.0

17. A car is travelling with uniform acceleration along a straight road. The road has marker postsevery 100 m. When the car passes one post, it has a speed of 10 m s^{-1} and, when it passes the next one, its speed is 20 m s^{-1}.

What is the car's acceleration?

A $0.67\,m\,s^{-2}$ B $1.5\,m\,s^{-2}$ C $2.5\,m\,s^{-2}$ D $6.0\,m\,s^{-2}$

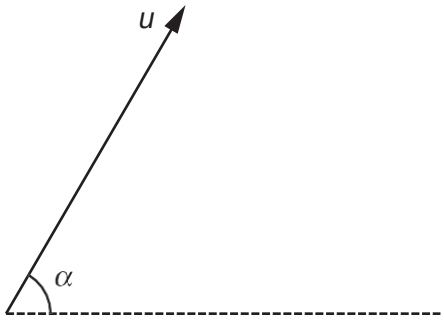
18. A motorcycle stunt-rider moving horizontally takes off from a point 1.25 m above the ground,landing 10 m away as shown.



What was the speed at take-off?

A $5\,m\,s^{-1}$ B $10\,m\,s^{-1}$ C $15\,m\,s^{-1}$ D $20\,m\,s^{-1}$

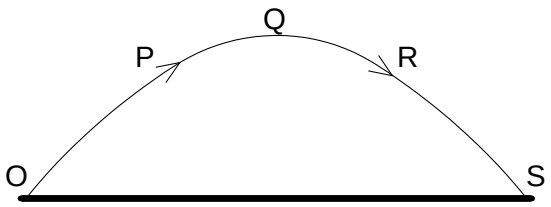
19. A projectile is fired at an angle α to the horizontal at a speed u, as shown.



What will be the vertical and horizontal components of its velocity after a time t?
Assume that air resistance is negligible. The acceleration of free fall is g.

	vertical component	horizontal component
A	$u \sin \alpha$	$u \cos \alpha$
B	$u \sin \alpha - gt$	$u \cos \alpha - gt$
C	$u \sin \alpha - gt$	$u \cos \alpha$
D	$u \cos \alpha$	$u \sin \alpha - gt$

20. A projectile is launched at point O and follows the path OPQRS, as shown. Air resistance may be neglected.



Which statement is true for the projectile when it is at the highest point Q of its path?

A The horizontal component of the projectile's acceleration is zero.

B The horizontal component of the projectile's velocity is zero.

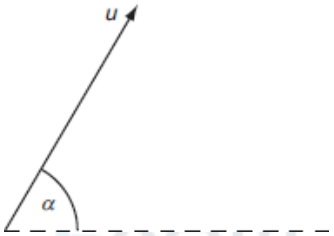
C The kinetic energy of the projectile is zero.

D The momentum of the projectile is zero.

21. A motorist travelling at 10 m s^{-1} can bring his car to rest in a braking distance of 10 m. In what distance could he bring the carto rest from a speed of 30 m s^{-1} using the same braking force?

A 17 m B 30 m C 52 m D 90 m

22. A projectile is fired at an angle α to the horizontal at a speedu, as shown.



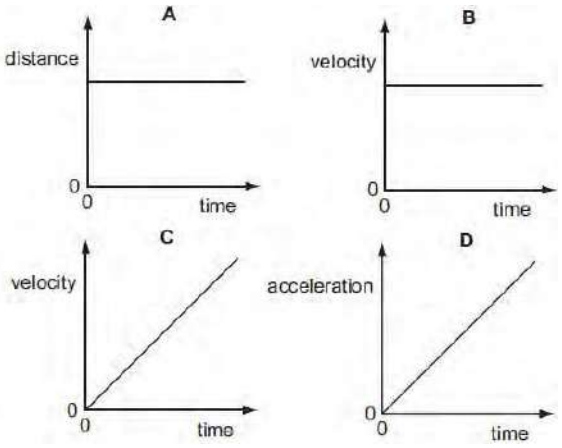
What are the vertical and horizontal components of its velocityafter a time t? Assume that air resistance is negligible.

	vertical component	horizontal component
A	$u \sin \alpha$	$u \cos \alpha$
B	$u \sin \alpha - gt$	$u \cos \alpha - gt$
C	$u \sin \alpha - gt$	$u \cos \alpha$
D	$u \cos \alpha$	$u \sin \alpha - gt$

23. A force F is applied to a freely moving object. At one instant oftime, the object has velocity v and acceleration a.
Which quantities must be in the same direction?

A a and v only B a and F only C v and F only D v, F and a

24. A particle is moving in a straight line with uniform acceleration.Which graph represents the motion of the particle?



25. What gives the value of a body's acceleration?

A the area under its displacement-time graph
B the area under its velocity-time graph
C the gradient of its displacement-time graph
D the gradient of its velocity-time graph

26. In a cathode-ray tube, an electron is accelerated uniformly in a straight line from a speed of $4 \times 10^3\,m\,s^{-1}$ to $2 \times 10^7\,m\,s^{-1}$ over a distance of 10 mm.

What is the acceleration of the electron?

A $2 \times 10^3\,m\,s^{-2}$

B $2 \times 10^6\,m\,s^{-2}$

C $2 \times 10^{13}\,m\,s^{-2}$

D $2 \times 10^{16}\,m\,s^{-2}$

27. One object moves directly from P to R.

R

Q

P

In a shorter time, a second object moves from P to Q to R.

Which statement about the two objects is correct for the journey from P to R?

A They have the same average speed.

B They have the same average velocity.

C They have the same displacement.

D They travel the same distance.

28. An aeroplane travels at an average speed of 600 km h^{-1} on an outward flight and at 400 km h^{-1} onthe return flight over the same distance.

What is the average speed of the whole flight?

A 111 m s^{-1} B 167 m s^{-1} C 480 km h^{-1} D 500 km h^{-1}

29. On a particular railway, a train driver applies the brake of the train at a yellow signal, a distance of 1.0 km from a red signal, where the train stops.

The maximum deceleration of the train is 0.20 m s^{-2}.

Assuming uniform deceleration, what is the maximum safe speed of the train at the yellow signal?

A 14 m s^{-1} B 20 m s^{-1} C 40 m s^{-1} D 400 m s^{-1}

30. A person, travelling on a motorway a total distance of 200 km, travels the first 90 km at an average speed of 80 km h^{-1}.

Which average speed must be obtained for the rest of the journey if the person is to reach the destination in a total time of 2 hours 0 minutes?

A 110 km h^{-1} B 120 km h^{-1} C 122 km h^{-1} D 126 km h^{-1}

31. An insect jumps with an initial vertical velocity of 1.0 m s^{-1}, reaching a maximum height of 3.5×10^{-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}

32. 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*?

- $ut + \frac{1}{2}at^2$
- $vt - \frac{1}{2}at^2$
- $\frac{(v+u)(v-u)}{2a}$
- $\frac{(v-u)t}{2}$

33. 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

34. The acceleration of free fall on the Moon is one-sixth of that on Earth.On Earth it takes time *t* for a stone to fall from rest a distance of 2 m.

What is the time taken for a stone to fall from rest a distance of 2 m on the Moon?

A $6t$ B $\frac{t}{6}$ C $t\sqrt{6}$ D $\frac{t}{\sqrt{6}}$

35. What is the correct name for a material containing long-chain molecules that are tangled and coiled?

- amorphous metal
- amorphous polymer
- crystalline metal
- crystalline polymer

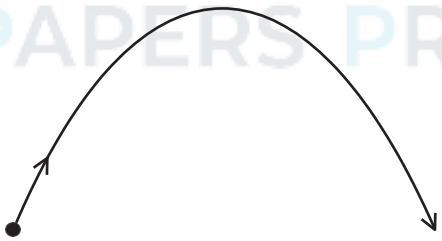
36. On a particular railway, a train driver applies the brake of the train at a yellow signal, a distance of 1.0 km from a red signal, where it stops.

The maximum deceleration of the train is $0.2\,m\,s^{-2}$.

Assuming uniform deceleration, what is the maximum safe speed of the train at the yellow signal?

A $20\,m\,s^{-1}$ B $40\,m\,s^{-1}$ C $200\,m\,s^{-1}$ D $400\,m\,s^{-1}$

37. A stone is thrown upwards and follows a curved path.



Air resistance is negligible.

Why does the path have this shape?

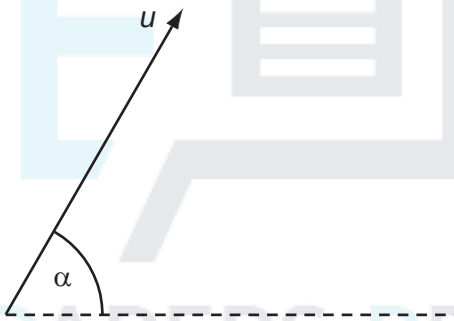
- The stone has a constant horizontal velocity and constant vertical acceleration.
- The stone has a constant horizontal acceleration and constant vertical velocity.
- The stone has a constant upward acceleration followed by a constant downward acceleration.
- The stone has a constant upward velocity followed by a constant downward velocity.

38. A stone is dropped from the top of a tower of height 40 m. The stone falls from rest and airresistance is negligible.

What time is taken for the stone to fall the last 10 m to the ground?

A 0.38 s B 1.4 s C 2.5 s D 2.9 s

39. A projectile is fired at an angle α to the horizontal at a speed u, as shown.



What are the vertical and horizontal components of its velocity after a time t? Assume that air resistance is negligible. The acceleration of free fall is g.

	vertical component	horizontal component
A	$u \sin\alpha$	$u \cos\alpha$
B	$u \sin\alpha - gt$	$u \cos\alpha - gt$
C	$u \sin\alpha - gt$	$u \cos\alpha$
D	$u \cos\alpha$	$u \sin\alpha - gt$

40. An experiment is done to measure the acceleration of free fall of a body from rest.

Which measurements are needed?

A the height of fall and the time of fall

B the height of fall and the weight of the body

C the mass of the body and the height of fall

D the mass of the body and the time of fall