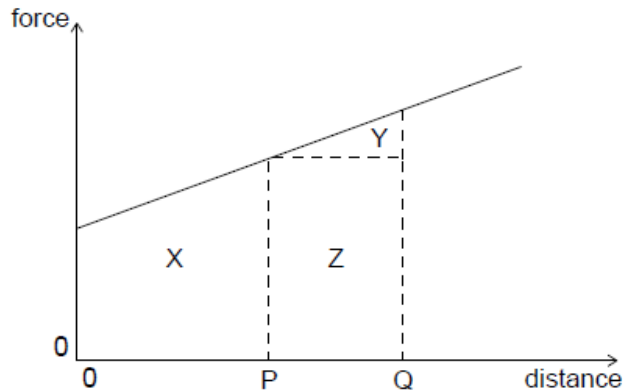


Motion-practice-2-MC [68 marks]

1. A graph shows the variation of force acting on an object moving in a straight line with distance moved by the object. Which area represents the work done on the object during its motion from P to Q? [1 mark]



- A. X
B. Y
C. Y + Z
D. X + Y + Z
2. A car travelling at a constant velocity covers a distance of 100 m in 5.0 s. [1 mark]
The thrust of the engine is 1.5 kN. What is the power of the car?
- A. 0.75 kW
B. 3.0 kW
C. 7.5 kW
D. 30 kW
3. An inelastic collision occurs between two bodies in the absence of external forces. [1 mark]
What must be true about the total momentum of the two bodies and the total kinetic energy of the two bodies during this interaction?
- A. Only momentum is conserved.
B. Only kinetic energy is conserved.
C. Both momentum and kinetic energy are conserved.
D. Neither momentum nor kinetic energy are conserved.

4. A stone falls from rest to the bottom of a water well of depth d . The time t [1 mark] taken to fall is 2.0 ± 0.2 s. The depth of the well is calculated to be 20 m using $d = \frac{1}{2}at^2$. The uncertainty in a is negligible.

What is the absolute uncertainty in d ?

- A. ± 0.2 m
- B. ± 1 m
- C. ± 2 m
- D. ± 4 m

5. A ball is tossed vertically upwards with a speed of 5.0 m s^{-1} . After how many seconds will the ball return to its initial position? [1 mark]

- A. 0.50 s
- B. 1.0 s
- C. 1.5 s
- D. 2.0 s

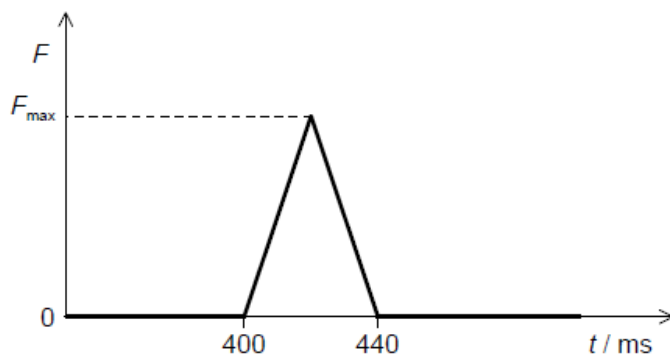
6. A projectile is fired horizontally from the top of a cliff. The projectile hits the ground 4 s later at a distance of 2 km from the base of the cliff. What is the height of the cliff? [1 mark]

- A. 40 m
- B. 80 m
- C. 120 m
- D. 160 m

7. A tennis ball is released from rest at a height h above the ground. At each bounce 50 % of its kinetic energy is lost to its surroundings. What is the height reached by the ball after its second bounce? [1 mark]

- A. $\frac{h}{8}$
- B. $\frac{h}{4}$
- C. $\frac{h}{2}$
- D. zero

8. The initial kinetic energy of a block moving on a horizontal floor is 48 J. A constant frictional force acts on the block bringing it to rest over a distance of 2 m. What is the frictional force on the block? [1 mark]
- A. 24 N
B. 48 N
C. 96 N
D. 192 N
-
9. The efficiency of an electric motor is 20 %. When lifting a body 500 J of energy are wasted. What is the useful work done by the motor? [1 mark]
- A. 100 J
B. 125 J
C. 250 J
D. 400 J
-
10. A net force acts on a body. Which characteristic of the body will definitely change? [1 mark]
- A. Speed
B. Momentum
C. Kinetic energy
D. Direction of motion
-
11. A ball of mass 0.2 kg strikes a force sensor and sticks to it. Just before impact the ball is travelling horizontally at a speed of 4.0 m s^{-1} . The graph shows the variation with time t of the force F recorded by the sensor. [1 mark]



What is F_{max} ?

- A. 2 N
B. 4 N
C. 20 N
D. 40 N

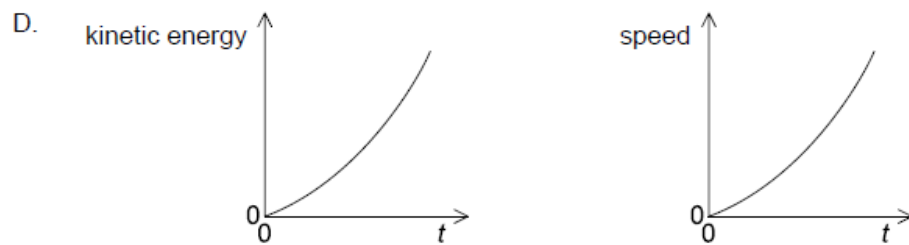
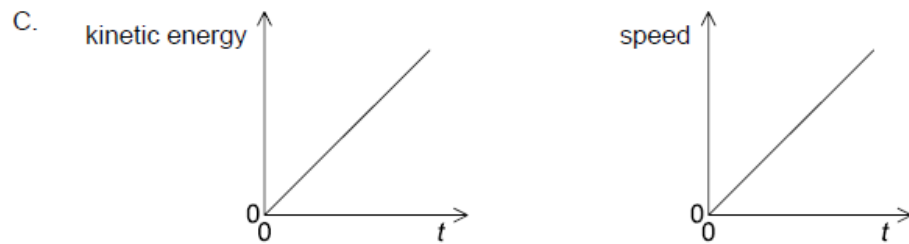
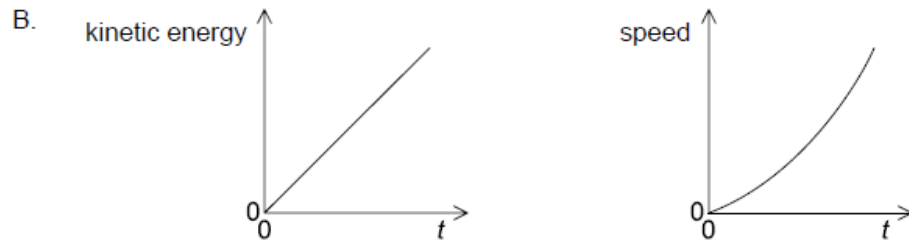
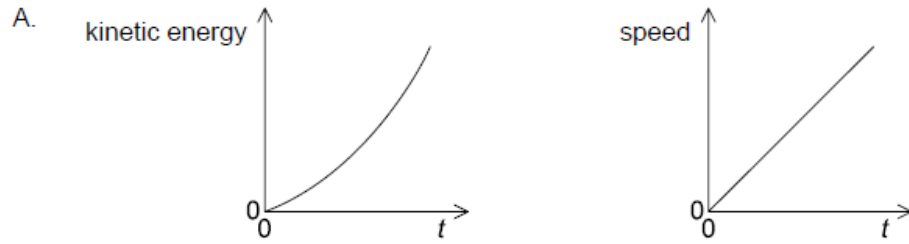
12. A boy jumps from a wall 3m high. What is an estimate of the change in momentum of the boy when he lands without rebounding? [1 mark]
- A. $5 \times 10^0 \text{ kg m s}^{-1}$
 - B. $5 \times 10^1 \text{ kg m s}^{-1}$
 - C. $5 \times 10^2 \text{ kg m s}^{-1}$
 - D. $5 \times 10^3 \text{ kg m s}^{-1}$
-

13. Light of wavelength 400nm is incident on two slits separated by $1000\mu\text{m}$. [1 mark]
The interference pattern from the slits is observed from a satellite orbiting 0.4Mm above the Earth. The distance between interference maxima as detected at the satellite is
- A. 0.16Mm.
 - B. 0.16km.
 - C. 0.16m.
 - D. 0.16mm.
-

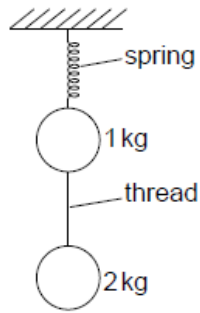
14. An object of weight W is falling vertically at a constant speed in a fluid. [1 mark]
What is the magnitude of the drag force acting on the object?
- A. 0
 - B. $\frac{W}{2}$
 - C. W
 - D. $2W$
-

15. An object, initially at rest, is accelerated by a constant force. Which graphs show the variation with time t of the kinetic energy and the variation with time t of the speed of the object?

[1 mark]



16. Two stationary objects of mass 1kg and 2kg are connected by a thread and suspended from a spring [1 mark] and suspended from a spring.



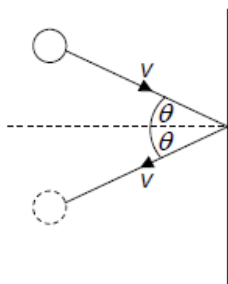
The thread is cut. Immediately after the cut, what are the magnitudes of the accelerations of the objects in terms of the acceleration due to gravity g ?

	Acceleration of 1 kg object	Acceleration of 2 kg object
A.	$3g$	$2g$
B.	$2g$	$2g$
C.	$3g$	$1g$
D.	$2g$	$1g$

17. A student of weight 600N climbs a vertical ladder 6.0m tall in a time of 8.0s. What is the power developed by the student against gravity? [1 mark]

- A. 22W
- B. 45W
- C. 220W
- D. 450W

18. A ball of mass m strikes a vertical wall with a speed v at an angle of θ to the wall. The ball rebounds at the same speed and angle. What is the change in the magnitude of the momentum of the ball? [1 mark]



- A. $2 mv \sin \theta$
- B. $2 mv \cos \theta$
- C. $2 mv$
- D. zero

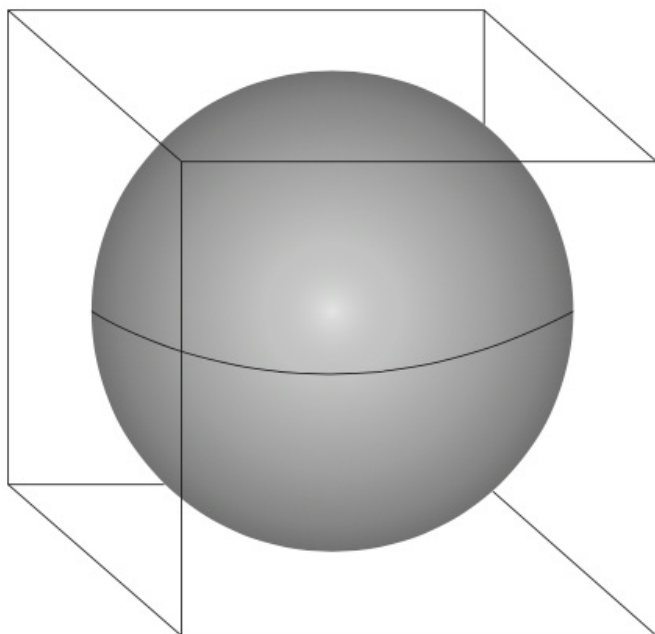
19. Two objects m_1 and m_2 approach each other along a straight line with speeds v_1 and v_2 as shown. The objects collide and stick together. [1 mark]



What is the total change of linear momentum of the objects as a result of the collision?

- A. $m_1 v_1 + m_2 v_2$
- B. $m_1 v_1 - m_2 v_2$
- C. $m_2 v_2 - m_1 v_1$
- D. zero

20. A sphere fits inside a cube. [1 mark]



The length of the cube and the diameter of the sphere are 10.0 ± 0.2 cm.

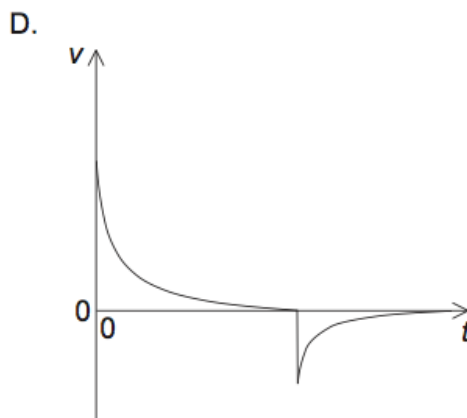
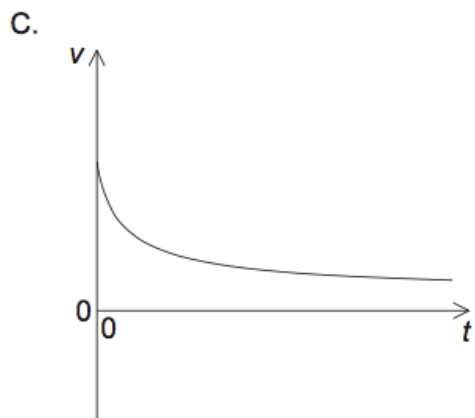
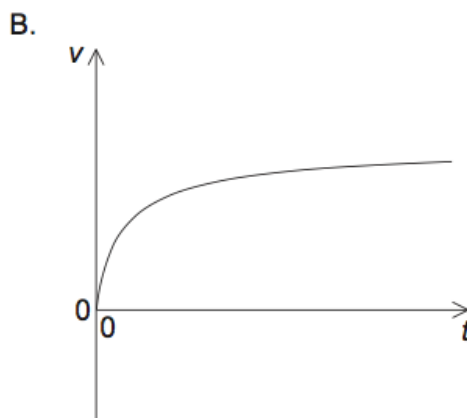
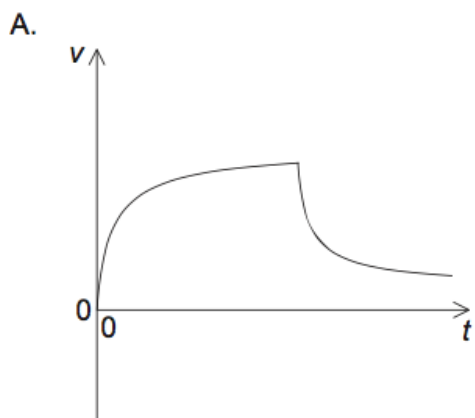
What is the ratio $\frac{\text{percentage uncertainty of the volume of the sphere}}{\text{percentage uncertainty of the volume of the cube}}$?

- A. $\frac{3}{4\pi}$
- B. 1
- C. 2
- D. 8

21. A swimming pool contains 18×10^6 kg of pure water. The molar mass of water is 18 g mol^{-1} . What is the correct estimate of the number of water molecules in the swimming pool? [1 mark]

- A. 10^4
- B. 10^{24}
- C. 10^{25}
- D. 10^{33}

22. An aircraft is moving horizontally. A parachutist leaves the aircraft and a few seconds later opens her parachute. Which graph shows the variation of the vertical speed v with time t for the parachutist from the time she leaves the aircraft until just before landing? [1 mark]



23. An object of mass m rests on a horizontal plane. The angle θ that the plane makes with the horizontal is slowly increased from zero. When $\theta = \theta_0$, the object begins to slide. What are the coefficient of static friction μ_s and the normal reaction force N of the plane at $\theta = \theta_0$? [1 mark]

	μ_s	N
A.	$\sin \theta_0$	$mg \cos \theta_0$
B.	$\tan \theta_0$	$mg \sin \theta_0$
C.	$\sin \theta_0$	$mg \sin \theta_0$
D.	$\tan \theta_0$	$mg \cos \theta_0$

24. A stone is falling at a constant velocity vertically down a tube filled with oil. Which of the following statements about the energy changes of the stone during its motion are correct? [1 mark]

- I. The gain in kinetic energy is less than the loss in gravitational potential energy.
- II. The sum of kinetic and gravitational potential energy of the stone is constant.
- III. The work done by the force of gravity has the same magnitude as the work done by friction.

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

25. A spring of negligible mass and length l_0 hangs from a fixed point. When a mass m is attached to the free end of the spring, the length of the spring increases to l . The tension in the spring is equal to $k\Delta x$, where k is a constant and Δx is the extension of the spring. What is k ? [1 mark]

A. $\frac{mg}{l_0}$

B. $\frac{mg}{l}$

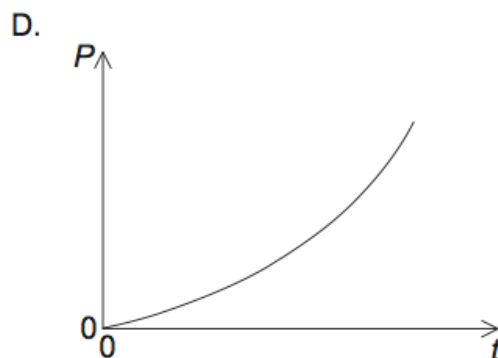
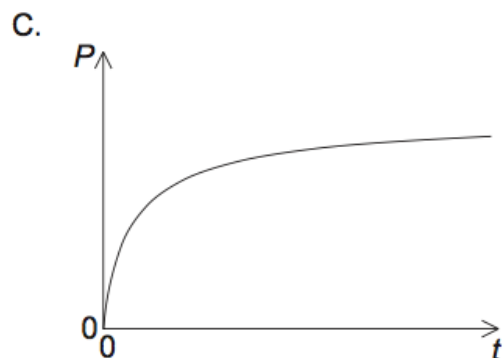
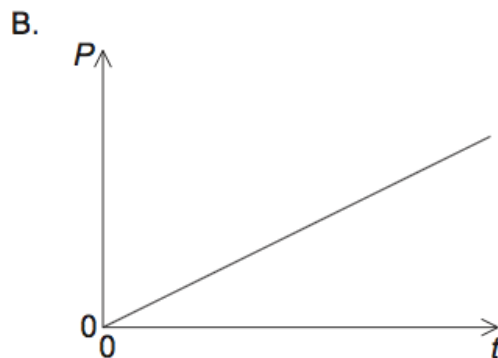
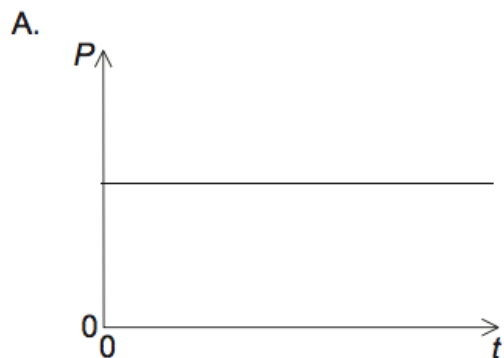
C. $\frac{mg}{l-l_0}$

D. $\frac{mg}{l_0-l}$

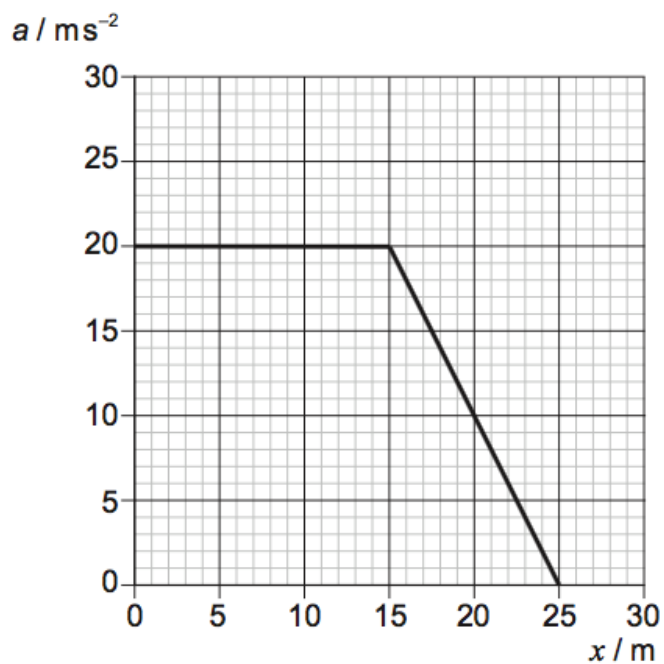
26. A ball with mass m moves horizontally with speed u . The ball hits a vertical wall and rebounds in the opposite direction with speed $v < u$. The duration of the collision is T . What are the magnitude of the average force exerted by the wall on the ball and the loss of kinetic energy of the ball? [1 mark]

	Average force	Loss of kinetic energy
A.	$\frac{m(u+v)}{T}$	$\frac{m(u^2-v^2)}{2}$
B.	$\frac{m(u+v)}{T}$	$\frac{m(u-v)^2}{2}$
C.	$\frac{m(u-v)}{T}$	$\frac{m(u^2-v^2)}{2}$
D.	$\frac{m(u-v)}{T}$	$\frac{m(u-v)^2}{2}$

27. A train on a straight horizontal track moves from rest at constant acceleration. The horizontal forces on the train are the engine force and a resistive force which increases with speed. Which graph represents the variation with time t of the power P developed by the engine? [1 mark]



28. The graph shows how the acceleration a of an object varies with distance x [1 mark]
travelled x .



The mass of the object is 3.0 kg. What is the total work done on the object?

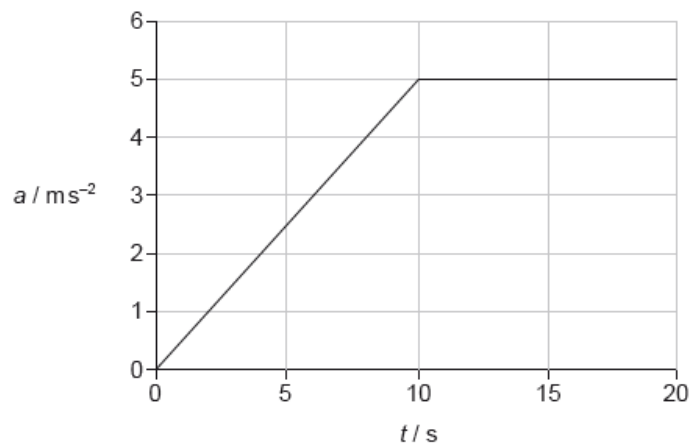
1. 300 J
2. 400 J
3. 1200 J
4. 1500 J

29. Which of the following is a derived unit?

[1 mark]

- A. Mole
- B. Kelvin
- C. Coulomb
- D. Ampere

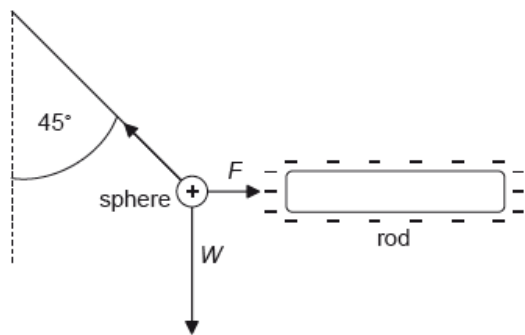
30. An object is at rest at time $t = 0$. The variation with t of the acceleration a of the object is shown from $t = 0$ to $t = 20$ s. [1 mark]



What is the speed of the object when $t = 15$ s?

- A. 25 m s^{-1}
 - B. 50 m s^{-1}
 - C. 75 m s^{-1}
 - D. 100 m s^{-1}
-
31. Which of the following is proportional to the net external force acting on a [1 mark] body?
- A. Speed
 - B. Velocity
 - C. Rate of change of speed
 - D. Rate of change of velocity

32. A small positively charged sphere is suspended from a thread and placed [1 mark] close to a negatively charged rod. When the thread is at 45° to the vertical the system is in equilibrium. The weight of the sphere is W and the magnitude of the electrostatic force between the rod and the sphere is F .



(not to scale)

What is the magnitude of W compared with the magnitude of F ?

- A. $W = \sqrt{2}F$
B. $F < W < \sqrt{2}F$
C. $W = F$
D. $W > F$
33. An object of mass m is initially at rest. When an impulse I acts on the [1 mark] object its final kinetic energy is E_K . What is the final kinetic energy when an impulse of $2I$ acts on an object of mass $2m$ initially at rest?

- A. $\frac{E_K}{2}$
B. E_K
C. $2E_K$
D. $4E_K$

34. A heat engine does 300 J of work during one cycle. In this cycle 900 J of [1 mark] energy is wasted. What is the efficiency of the engine?

- A. 0.25
B. 0.33
C. 0.50
D. 0.75

35. What is the unit of energy density?

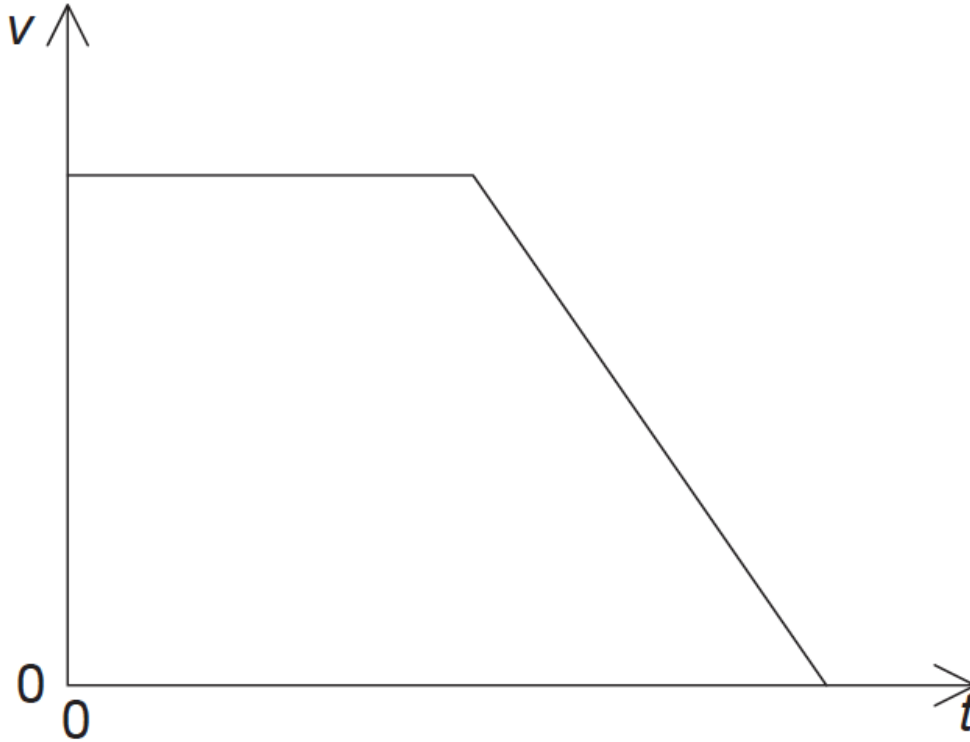
[1 mark]

- A. J kg^{-1}
B. $\text{J kg}^{-1} \text{m}^3$
C. J mol^{-1}
D. J K^{-1}

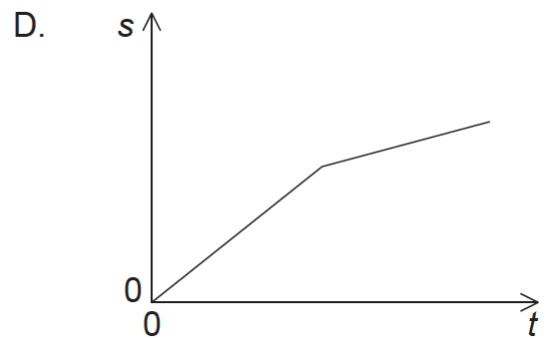
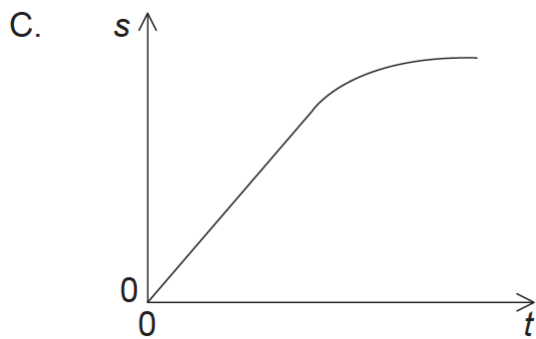
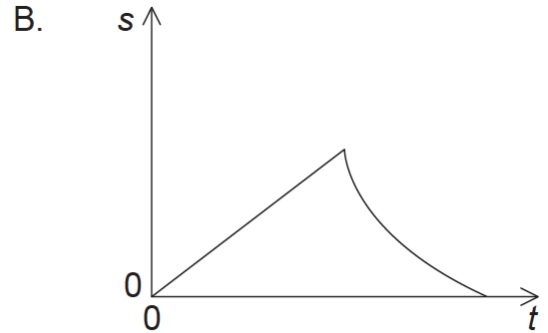
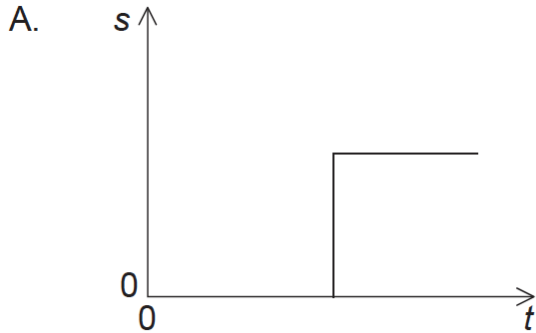
36. A tennis ball is released from rest and falls vertically through a small distance in air. What is the change in the speed of the ball and the change in the acceleration of the ball as it falls? [1 mark]

	Speed of the ball	Acceleration of the ball
A.	increases	decreases
B.	decreases	increases
C.	increases	increases
D.	decreases	decreases

37. The graph below shows the variation with time t of the velocity v of a car [1 mark] travelling in a straight line.

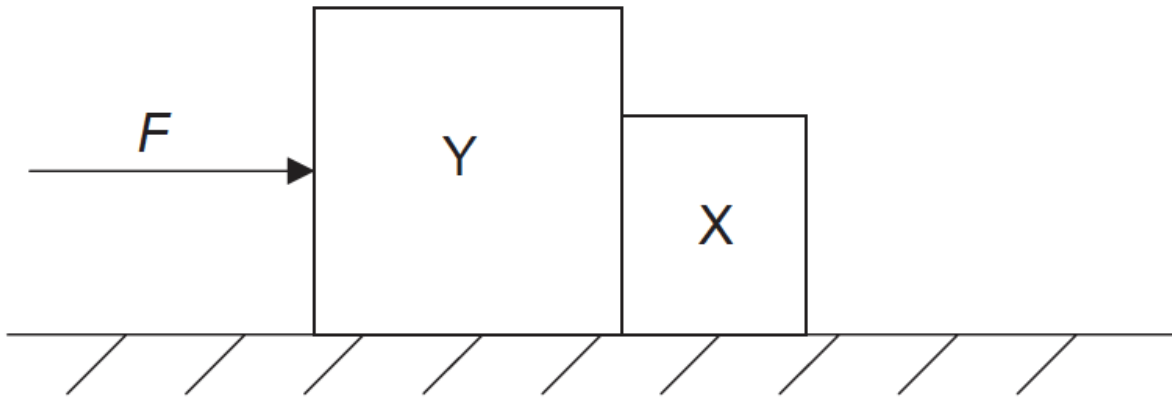


Which graph shows the variation with t of the displacement s of the car?



38. Which statement applies to an object in translational equilibrium? [1 mark]
- A. The object must be stationary.
 - B. The object must be moving with constant acceleration.
 - C. The resultant force acting on the object must be zero.
 - D. There must be no external forces acting on the object.

39. A constant horizontal force F is applied to a block Y. Block Y is in contact with a separate block X. [1 mark]



The blocks remain in contact as they accelerate along a horizontal frictionless surface. Y has a greater mass than X. Air resistance is negligible.

Which statement is correct?

- A. The force F is equal to the product of the mass of Y and the acceleration of Y.
- B. The force that Y exerts on X is less than F .
- C. The force that Y exerts on X is less than the force that X exerts on Y.
- D. The force that Y exerts on X is equal to F .

40. Two identical spheres, each of mass m and speed v , travel towards each other on a frictionless surface in a vacuum. [1 mark]

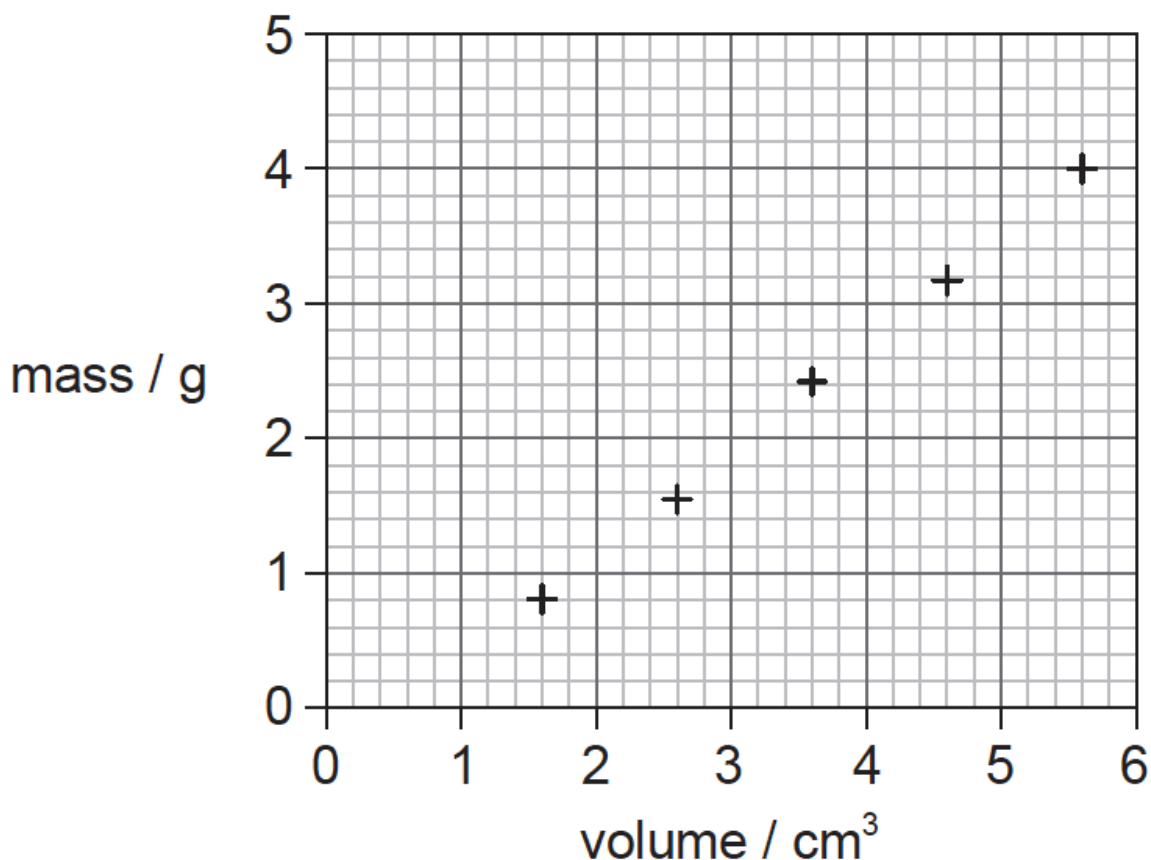


The spheres undergo a head-on elastic collision.

Which statement correctly describes the spheres after the collision?

- A. The total momentum of the spheres is $2mv$.
 - B. Each sphere has zero momentum.
 - C. The total kinetic energy of the spheres is mv^2 .
 - D. Each sphere has zero kinetic energy.
-
41. Which of the following expresses the watt in terms of fundamental units? [1 mark]
- A. $\text{kg m}^2 \text{s}$
 - B. $\text{kg m}^2 \text{s}^{-1}$
 - C. $\text{kg m}^2 \text{s}^{-2}$
 - D. $\text{kg m}^2 \text{s}^{-3}$

42. The graph shows a set of experimental results to determine the density of [1 mark] oil. The results have systematic errors and random errors.

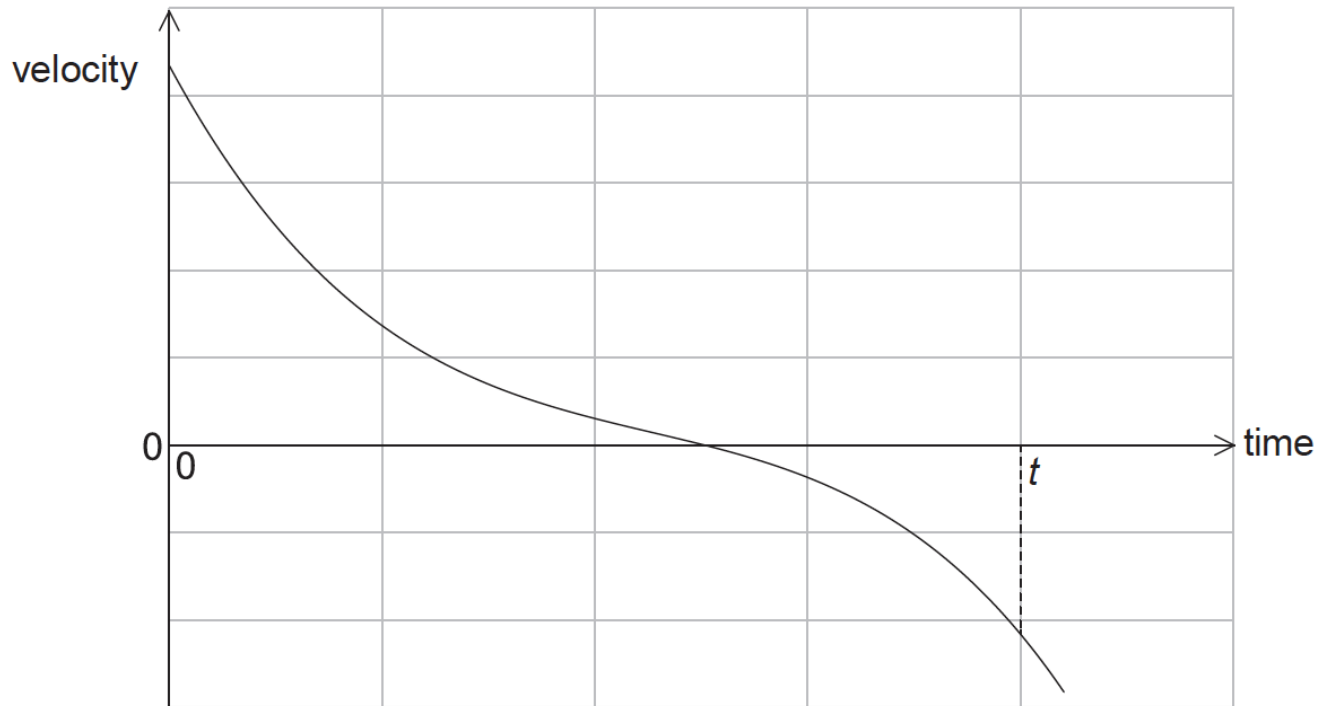


Using the information on the graph, what can be said about the measurements used to find the density of oil?

	Systematic errors	Random errors
A.	small	small
B.	small	large
C.	large	small
D.	large	large

43. A body moves in a straight line. In order for the equations for uniformly accelerated motion to be applied, which condition **must** be true? [1 mark]
- A. A constant net force acts on the body of fixed mass.
 - B. A constant net force acts on the body.
 - C. The body falls towards the surface of a planet.
 - D. The body has an initial velocity of zero.

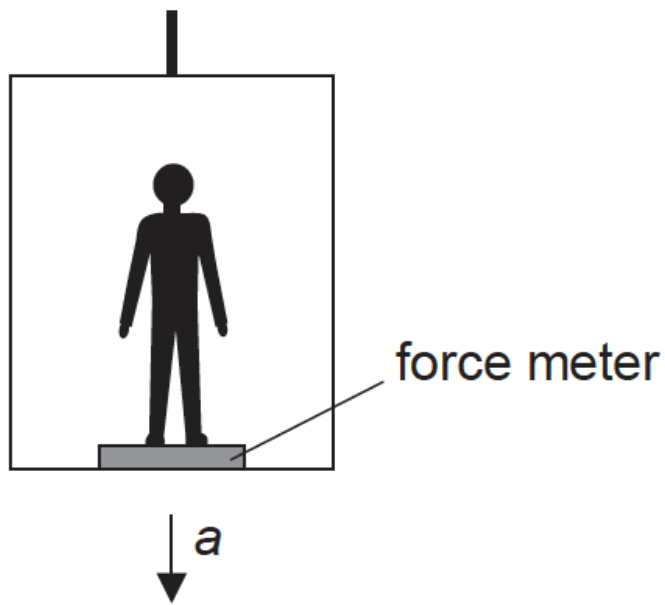
44. The graph shows the variation with time of the velocity of a truck of fixed mass. [1 mark]



What can be deduced from the graph?

- A. The truck is always accelerating.
- B. The truck is always moving.
- C. The truck is always moving in one direction.
- D. The displacement of the truck after time t is zero.

45. A student of mass m is in an elevator which is accelerating downwards at a . [1 mark]

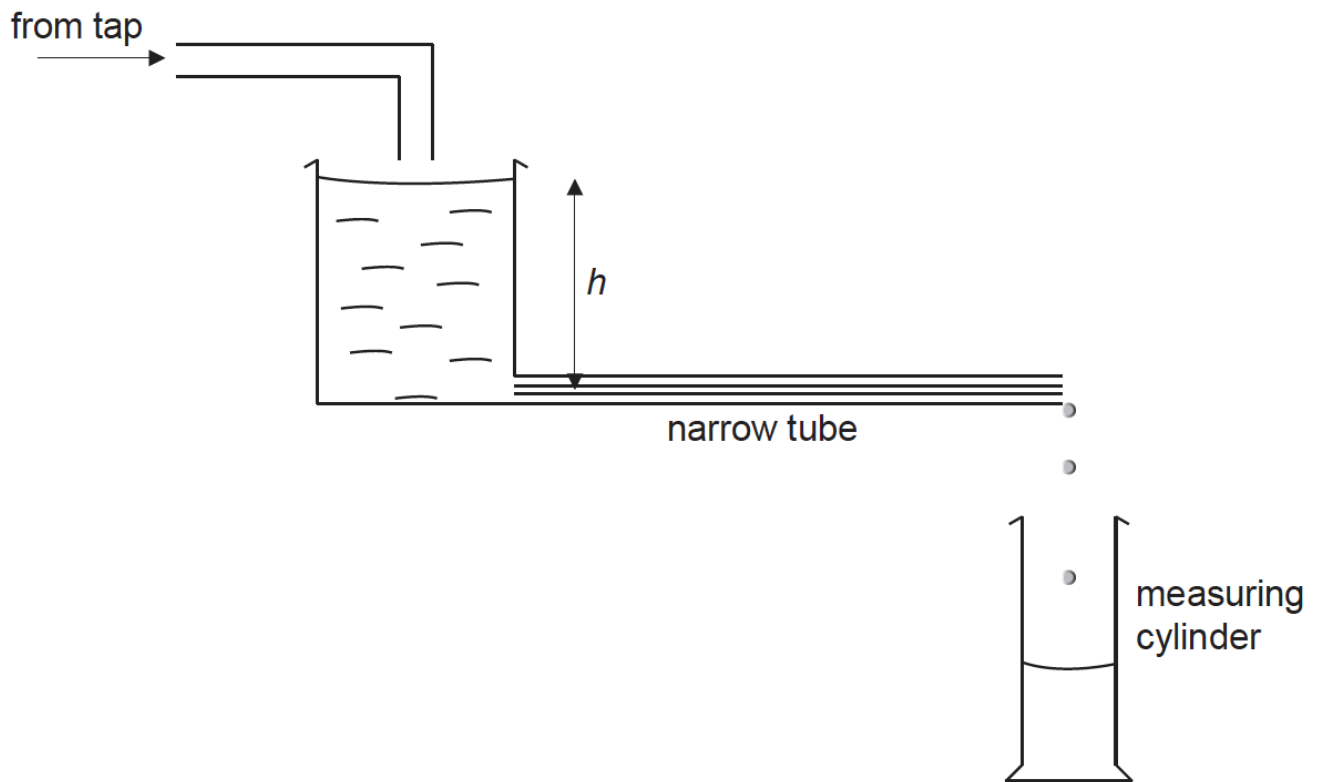


What is the reading on the force meter?

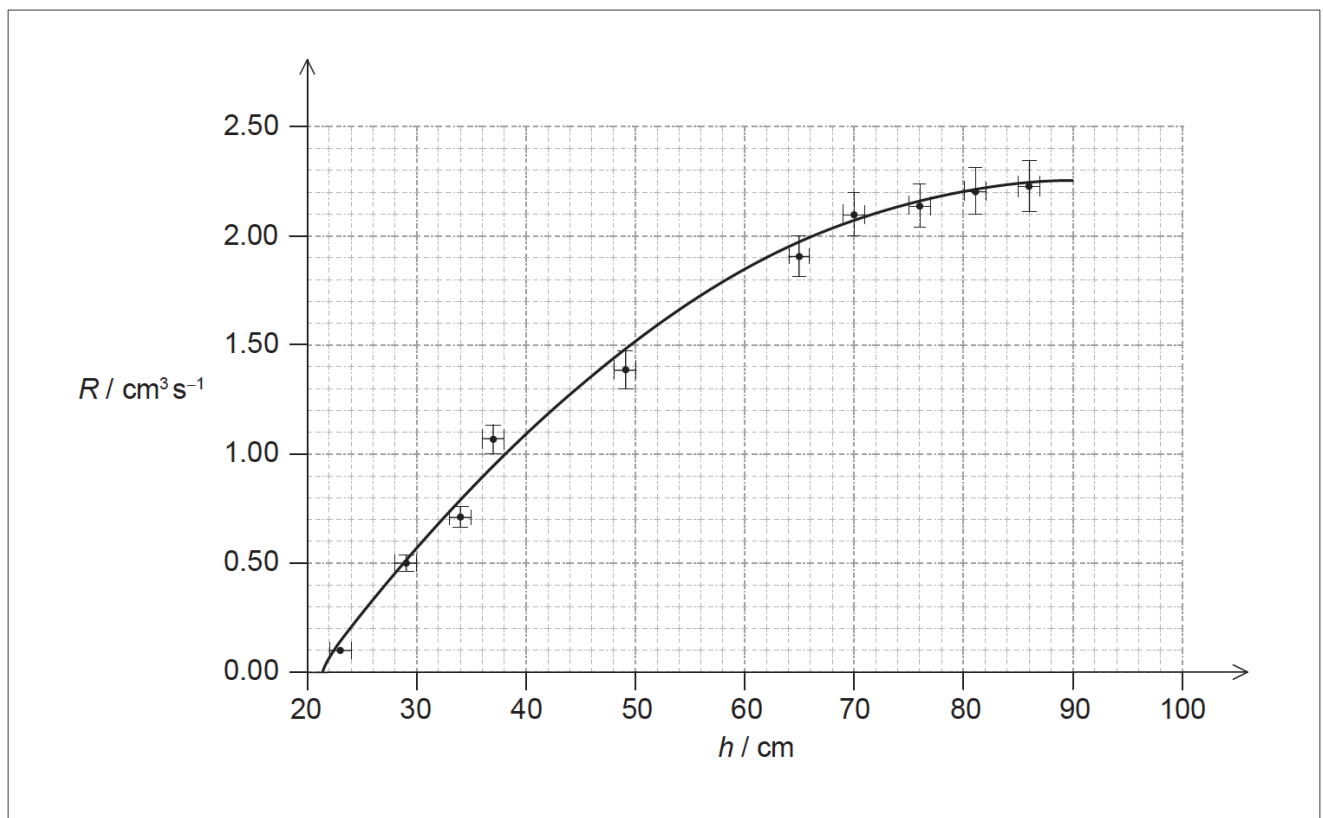
- A. mg
- B. $mg - ma$
- C. $mg + ma$
- D. $ma - mg$

This question is about the flow of liquids.

A student carries out an experiment to investigate how the rate of flow R of water through a narrow tube varies with the pressure difference across the tube. The pressure difference is proportional to the height h shown in the diagram. The student measures h in cm with a metre ruler. R is obtained by measuring the volume of water collected in a measuring cylinder in a time of 100s.



46a. The student enters the data on a spreadsheet and produces the graph [5 marks] and trend line shown below.



The data point for $h = 57\text{cm}$, $R = 1.70\text{cm}^3\text{s}^{-1}$ has not been shown on the graph. The student estimates the uncertainties in all values of h to be $\pm 1\text{cm}$ and the uncertainties in the values of R to be $\pm 5\%$.

(i) On the graph, draw the missing data point.

- (ii) On the graph, draw the vertical error bar for this data point.
- (iii) Comment on why the trend line is not a perfect match for the data.
- (iv) Explain why the student's estimate of a 5% uncertainty in all values for R is unlikely to be correct.

46b. The student estimates that the uncertainty in timing 100s is ± 1 s. Using [4 marks] the data on the graph, deduce the absolute uncertainty in the volume of water collected when $R = 2.1\text{cm}^3\text{s}^{-1}$.

47. Which of the following is a fundamental unit?

[1 mark]

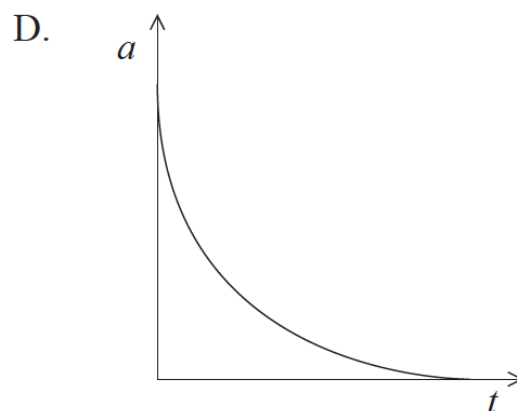
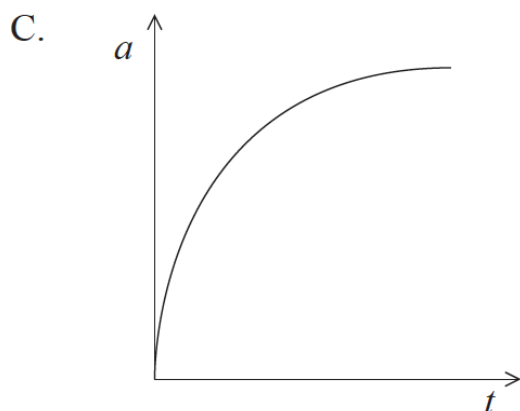
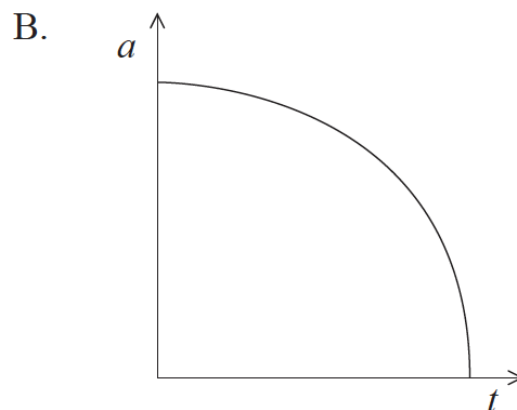
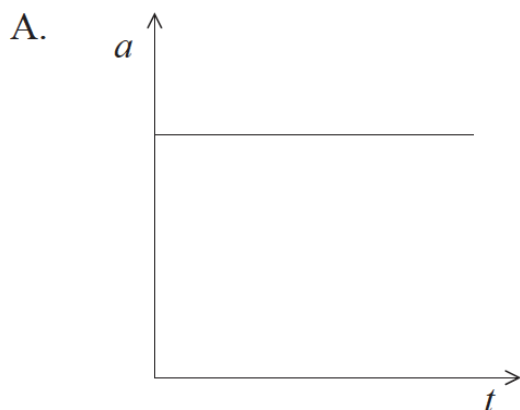
- A. Ampere
- B. Coulomb
- C. Ohm
- D. Volt

48. The maximum acceleration a_{max} of an oscillator undergoing simple harmonic motion (SHM) has a percentage uncertainty of 12%. The amplitude x_0 of the oscillation has a percentage uncertainty of 20%. If $k = \sqrt{\frac{a_{\text{max}}}{x_0}}$ what is the percentage uncertainty in the constant k ?

[1 mark]

- A. 4%
- B. 8%
- C. 16%
- D. 32%

49. An object is dropped from rest above the Earth's surface. Air resistance acts on the object. What is the variation of acceleration a with time t for the object? [1 mark]



50. Which of the following is a condition for an object to be in translational equilibrium? [1 mark]

- A. The object must be moving at constant speed.
- B. The velocity of the object in any direction must be zero.
- C. The forces acting horizontally on the object must equal the forces acting vertically on the object.
- D. The resultant force acting on the object must be zero.

51. An object rotates in a horizontal circle when acted on by a centripetal force F . What is the centripetal force acting on the object when the radius of the circle doubles and the kinetic energy of the object halves? [1 mark]

- A. $\frac{F}{4}$
- B. $\frac{F}{2}$
- C. F
- D. $4F$

52. No external forces act on a given system during an inelastic collision. For [1 mark] this system, which is correct about the conservation of kinetic energy and the conservation of linear momentum?

	Kinetic energy	Linear momentum
A.	must be conserved	may be conserved
B.	must be conserved	must be conserved
C.	is not conserved	may be conserved
D.	is not conserved	must be conserved

53. An object of mass m_1 has a kinetic energy E_1 . Another object has a mass m_2 and kinetic energy E_2 . The objects have the same momentum. What is the ratio $\frac{E_1}{E_2}$? [1 mark]

A. 1

B. $\sqrt{\frac{m_2}{m_1}}$

C. $\frac{m_2}{m_1}$

D. $\left(\frac{m_2}{m_1}\right)^2$

54. A metal sphere is at rest on a bench. According to Newton's third law of motion, what is a possible action-reaction pair for this situation? [1 mark]

	Action	Reaction
A.	downwards gravitational force of Earth on the sphere	upwards gravitational force of the sphere on Earth
B.	upwards gravitational force of Earth on the sphere	downwards gravitational force of the sphere on Earth
C.	upwards electrostatic force acting on the sphere due to the atoms in the bench surface	upwards gravitational force of the sphere on Earth
D.	upwards electrostatic force acting on the sphere due to the atoms in the bench surface	downwards gravitational force of the sphere on Earth

55. The radius of a sphere is measured with an uncertainty of 2%. What is the uncertainty in the volume of the sphere? [1 mark]

- A. 2%
- B. 4%
- C. 6%
- D. 8%

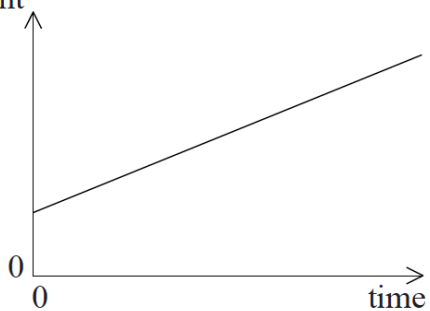
56. The force of air resistance F that acts on a car moving at speed v is given by $F = kv^2$ where k is a constant. What is the unit of k ? [1 mark]

- A. kg m^{-1}
- B. $\text{kg m}^{-2}\text{s}^2$
- C. kg m^{-2}
- D. $\text{kg m}^{-2}\text{s}^{-2}$

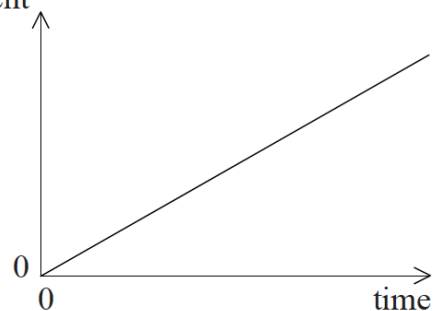
57. A body moves on a straight line. The graphs show the variation of displacement with time. Which graph shows motion with negative acceleration?

[1 mark]

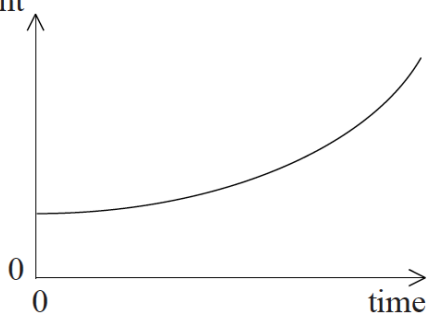
A. displacement



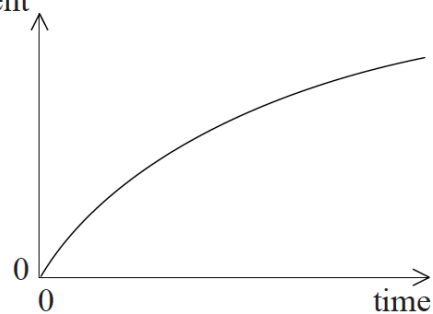
B. displacement



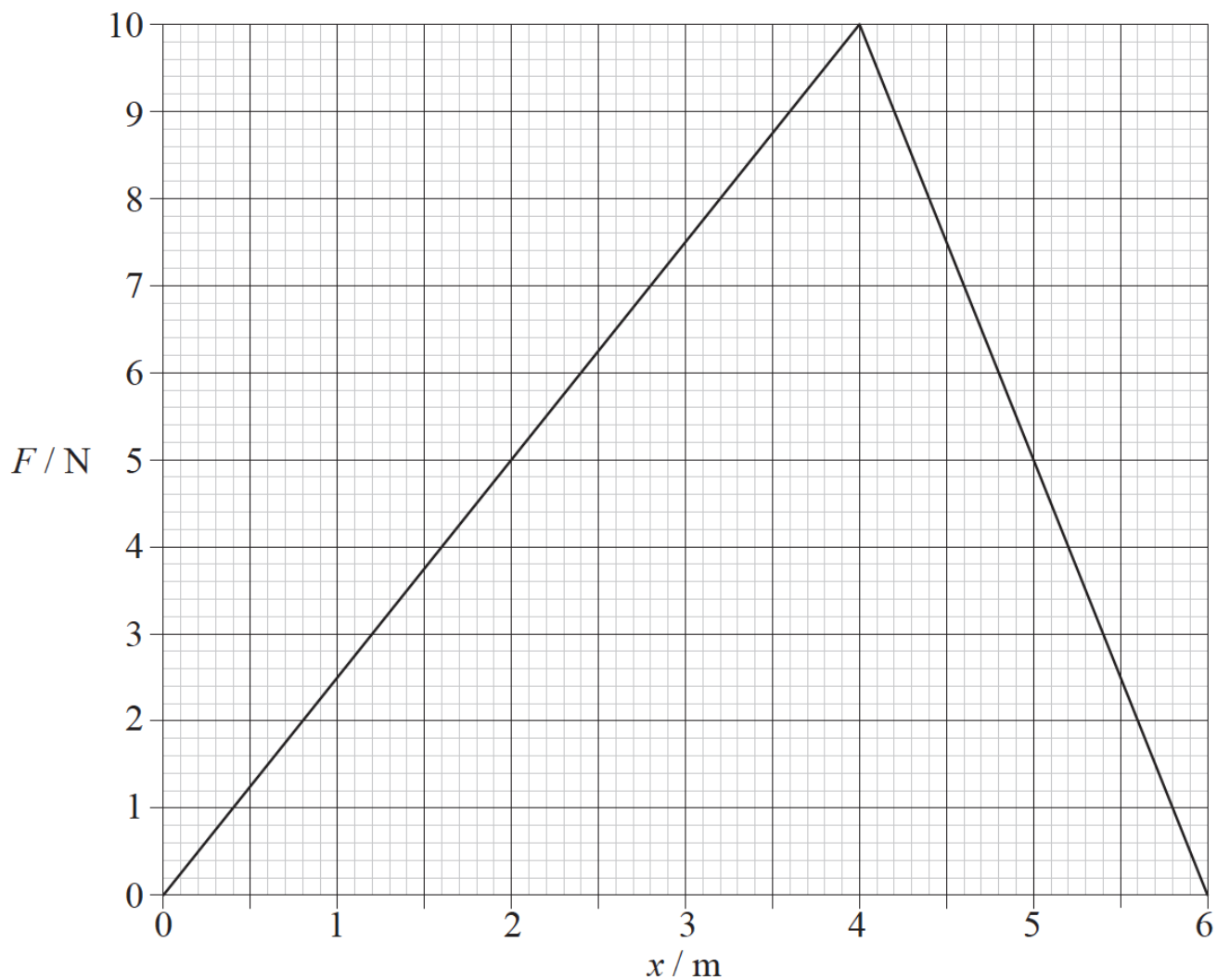
C. displacement



D. displacement



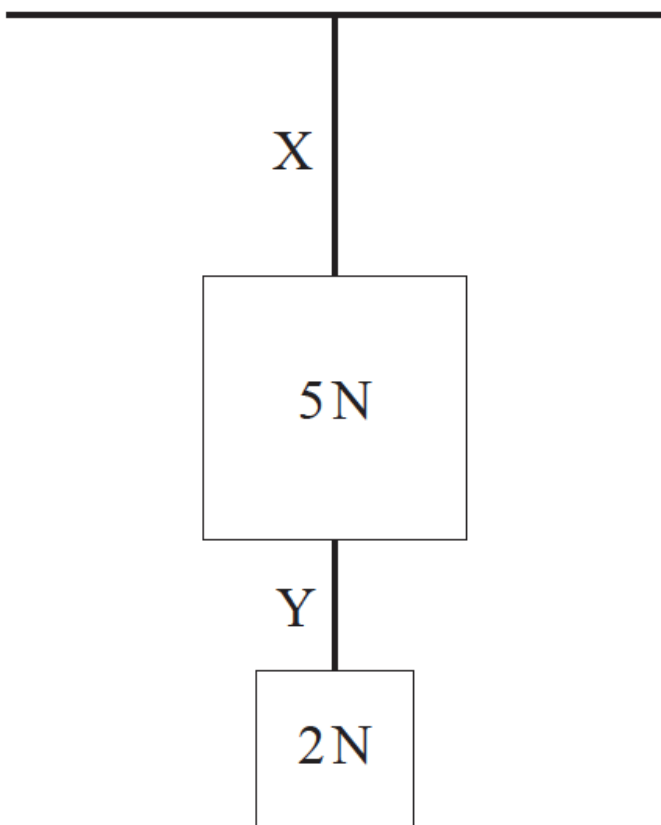
58. The graph shows how the net force F that acts on a body varies with the distance x that the body has travelled. [1 mark]



After travelling 6 m, the change in the kinetic energy of the body is

- A. 0 J.
- B. 20 J.
- C. 30 J.
- D. 60 J.

59. Two blocks of weight 5 N and 2 N are attached to two ropes, X and Y. [1 mark]



The blocks hang vertically. The mass of the ropes is negligible. What is the tension in X and the tension in Y?

	Tension in X	Tension in Y
A.	7N	7N
B.	7N	2N
C.	5N	2N
D.	5N	3N

60. A constant force of 12 N is applied for 3.0 s to a body initially at rest. The [1 mark] final velocity of the body is 6.0 m s^{-1} . What is the mass of the body?

- A. 1.5 kg
- B. 6.0 kg
- C. 24 kg
- D. 36 kg

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