The following list of formulae may be found useful :

For uniformly accelerated motion

$$v = u + at$$

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

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

Equation of a straight line

$$y = mx + c$$

Use the following data wherever necessary :

Acceleration due to gravity $g = 9.81\ \text{m s}^{-2}$ (close to the Earth)

Part A : HKCE examination questions

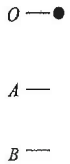
1. < HKCE 1980 Paper II - 9 >

A body is dropped from rest down a cliff on a planet X. After falling for 1 s, it is 4 m below the starting point. How far below the starting point will it be after a further 4 s ?

A. 40 m
B. 64 m
C. 80 m
D. 100 m

2. < HKCE 1981 Paper II - 5 >

A particle released from rest at O falls freely under gravity and passes A and B, as shown in the figure (not drawn to scale). If the particle takes 4 s to move from A to B, where $AB = 100$ m, how long does it take to fall from O to A ?



A. 0.55 s
B. 1.10 s
C. 2.20 s
D. 4.40 s

3. < HKCE 1981 Paper II - 8 >

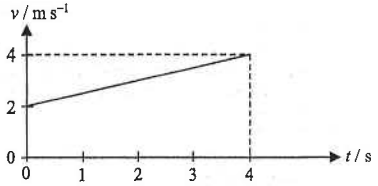
Which of the following statements concerning the motion of a body is/are correct ?

(1) A body has no acceleration when it is moving with a uniform velocity.
(2) A body can have zero velocity but also be accelerating.
(3) A body can have a constant speed but a varying velocity.

A. (1) only
B. (1) & (2) only
C. (2) & (3) only
D. (1), (2) & (3)

4. < HKCE 1984 Paper II - 2 >

The diagram shows how the velocity of a body varies with time. What is the distance travelled in the first 4 s ?

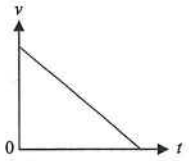


A. 4 m
B. 8 m
C. 10 m
D. 12 m

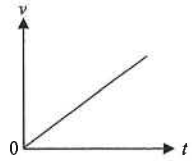
5. < HKCE 1984 Paper II - 3 >

Which of the following velocity-time graphs correctly shows the motion of a ping-pong ball falling freely in a vacuum ?

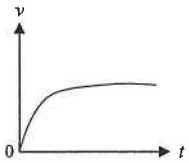
A.



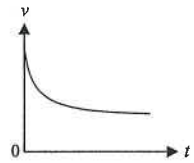
B.



C.



D.

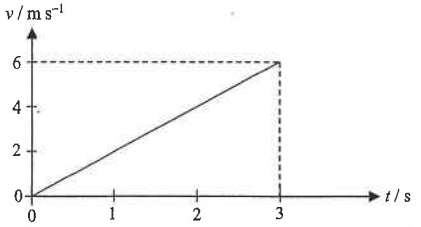


6. < HKCE 1985 Paper II - 2 >

A car moving with speed 50 km h^{-1} can be stopped in a distance of 15 m. In what distance can the car be stopped when its speed is 70 km h^{-1} under the same condition ?

A. 10.9 m
B. 17.7 m
C. 21.0 m
D. 29.4 m

7. < HKCE 1985 Paper II - 1 >



The graph shows the variation of the velocity of a car with time. What is the acceleration of the car ?

A. $0.5\ \text{m s}^{-2}$
B. $1.5\ \text{m s}^{-2}$
C. $2.0\ \text{m s}^{-2}$
D. $4.0\ \text{m s}^{-2}$

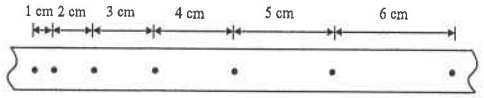
8. < HKCE 1986 Paper II - 2 >

A body falls freely from rest. What are the distances travelled in the first and third second ?

	First second	Third second
A.	4.9 m	14.7 m
B.	4.9 m	19.6 m
C.	4.9 m	24.5 m
D.	9.8 m	39.2 m

Provided by dse.life

9. **< HKCE 1986 Paper II - 1 >**

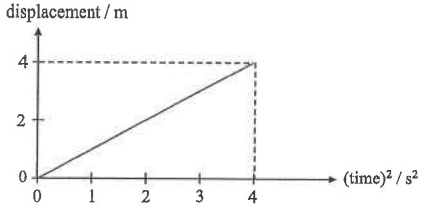


The diagram above shows a ticker-tape produced by a trolley being pulled by a rubber band. Which of the following statements about the trolley is/are true ?

(1) Its displacement increases uniformly with time.
(2) Its velocity increases uniformly with time.
(3) Its acceleration increases uniformly with time.

A. (1) only
B. (2) only
C. (1) & (2) only
D. (2) & (3) only

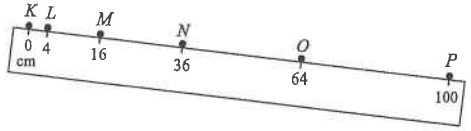
10. **< HKCE 1987 Paper II - 6 >**



An object is accelerated from rest along a straight line. The above graph shows the variation of its displacement with the square of time. What is the acceleration of the object ?

A. 0.5 m s^{-2}
B. 1.0 m s^{-2}
C. 2.0 m s^{-2}
D. 4.0 m s^{-2}

11. **< HKCE 1988 Paper II - 1 >**



The above figure shows the stroboscopic photograph of a ball rolling down a slope. If the stroboscope makes 2 flashes per second, in which region does the ball have an average speed of 40 cm s^{-1} ?

A. *LM*
B. *MN*
C. *NO*
D. *OP*

12. **< HKCE 1989 Paper II - 2 >**

An object is falling from rest with an acceleration of 9.8 m s^{-2}. Which of the following statements is/are correct ?

(1) It falls with a constant speed of 9.8 m s^{-1}.
(2) It falls 9.8 m every second.
(3) It has a speed of 19.6 m s^{-1} after 2 s.

A. (1) only
B. (3) only
C. (1) & (2) only
D. (2) & (3) only

13. **< HKCE 1989 Paper II - 3 >**

A particle is thrown vertically upwards. When the particle is at the maximum height, its acceleration is

A. zero.
B. changing from upwards to downwards.
C. pointing upwards.
D. pointing downwards.

14. **< HKCE 1989 Paper II - 4 >**

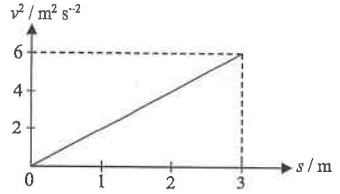
A coin and a feather are allowed to fall in a long vertical glass tube from which the air has been evacuated. Which one of the following combinations best describes the motion of the coin and the feather ?

	Coin	**Feather**
A.	uniform speed	same uniform speed
B.	uniform acceleration	same uniform acceleration
C.	uniform acceleration	smaller uniform acceleration
D.	uniform acceleration	greater uniform acceleration

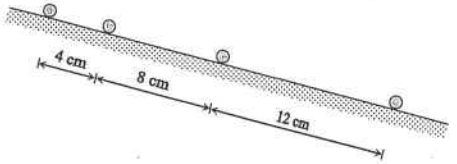
15. **< HKCE 1990 Paper II - 1 >**

The graph shows how the square of velocity of an object undergoing uniform acceleration varies with displacement. The object is initially at rest and travels along a straight line. The acceleration of the object is

A. 0.5 m s^{-2}
B. 1.0 m s^{-2}
C. 2.0 m s^{-2}
D. 4.0 m s^{-2}



16. **< HKCE 1991 Paper II - 4 >**



The above figure shows the strobe photograph of a ball rolling down a slope. The stroboscope is flashing at a frequency of 5 Hz. Find the acceleration of the ball.

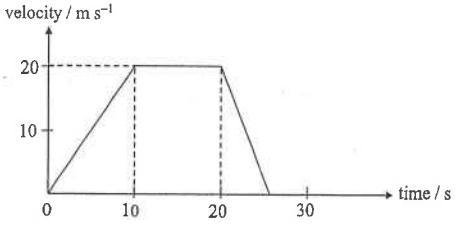
A. 0.20 m s^{-2}
B. 0.50 m s^{-2}
C. 0.67 m s^{-2}
D. 1.00 m s^{-2}

17. **< HKCE 1991 Paper II - 5 >**

The figure shows the velocity-time graph of an object. Which of the following statements about the object is/are true ?

(1) Its acceleration in the first 10 s is 2 m s^{-2}.
(2) The total distance travelled is 250 m.
(3) It returns to its starting point after 25 s.

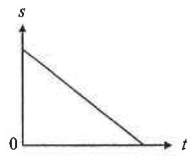
A. (1) only
B. (2) only
C. (1) & (3) only
D. (2) & (3) only

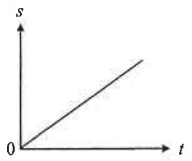


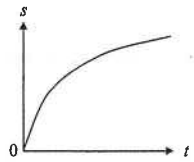
Provided by dse.life

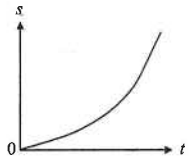
18. **< HKCE 1992 Paper II - 1 >**

Which of the following displacement-time graphs describes the motion of a particle moving in a straight line with uniform deceleration ?

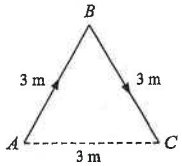
A. 

B. 

C. 

D. 

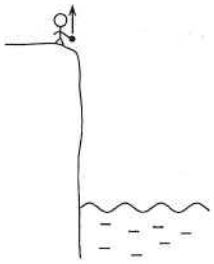
19. **< HKCE 1992 Paper II - 2 >**

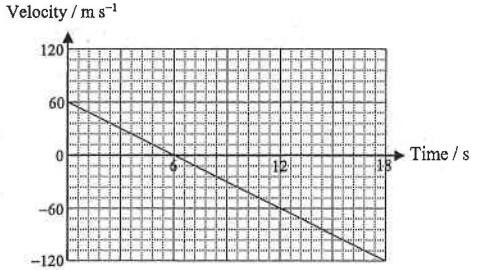


A man takes 2 s to walk from point *A* to point *B*, and then takes 3 s to walk from point *B* to point *C*, where *ABC* is an equilateral triangle of side 3 m. Find the magnitude of his average VELOCITY from *A* to *C*.

A. 0.60 m s^{-1}
B. 1.00 m s^{-1}
C. 1.20 m s^{-1}
D. 1.25 m s^{-1}

20. **< HKCE 1992 Paper II - 4 >**





The above figure shows a man near the edge of a cliff projecting a stone vertically upwards. The stone reaches the sea after 18 s. The graph shows the velocity ~ time for the motion of the stone. Find the height of the cliff. (Take g = 10 m s^{-2}.)

A. 180 m
B. 540 m
C. 720 m
D. 900 m

21. **< HKCE 1993 Paper II - 3 >**

An object is thrown vertically upwards from a point *A*. It travels to the highest point *B* and then falls back to *A*. Neglecting air resistance, which of the following statements is/are true ?

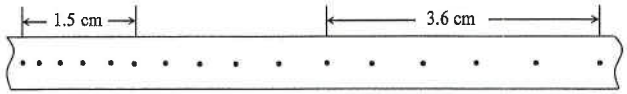
(1) The total displacement of the object is zero.
(2) The acceleration of the object is constant throughout the motion.
(3) The time for the upward motion is longer than the time for the downward motion.

A. (1) only
B. (3) only
C. (1) & (2) only
D. (2) & (3) only

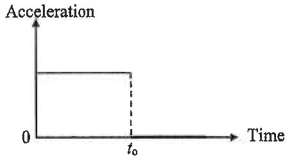
22. **< HKCE 1993 Paper II - 2 >**

The paper tape shown is obtained from a trolley moving with uniform acceleration. The frequency of the ticker-tape timer is 50 Hz. Find the acceleration of the trolley.

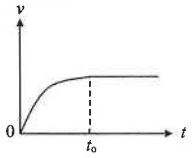
A. 0.21 m s^{-2}
B. 0.70 m s^{-2}
C. 0.73 m s^{-2}
D. 1.05 m s^{-2}

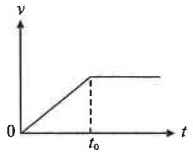


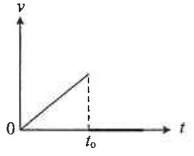
23. **< HKCE 1993 Paper II - 5 >**

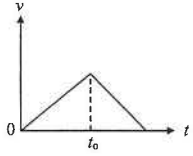


The above diagram shows the variation of the acceleration of an object which is initially at rest. Which of the following velocity-time graphs correctly describes the motion of the object ?

A. 

B. 

C. 

D. 

24. **< HKCE 1994 Paper II - 5 >**

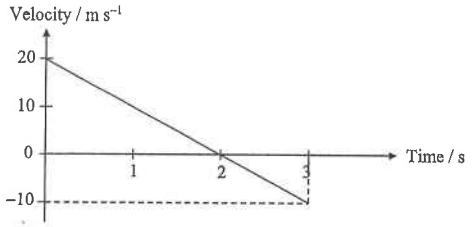
A man takes 30 s to walk 80 m towards the east. He then takes 10 s to run 60 m towards the south. Which of the following statements is/are correct ?

(1) The magnitude of the resultant displacement of the man is 140 m.
(2) The average speed of the man is 4.3 m s^{-1}.
(3) The magnitude of the average velocity of the man is 2.5 m s^{-1}.

A. (1) only
B. (3) only
C. (1) & (2) only
D. (2) & (3) only

Provided by dse.life

25. **< HKCE 1995 Paper II - 8 >**



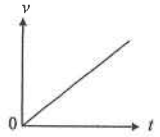
The above diagram shows the variation of the velocity of an object with time. What is the distance travelled by the object in the first 3 seconds ?

A. 5 m
B. 15 m
C. 25 m
D. 30 m

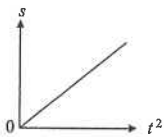
26. **< HKCE 1995 Paper II - 4 >**

An object starts from rest and moves with uniform acceleration along a straight line. Which of the graphs below concerning the motion of the object is/are correct ? (s = displacement, v = velocity, t = time)

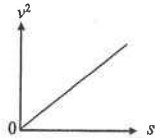
(1)



(2)



(3)



A. (1) only
B. (1) & (2) only
C. (2) & (3) only
D. (1), (2) & (3)

27. **< HKCE 1996 Paper II - 2 >**

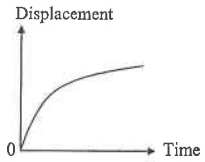
A man walks 40 m towards the west. He then walks 40 m towards the south and lastly walks 70 m towards the east. Find the magnitude of the resultant displacement of the man.

A. 30 m
B. 40 m
C. 50 m
D. 70 m

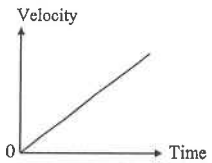
28. **< HKCE 1996 Paper II - 4 >**

An object moves with uniform acceleration along a straight line. Which of the following graphs correctly describe(s) the motion of the object ?

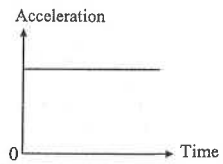
(1)



(2)



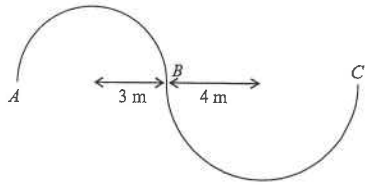
(3)



A. (1) only
B. (2) only
C. (1) & (3) only
D. (2) & (3) only

29. **< HKCE 1997 Paper II - 2 >**

A student walks along a curve ABC, which is made up of two semi-circular parts AB and BC of radius 3 m and 4 m respectively. He takes 2 s to walk from A to B and 5 s from B to C. Find the magnitude of the average velocity of the student from A to C.



A. 1.0 m s^{-1}
B. 2.0 m s^{-1}
C. 2.3 m s^{-1}
D. 3.1 m s^{-1}

30. **< HKCE 1997 Paper II - 6 >**

A particle is released from rest and falls vertically under gravity. If the distance travelled by the particle in the 1st second is x and that travelled in the 2nd second is y, find the ratio $x : y$.

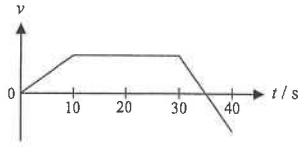
A. 1 : 1
B. 1 : 2
C. 1 : 3
D. 1 : 4

31. **< HKCE 1998 Paper II - 2 >**

A car undergoes uniform deceleration along a straight road. Its velocity decreases from 30 m s^{-1} to 20 m s^{-1} after travelling a distance of 100 m. How much further will the car travel before it comes to a rest ?

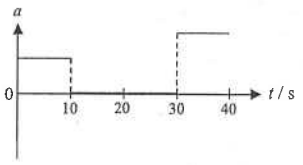
A. 50 m
B. 80 m
C. 180 m
D. 200 m

32. **< HKCE 1998 Paper II - 4 >**

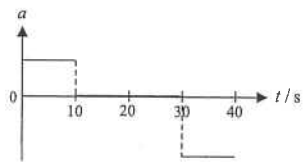


The velocity-time graph of a car travelling along a straight horizontal road is shown above. Which of the following graphs shows the variation of the acceleration a of the car with the time t ?

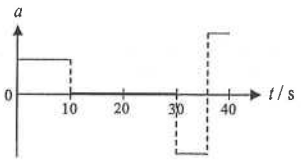
A.



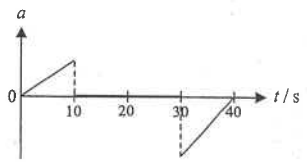
B.



C.



D.



Provided by dse.life

36. **< HKCE 2000 Paper II - 3 >**

A racing car accelerates from rest to a speed of 100 km h^{-1} in 3.2 s. Find the average acceleration of the car.

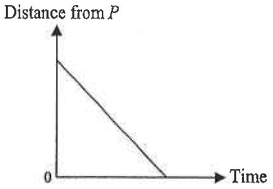
A. 4.34 m s^{-2}
B. 8.68 m s^{-2}
C. 15.63 m s^{-2}
D. 31.25 m s^{-2}

37. **< HKCE 2001 Paper II - 2 >**

A girl walks along a straight road from a point A to a point B with an average speed 1 m s^{-1}. She then returns from B to A along the same road with an average speed 2 m s^{-1}. Find the average speed of the girl for the whole journey.

A. zero.
B. 0.67 m s^{-1}
C. 1.33 m s^{-1}
D. 1.50 m s^{-1}

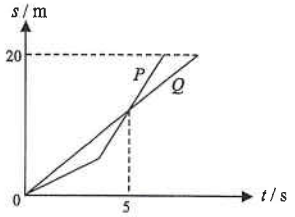
38. **< HKCE 2001 Paper II - 1 >**



A car travels along a straight road. The variation of the distance of the car from a fixed point P on the road with time is shown above. Which of the following statements is correct ?

A. The speed of the car is decreasing.
B. The car is moving towards P.
C. There is an unbalanced force acting on the car.
D. The area under the graph denotes the total distance travelled by the car.

39. **< HKCE 2002 Paper II - 1 >**



The figure above shows the distance-time graphs of two toy cars P and Q moving along linear track. Which of the following statements is/are correct ?

(1) Car P will reach the 20 m-mark first.
(2) Car P is overtaking car Q at $t = 5$ s.
(3) The average speed of car P in the first 5 s is smaller than that of car Q.

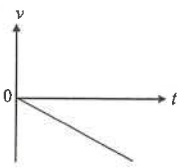
A. (1) & (2) only
B. (1) & (3) only
C. (2) & (3) only
D. (1), (2) & (3)

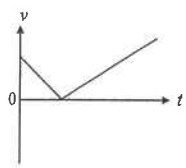
Provided by dse.life

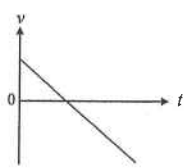
40. **< HKCE 2002 Paper II - 3 >**

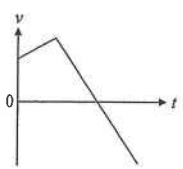
A piece of stone is hung from a balloon, which is rising vertically upward. If the string connecting the stone and the balloon suddenly breaks, which of the following velocity-time graphs represents the subsequent motion of the stone ?

(Note : Velocity pointing upward is taken to be positive.)

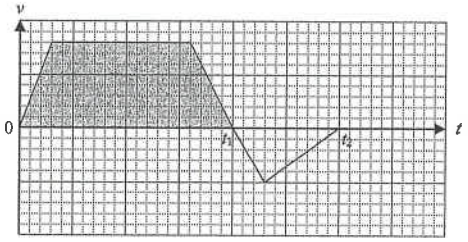
A. 

B. 

C. 

D. 

Questions 41 and 42 : The figure shows the velocity-time graph of a car travelling along a straight road.



41. **< HKCE 2003 Paper II - 1 >**

What physical quantity does the area of the shaded region represent ?

A. energy
B. momentum
C. acceleration
D. displacement

42. **< HKCE 2003 Paper II - 2 >**

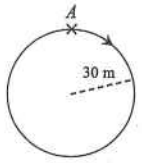
Which of the statements are correct ?

(1) The car changes its direction of travel at $t = t_1$.
(2) The car is farthest away from the starting point at $t = t_1$.
(3) The car returns to its starting point at $t = t_2$.

A. (1) & (2) only
B. (1) & (3) only
C. (2) & (3) only
D. (1), (2) & (3)

43. **< HKCE 2003 Paper II - 3 >**

A car starts at point A and travels along a circular path of radius 30 m. After 15 s, the car returns to point A. Find the average speed of the car within this period of time.



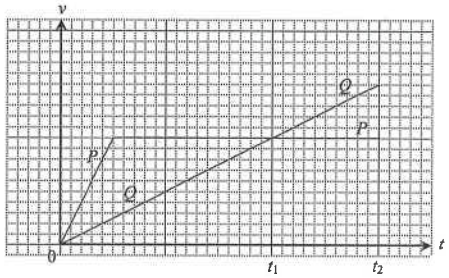
A. zero
B. 2 m s^{-1}
C. 6.3 m s^{-1}
D. 12.6 m s^{-1}

44. **< HKCE 2003 Paper II - 4 >**

A plane starts from rest and accelerates at 2 m s^{-2}. If the minimum take-off speed is 60 m s^{-1}, find the minimum distance travelled by the plane before it takes off.

A. 450 m
B. 900 m
C. 1800 m
D. 3600 m

45. **< HKCE 2004 Paper II - 3 >**



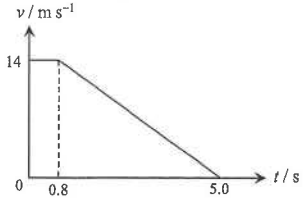
The figure shows the velocity-time graphs of two students P and Q running along a straight road. They start at the same point. Which of the following statements is/are correct ?

(1) The average speed of P between $t = 0$ and $t = t_1$ is larger than that of Q.
(2) At $t = t_1$, P and Q reach the same point.
(3) At $t = t_2$, Q is ahead of P.

A. (1) only
B. (3) only
C. (1) & (2) only
D. (2) & (3) only

Questions 46 and 47 :

Patrick is driving along a straight horizontal road. At time $t = 0$, he observes that an accident has happened. He then applies the brakes to stop his car with uniform deceleration. The graph shows the variation of the speed of the car with time.



46. **< HKCE 2005 Paper II - 1 >**

What is the reaction time of Patrick ?

A. zero
B. 0.8 s
C. 4.2 s
D. 5.0 s

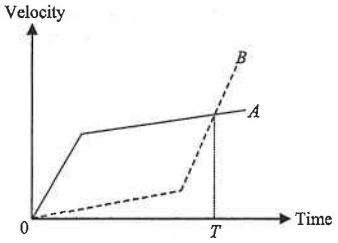
47. **< HKCE 2005 Paper II - 2 >**

Find the distance travelled by the car from time $t = 0$ to 5.0 s.

A. 29.4 m
B. 40.6 m
C. 46.2 m
D. 81.2 m

Provided by dse.life

48. < HKCE 2006 Paper II - 1 >



Two cars *A* and *B* start from rest simultaneously and travel along the same straight road. The velocity-time graphs of the two cars are shown above. Which of the following statements about the motion of the two cars is/are always correct ?

(1) *A* and *B* have the same average velocity during the time interval 0 to *T*.
(2) *A* and *B* have the same average acceleration during the time interval 0 to *T*.
(3) *A* and *B* travel the same displacement during the time interval 0 to *T*.

A. (1) only
B. (2) only
C. (1) & (3) only
D. (2) & (3) only

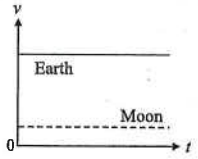
49. < HKCE 2006 Paper II - 28 >

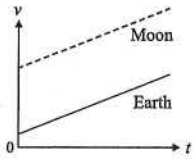
A car travels along a straight road from *A* to *B* with a uniform acceleration. The speed of the car is v_1 at the instant when half of the journey time from *A* to *B* is elapsed and its speed is v_2 at the mid-way of *A* and *B*. Which of the following is correct ?

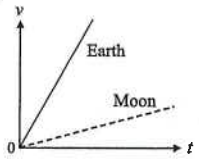
A. v_1 is always smaller than v_2.
B. v_1 is always greater than v_2.
C. v_1 and v_2 are always equal.
D. Whether v_1 is greater than or smaller than v_2 depends on the initial velocity of the car at *A*.

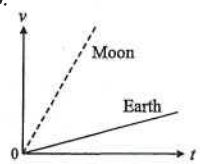
50. < HKCE 2006 Paper II - 7 >

The acceleration of objects due to gravity on the Moon is about 1/6 that on the Earth. Which of the following diagrams shows the correct velocity-time graphs for a free falling object dropping respectively on the Earth's surface and the Moon's surface ?

A.


B.


C.


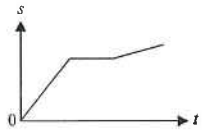
D.


51. < HKCE 2007 Paper II - 1 >

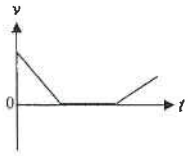
A bicycle finishes a 100-metre journey in 9.77 s. Assume that the bicycle starts from rest and moves with a uniform acceleration. What is the acceleration of the bicycle throughout the journey ?

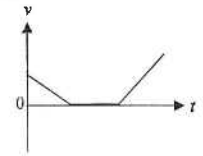
A. 1.05 m s^{-2}
B. 2.10 m s^{-2}
C. 10.2 m s^{-2}
D. 20.5 m s^{-2}

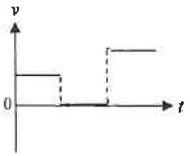
52. The displacement-time graph of an object moving along a straight line is shown below.
(07)

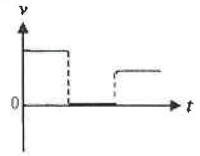


Which of the following graphs best represents the relationship between the velocity and time of the object ?

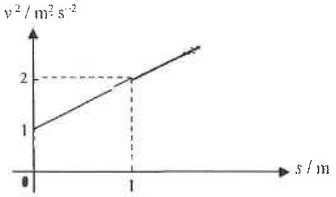
A.


B.


C.


D.


53.
(07)



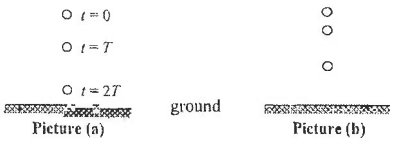
The above graph shows the variation of the square of velocity v^2 with the displacement *s* of a particle moving along a straight line. What is the acceleration of the particle ?

A. 0.5 m s^{-2}
B. 1 m s^{-2}
C. 1.5 m s^{-2}
D. 2 m s^{-2}

54. A fish jumps up vertically to a maximum height of 0.5 m above the water surface. What is the speed when it just leaves the surface ?
(08)

A. 3.13 m s^{-1}
B. 4.43 m s^{-1}
C. 6.26 m s^{-1}
D. 9.81 m s^{-1}

55.
(08)

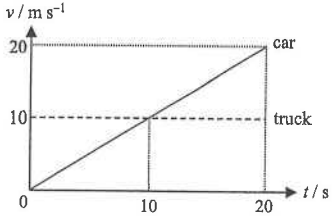


An experiment is conducted by releasing a stone from rest to the ground. At constant time interval *T*, the positions of the stone are recorded. Picture (a) shows its positions at different time. Which of the following changes will give a path of the stone as shown in Picture (b) ? (Neglect air resistance.)

A. A shorter time interval is used.
B. A longer time interval is used.
C. A lighter stone is used.
D. A heavier stone is used.

Provided by dse.life

56. **< HKCE 2008 Paper II - 6 >**

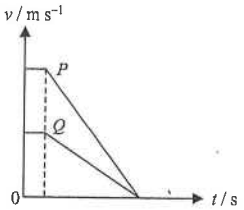


At $t = 0$, a car and a truck are at the same point on a horizontal straight road. Their velocity - time graph is shown in the figure above. Which of the following statements is correct ?

At $t = 10$ s, the car is 100 m behind the truck.
At $t = 10$ s, the car catches up the truck.
At $t = 20$ s, the car is 100 m behind the truck.
At $t = 20$ s, the car catches up the truck.

57. **< HKCE 2009 Paper II - 5 >**

John and Mary are driving two cars, P and Q, along a straight horizontal road respectively. At time $t = 0$, they both see an obstacle and apply the brakes to stop the cars with uniform deceleration. The variation of velocity with time of the two cars is shown in the figure below. Which of the following statements is/are correct ?



(1) The two cars have the same initial speeds.
(2) The reaction times of John and Mary are the same.
(3) The total stopping distances of the two cars are the same.

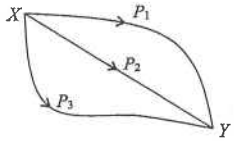
(2) only
(3) only
(1) & (2) only
(1) & (3) only

58. **< HKCE 2009 Paper II - 1 >**

A car is travelling at a constant speed of 50 km h^{-1}. How much time does it take to travel 500 m ?

0.1 s
10 s
36 s
360 s

59. **< HKCE 2009 Paper II - 2 >**



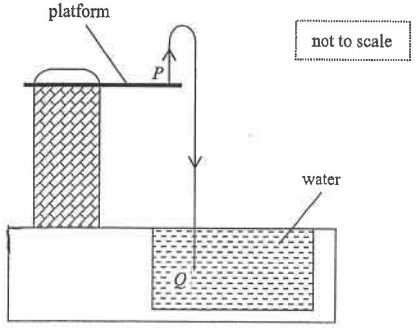
The figure above shows three paths P_1, P_2 and P_3 from X to Y on a horizontal plane. Three students take the same time to travel from X to Y via the three paths respectively. Which of the following physical quantities about their journey is/are the same ?

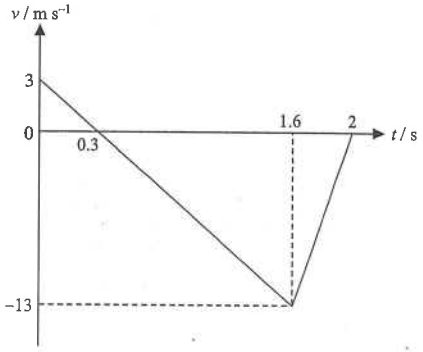
(1) displacement
(2) distance
(3) average speed

(1) only
(2) only
(1) & (3) only
(2) & (3) only

60. **< HKCE 2009 Paper II - 28 >**

A diver jumps up vertically in the air from a high platform and falls into water. The v-t graph below shows the variation of the velocity of the diver against time from the point he jumps (P) until he is at the lowest point (Q) in the water.

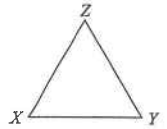




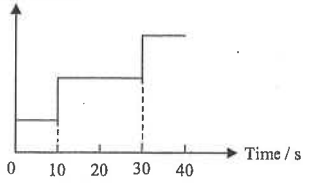
Which of the following is correct ?

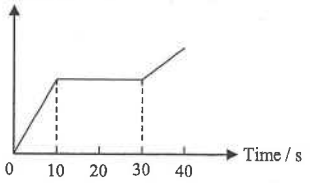
	total distance travelled from P to Q	height of the platform above water surface
A.	8.9 m	8 m
B.	10.6 m	10 m
C.	11.5 m	8 m
D.	11.5 m	10.6 m

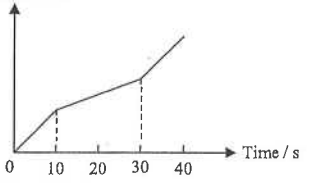
61. **< HKCE 2010 Paper II - 1 >**

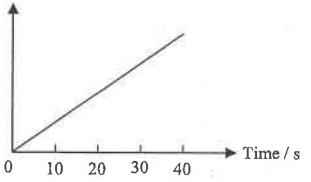


Mary walks along a triangular path XYZ where $XY = YZ = ZX$. It takes her 10 s, 20 s and 10 s to travel through XY, YZ and ZX respectively. Which of the following graphs best represents the variation of distance travelled with time ?

A.


B.


C.


D.


Provided by dse.life

M62 (11) An object of mass m, released from rest at height h above the ground, takes time t to reach the ground. If another object of mass $2m$ is released from rest at the same height, how long does it take to reach the ground ? (Neglect air resistance.)

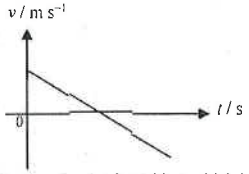
A. $\frac{t}{\sqrt{2}}$

B. $\frac{t}{2}$

C. t

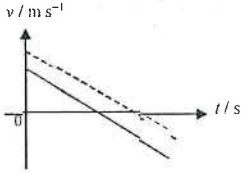
D. $\sqrt{2}\,t$

M63. (11)

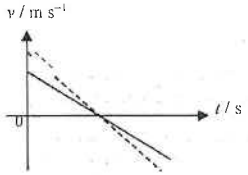


The graph above shows the velocity-time graph of an object which is thrown vertically upwards under gravity. If the object is thrown vertically upwards with a higher initial velocity, which of the following graphs (in dotted lines) best represents the expected result ? (Neglect air resistance.)

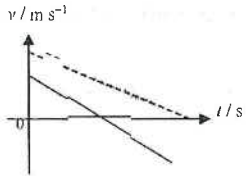
A.



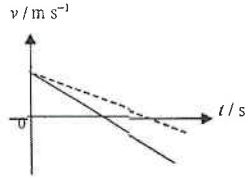
B.



C.



D.



Provided by dse.life

M78. a ball is released from rest at a certain height above the ground. If air resistance is neglected, what is the ratio of (6) the distance travelled by the stone in the second to that travelled in the third second?

A. 1 : 3
B. 1 : 5
C. 3 : 5
D. 5 : 8

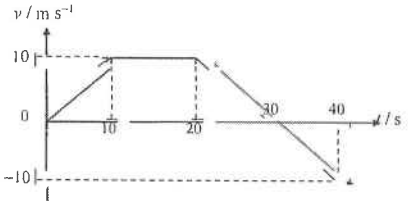
Part C:

The following questions are designed to give supplemental exercise for this chapter.

M69. A car travels with a speed of 18 m s^{-1}. The driver suddenly sees a girl standing at 36 m in front. If the reaction time of the driver is 0.5 s, what should be the minimum deceleration of the car in order to avoid collision with the girl ?

A. 3.0 m s^{-2}
B. 4.5 m s^{-2}
C. 6.0 m s^{-2}
D. 9.0 m s^{-2}

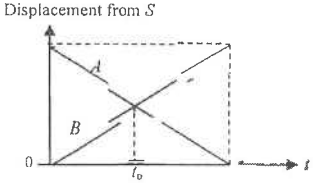
M70.



The figure shows the time variation of the velocity of a car travelling along a straight road, starting from rest at a certain point *P*. What is the maximum distance from the point *P* that the car would reach within the time shown in the figure ?

A. 100 m
B. 150 m
C. 200 m
D. 250 m

M71.



Two cars *A* and *B* move along the same straight road. The variations of their displacement from an oil station *S* with time are shown in the above figure. Which of the following statements is/are correct ?

(1) The cars travel with the same velocity.
(2) At time t_o, the two cars meet each other.
(3) The two cars have travelled the same distance from $t = 0$ to $t = t_o$.

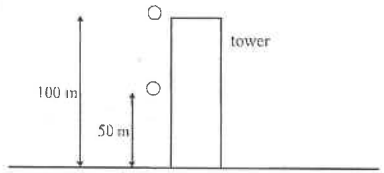
A. (2) only
B. (3) only
C. (1) & (2) only
D. (2) & (3) only

M72 Peter walks along a straight road from point *P* to point *Q* with an average speed of 2 m s^{-1}. He then runs back from *Q* to *P* along the same road with an average speed of 4 m s^{-1}. Which of the following statements are correct ?

(1) The resultant displacement of Peter in the whole journey is zero.
(2) The average velocity of Peter in the whole journey is 0 m s^{-1}.
(3) The average speed of Peter in the whole journey is 3 m s^{-1}.

A. (1) & (2) only
B. (1) & (3) only
C. (2) & (3) only
D. (1), (2) & (3)

M73. In the figure shown, one ball is released from rest at the top of a tower that is 100 m high. The other ball is released from rest at the mid-point of the tower. Which of the following quantities is the same for both balls as they fall in air ? (Neglect air resistance.)



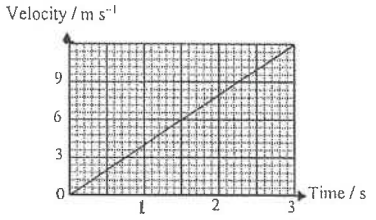
A. change of velocity just before reaching the ground
B. acceleration during the fall
C. final velocity just before reaching the ground
D. time of travel in the journey

M74. A boy wants to measure the height of building. He releases a stone at the top of the building from rest and starts to keep the time. If the stone takes 2 s to reach the mid-height of the building, which of the following statements is/are correct ? Take g to be 10ms-2.

(1) The height of the building is 40m.
(2) The stone takes 4s to reach the bottom of the building
(3) The stone reaches the bottom of the building with a speed of 40ms-1

A. (1) only
B. (3) only
C. (1) & (2) only
D. (2) & (3) only

M75. The graph shows the velocity of a body travelling in a straight line. What is the average velocity of the body during the first 3 s ?



A. 4 m s^{-1}
B. 6 m s^{-1}
C. 9 m s^{-1}
D. 12 m s^{-1}

M76. A car takes 20 s to travel the first 80 m, and another 10 s to travel a further 70 m. What is the average speed ?

A. 2.5 m s^{-1}
B. 4.0 m s^{-1}
C. 5.0 m s^{-1}
D. 5.5 m s^{-1}

M77. Peter throws a ball downwards at an initial velocity of 5 m s^{-1} from the top of a building. After3 s, the ball reaches the ground. What is the height of the building ?

A. 29 m
B. 44 m
C. 59 m
D. 88 m

Provided by dse.life

78. A feather is dropped downwards with an initial velocity of 2 m s^{-1} at a height of 15 m above the surface of the Moon. It is known that the acceleration due to gravity on the Moon's surface is 16% of that of the Earth. Calculate the speed of the feather when it reaches the surface of the Moon.

A 6.85 m s^{-1}
B 7.15 m s^{-1}
C 8.45 m s^{-1}
D 9.25 m s^{-1}

79. Two balls of the same mass are dropped from the top of a tall building one after the other. Air resistance is negligible. The separation between the two balls

A remains constant.
B decreases with time.
C increases with time.
D depends on the mass of the two balls.

80. Two identical balls are held above the ground as shown. One ball is higher than the other ball by a separation Δs. Air resistance is negligible. Suppose the two balls are released at the same time. During the flight, their separation will

A remain constant.
B decreases with time.
C increases with time.
D increases and then decreases.

81. A fish jumps up with a certain initial speed to leave the water surface. It reaches a maximum height of 80 cm above the water surface and returns back to the water. Treat the fish as a particle and neglect the air resistance, what is the time interval that the fish is above the water surface ? (Take g to be 10 m s^{-2}.)

A 0.2 s
B 0.4 s
C 0.8 s
D 1.6 s

82. Ball P is thrown vertically upwards from the ground with an initial velocity of 25 m s^{-1}. At the same time, ball Q is thrown vertically downwards with an initial velocity of 15 m s^{-1} at the top of a building 80 m above the ground. Assume air resistance is negligible and their motions are along the same vertical line, determine the height that the two balls meet.

Take the acceleration due to gravity to be 10 m s^{-2}.

A. 30 m
B. 40 m
C. 50 m
D. 60 m

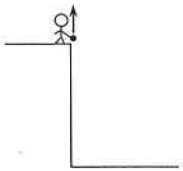
83. A particle accelerates from rest with a uniform acceleration a along a straight line. It travels a distance of x in the third second and travels a distance of y in the fifth second. Find the ratio of x to y.

A. 3 : 5
B. 5 : 9
C. 9 : 16
D. 9 : 25

84. A car travels with a constant speed of 50 km h^{-1} during a time interval. Which of the following values CANNOT be the possible average velocity of the car in this time interval ?

A. 0 km h^{-1}
B. 25 km h^{-1}
C. 50 km h^{-1}
D. 75 km h^{-1}

85. A boy throws a small ball upwards with an initial velocity of 15 m s^{-1} at the top of a building. The height of the building is 30 m. If air resistance is negligible, calculate the time taken for the ball to reach the ground.



A. 2.22 s
B. 3.33 s
C. 4.44 s
D. 5.55 s

86. A particle moves with an initial velocity of 5 m s^{-1} on a straight line under a uniform acceleration of 2 m s^{-2}. What is the distance travelled by the particle in the fourth second ?

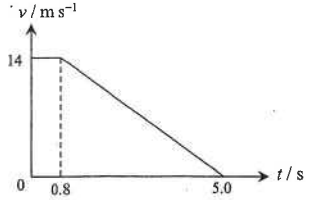
A. 12 m
B. 24 m
C. 36 m
D. 48 m

87. A ball is thrown vertically upwards with an initial velocity of 16 m s^{-1}. What is the total distance travelled by the ball when it returns to the original position.

A. 13 m
B. 18 m
C. 26 m
D. 32 m

Part D : HKDSE examination questions

88. **< HKDSE Sample Paper IA - 7 >**



Patrick is driving along a straight horizontal road. At time $t = 0$, he observes that an accident has happened. He then applies the brakes to stop his car with uniform deceleration. The graph shows the variation of the speed of the car with time. Find the distance travelled by the car from time $t = 0$ to 5.0 s.

A. 29.4 m
B. 40.6 m
C. 46.2 m
D. 81.2 m

Provided by dse.life

89. **< HKDSE Sample Paper IA - 12 >**

Two small identical objects P and Q are released from the top of a building 80 m above the ground. Q is released 1 s after P. Neglecting air resistance, what is the maximum vertical separation between P and Q in the air ?

A. 5 m
B. 10 m
C. 35 m
D. 45 m

90. **< HKDSE Practice Paper IA - 7 >**

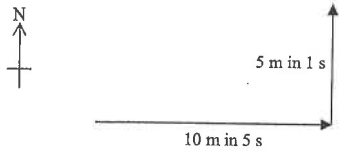
A stone falls from rest. Neglecting air resistance, the ratio of the distance travelled by the stone in the 1st second to that travelled in the 2nd second is

A. 1 : 1
B. 1 : 2
C. 1 : 3
D. 1 : 4

91. **< HKDSE Practice Paper IA - 6 >**

A toy car travelled due east for 10 m in 5 s, then immediately turned north and travelled 5 m for 1 s. What was the average speed of the car ?

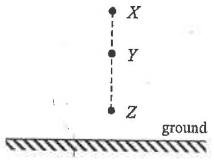
A. 1.9 m s^{-1}
B. 2.2 m s^{-1}
C. 2.5 m s^{-1}
D. 3.5 m s^{-1}



92. **< HKDSE 2013 Paper IA - 8 >**

A particle is released from rest at X as shown. It takes time t_1 to fall from X to Y and time t_2 to fall from Y to Z. If $XY : YZ = 9 : 16$, find $t_1 : t_2$. Neglect air resistance.

A. 2 : 3
B. 3 : 4
C. 4 : 3
D. 3 : 2

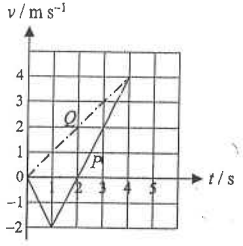


93. **< HKDSE 2013 Paper IA - 11 >**

Two particles P and Q start from the same position and travel along the same straight line. The above figure shows the velocity-time (v-t) graph for P and Q. Which of the following descriptions about their motion is/are correct ?

(1) At $t = 1$ s, P changes its direction of motion.
(2) At $t = 2$ s, the separation between P and Q is 4 m.
(3) At $t = 4$ s, P and Q meet each other.

A. (1) only
B. (2) only
C. (1) & (3) only
D. (2) & (3) only



94. **< HKDSE 2014 Paper IA - 5 >**

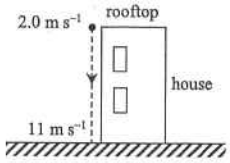
A particle is moving along a straight line with uniform acceleration. It takes 4 s to travel a distance of 36 m and then 2 s to travel the next 36 m. What is its acceleration ?

A. 2.5 m s^{-2}
B. 3.0 m s^{-2}
C. 4.0 m s^{-2}
D. 4.5 m s^{-2}

95. **< HKDSE 2014 Paper IA - 9 >**

A particle is projected vertically downward with an initial speed of 2.0 m s^{-1} from the rooftop of a house. The particle reaches the ground with a speed of 11 m s^{-1} as shown. Estimate the height of the house. Neglect air resistance.

A. 3.3 m
B. 6.0 m
C. 6.5 m
D. 12 m

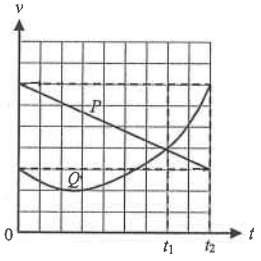


96. **< HKDSE 2015 Paper IA - 4 >**

The figure shows the velocity-time (v-t) graph of two cars P and Q travelling along the same straight road. At $t = 0$, the cars are at the same position. Which deductions about the cars between $t = 0$ and $t = t_2$ are correct ?

(1) P and Q are always travelling in the same direction.
(2) At $t = t_1$, the separation between P and Q is at a maximum.
(3) At $t = t_2$, Q lags behind P.

A. (1) & (2) only
B. (1) & (3) only
C. (2) & (3) only
D. (1), (2) & (3)



97. **< HKDSE 2015 Paper IA - 9 >**

A particle travels at 2.0 m s^{-1} due east for 1.5 s and then travels at 4.0 m s^{-1} due north for 1.0 s. What is the magnitude of its average velocity for the whole journey ?

A. 2.0 m s^{-1}
B. 2.8 m s^{-1}
C. 3.0 m s^{-1}
D. 5.0 m s^{-1}

98. **< HKDSE 2016 Paper IA - 4 >**

The speedometer of a car shown indicates the car's

A. instantaneous speed.
B. instantaneous velocity.
C. average speed of the whole journey.
D. average velocity of the whole journey.

Provided by dse.life

99. < HKDSE 2017 Paper IA - 5 >

Which of the following statements about the motion of any two objects is correct ?

The object that takes a shorter time to complete the same path must have greater average speed.

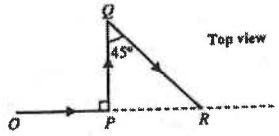
The object that travels a greater distance in 1 s must have greater average velocity.

The object with greater velocity must have greater acceleration.

If the two objects have the same acceleration, they must be moving in the same direction.

100. <HKDSE 2019 Paper IA-4>

101 <HKDSE 2020 Paper IA-4>



A car takes 8 minutes to travel along a path $OPQR$ on a horizontal surface as shown. Given that $OP = PQ = 2$ km, find the magnitude of the average velocity of the car in this journey.

A. 30 km h^{-1}
B. 36 km h^{-1}
C. 41 km h^{-1}
D. 51 km h^{-1}

HKEAA's Marking Scheme is prepared for the markers' reference. It should not be regarded as a set of model answers. Students and teachers who are not involved in the marking process are advised to interpret the Marking Scheme with care.

M.C. Answers

1. D	11. B	21. C	31. B	41. D	101. A
2. A	12. B	22. D	32. B	42. A	
3. D	13. D	23. B	33. C	43. D	
4. D	14. B	24. B	34. D	44. B	
5. B	15. B	25. C	35. B	45. A	
6. D	16. D	26. D	36. B	46. B	
7. C	17. A	27. C	37. C	47. B	
8. C	18. C	28. D	38. B	48. B	
9. B	19. A	29. B	39. A	49. A	
10. C	20. B	30. C	40. C	50. C	
51. B	61. C	71. D	81. C	91. C	
52. D	62. C	72. A	82. A	92. D	
53. A	63. A	73. B	83. B	93. B	
54. A	64. B	74. A	84. D	94. B	
55. A	65. A	75. B	85. C	95. B	
56. D	66. C	76. C	86. A	96. D	
57. A	67. D	77. C	87. C	97. A	
58. C	68. C	78. B	88. B	98. A	
59. A	69. C	79. C	89. C	99. A	
60. C	70. C	80. A	90. C	**100. D**	

M.C. Solution

1. D

$s = ut + \frac{1}{2}at^2$ $\therefore$ $(4) = (0) + \frac{1}{2}g(1)^2$ $\therefore$ $g = 8\ \text{m s}^{-2}$

$s = ut + \frac{1}{2}gt^2 = (0) + \frac{1}{2}(8)(1+4)^2 = 100\ \text{m}$

2. A

From A to B: $s = ut + \frac{1}{2}at^2$ $\therefore$ $(100) = u(4) + \frac{1}{2}(9.81)(4)^2$ $\therefore$ $u = 5.38\ \text{m s}^{-1}$

From O to A: $v = u + at$ $\therefore$ $(5.38) = (0) + (9.81)t$ $\therefore$ $t = 0.548 \approx 0.55$ s

Provided by dse.life

3. D

✓ (1) Uniform velocity $\Rightarrow$ acceleration $a = 0$

✓ (2) Example : If a ball is projected upwards, its velocity is zero at the highest point, but $a = g \neq 0$

✓ (3) Example : If a car turns round with constant speed, as the direction is changing, the velocity varies.

4. D

s = area of the graph = $\frac{(2+4)\times 4}{2} = 12$ m

5. B

In vacuum, there is no air resistance, the ping-pong ball would fall under the acceleration due to gravity.

$v = u + at = 0 + gt$

$\therefore\ v \propto t$

$\therefore$ $v \sim t$ graph is a straight line through the origin

6. D

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

$\therefore\ 0 = u^2 + 2(-a)s$ $\therefore\ u^2 = 2as$ $\therefore\ u^2 \propto s$

$\therefore\ \left(\frac{u_1}{u_2}\right)^2 = \left(\frac{s_1}{s_2}\right)$ $\therefore\ \left(\frac{50}{70}\right)^2 = \left(\frac{15}{s_2}\right)$ $\therefore\ s_2 = 29.4$ m

7. C

a = slope of the graph = $\frac{6-0}{3-0} = 2\ \text{m s}^{-2}$

8. C

By $s = ut + \frac{1}{2}at^2 = (0) + \frac{1}{2}(9.81)t^2 \approx 4.9t^2$

After falling for 1 s : $s_1 = 4.9 \times (1)^2 = 4.9$ m

After falling for 2 s : $s_2 = 4.9 \times (2)^2 = 19.6$ m

After falling for 3 s : $s_3 = 4.9 \times (3)^2 = 44.1$ m

Distance travelled in the first second = 4.9 m

Distance travelled in the third second = 44.1 − 19.6 = 24.5 m

9. B

× (1) Displacement increases in : 1 cm, 3 cm, 6 cm, 10 cm, 15 cm, 21 cm ; not uniformly

✓ (2) Length of each section of tape represents the velocity
$\therefore$ Velocity increases in unit of : 1, 2, 3, 4, 5, 6 ; i.e. increases uniformly

× (3) Since velocity increases uniformly, the acceleration is constant and not increasing

10. C

$s = ut + \frac{1}{2}at^2 = (0)t + \frac{1}{2}at^2$

$\therefore$ slope of the graph = $\frac{1}{2}a$

$\therefore\ \frac{4-0}{4-0} = \frac{1}{2}a$ $\therefore\ a = 2\ \text{m s}^{-2}$

OR

At $t^2 = 4\ \text{s}^2$, displacement $s = 4$ m.

By $s = ut + \frac{1}{2}at^2$ $\therefore\ (4) = (0) + \frac{1}{2}a(4)$ $\therefore\ a = 2\ \text{m s}^{-2}$

11. B

Time interval for each flash = $\frac{1}{2} = 0.5$ s

At MN, average speed : $v = \frac{36-16}{0.5} = 40\ \text{cm s}^{-1}$

12. B

× (1) It falls with the acceleration due to gravity, thus the speed is increasing.

× (2) After 1 s, $s = ut + \frac{1}{2}at^2 = (0) + \frac{1}{2}(9.8)(1)^2 = 4.9$ m.
Moreover, as it falls with acceleration, the distance travelled in every second should be increasing.

✓ (3) Acceleration of 9.8 m s^{-2} means in each second, there is a change in velocity of 9.8 m s^{-1}.
After 2 s, speed = $9.8 \times 2 = 19.6\ \text{m s}^{-1}$.

13. D

At the maximum height, velocity is zero

but the acceleration of the particle is still equal to the acceleration due to gravity which is pointing downwards.

14. B

As air has been evacuated, the tube is vacuum, thus there is no air resistance acting on the falling object.

Coin : falls with uniform acceleration (as it falls under gravity)

Feather : falls with same uniform acceleration (as it experiences the same acceleration due to gravity if no air resistance)

15. B

By $v^2 = u^2 + 2as$ $\therefore\ v^2 = 2as$

$\therefore$ slope of the graph = $2a$ $\therefore\ \frac{4-0}{2-0} = 2a$ $\therefore\ a = 1\ \text{m s}^{-2}$

OR

At the point when $s = 3$ m, $v^2 = 6\ \text{m}^2\ \text{s}^{-2}$

By $v^2 = u^2 + 2as$ $\therefore\ (6) = (0) + 2a(3)$ $\therefore\ a = 1\ \text{m s}^{-2}$

Provided by dse.life

16. D

Time interval between 2 flashes $= \frac{1}{5} = 0.2$ s

$u = \frac{0.04}{0.2} = 0.2\,\text{m s}^{-1}$ (occur at the instant of the mid point of 4 cm)

$v = \frac{0.12}{0.2} = 0.6\,\text{m s}^{-1}$ (occur at the instant of the mid point of 12 cm)

From the instant of u to the instant of v, there are only 2 time intervals, that is, 2 × 0.2 s.

$\therefore\ a = \frac{v-u}{t} = \frac{0.6-0.2}{2\times0.2} = 1\,\text{m s}^{-2}$

17. A

✓ (1) a = slope of the graph $= \frac{20-10}{10-0} = 2\,\text{m s}^{-2}$

× (2) s = area of the graph $= \frac{1}{2}(10+25)\times20 = 350$ m

× (3) At 25 s, the displacement s is 350 m, which is not 0 m, thus it is not the starting point.

18. C

Slope of $s \sim t$ graph represents velocity.

For a particle moving with deceleration, its velocity is decreasing.

The $s \sim t$ graph with decreasing slope represents uniform deceleration.

19. A

$v = \frac{\text{resultant displacement}}{\text{total time taken}} = \frac{3}{2+3} = 0.6\,\text{m s}^{-1}$

20. B

Displacement s = net area of v-t graph

$= \frac{1}{2}(6)(60) - \frac{1}{2}(18-6)(120)$

$= -540$ m

$\therefore$ The displacement is 540 m in downward direction

$\therefore$ Height of the cliff is 540 m

21. C

✓ (1) Falling back to A means returning to the original position $\therefore\ s = 0$

✓ (2) When moving in air, the acceleration is equal to the acceleration due to gravity g which is constant.

× (3) Same acceleration in upward and downward motion if there is no air resistance
$\therefore$ time for upward motion = time for downward motion

22. D

Time interval between 2 dots : 1 tick $= \frac{1}{50} = 0.02$ s

$u = \frac{0.015}{5\times0.02} = 0.15\,\text{m s}^{-1}$ (occur at the instant of the mid point of 1.5 cm)

$v = \frac{0.036}{5\times0.02} = 0.36\,\text{m s}^{-1}$ (occur at the instant of the mid point of 3.6 cm)

From the instant of u to the instant of v, there are 10 ticks, that is, 10 × 0.02 s.

$\therefore\ a = \frac{v-u}{t} = \frac{0.36-0.15}{10\times0.02} = 1.05\,\text{m s}^{-2}$

23. B

Slope of the $v \sim t$ graph = acceleration

Before $t = t_0$, acceleration is positive and constant, $v \sim t$ graph is a straight line that v increases from 0 to v

After $t = t_0$, acceleration is zero, thus $v \sim t$ graph a horizontal line and velocity continues from v and remains constant

24. B

× (1) Displacement $s = \sqrt{80^2+60^2} = 100$ m

× (2) speed $= \frac{80+60}{30+10} = 3.5\,\text{m s}^{-1}$

✓ (3) $v = \frac{100}{30+10} = 2.5\,\text{m s}^{-1}$

25. C

Distance travelled = total area of the graph between the line and the x-axis

As distance is a scalar, the direction is not relevant.

Thus, the absolute value of the area represents the distance travelled.

$\therefore\ d = \frac{1}{2}(20)(2) + \frac{1}{2}(3-2)(10) = 25$ m

26. D

✓ (1) $v = u + at = 0 + at$ $\therefore\ v \propto t$

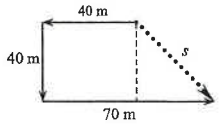
✓ (2) $s = ut + \frac{1}{2}at^2 = 0 + \frac{1}{2}at^2$ $\therefore\ s \propto t^2$

✓ (3) $v^2 = u^2 + 2as = 0 + 2as$ $\therefore\ v^2 \propto s$

27. C

The resultant displacement s is pointing from the starting position to the final position.

$s = \sqrt{(40)^2+(30)^2} = 50$ m



Provided by dse.life

28. D

× (1) Slope of $s \sim t$ graph = velocity.
Decreasing slope ⇒ decreasing velocity.
∴ The $s \sim t$ graph with decreasing slope represents uniform deceleration, not acceleration.

✓ (2) Slope of $v \sim t$ graph = acceleration.
Slope of $v \sim t$ graph is positive and is a straight line ⇒ a uniform acceleration.

✓ (3) Constant positive acceleration ⇒ uniform acceleration

29. B

$$\text{Average velocity} = \frac{\text{resultant displacement}}{\text{total time taken}}$$

$$\therefore \quad v = \frac{3\times2+4\times2}{2+5} = 2\ \text{m s}^{-1}$$

30. C

By $s = \frac{1}{2} g t^2 = \frac{1}{2} (10) t^2 = 5 t^2$ (Take g to be 10 m s^{-2} for simplicity.)

Displacement in 1 s : $s_1 = 5 \times (1)^2 = 5$ m

Displacement in 2 s : $s_2 = 5 \times (2)^2 = 20$ m

Distance travelled in the 1st second = 5 m

Distance travelled in the 2nd second = 20 – 5 = 15 m

Ratio = 5 : 15 = 1 : 3

31. B

By $v^2 = u^2 + 2as$ for the first journey

$\therefore \quad (20)^2 = (30)^2 + 2a(100) \qquad \therefore \quad a = -2.5\ \text{m s}^{-2}$

By $v^2 = u^2 + 2as$ for the second journey

$\therefore \quad (0)^2 = (20)^2 + 2(-2.5)s \qquad \therefore \quad s = 80$ m

32. B

slope of $v \sim t$ graph = a

For t = 0 s to t = 10 s, slope of $v \sim t$ graph is (+) ⇒ a is (+)

For t = 10 s to t = 30 s, slope of $v \sim t$ graph is 0 ⇒ a = 0

For t = 30 s to t = 40 s, slope of $v \sim t$ graph is (–) ⇒ a is (–)

33. C

$$v = \frac{s}{t} = \frac{120+100}{30+20}$$

$\therefore \quad v = 4.4\ \text{m s}^{-1}$

34. D

As slope of $v \sim t$ graph = acceleration,

When t = 0 s to t = 10 s, a : (+) ⇒ slope of $v \sim t$ graph : (+)

When t = 10 s to t = 20 s, a : (+) ⇒ slope of $v \sim t$ graph : 0 (a horizontal line)

When t = 20 s to t = 30 s, a : (+) with larger value ⇒ slope of $v \sim t$ graph : (+) with larger slope

35. B

× (1) At T_0, the two cars do not have same displacement, therefore, they do not meet each other.

× (2) At T_0, the two cars have the same positive velocity, thus they must move in the same direction.

✓ (3) Car A travels with increasing velocity while car B travels with decreasing velocity

36. B

$$v = \frac{100\times1000}{3600} = 27.78\ \text{m s}^{-1}$$

By $v = u + at$ $\therefore \quad (27.78) = (0) + a(3.2)$ $\therefore \quad a = 8.68\ \text{m s}^{-2}$

37. C

Assume an arbitrary value (任意數值) for the distance between A and B, say 10 m.

Time taken from A to B = $\frac{10}{1}$ = 10 s

Time taken from B to A = $\frac{10}{2}$ = 5 s

$$\text{Average speed} = \frac{\text{Total distance travelled}}{\text{Total time taken}} = \frac{10+10}{10+5} = 1.33\ \text{m s}^{-1}$$

38. B

× A. Since the slope represents the speed, a straight line indicates a constant speed without change.

✓ B. Since distance from P is decreasing, it is moving towards P.

× C. Since the speed is constant, acceleration is zero and thus no unbalanced (net) force acting on the car.

× D. Area under a distance-time graph has no physical meaning.

39. A

✓ (1) From the graph, when s = 20 m, car P has a smaller value of t.
Thus, P reaches the mark with a shorter time t.

✓ (2) From the graph, before t = 5 s, car Q has a larger value of s, car P is behind car Q.
At t = 5 s, car P and Q meet and car P is overtaking car Q.

× (3) Average speed = distance / time
In the first 5 s, car P and car Q travel the same distance, so they have the same average speed.

Provided by dse.life

40. C

When the string is broken, the stone has the same initial velocity as the balloon, thus it moves upward at $t = 0$.

So the stone first moves upward (v is positive), at the highest point, it is momentarily at rest ($v = 0$ m s^{-1}), and then falls down (v is negative).

During the whole motion of falling, the stone experiences the same acceleration due to gravity g, thus the slope of the graph is constant and equal to $-g$.

41. D

Area of a velocity-time graph represents the displacement of the car.

42. A

✓ (1) At $t = t_1$, $v = 0$, the car reaches the extreme point and is momentarily at rest, it then reverses its direction of travel.

✓ (2) After $t = t_1$, the car reverses its direction and travels backwards. Thus the car is farthest away at t_1.

× (3) The area from $t = 0$ to $t = t_1$ represents the distance travelled in forward direction while the area from $t = t_1$ to $t = t_2$ represents the distance travelled in backward direction. As the two areas are not equal, the car does not return to its starting point at t_2.

43. D

Distance travelled : $d = 2\pi \times (30) = 188.5$ m

Average speed $= \dfrac{d}{t} = \dfrac{188.5}{15} = 12.6$ m s^{-1}

44. B

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

$\therefore\ (60)^2 = (0) + 2(2)s$

$\therefore\ s = 900$ m

45. A

✓ (1) Area under a v-t graph represents the displacement.
At time t_1, area of P is greater, thus P travels a greater distance, therefore, P has a greater average speed.

× (2) At time t_1, P and Q have different areas, thus they have different displacements, therefore, they must be at different points.

× (3) At time t_2, the area under the graph of P is greater, thus P should have travelled a greater distance, therefore, P should be ahead of Q.

46. B

Reaction time is the time taken before Patrick takes action to brake the car, thus it is the time interval of the horizontal line.

47. B

Distance travelled = area under the graph from 0 to 5 s

$= \frac{1}{2}(5.0 + 0.8) \times 14$

$= 40.6$ m

48. B

× (1) Average velocity $= \dfrac{\text{resultant displacement}}{\text{total time}}$

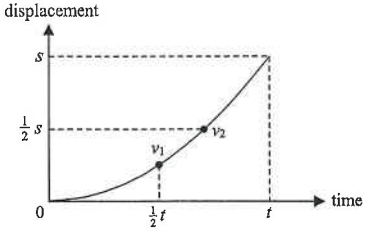
Since the area under the v-t graph represents the displacement, as the areas under the graph for A and B are different, they have different displacement from 0 to T, thus their average velocity must not be the same.

✓ (2) Average acceleration $= \dfrac{v-u}{t}$

As both cars have the same initial velocity u and final velocity v in time T, they must have the same average acceleration.

× (3) Since the areas under the two graphs A and B are different, their displacement must not be the same.

49. A



The displacement-time graph of a car undergoing acceleration is a quadratic curve shown as above.
At half of the time of the journey, the velocity is v_1 that is represented by the slope at that point.
At half of the displacement of the journey, the velocity is v_2 that is represented by the slope at that point.
Consider the slope, v_1 must be smaller than v_2.
OR
As the car is accelerating, the speed is increasing, thus v_2 is greater than v_1.

50. C

Slope of the v-t graph is the acceleration due to gravity g.
Since the acceleration due to gravity on the Moon is smaller, the slope should also be smaller, thus option C is the answer.

51. B

By $s = ut + \frac{1}{2}at^2$ $\therefore\ (100) = (0) + \frac{1}{2}a(9.77)^2$ $\therefore\ a = 2.10$ m s^{-2}

Provided by dse.life

52. D

Slope of the velocity-time graph = acceleration

Straight line indicates constant slope, and thus constant acceleration.

The first part is a constant acceleration.

The second part is zero acceleration.

The third part is a constant acceleration with values less than the first part, as the slope is smaller.

53. A

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

When $s = 0, u^2 = 1$ and when $s = 1, v^2 = 2$

$\therefore$ (2) = (1) + 2 a (1) $\therefore$ $a = 0.5\ \text{m s}^{-2}$

54. A

By $v^2 = u^2 + 2as$ $\therefore$ $(0) = u^2 + 2(-9.81)(0.5)$ $\therefore$ $u = 3.13\ \text{m s}^{-1}$

55. A

By $s = ut + \frac{1}{2}at^2$ $\therefore$ $s = \frac{1}{2}gt^2$

✓ A. As the positions of the stones are closer, i.e. s is smaller, thus a smaller time interval t should be used.

× B. If a longer time interval is used, the positions of the stone should be more separated.

× C. If a lighter stone is used, the positions should be unchanged since g is independent of the mass of stone.

× D. If a heavier stone is used, the positions should be unchanged since g is independent of the mass of stone.

56. D

Area under a $v - t$ graph = displacement

At $t = 10$ s :

displacement of the car = $\frac{1}{2}(10)(10) = 50$ m

displacement of the truck = $(10)(10) = 100$ m

$\therefore$ the car is 50 m behind the truck.

At $t = 20$ s :

displacement of the car = $\frac{1}{2}(20)(20) = 200$ m

displacement of the truck = $(10)(20) = 200$ m

$\therefore$ the car catches up the truck.

57. A

× (1) From the graph, the initial speed of P is about two times of that of Q.

✓ (2) The time interval of the horizontal line is the reaction time, which are the same.

× (3) The total stopping distance is represented by the area under the graph, thus the total stopping distance of P is greater than that of Q.

58. C

The speed of 50 km h^{-1} should be changed into the SI unit of $50 \times \frac{1000}{3600}$ m s^{-1}.

By $s = ut$ $\therefore$ $(500) = (50 \times \frac{1000}{3600})t$ $\therefore$ $t = 36$ s

59. A

✓ (1) Displacement is the distance between the starting point and the ending point. They have same displacement.

× (2) Distance travelled depends on the path, thus the three students have different distance travelled.

× (3) Average speed is the distance travelled per time taken. Although they take the same time, they have different distance, thus they have different average speed.

60. C

Total distance travelled from P to Q = total area under the graph from 0 s to 2 s

$= \frac{1}{2}(0.3) \times (3) + \frac{1}{2}(2 - 0.3) \times (13) = 11.5$ m

Displacement from P to the water surface = net area under the graph from 0 s to 1.6 s

$= \frac{1}{2}(0.3) \times (3) - \frac{1}{2}(1.6 - 0.3) \times (13) = -8$ m

Thus, height of the platform above water surface = 8 m

61. C

Slope of the distance-time graph represents the speed.

The speed through XY and ZX are the same since they take the same time.

The speed through YZ is smaller as it takes longer time, thus the slope through YZ is lower.

62. C

Since the acceleration due to gravity g is independent of mass,

thus the heavier body of mass 2 m falls with the same g to reach the ground, therefore, the time taken is the same, t.

63. A

Since the slope of the $v - t$ graph is equal to the acceleration due to gravity g,

and g is not affected by the initial velocity, thus the slope should be the same,

that is, the dotted line should be parallel to the original line.

64. B

As slope of $s \sim t$ graph = velocity,

At the 1st ¼ cycle, $v\uparrow$ and v is (+) $\Rightarrow$ slope of s-t graph $\uparrow$ and the slope is (+)

At the 2nd ¼ cycle, $v\downarrow$ and v is (+) $\Rightarrow$ slope of s-t graph $\downarrow$ and the slope is (+)

At the 3rd ¼ cycle, $v\uparrow$ and v is (–) $\Rightarrow$ slope of s-t graph $\uparrow$ and the slope is (–)

At the 4th ¼ cycle, $v\downarrow$ and v is (–) $\Rightarrow$ slope of s-t graph $\downarrow$ and the slope is (–)

Provided by dse.life

65. A

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

Let the speed of the object when it passes Y be v and let the distance between XY be d. Distance between YZ is also d.

$X \to Y$: $v^2 = (10)^2 + 2a(d)$

$Y \to Z$: $(20)^2 = v^2 + 2a(d)$

Combining the above two equations : $v^2 - (10)^2 = (20)^2 - v^2$

$\therefore\ 2v^2 = (10)^2 + (20)^2 \qquad \therefore\ v = 15.8\ \text{m s}^{-1}$

66. C

For simplicity, take g to be $10\ \text{m s}^{-2}$.

As both balls are released from rest, $u = 0$.

Displacement of A at time t after A is released : $s_A = ut + \frac{1}{2}at^2 = \frac{1}{2}(10)t^2 = 5t^2$

Displacement of B at time t after A is released : $s_B = 5(t-2)^2$ (Ball B falls at 2 s later)

Maximum separation occurs when A just reaches the ground, that is, A falls for 180 m.

$\therefore\ (180) = 5t^2 \qquad \therefore\ t = 6\ \text{s}$

When A just reaches the ground : $s_B = 5(6-2)^2 = 80\ \text{m}$

Maximum separation $= 180 - 80 = 100\ \text{m}$

67. D

Let the height of the building be h and the time taken to reach the ground be t.

By $s = \frac{1}{2}gt^2$ if the motion starts from rest at the top

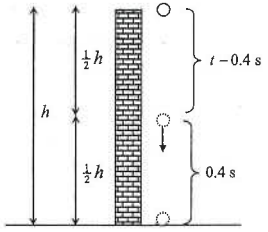
Motion from top to the mid point : $(\frac{1}{2}h) = \frac{1}{2}g(t-0.4)^2 \quad \ldots\ (1)$

Motion from top to the bottom : $(h) = \frac{1}{2}gt^2 \quad \ldots\ (2)$

$\frac{(1)}{(2)}$: $\frac{1}{2} = \frac{(t-0.4)^2}{t^2} \qquad \therefore\ t^2 = 2(t-0.4)^2$

Both sides take square root :

$\therefore\ t = 1.414(t-0.4) \qquad \therefore\ 1.414t - t = 1.414 \times 0.4 \qquad \therefore\ t = 1.37\ \text{s}$



68. C

Take $g = 10\ \text{m s}^{-2}$.

By $s = ut + \frac{1}{2}at^2 = \frac{1}{2}(10)t^2 = 5t^2$

After 1 s, $s = 5 \times (1)^2 = 5\ \text{m}$

After 2 s, $s = 5 \times (2)^2 = 20\ \text{m}$

After 3 s, $s = 5 \times (3)^2 = 45\ \text{m}$

Distance travelled in the second sec $= 20 - 5 = 15\ \text{m}$

Distance travelled in the third sec $= 45 - 20 = 25\ \text{m}$

Ratio $= 15 : 25 = 3 : 5$

69. C

Distance travelled by the car in 0.5 s $= 18 \times 0.5 = 9\ \text{m}$

Distance of the girl from the car when the brake is applied $= 36 - 9 = 27\ \text{m}$

By $v^2 = u^2 + 2as \qquad \therefore\ (0) = (18)^2 + 2a(27) \qquad \therefore\ a = -6\ \text{m s}^{-2}$

$\therefore$ Minimum deceleration $= 6\ \text{m s}^{-2}$

70. C

Maximum distance from P = area from 0 to 30 s

$= \frac{1}{2} \times (10 + 30) \times 10 = 200\ \text{m}$

71. D

× (1) Since car A is moving towards S but car B is moving away from S, they move in opposite directions. As their directions are not the same, their velocities must not be the same.

✓ (2) At t_o, since they are at the same position, they meet each other.

✓ (3) Since they have the same speed, they must have travelled the same distance in the same time.

72. A

✓ (1) As Peter returns to the original position, the resultant displacement is zero.

✓ (2) Average velocity is defined as the total displacement per total time taken. As the total displacement is zero, the average velocity must be zero.

× (3) Assume the distance between P and Q is D.

Time taken to travel from P to $Q = \frac{D}{2}$

Time taken to travel from Q to $P = \frac{D}{4}$

Average speed in whole journey $= \frac{D+D}{D/2 + D/4} = 2.67\ \text{m s}^{-1}$

73. B

All bodies fall down with the same acceleration g in air where g is the acceleration due to gravity, if air resistance is neglected.

74. A

✓ (1) By $s = \frac{1}{2}gt^2 = \frac{1}{2}(10)(2)^2 \qquad \therefore\ s = 20\ \text{m}$

$\therefore$ mid height $= 20\ \text{m}$

$\therefore$ height of the building $= 2 \times 20 = 40\ \text{m}$

× (2) By $s = \frac{1}{2}gt^2 \qquad \therefore\ (40) = \frac{1}{2}(10)t^2 \qquad \therefore\ t = 2.83\ \text{s}$

× (3) By $v = gt = (10)(2.83) = 28.3\ \text{m s}^{-1}$

Provided by dse.life

75. B

Displacement during the first 3 seconds = area under the graph = $\frac{1}{2} \times 3 \times 12 = 18$ m

Average velocity = $\frac{s}{t} = \frac{18}{3} = 6\ \text{m s}^{-1}$

76. C

Average speed = $\frac{d}{t} = \frac{80+70}{20+10} = 5.0\ \text{m s}^{-1}$

77. C

Since the ball falls down with acceleration, $a = +g$.

By $s = ut + \frac{1}{2}at^2$

$\therefore\ s = (5) \times (3) + \frac{1}{2}(9.81) \times (3)^2 = 59.145 \approx 59$ m

78. B

There is no air on Moon, thus there is no air resistance on the feather.

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

$\therefore\ v^2 = (2)^2 + 2\,(9.81 \times 16\%) \times (15)$

$\therefore\ v = 7.15\ \text{m s}^{-2}$

79. C

$\Delta s = s_1 - s_2 = \frac{1}{2}gt^2 - \frac{1}{2}g(t - t_0)^2 = g \cdot t \cdot t_0 - \frac{1}{2}g \cdot t_0^2$

As t increases, Δs increases.

Thus the separation Δs increases with time.

80. A

Since the two balls are released at the same time, their displacements are always the same,

thus, their separation remains unchanged throughout the flight.

81. C

From the instant of leaving the water surface to that reaching the maximum height :

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

$\therefore\ (0) = u^2 + 2\,(-10)\,(0.8)$

$\therefore\ u = 4\ \text{m s}^{-1}$

From the instant of leaving water surface to that of returning back to water surface :

By $s = ut + \frac{1}{2}at^2$

$\therefore\ (0) = (4)\,t + \frac{1}{2}(-10)\,t^2$

$\therefore\ t = 0.8$ s

82. A

For ball P : $s_1 = 25\,t + \frac{1}{2}(-10)\,t^2$

For ball Q : $s_2 = 15\,t + \frac{1}{2}(+10)\,t^2$

By $s_1 + s_2 = 80$

$\therefore\ 25\,t + 15\,t = 80 \qquad \therefore\ t = 2$ s

Height above the ground = $s_1 = 25 \times (2) + \frac{1}{2}(-10)\,(2)^2 = 30$ m

83. B

By $s = \frac{1}{2}at^2 \quad (u = 0)$

① $\quad x = \frac{1}{2}a\,(3^2 - 2^2)$

② $\quad y = \frac{1}{2}a\,(5^2 - 4^2)$

$\therefore\ x : y = (3^2 - 2^2) : (5^2 - 4^2) = 5 : 9$

84. D

During this time interval, the car travels a total distance d where $d = vt$.

If the car travels in straight line, then the resultant displacement s is equal to d, and the average velocity is 50 km h^{-1}

If the car does not travel in straight line, the resultant displacement s must be less than d,
average velocity may be 25 km h^{-1}.

If the car returns to the starting point finally, then $s = 0$, and the average velocity is 0 km h^{-1}.

The resultant displacement s can never be greater than d, thus the average velocity cannot be 75 km h^{-1}.

85. C

By $s = ut + \frac{1}{2}at^2$

$\therefore\ (-30) = (15)\,t + \frac{1}{2}(-9.81)\,t^2$

$\therefore\ t = 4.44$ s

86. A

By $s = ut + \frac{1}{2}at^2$

$\therefore\ \Delta s = u\,(t_2 - t_1) + \frac{1}{2}a\,(t_2^2 - t_1^2) = (5)\,(4 - 3) + \frac{1}{2}(2)\,(4^2 - 3^2) = 12$ m

87. C

Maximum height reached by the ball :

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

$\therefore\ (0) = (16)^2 + 2\,(-9.81)\,s$

$\therefore\ s = 13.0$ m

Total distance travelled = $13.0 \times 2 = 26$ m

Provided by dse.life

88. B

Distance travelled = area under the graph from 0 to 5 s = $\frac{1}{2}(5.0 + 0.8) \times 14 = 40.6$ m

89. C

For simplicity, take g to be 10 m s^{-2}.

For P, $s_P = ut + \frac{1}{2}at^2 = \frac{1}{2}(10)t^2 = 5t^2$

For Q, $s_Q = 5(t-1)^2$

$\Delta s = 5t^2 - 5(t-1)^2 = 10t - 5$

Maximum separation occurs when P just reaches the ground.

$\therefore \quad (80) = 5t^2 \quad \therefore \quad t = 4$ s

$\therefore \quad \Delta s_{max} = 10 \times 4 - 5 = 35$ m

90. C

By $s = \frac{1}{2}gt^2 = \frac{1}{2}(10)t^2 = 5t^2$ (Take g to be 10 m s^{-2} for simplicity.)

Displacement in 1 s : $s_1 = 5 \times (1)^2 = 5$ m

Displacement in 2 s : $s_2 = 5 \times (2)^2 = 20$ m

Distance travelled in the 1st second = 5 m

Distance travelled in the 2nd second = 20 – 5 = 15 m

Ratio = 5 : 15 = 1 : 3

91. C

Average speed = $\frac{d}{t} = \frac{10+5}{5+1} = 2.5$ m s^{-1}

92. D

From X to Y: $XY = \frac{1}{2}gt_1^2$

From X to Z: $XY + YZ = \frac{1}{2}g(t_1 + t_2)^2$

$$\frac{XY}{XY+YZ} = \frac{t_1^2}{(t_1+t_2)^2} \qquad \therefore \quad \frac{9}{9+16} = \left(\frac{t_1}{t_1+t_2}\right)^2$$

Take root of both sides :

$$\therefore \quad \frac{3}{5} = \frac{t_1}{t_1+t_2} \qquad \therefore \quad \frac{t_1}{t_2} = \frac{3}{2}$$

93. B

× (1) At $t = 1$ s, the velocity of P still remains negative, thus it is still moving in backward direction.

✓ (2) At $t = 2$ s, displacement of P is – 2 m and displacement of Q is + 2 m, thus their separation is 4 m.

× (3) At $t = 4$ s, since the area under the two graphs are not the same, their displacements are not the same, thus, they cannot meet each other.

94. B

Let the initial velocity of the particle be u and the acceleration be a.

By $s = ut + \frac{1}{2}at^2$

Consider the first 4 s :

$\therefore \quad (36) = u(4) + \frac{1}{2}a(4)^2$

$\therefore \quad 36 = 4u + 8a$

Consider the whole journey of 6 s :

$\therefore \quad (36+36) = u(6) + \frac{1}{2}a(6)^2$

$\therefore \quad 72 = 6u + 18a$

Combine the two equations : $a = 3$ m s^{-2}

95. B

Since the particle falls down with acceleration, $a = +g$

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

$\therefore \quad (11)^2 = (2)^2 + 2(9.81)s$

$\therefore \quad s = 6.0$ m

96. D

✓ (1) As the signs of the velocity v of car P and car Q are always positive, both car P and car Q are always travelling in forward direction.

✓ (2) From $t = 0$ to t_1, speed of P is greater than that of Q. Thus, their separation is increasing.
From $t = t_1$ to t_2, speed of P is smaller than that of Q. Thus, their separation is decreasing.
Therefore, at t_2, the separation between two cars is at a maximum.

✓ (3) The area under v–t graph represents the displacement of the moving body.
From $t = 0$ to t_2, the total area under the graph P is greater than that of Q.
Therefore, the displacement of car P is greater than that of Q.
Thus, car Q lags behind car P at time t_2.

97. A

Displacement of the whole journey : $s = \sqrt{(2.0\times1.5)^2 + (4.0\times1.0)^2} = 5$ m

Average velocity = $\frac{s}{t} = \frac{(5)}{(1.5+1.0)} = 2.0$ m s^{-1}

98. A

Speedometer shows the speed of the car at an instant since speed is a scalar that has magnitude only.

Speedometer can also show the magnitude of the velocity at an instant.

Since velocity is a vector that has both magnitude and direction,

a speedometer cannot show the velocity of the car since it does not indicate the direction of the car.

Provided by dse.life

99. A

✓ A. By average speed = total distance travelled / time taken
For the same path with same distance travelled, shorter time gives greater average speed.

× B. Average velocity = resultant displacement / time taken
An object may have greater distance travelled but smaller resultant displacement if it has direction changed.

× C. The object with greater velocity may not have greater acceleration, it may have even zero acceleration.

× D. For the same acceleration in forward direction,
an object have travel forward with acceleration,
but another object may travel backward with deceleration.

The following list of formulae may be found useful :

For uniformly accelerated motion $v = u + at$

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

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

Equation of a straight line $y = mx + c$

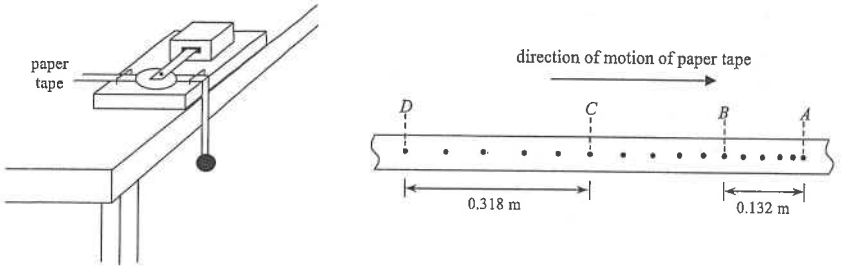
Use the following data wherever necessary :

Acceleration due to gravity $g = 9.81\ m\ s^{-2}$ (close to the Earth)

Part A : HKCE examination questions

1. < HKCE 1987 Paper I - 1 >

The figure below shows an experimental set-up to find the acceleration due to gravity g. The ticker-tape timer produces 50 dots per second. A heavy ball attached to a paper tape is released from rest.



(a) The paper tape obtained from the experiment is shown above. Find the average speed of the heavy ball in the interval *AB* and *CD*. Hence calculate the value of the acceleration due to gravity g obtained in this experiment. (4 marks)

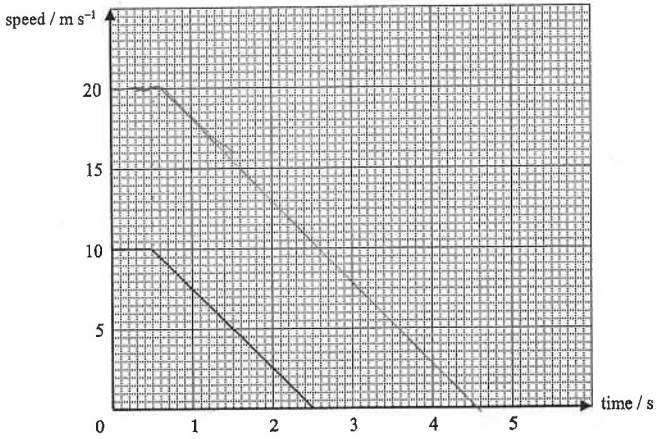
(b) State TWO precautions that should be taken in this experiment. (2 marks)

(c) How would the result of g obtained from the experiment be affected if the metal ball was replaced by a ping-pong ball ? Explain briefly. (2 marks)

Provided by dse.life

2. **< HKCE 1992 Paper I - 1 >**

A car is travelling at a uniform speed of 10 m s^{-1}. The driver sees a warning signal and applied the brakes to bring the car to rest with uniform deceleration. The figure below shows the speed-time graph of the car, starting from the instant the driver first sees the signal.



(a) Write down the reaction time of the driver, i.e. the time lapse between seeing the signal and starting to apply the brakes. (1 mark)

(b) Find the area under the graph in the above figure. State its physical meaning. (4 marks)

(c) If there is an obstacle 20 m ahead when the driver first sees the signal, would the car hit the obstacle ? Explain your answer. (2 marks)

(d) Assume that the reaction time of the driver and the deceleration of the car remain unchanged.

(i) In the figure above, draw a speed-time graph for the car if it is initially travelling at 20 m s^{-1}. (3 marks)

(ii) A student says 'If the initial speed of the car is doubled, the stopping distance of the car would also be doubled.' State whether his statement is true or false and explain briefly. (3 marks)

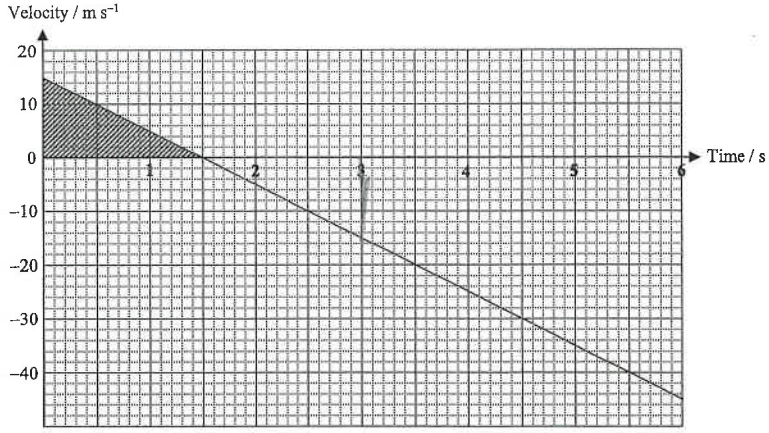
(e) Suggest TWO factors that would affect the deceleration of a car. (2 marks)

3. **< HKCE 1993 Paper I - 1 >**

A helicopter is initially at rest at a certain level above the ground. It accelerates uniformly and vertically upwards for 75 m and reaches a speed of 15 m s^{-1}. Assume the air resistance is negligible.

(a) Calculate the acceleration of the helicopter. (2 marks)

(b) At this moment, an object is released from the helicopter. The object reaches the ground after 6 s. The figure below shows the velocity-time graph of the object, starting from the instant the object is released. (g is taken to be 10 m s^{-2}.)



(i) Write down the velocity of the object when it reaches the ground. (1 mark)

(ii) State the physical meaning of the area of the shaded region in the figure above. (2 marks)

(iii) Using the above figure, find the height of the object above the ground when it is released. (3 marks)

(iv) Comment on the following two statements : (4 marks)

Statement 1 : At time t = 1.5 s, the acceleration of the object is zero.

Statement 2 : If the object is replaced by a heavier one, it would take the same time to reach the ground.

Provided by dse.life

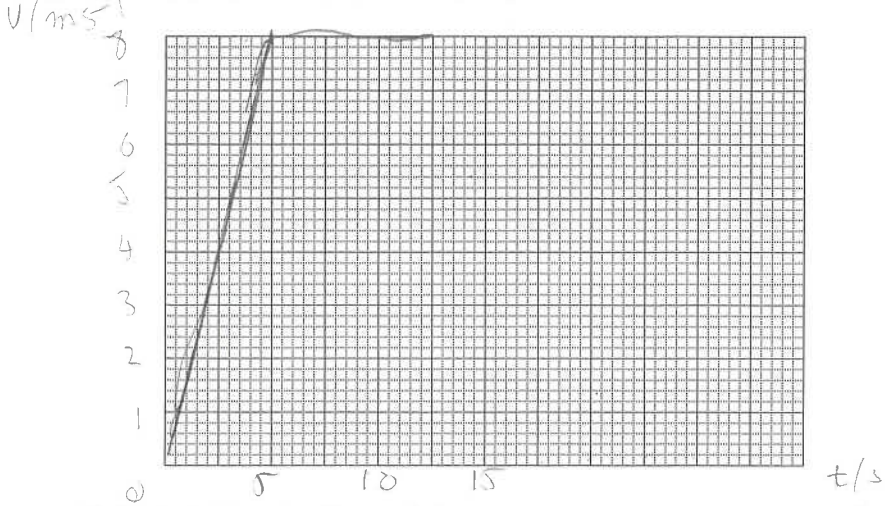
4. **< HKCE 1996 Paper I - 2 >**

Susan takes part in a 100 m race at an athletic meet. She starts at time $t = 0$ s and accelerate at a uniform rate of 1.6 m s^{-2} for 5 s. She then maintains a uniform speed afterwards and reaches the finishing line at $t = 15$ s.

(a) (i) Find the speed of Susan at $t = 5$ s. (2 marks)

(ii) Find Susan's average speed for the whole journey. (2 marks)

(b) (i) On the graph paper, draw the graph of Susan's speed against time from $t = 0$ to 15 s. (4 marks)

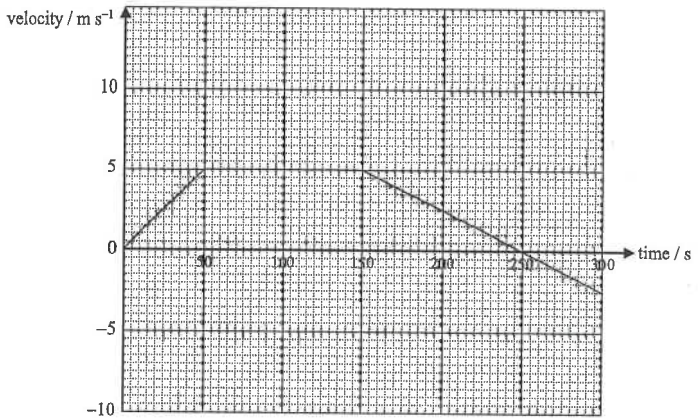


(ii) State the physical meaning of the area under the graph. (1 mark)

(c) Mary also takes part in the same race. She first accelerates at a uniform rate of 1.5 m s^{-2} for 6 s and then maintains a uniform speed afterwards.

Explain whether Susan or Mary will reach the finishing line first. (4 marks)

5. **< HKCE 1997 Paper I - 1 >**



A boat starts from rest at time $t = 0$ s and travels along straight line. The Figure above shows the velocity-time graph of the boat from $t = 0$ to 300 s.

(a) Describe the motion of the boat from $t = 0$ to 300 s. (4 marks)

(b) Find the acceleration of the boat in the first 50 s. (2 marks)

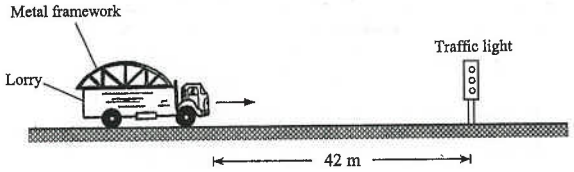
(c) Draw the acceleration-time graph of the boat from $t = 0$ to 300 s. (3 marks)

(d) Find the distance travelled by the boat in the first 50 s. (2 marks)

(e) A buoy is located 900 m ahead of the starting point of the boat. Explain whether the boat will pass the buoy during its motion as shown in the Figure above. (3 marks)

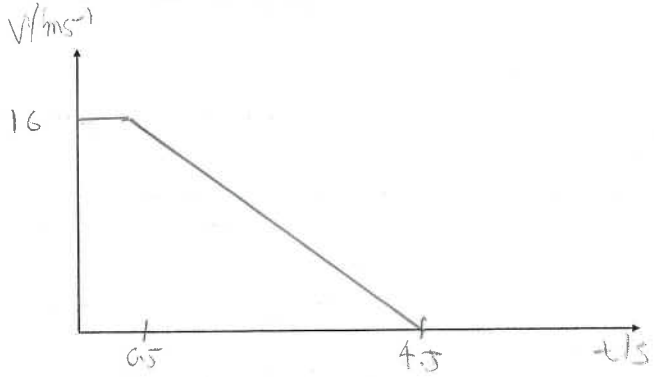
Provided by dse.life

6. **< HKCE 1999 Paper I - 7 >**



A lorry is travelling at a uniform speed of 16 m s^{-1} along a straight road. At time $t = 0$, the driver observes that a traffic light, which is at a distance of 42 m from the lorry, is turning red. The driver applies the brake at $t = 0.5$ s. The lorry then decelerates uniformly and comes to a rest at $t = 4.5$ s.

(a) Sketch the speed-time graph of the lorry from $t = 0$ to 4.5 s. (3 marks)



(b) Find the deceleration of the lorry from $t = 0.5$ to 4.5 s. (1 mark)

(c) Explain whether the lorry will stop in front of the traffic light. (3 marks)

7. **< HKCE 2000 Paper I - 7 >**

Susan uses the following method to examine John's reaction time :

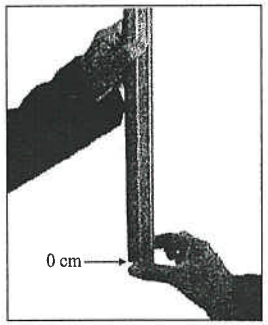


Figure 1

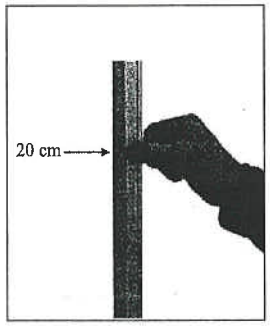


Figure 2

She holds a graduated ruler upright with the zero mark starting at the bottom. John lines up his fingers near the bottom of the ruler. (See Figure 1.) Without any warning, Susan releases the ruler and John grips the ruler with his finger as fast as possible. It is found that John grips at the 20 cm mark of the ruler. (See Figure 2.) Take the acceleration due to gravity g to be 10 m s^{-2}.

(a) Show that John's reaction time is 0.2 s. (2 marks)

(b) If a heavier ruler is used, how would the result of the above test be affected ? Explain your answer. (2 marks)

(c) Susan marks the other side of the ruler as shown in Figure 3 so that the reaction time can be read directly.

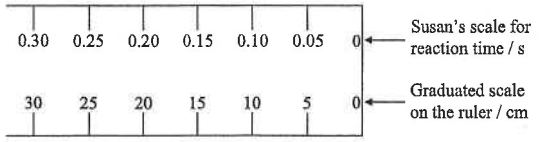


Figure 3

Explain whether Susan's scale for the reaction time is correct or not. (3 marks)

Provided by dse.life

8. **< HKCE 2002 Paper I - 8 >**

A car is travelling with a speed u on a road. The stopping distance of the car includes two parts :

① the thinking distance ℓ

(i.e. the distance travelled after the driver has seen a danger and before the brakes are on).

② the braking distance s

(i.e. the distance travelled after the brakes have been put on).

Figure 1 shows the variations between ℓ and s with u.

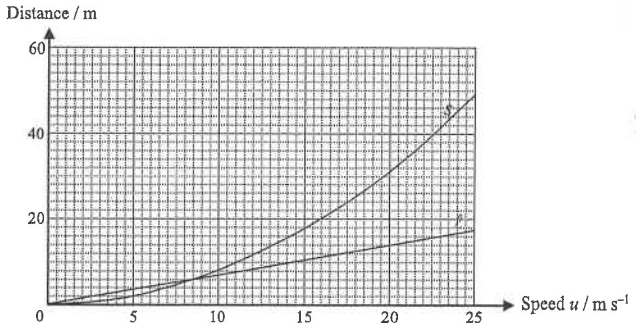


Figure 1

(a) Find the slope of the straight line in Figure 1 and state its physical meaning. (3 marks)

(b) Assume that the deceleration a of the car remains unchanged at different speeds. Write down an equation relating u, s and a. Using Figure 1, find the value of a. (3 marks)

8. (c) A boy was hit by the car when he was crossing a zebra-crossing. Figure 2 below shows a sketch of the accident drawn by the police. Let d be the distance between the car and the boy at the moment the driver first observed the boy. The driver applied the brakes and a skid mark 36.0 m long was left on the road. After hitting the boy, the car travelled a distance of 19.7 m before coming to rest. You may neglect the change in speed of the car during the impact.

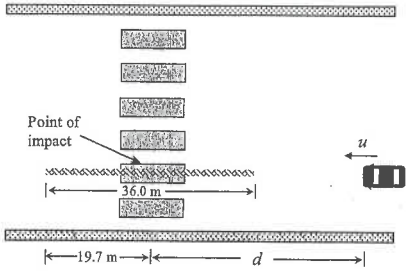


Figure 2

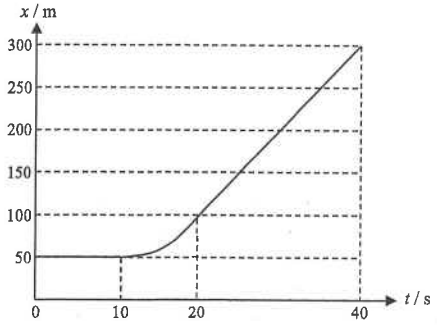
(i) Write down the braking distance of the car. (1 mark)

(ii) Using Figure 1, estimate the value of u. (1 mark)

(iii) Estimate the thinking distance and the value of d. (3 marks)

(iv) The speed limit of the road is 50 km h^{-1} (i.e. 13.9 m s^{-1}). If the car is travelling at this speed, explain whether it would hit the boy. (3 marks)

9. **< HKCE 2005 Paper I - 1 >**



Provided by dse.life

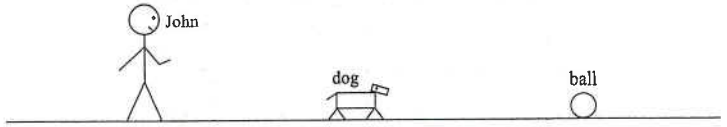
9. A car moves along a straight road. The Figure above shows the variation of the displacement x of the car from a certain point on the road with time t.

(a) Describe the motion of the car from $t = 0$ to 40 s. (3 marks)

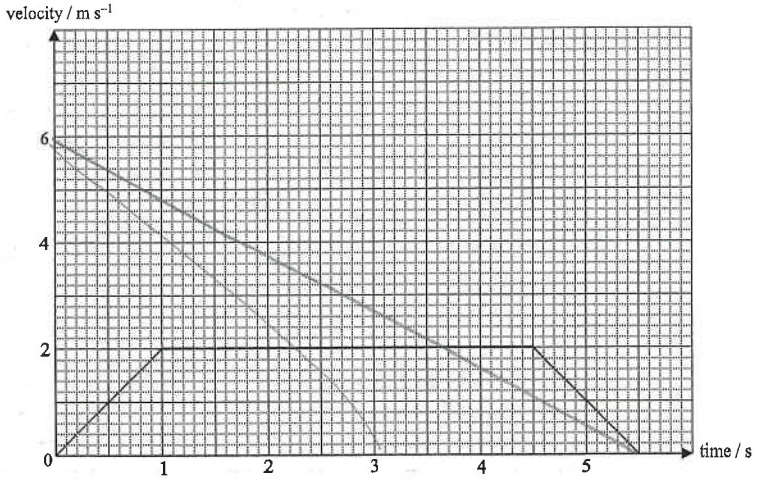
(b) Find the average velocity of the car from $t = 0$ to 40 s. (2 marks)

10. **< HKCE 2011 Paper I - 2 >**

On a horizontal grassland, John rolls a ball for his dog to catch. At time $t = 0$, John stands side by side with the dog and rolls the ball forward in a straight line. The dog immediately starts to run towards the ball. The figure below shows an instant at which the dog is running towards the ball.



The ball stops after a while, and the dog reaches the ball some time later. The velocity-time graph of the dog is shown in the figure below.



10. (a) Describe the motion of the dog between $t = 0$ and 5.5 s. (3 marks)

(b) The dog reaches the ball at $t = 5.5$ s. How far did the ball roll ? (2 marks)

(c) John rolls the ball with an initial velocity of 6 m s^{-1} and it decelerates uniformly afterwards. Draw the velocity-time graph of the ball in the above figure. (2 marks)

Part B : Supplemental exercise

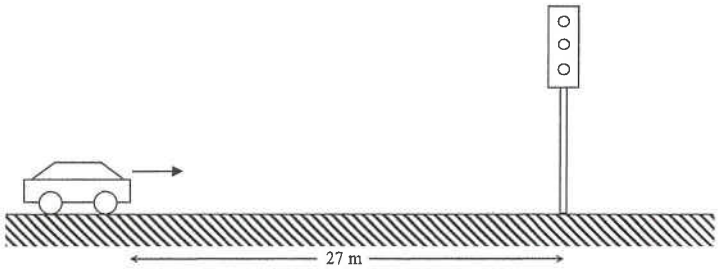
11. (a) If you are given a stopwatch and an iron ball, describe how you and your partner can find the height of a building, assuming that the value of g is already known. (2 marks)

(b) If the ball is released from the top of the building and the time for it to reach the ground is 2 s, estimate the height of the building. (2 marks)

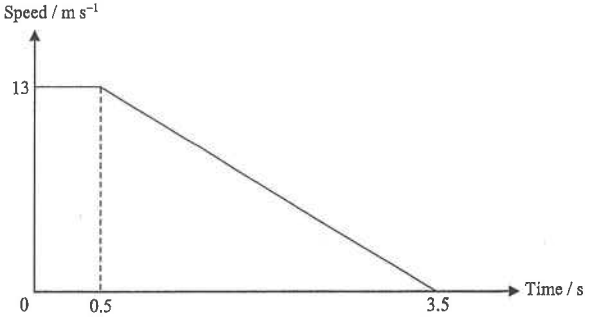
(c) If there is air resistance, what would be the effect on the time taken to reach the ground when the ball is released from the top of the building ? Explain briefly. (2 marks)

Provided by dse.life

12.



A car is travelling at a speed of 13 m s^{-1} along a straight road. At time $t = 0$, the car is 27 m from a traffic light and the light turns from green to yellow at this moment. The driver applies the brakes to stop the car. It is known that the red light will be on 3 s after the yellow light is on. The figure below shows the speed-time graph of the car.

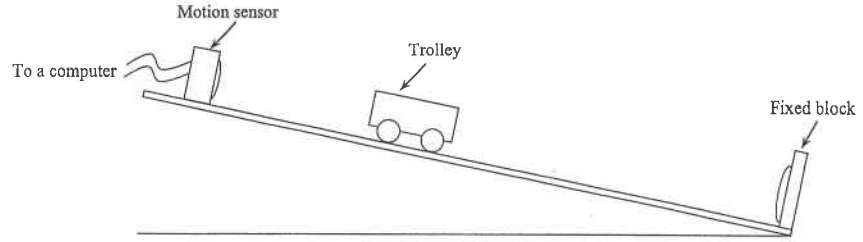


(a) What is the reaction time of the driver ? (1 mark)

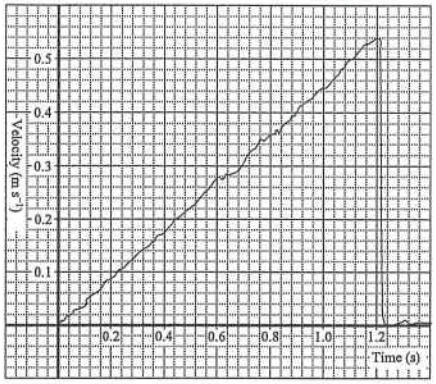
(b) Find the deceleration of the car from $t = 0.5$ to $t = 3.5$ s. (2 marks)

(c) Will the driver be charged for running a red light ? Explain your answer. (3 marks)

13. The figure below shows a data-logging experimental set-up to investigate the motion of a trolley. A trolley is held on an inclined runway and a motion sensor is mounted on the top of the runway to record the velocity of the trolley.



The trolley is released from rest so that it runs downwards along the runway. At the end of the runway, there is a fixed block used to stop the trolley. The velocity-time graph captured by the motion sensor is shown in the figure below.



(a) What is the time taken for the trolley to move from the starting point to reach the end of the runway ? (1 mark)

(b) What is the distance travelled by the trolley before it reaches the end of the runway ? (2 marks)

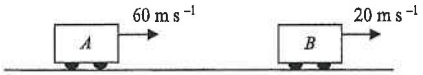
(c) Find the acceleration of the trolley. (2 marks)

Provided by dse.life

Part C : HKDSE examination questions

14. < HKDSE 2012 Paper IB - 4 >

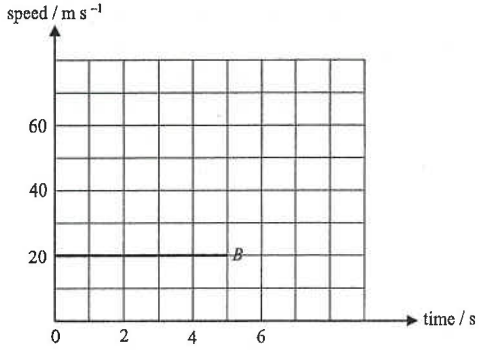
Train A initially travels at a speed of 60 m s^{-1} along a straight horizontal railway. Another identical train B travels ahead of A in the same direction on the same railway. Due to mechanical failure, B is only travelling at 20 m s^{-1}.



At time $t = 0$, A and B are x m apart, the captain of A receives a stopping signal and immediately A decelerates at 4 m s^{-2} while B continues to travel at 20 m s^{-1}. A eventually collides with B after 5 s. Neglect air resistance.

(a) Find the speed of A just before collision. (2 marks)

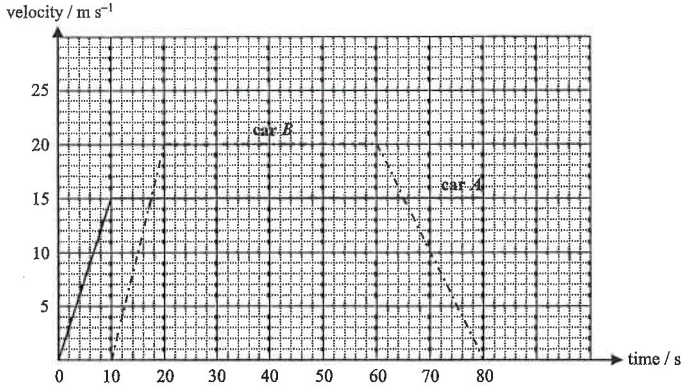
(b) The graph below shows how the speed of B varies with time within this 5 s. Sketch on the same graph the variation of the speed of A within the same period. (1 mark)



(c) Based on the above information, determine the separation x of the two trains at $t = 0$. (3 marks)

15. < HKDSE 2014 Paper IB - 3 >

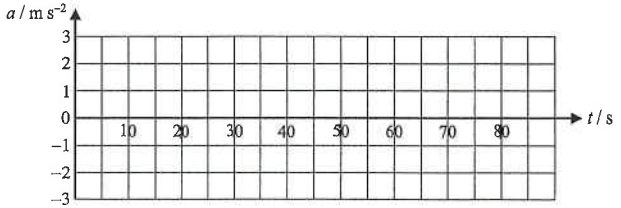
Two cars A and B initially at the same position, start to travel along the same straight horizontal road. The graph below shows how their velocities vary with time.



(a) Describe the motion of car A along the whole journey from $t = 0$ to $t = 80$ s. (2 marks)

(b) (i) Which car attained the greatest acceleration throughout the journey ? Find this acceleration. (2 marks)

(ii) Sketch the acceleration-time (a - t) graph of car B from $t = 0$ to $t = 80$ s. (2 marks)



(c) (i) At $t = 20$ s, what is the separation between cars A and B ? (2 marks)

(ii) Deduce the time at which car B catches up with car A. (2 marks)

Provided by dse.life

HKEAA's Marking Scheme is prepared for the markers' reference. It should not be regarded as a set of model answers. Students and teachers who are not involved in the marking process are advised to interpret the Marking Scheme with care.

Question Solution

1. (a) $u = \dfrac{0.132}{0.02 \times 5} = 1.32 \text{ m s}^{-1}$ [1]

$v = \dfrac{0.318}{0.02 \times 5} = 3.18 \text{ m s}^{-1}$ [1]

$g = \dfrac{v-u}{t} = \dfrac{3.18 - 1.32}{0.02 \times 10}$ [1]

$= 9.3 \text{ m s}^{-2}$ [1]

(b) ① The ball should be heavy enough so that air resistance is negligible. [1]

② Place polystyrene tile on the ground under the ball so that the ball would not hit the floor directly. [1]

(c) The result of g would be smaller. [1]

Since the air resistance will become significant. [1]

2. (a) Reaction time = 0.5 s [1]

(b) Area $= \frac{1}{2}(0.5 + 2.5) \times 10$ [1]

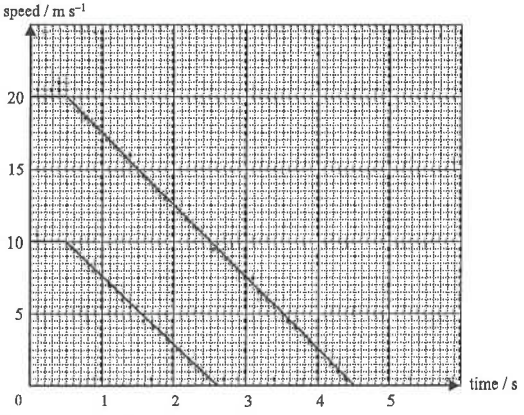
$= 15$ m [1]

Area under the graph is the **stopping distance** of the car. [2]

(c) The car would not hit the obstacle, [1]

since the total stopping distance travelled is 15 m which is less than 20 m. [1]

(d) (i)



< For same reaction time = 0.5 s > [1]

< For same slope > [1]

< For stopping time at $t = 4.5$ s > [1]

2. (d) (ii) False [1]

If initial speed is doubled, the area under the graph is not doubled. [2]

< OR >

False [1]

Area under the graph = stopping distance of the car $= \frac{1}{2}(0.5 + 4.5) \times 20 = 50$ m [1]

50 m is not doubled of the original 15 m. [1]

(e) Any **TWO** of the following : [2]

* Braking force of the car
* Number of passengers in the car **OR** Mass of the car
* Nature of the road surface **OR** Tyre condition
* Gradient of the road **OR** Angle of inclination of the road

3. (a) By $v^2 = u^2 + 2as$ [1]

$\therefore \quad (15)^2 = 0 + 2a(75)$

$\therefore \quad a = 1.5 \text{ m s}^{-2}$ [1]

(b) (i) $v = -45 \text{ m s}^{-1}$ [1]

(ii) The area represents the displacement (**OR** distance travelled) of the object [1]

in its upward motion. [1]

< OR >

The area represents the upward displacement of the object. [2]

(iii) Height = Area of graph below t-axis – area of shaded region [1]

$= \frac{1}{2} \times 45 \times 4.5 - \frac{1}{2} \times 15 \times 1.5$ [1]

$= 90$ m [1]

< OR >

Displacement $= \frac{1}{2} \times 15 \times 1.5 - \frac{1}{2} \times 45 \times 4.5$ [1]

$= -90$ m [1]

Height = 90 m [1]

(iv) Statement 1 : Incorrect (**OR** false) [1]

The acceleration of the object at $t = 1.5$ s is equal to the acceleration due to gravity. [1]

< OR >

The acceleration of the object at $t = 1.5$ s is equal to -10 m s^{-2} from the graph, which is not zero. [1]

Statement 2 : Correct (**OR** true) [1]

Acceleration due to gravity is independent of the mass of the object. [1]

Provided by dse.life

4. (a) (i) Speed of Susan at 5 s $= at$

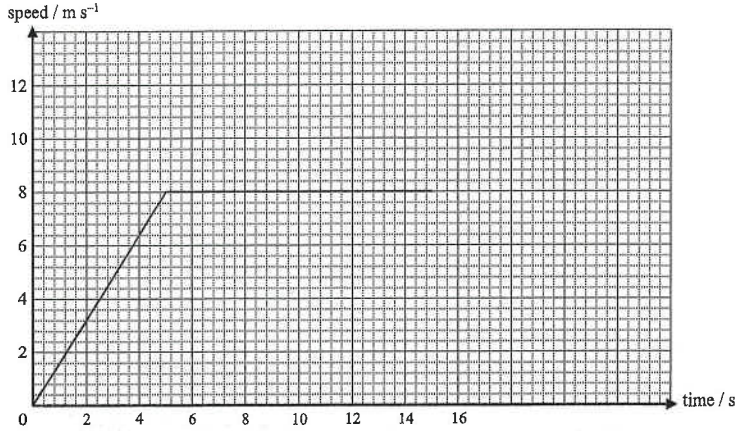
$= 1.6 \times 5$ [1]

$= 8\ \text{m s}^{-1}$ [1]

(ii) Average speed of Susan for the whole journey $= \frac{100}{15}$ [1]

$= 6.67\ \text{m s}^{-1}$ [1]

(b) (i)



< Two axes labelled with unit correctly > [1]

< From 0 s to 5 s, straight line with positive slope > [1]

< From 5 s, horizontal line > [1]

< Whole graph is correct > [1]

(ii) The area under the graph represents the distance travelled by Susan. [1]

OR

The area under the graph represents the displacement of Susan. [1]

(c) Distance travelled by Mary in the first 6 s $= \frac{1}{2} a t^2$

$= \frac{1}{2} \times (1.5) \times (6)^2$

$= 27\ \text{m}$ [1]

Speed of Mary at 6th second $= 1.5 \times 6 = 9\ \text{m s}^{-1}$

Time to cover the remaining journey $= \frac{100-27}{9} = 8.11\ \text{s}$ [1]

Total time taken by Mary $= 6 + 8.11 = 14.1\ \text{s}$ [1]

$\therefore$ Mary will win in the race. [1]

5. (a) From $t = 0$ to 50 s, the boat accelerates uniformly. [1]

From $t = 50$ to 150 s, the boat travels with a uniform velocity. [1]

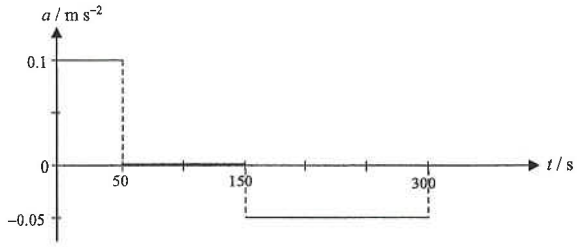
From $t = 150$ to 250 s, the boat decelerates uniformly. [1]

From $t = 250$ to 300 s, the boat travels backwards. [1]

(b) Acceleration = slope of the graph [1]

$= \frac{5}{50} = 0.1\ \text{m s}^{-2}$ [1]

(c)



< For $a = 0.1$ from $t = 0$ to 50 s > [1]

< For $a = 0$ from $t = 50$ s to 150 s > [1]

< For $a = -0.05$ from $t = 150$ to 300 s > [1]

(d) Distance travelled in the first 50 s = Area under the v-t graph [1]

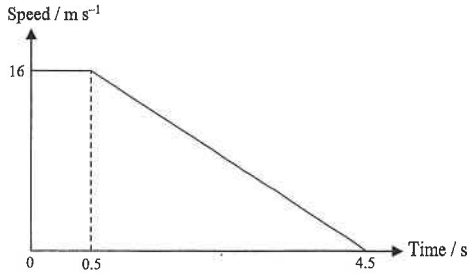
$= \frac{1}{2} \times 50 \times 5 = 125\ \text{m}$ [1]

(e) The boat is farthest away from the starting point at $t = 250$ s. [1]

At $t = 250$ s, distance travelled $= \frac{1}{2} \times (250 + 100) \times 5 = 875\ \text{m}$ [1]

As the farthest distance is smaller than 900 m, the boat will not pass the buoy. [1]

6. (a)



< Two axes labelled with correct unit > [1]

< From 0 to 0.5 s, a horizontal line > [1]

< From 0.5 to 4.5 s, a straight line of deceleration to rest > [1]

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6. (b) deceleration $= \frac{16}{4} = 4\ \text{m s}^{-2}$ [1]

(**OR** acceleration $= -4\ \text{m s}^{-2}$) [1]

(c) Stopping distance = area under the graph [1]

$= 16 \times 0.5 + \frac{1}{2} \times 16 \times 4 = 40\ \text{m}$ [1]

As the stopping distance < 42 m, the lorry will stop in front of the traffic light. [1]

7. (a) $s = ut + \frac{1}{2}at^2$ [1]

$(0.2) = \frac{1}{2}(10)t^2 \quad \therefore\ t = 0.2\ \text{s}$ [1]

(b) The result would not be affected [1]

because the acceleration due to gravity is independent of the mass. [1]

(c) Susan's scale is not correct [1]

Since $s = \frac{1}{2}at^2$ [1]

thus s should be proportional to t^2. [1]

8. (a) Slope of the line $= \frac{14}{20}$ [1]

$= 0.7\ \text{s}$ [1]

The slope represents the reaction time of the driver. [1]

(b) By $v^2 = u^2 + 2as$

$\therefore\ 0 = (u)^2 + 2(-a)s \quad \therefore\ u^2 = 2as$ [1]

From Figure 1, when $s = 20$ m, $u = 16\ \text{m s}^{-1} \quad \therefore\ (16)^2 = 2a(20)$ [1]

$\therefore\ a = 6.4\ \text{m s}^{-2}$ [1]

(c) (i) Braking distance = 36 m [1]

(ii) From Figure 1, when $s = 36$ m, $u = 21.5\ \text{m s}^{-1}$ [1]

(iii) From Figure 1, when $u = 21.5\ \text{m s}^{-1}$, the thinking distance $\ell = 15$ m [1]

From Figure 2, $d = 15 + 36 - 19.7$ [1]

$= 31.3$ m [1]

(iv) If u is equal to $13.9\ \text{m s}^{-1}$, then the thinking distance ℓ is equal to 10 m

and the braking distance s is equal to 15 m from Figure 1. [1]

Thus the stopping distance is equal to 25 m. [1]

As the stopping distance is smaller than d, the car will not hit the boy. [1]

9. (a) From $t = 0$ to 10 s, the car remains at rest. [1]

From $t = 10$ to 20 s, the car moves with acceleration. [1]

From $t = 20$ to 40 s, the car travels with a uniform velocity. [1]

(b) Average velocity $= \frac{s}{t} = \frac{300 - 50}{40}$ [1]

$= 6.25\ \text{m s}^{-1}$ [1]

10. (a) The dog accelerates from rest between $t = 0$ to $t = 1$ s. [1]

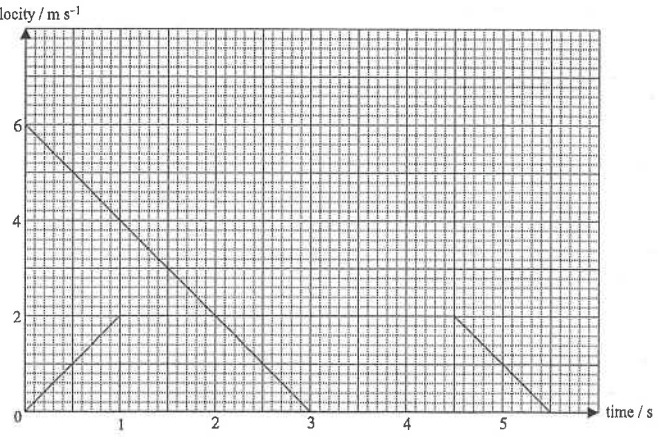
It then maintains a constant velocity between $t = 1$ to $t = 4.5$ s. [1]

It then decelerates and stops at $t = 5.5$ s. [1]

(b) Distance = area under the graph [1]

$= \frac{1}{2}(3.5 + 5.5) \times (2) = 9$ m [1]

(c)



[2]

11. (a) The partner should release the iron ball at the top of the building and

I should record the time, t, taken for the ball to fall to the ground. [1]

Then the height of the building can be calculated by $s = \frac{1}{2}gt^2$ [1]

(b) Height of building $= \frac{1}{2}gt^2 = \frac{1}{2}(9.81)(2)^2$ [1]

$= 19.6$ m [1]

(c) The time taken would be longer [1]

since the acceleration would become smaller due to air resistance. [1]

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12. (a) Reaction time = 0.5 s [1]

(b) Deceleration = slope of the graph

$= \frac{13}{3.5-0.5}$ [1]

$= 4.33 \text{ m s}^{-2}$ [1]

(c) Stopping distance = Total area under the graph

$= (13) \times (0.5) + \frac{1}{2}(13) \times (3.5 - 0.5)$ [1]

$= 26 \text{ m}$ [1]

Since the stopping distance is less than 27 m, the driver will not be charged. [1]

13. (a) Time taken = 1.2 s [1]

(b) Distance travelled = area from 0 to 1.2 s

$= \frac{1}{2}(0.54) \times (1.2)$ [1]

$= 0.324 \text{ m}$ [1]

(c) Acceleration = slope of the line

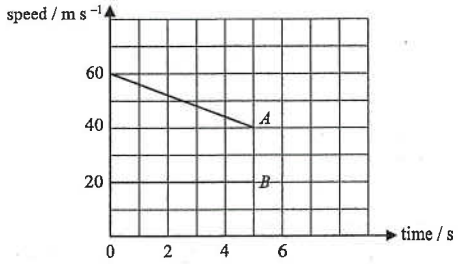
$= \frac{0.54}{1.2}$ [1]

$= 0.45 \text{ m s}^{-2}$ [1]

14. (a) $v = u + at = (60) + (-4)(5)$ [1]

$= 40 \text{ m s}^{-1}$ [1]

(b)



< Straight line from 60 m s^{-1} to 40 m s^{-1} during the 5 s > [1]

(c) Distance travelled by A during the 5 s = area under the graph = $\frac{1}{2}(40 + 60)(5) = 250 \text{ m}$ [1]

Distance travelled by B during the 5 s = $20 \times 5 = 100 \text{ m}$ [1]

Separation $x = 250 - 100 = 150 \text{ m}$ [1]

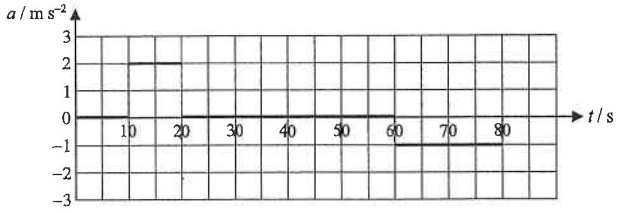
15. (a) From $t = 0$ to 10 s, car A accelerates uniformly. [1]

From $t = 10$ to 80 s, car A travels with the uniform velocity. [1]

(b) (i) Car B attained the greater acceleration. [1]

a = slope = $\frac{20-0}{20-10} = 2 \text{ m s}^{-2}$ [1]

(ii)



< Acceleration from 10 s to 20 s and deceleration from 60 s to 80 s correct > [1]

< All correct > [1]

(c) (i) Displacement of car A at 20 s = $\frac{1}{2}(10 + 20) \times (15) = 225 \text{ m}$ [1]

Displacement of car B at 20 s = $\frac{1}{2}(10) \times (20) = 100 \text{ m}$

Separation = 225 − 100 = 125 m [1]

(ii) Car B travels faster than car A by 5 m s^{-1}.

$\therefore \Delta s = \Delta v \times \Delta t$ $\therefore (125) = (5) \times \Delta t$ $\therefore \Delta t = 25 \text{ s}$ [1]

The time that car B catches up with car A is at 45 s. [1]

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