Q1. Which one of the following has the same unit as the rate of change of momentum?

    A   work

    B   energy

    C   acceleration

    D   weight

(Total 1 mark)

Q2. The nucleus of a radioactive isotope X is at rest and decays by emitting an α particle so that a new nuclide Y is formed.
Which one of the following statements about the decay is correct?

    A   The momentum of Y is equal and opposite to the momentum of the α particle.

    B   The momentum of Y is equal to the momentum of X.

    C   The kinetic energy of Y is equal to the kinetic energy of the α particle.

    D   The total kinetic energy is the same before and after the decay.

(Total 1 mark)

Q3. Trolley T_1, of mass 2.0 kg, collides on a horizontal surface with trolley T_2, which is also of mass 2.0 kg. The collision is elastic. Before the collision T_1 was moving at 4.0 m s^{-1} and T_2 was at rest.

Which one of the following statements is correct?

Immediately after the collision

A T_1 is at rest and T_2 moves at 4.0 m s^{-1}.

B T_1 will rebound from T_2 at 4.0 m s^{-1}.

C T_1 and T_2 will both move at 2.8 m s^{-1}.

D T_1 and T_2 will both move at 1.4 m s^{-1}.

(Total 1 mark)

Q4. Four rectangular loops of wire **A**, **B**, **C** and **D** are each placed in a uniform magnetic field of the same flux density B. The direction of the magnetic field is parallel to the plane of the loops as shown.

When a current of 1 A is passed through each of the loops, magnetic forces act on them. The lengths of the sides of the loops are as shown.
Which loop experiences the largest couple?

| A | B | C | D |
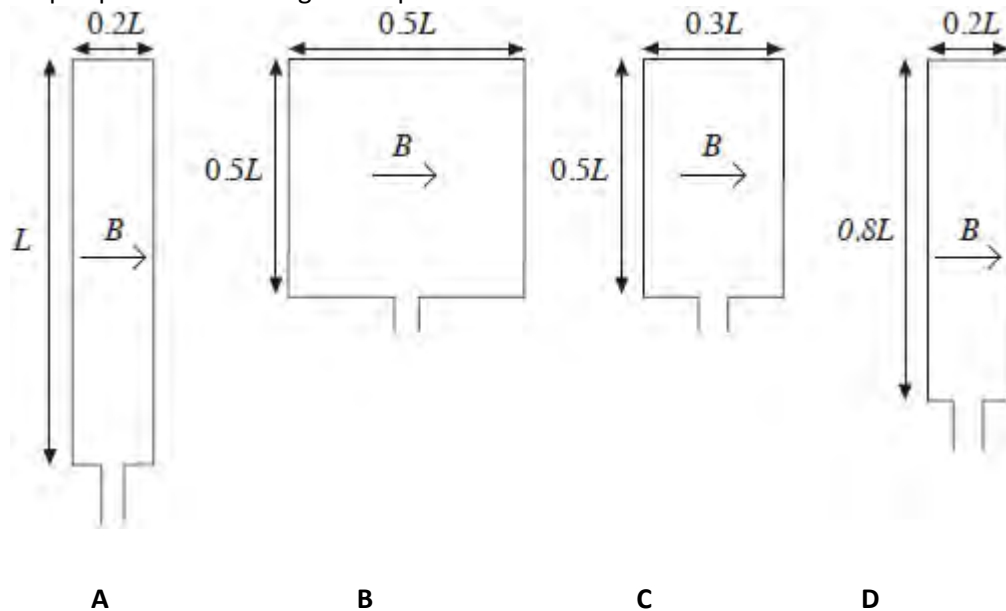
(Total 1 mark)

Q5. Which of the following is a scalar quantity?

A   velocity   ◻

B   kinetic energy   ◻

C   force   ◻

D   momentum   ◻

(Total 1 mark)

Q6. An object is accelerated from rest by a constant force *F* for a time *t*. Which graphs represent the variation of time with the change in the kinetic energy and the change in momentum of the object?

	Kinetic energy	Momentum
A		
B		
C		
D		
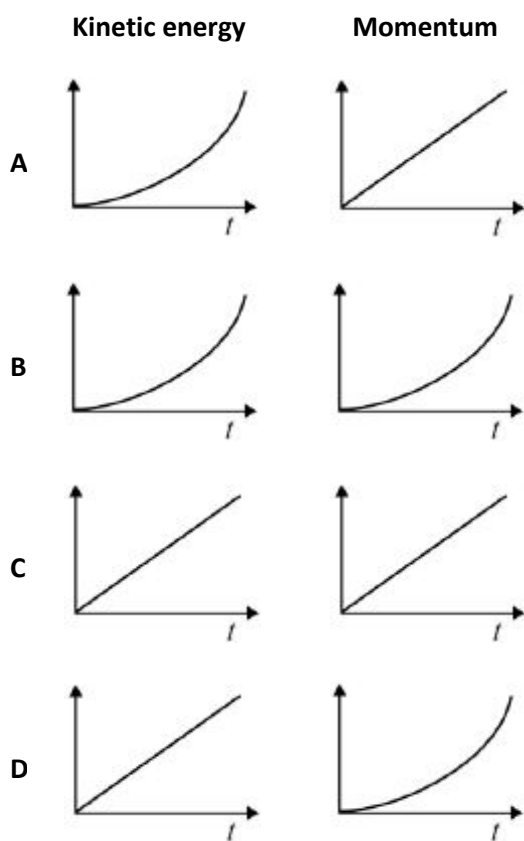
A ☐

B ☐

C ☐

D ☐

(Total 1 mark)

Q7. An object is dropped from a cliff. How far does the object fall in the third second? Assume that $g = 10$ m s^{-2}.

A	10 m	⬭
B	20 m	⬭
C	25 m	⬭
D	45 m	⬭

(Total 1 mark)

Q8. A body falls freely, with negligible air resistance. What quantity of the body is its rate of change of momentum?

| A	mass	⬭
B	power	⬭
C	kinetic energy	⬭
D	weight	⬭

(Total 1 mark)

Q9. A firework rocket is fired vertically into the air and explodes at its highest point. What are the changes to the total kinetic energy of the rocket and the total momentum of the rocket as a result of the explosion?

	total kinetic energy of rocket	total momentum of rocket	
A	unchanged	unchanged	⬭
B	unchanged	increased	⬭
C	increased	unchanged	⬭
D	increased	increased	⬭

(Total 1 mark)

Q10. A lift and its passengers with a total mass of 500 kg accelerates upwards at 2 m s^{-2} as shown. Assume that $g = 10$ m s^{-2}.
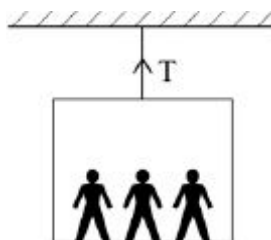
What is the tension in the cable?

A	1000 N	⬭
B	4000 N	⬭
C	5000 N	⬭
D	6000 N	⬭

(Total 1 mark)

Q11. Which of the following is **not** a unit of power?

A $N\,m\,s^{-1}$ [○]

B $kg\,m^2\,s^{-3}$ [○]

C $J\,s^{-1}$ [○]

D $kg\,m^{-1}\,s^{-1}$ [○]

(Total 1 mark)

Q12. A car accelerates uniformly from rest along a straight road. Which graph shows the variation of displacement x of the car with time t?
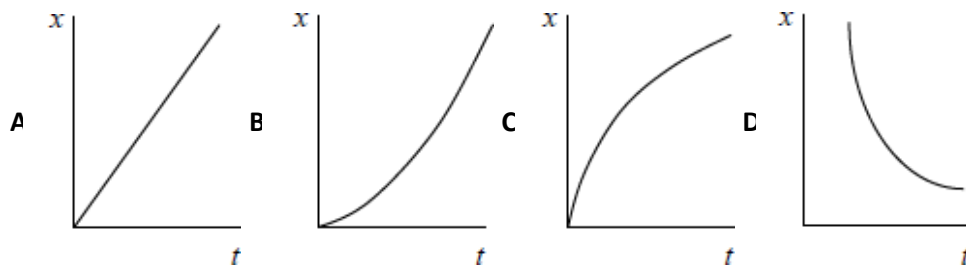
A   [○]

B   [○]

C   [○]

D   [○]

(Total 1 mark)

Q13. Which of the following statements is correct?

The force acting on an object is equivalent to

A   its change of momentum.

B   the impulse it receives per second.

C   the energy it gains per second.

D   its acceleration per metre.

(Total 1 mark)

Q14. Two forces of 6 N and 10 N act at a point. Which of the following could **not** be the magnitude of the result?

A   16 N

B   8 N

C   5 N

D   3 N

(Total 1 mark)

Q15. A car wheel nut can be loosened by applying a force of 200 N on the end of a bar of length 0.8 m as in **X**. A car mechanic is capable of applying forces of 500 N simultaneously in opposite directions on the ends of a wheel wrench as in **Y**.
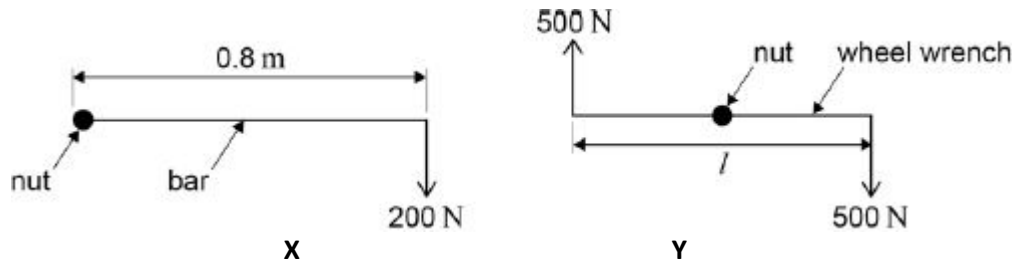
What is the minimum length *l* of the wrench which would be needed for him to loosen the nut?

A   0.16 m

B   0.32 m

C   0.48 m

D   0.64 m

(Total 1 mark)

Q16. A ballbearing **X** of mass $2m$ is projected vertically upwards with speed u. A ballbearing **Y** of mass m is projected at 30° to the horizontal with speed $2u$ at the same time. Air resistance is negligible. Which of the following statements is correct?

A   The horizontal component of **Y**'s velocity is u.

B   The maximum height reached by **Y** is half that reached by **X**

C   **X** and **Y** reach the ground at the same time.

D   **X** reaches the ground first.

(Total 1 mark)

Q17. What is the relationship between the distance y travelled by an object falling freely from rest and the time x the object has been falling?

A y is proportional to x^2 ▢

B y is proportional to $\sqrt{x}$ ▢

C y is proportional to $\dfrac{1}{x}$ ▢

D y is proportional to $\dfrac{1}{x^2}$ ▢

(Total 1 mark)

Q18. A car exerts a driving force of 500 N when travelling at a constant speed of 72 km h^{-1} on a level track. What is the work done in 5 minutes?
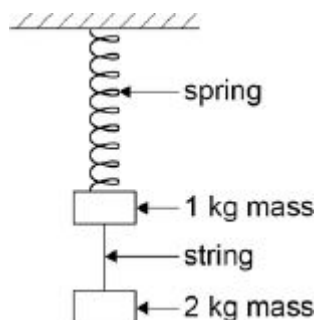
A 3.0×10^6 J   ▢

B 2.0×10^6 J   ▢

C 2.0×10^5 J   ▢

D 1.1×10^5 J   ▢

(Total 1 mark)

Q19. Two masses hang at rest from a spring, as shown in the diagram. The string separating the masses is burned through.

Which of the following gives the accelerations of the two masses as the string breaks?

acceleration of free fall = g

	acceleration of 1 kg mass upwards in m s^{-2}	acceleration of 2 kg mass downwards in m s^{-2}	
A	3 g	1 g	○
B	2 g	2 g	○
C	2 g	1 g	○
D	1 g	1 g	○

(Total 1 mark)

Q20. An object falls freely from rest. After falling a distance d its velocity is v. What is its velocity after it has fallen a distance $2d$?

A 2 v

B 4 v

C 2 v^2

D √2 v

(Total 1 mark)

Q21. An electric motor of input power 100 W raises a mass of 10 kg vertically at a steady speed of 0.5 m s^{-1}. What is the efficiency of the system?
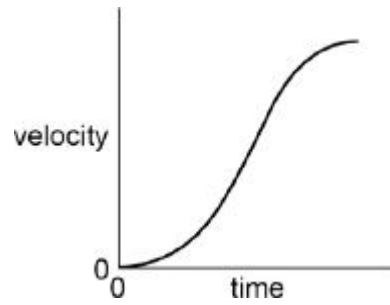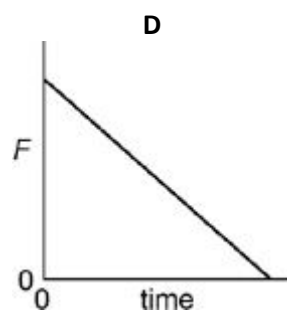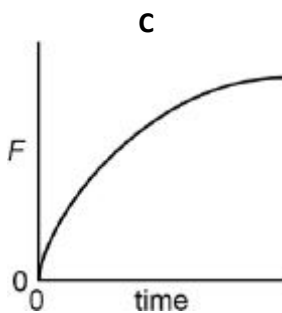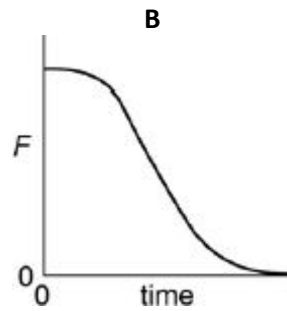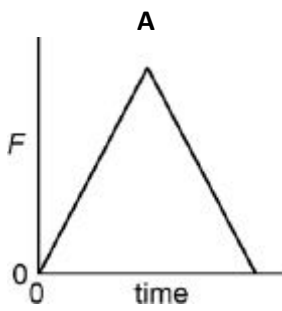
A 5%

B 12%

C 50%

D 100%

(Total 1 mark)

Q22. The velocity of a vehicle varies with time as shown by the following graph.

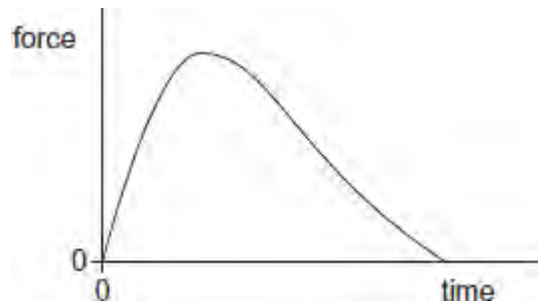Which graph below represents how the resultant force *F* on the car varies during the same time?

A ☐

B ☐

C ☐

D ☐

(Total 1 mark)

Q23. The graph shows how the force acting on a rocket varies with time.

Which one of the following is represented by the area under the graph?

A   distance travelled

B   gain in kinetic energy

C   change in velocity

D   change in momentum

(Total 1 mark)

Q24. A golf club strikes a stationary golf ball of mass 4.8×10^{-2} kg and the ball leaves the club with a speed of 95 m s^{-1}. If the average force exerted on the ball is 7800 N, how long are the ball and club in contact?

A 5.8×10^{-4} s

B 1.2×10^{-2} s

C   0.51 s

D   0.58 s

(Total 1 mark)

Q25. Water of density 1000 kg m^{-3} flows out of a garden hose of cross-sectional area 7.2×10^{-4} m^2 at a rate of 2.0×10^{-4} m^3 per second. How much momentum is carried by the water leaving the hose per second?

A 5.6×10^{-5} N s

B 5.6×10^{-2} N s

C   0.20 N s

D   0.72 N s

(Total 1 mark)

Q26. Which one of the following is a possible unit of impulse?

A   Ns^{-1}

B   kg ms^{-1}

C   kg ms^{-2}

D   sN^{-1}

(Total 1 mark)

Q27. A railway truck of mass 8000 kg travels along a level track at a velocity of 2.5 ms^{-1} and collides with a stationary truck of mass 12000 kg. The two trucks move together at the same velocity after the collision.
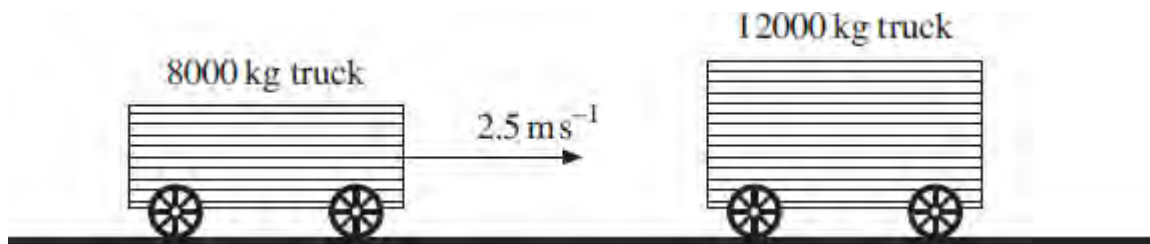
What is the change in momentum of the 8000 kg truck due to the impact?

A   8000 N s

**B**   12000 N s

C   20000 N s

D   25000 N s

(Total 1 mark)

Q28. A gas molecule of mass m moving at velocity u collides at right angles with the side of a container and rebounds elastically. Which one of the following statements concerning the motion of the molecule is **incorrect?**

A   The magnitude of the change in momentum of the molecule is zero.

B   The magnitude of the change in momentum of the molecule is 2mu.

C   The force exerted by the molecule on the side of the container is equal to the force exerted by the container on the molecule.

D   The change in kinetic energy of the molecule is zero.

(Total 1 mark)

The graph shows how the resultant force, *F*, acting on a body varies with time, *t*.
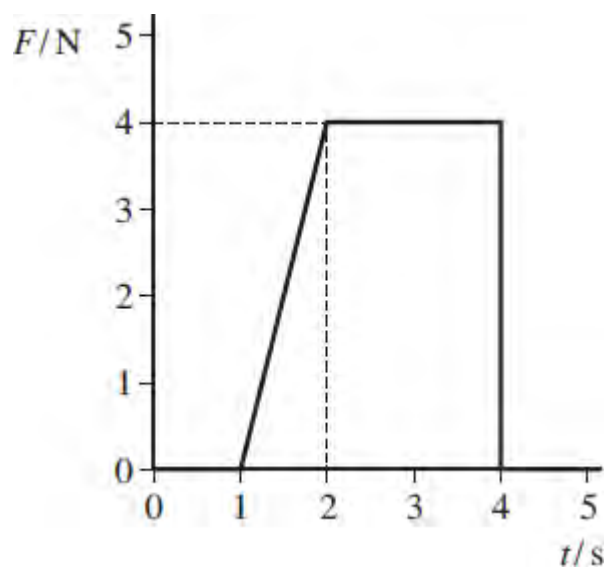
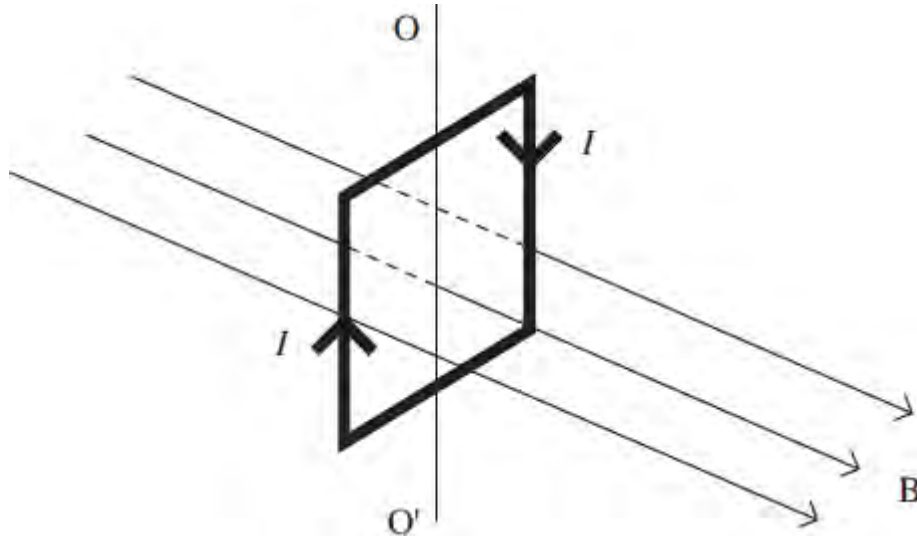

What is the change in momentum of the body over the 5 s period?

A   2N s

B   8N s

C   10N s

D   12N s

(Total 1 mark)

Q30. The diagram shows a vertical square coil whose plane is at right angles to a horizontal uniform magnetic field B. A current, I, is passed through the coil, which is free to rotate about a vertical axis OO'.


Which one of the following statements is correct?

A   The forces on the two vertical sides of the coil are equal and opposite.

B   A couple acts on the coil.

C   No forces act on the horizontal sides of the coil.

D   If the coil is turned through a small angle about OO' and released, it will remain in position.

(Total 1 mark)

Q31. A ball of mass m travelling at velocity v collides normally with a smooth wall, as shown in the diagram, and rebounds elastically.
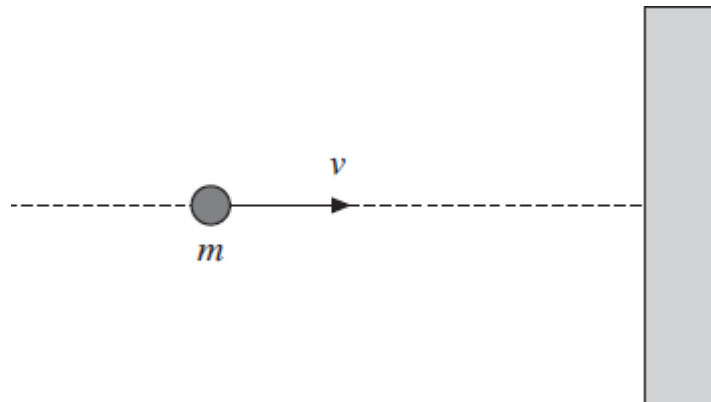
Which line, **A** to **D**, in the table, gives the correct expressions for the magnitude of the change of momentum, and the change of kinetic energy, of the ball?

|	magnitude of change of momentum	change of kinetic energy
A	$2mv$	0
B	$2mv$	mv^2
C	0	0
D	0	mv^2

(Total 1 mark)

Q32. A cricket ball of mass 0.16 kg travelling at a speed of 35 ms^{-1} is hit by a bat and, as a result of the impact, leaves the bat in the opposite direction at 30 ms^{-1}. If the duration of the impact is 52 ms, what is the magnitude of the average force on the ball?

A   0.015 N

B   0.20 N

C   15 N

D   200 N

(Total 1 mark)

Q33. A ball is released so that it falls vertically. The graph shows how the resultant force acting on the ball changes with time.
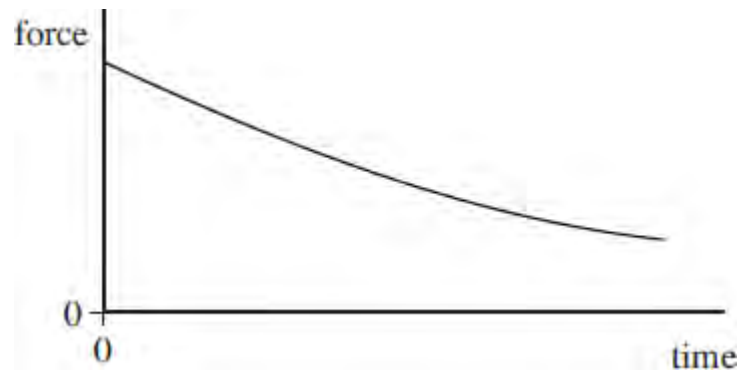

Which one of the following is represented by the area under the graph?

A   distance travelled

B   gain in kinetic energy

C   acceleration

D   impulse

(Total 1 mark)

Q34. A small sphere, of mass m and carrying a charge Q, is suspended from a thread and placed in a uniform horizontal electric field of strength E. When the sphere comes to rest the thread makes an angle ϑ with the vertical and the tension in it is T, as shown in the diagram. W is the weight of the sphere and F is the electric force acting on it.
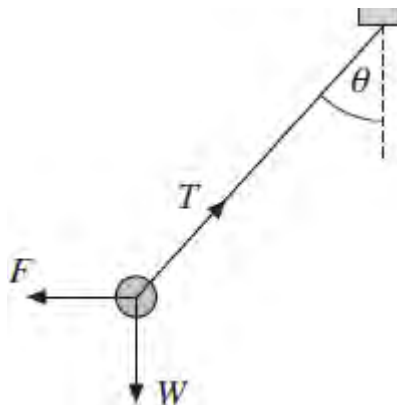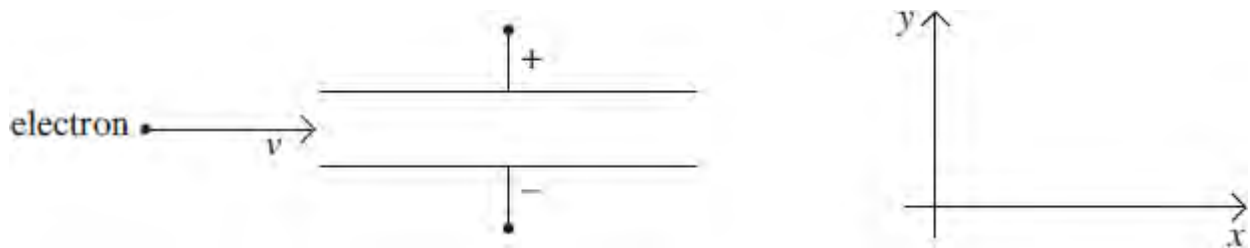

Under these conditions, which one of the following equations is **incorrect**?

A $T \sin \vartheta = EQ$

B $T = mg \cos\vartheta + EQ \sin\vartheta$

C $T^2 = (EQ)^2 + (mg)^2$

D $mg = EQ \tan\vartheta$

(Total 1 mark)

Q35. A beam of electrons, moving with a constant velocity *v* in a vacuum, enters a uniform electric field between two metal plates.

Which line, **A** to **D**, in the table describes the components of the acceleration of the electrons in the *x* and *y* directions as they move through the field?

|	acceleration in *x* direction	acceleration in *y* direction
A	zero	zero
B	zero	constant
C	constant	zero
D	constant	constant

(Total 1 mark)

Q36. Which line, **A** to **D**, in the table correctly describes the trajectory of charged particles which enter separately, at right angles, a uniform electric field, and a uniform magnetic field?

	uniform electric field	uniform magnetic field
A	parabolic	circular
B	circular	parabolic
C	circular	circular
D	parabolic	parabolic

(Total 1 mark)

Q37. The graph shows how the force acting on a body changes with time.
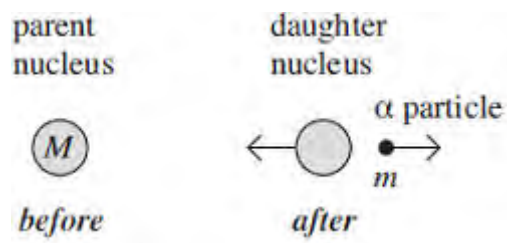

force/N

time/ s
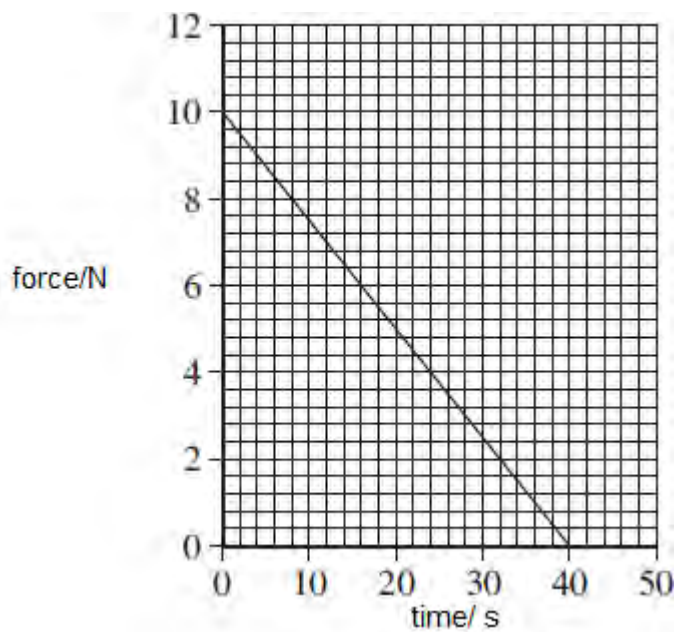
The body has a mass of 0.25 kg and is initially at rest. What is the speed of the body after 40 s assuming no other forces are acting?

    A   200 ms^{-1}

    B   400 ms^{-1}

    C   800 ms^{-1}

    D   1600 ms^{-1}

(Total 1 mark)

Q38. A stationary unstable nucleus of mass M emits an α particle of mass m with kinetic energy E.

parent
nucleus

daughter
nucleus

α particle

M

m

before

after

What is the speed of recoil of the daughter nucleus?

A $\dfrac{\sqrt{2mE}}{(M-m)}$

B $\dfrac{\sqrt{2mE}}{M}$

C $\dfrac{(M-m)}{\sqrt{2mE}}$

D $\dfrac{2mE}{(M-m)^2}$

(Total 1 mark)

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Q39. Two ice skaters, initially at rest and in contact, push apart from each other.

Which line, **A** to **D**, in the table states correctly the change in the total momentum and the total kinetic energy of the two skaters?

	total momentum	total kinetic energy
A	unchanged	increases
B	unchanged	unchanged
C	increases	increases
D	increases	unchanged

(Total 1 mark)

Q40. A ball of mass 2.0 kg, initially at rest, is acted on by a force F which varies with time t as shown by the graph.
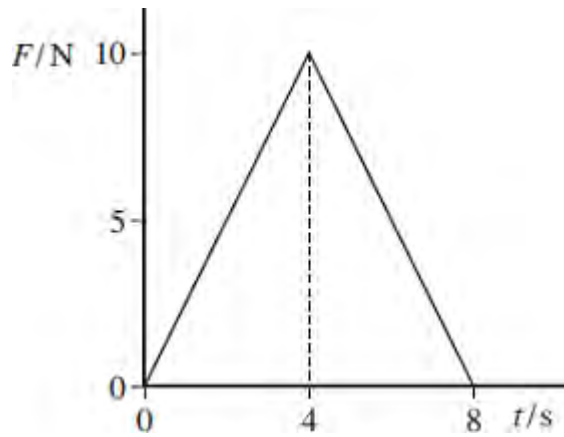
What is the velocity of the ball after 8.0 s?

A   20 ms^{-1}

B   40 ms^{-1}

C   80 ms^{-1}

D   160 ms^{-1}

(Total 1 mark)

Q41. A body X moving with a velocity v makes an elastic collision with a stationary body Y of equal mass on a smooth horizontal surface.

Which line, **A** to **D**, in the table gives the velocities of the two bodies after the collision?

|	velocity of X	velocity of Y
A	$\dfrac{v}{2}$	$-\dfrac{v}{2}$
B	$-\dfrac{v}{2}$	$\dfrac{v}{2}$
C	v	0
D	0	v

(Total 1 mark)

Q42. Which line, **A** to **D**, in the table shows correctly whether the moment of a force, and momentum, are scalar or vector quantities?

	moment of force	momentum
A	scalar	scalar
B	scalar	vector
C	vector	scalar
D	vector	vector

(Total 1 mark)

Q43. The graph shows how the resultant force applied to an object of mass 2.0 kg, initially at rest, varies with time.
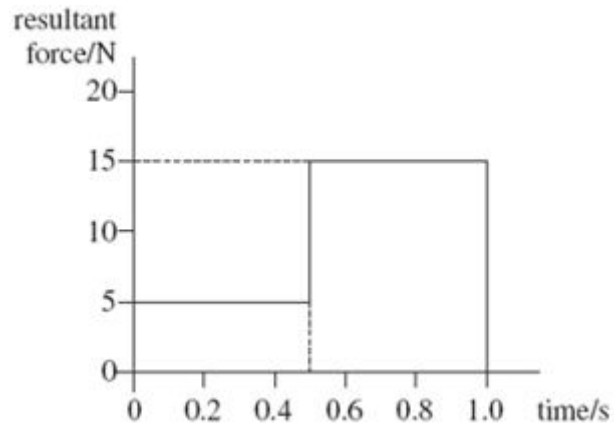
What is the speed of the object after 1.0 s?

A   2.5 ms^{-1}

B   5.0 ms^{-1}

C   7.5 ms^{-1}

D   10 ms^{-1}

(Total 1 mark)

Q44. Which of the following is a possible unit for rate of change of momentum?

A   N s

B   N s^{-1}

C   kg ms^{-1}

D   kg ms^{-2}

(Total 1 mark)

Q45. A rail truck X travels along a level track and collides with a stationary truck Y. The two trucks move together at the same velocity after the collision.

Which line, **A** to **D**, in the table states how the total momentum and the total kinetic energy of the trucks change as a result of the impact.

	total momentum	total kinetic energy
A	unchanged	unchanged
B	unchanged	decreases
C	decreases	decreases
D	decreases	unchanged

(Total 1 mark)

Q46. What is the acceleration of an electron at a point in an electric field where the field strength is 1.5×10^5 V m^{-1}?

    A 1.2×10^6 m s^{-2}

    B 1.4×10^{13} m s^{-2}

    C 2.7×10^{15} m s^{-2}

    D 2.6×10^{16} m s^{-2}
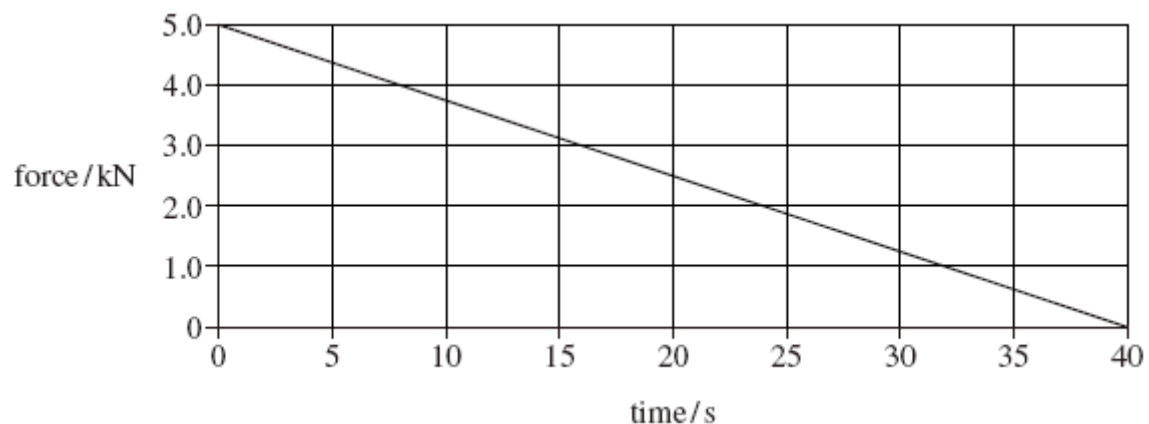
(Total 1 mark)

Q47.   Which one of the following statements is correct?

The force acting on an object is equivalent to

A   its change of momentum.

B   the impulse it receives per second.

C   the energy it gains per second.

D   its acceleration per metre.

(Total 1 mark)

Q48.   The graph shows how the force on a glider of mass 2000 kg changes with time as it is launched from a level track using a catapult.

Assuming the glider starts at rest what is its velocity after 40 s?

A   2.5 m s⁻¹

B   10 m s⁻¹

C   50 m s^{-1}

D   100 m s^{-1}

(Total 1 mark)

Q49.   A gas molecule of mass m in a container moves with velocity v. If it makes an elastic collision at right angles to the walls of the container, what is the change in momentum of the molecule?

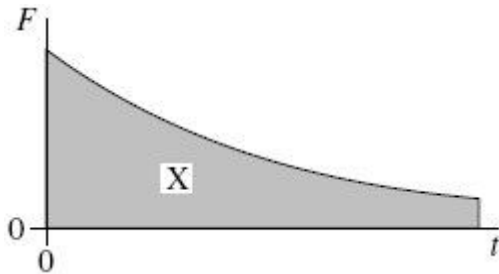**A**   zero

B $\dfrac{1}{2} mv$

C mv

D $2 mv$

(Total 1 mark)

Q50.   Which one of the following could **not** be used as a unit of force?

A   A T m

B   W s^{-2}

C   kg m s^{-2}

D   J m^{-1}

(Total 1 mark)

Q51.   The graph shows the variation with time, t, of the force, F, acting on a body.

What physical quantity does the area X represent?

A   the displacement of the body

B   the acceleration of the body

C   the change in momentum of the body

D   the change in kinetic energy of the body

(Total 1 mark)

Q52.   Water of density 1000 kg m^{-3} flows out of a garden hose of cross-sectional area 7.2×10^{-4} m^2 at a rate of 2.0×10^{-4} m^3 per second. How much momentum is carried by the water leaving the hose per second?

A 5.6×10^{-5} N s

B 5.6×10^{-2} N s

C   0.20 N s

D   0.72 N s

(Total 1 mark)

Q53. Which row, **A** to **D**, in the table correctly shows the quantities conserved in an inelastic collision?

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

(Total 1 mark)

Q54. A 10 mF capacitor is charged to 10 V and then discharged completely through a small motor. During this process, the motor lifts a weight of mass 0.10 kg. If 10% of the energy stored in the capacitor is used to lift the weight, through what approximate height will the weight be lifted?

A   0.05 m

B   0.10 m

C   0.50 m

D   1.00 m

(Total 1 mark)

Q55.
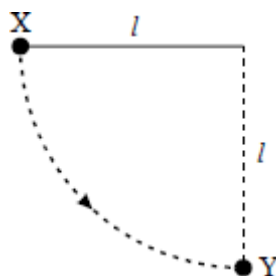
A ball of mass m, which is fixed to the end of a light string of length l, is released from rest at X. It swings in a circular path, passing through the lowest point Y at speed v. If the tension in the string at Y is T, which one of the following equations represents a correct application of Newton☒s laws of motion to the ball at Y?

A $\quad T = \dfrac{mv^2}{l} - mg$

B $\quad T - mg = \dfrac{mv^2}{l}$

C $\quad mg - T = \dfrac{mv^2}{l}$

D $\quad T + \dfrac{mv^2}{l} = mg$

(Total 1 mark)

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Q56. Take the acceleration due to gravity, g_E, as 10 ms^{-2} on the surface of the Earth.

The acceleration due to gravity on the surface of the Moon is $\frac{g_E}{6}$. An object whose weight on

Earth is 5.0 N is dropped from rest above the Moon's surface. What is its momentum after falling for 3.0s?

A   2.5 kg m s^{-1}

B   6.2 kg m s^{-1}

C   15 kg m s^{-1}

D   25 kg m s^{-1}

(Total 1 mark)

Q57. Coplanar forces of 5 N, 4 N and 3 N act on an object. Which force, in N, **could not possibly** be the resultant of these forces?

    A   0

    B   4

    C   12

    D   16

(Total 1 mark)

Q58. In the system shown a light rigid beam, pivoted at **X**, is held in position by a string which is fixed at **Y**. The beam carries a load of 200 N. The load is moved towards **X**. Which one of the following statements is correct?
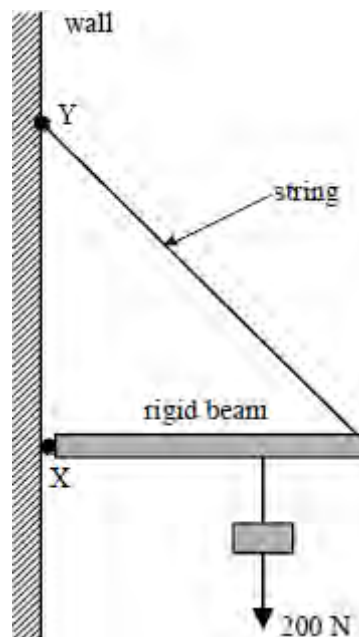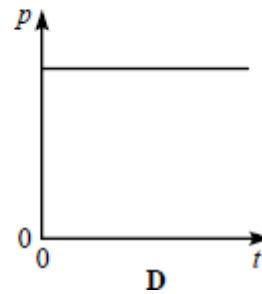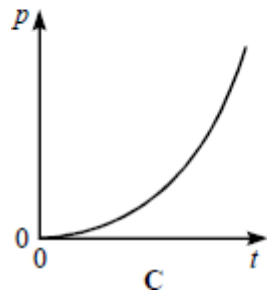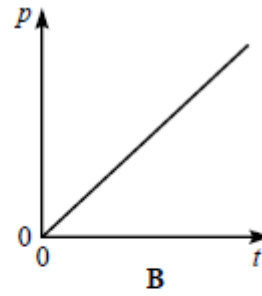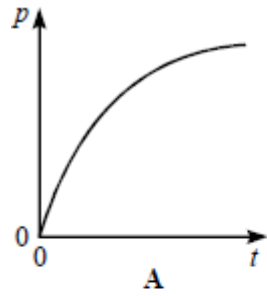

A   The tension in the string increases

B   The compression force in the beam increases

C   The moment of the load about **X** increases

D   The magnitude of the vertical component of the reaction at **X** increases

(Total 1 mark)

Q59. A body is accelerated from rest by a constant force.

Which one of the following graphs best represents the variation of the body's momentum p with time t?

(Total 1 mark)