Dynamics

(Past Year Topical Questions 2010-2015)

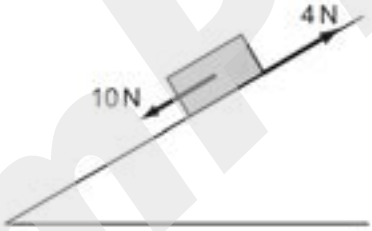
May/June 2010 (11)

10 Two equal masses travel towards each other on a frictionless air track at speeds of 60 cm s^{-1} and 40 cm s^{-1}. They stick together on impact.

What is the speed of the masses after impact?

A 10 cm s^{-1} **B** 20 cm s^{-1} **C** 40 cm s^{-1} **D** 50 cm s^{-1}

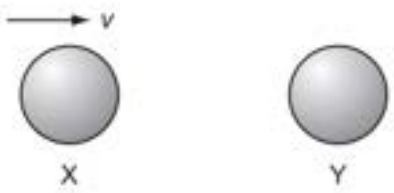
11 A brick weighing 20 N rests on an inclined plane. The weight of the brick has a component of 10 N parallel with the plane. The brick also experiences a frictional force of 4 N.



What is the acceleration of the brick down the plane? Assume that the acceleration of free fall g is equal to 10 m s^{-2}.

A 0.3 m s^{-2} **B** 0.8 m s^{-2} **C** 3.0 m s^{-2} **D** 8.0 m s^{-2}

12 The diagram shows two identical spheres X and Y.



Initially, X moves with speed v directly towards Y. Y is stationary. The spheres collide elastically.

What happens?

	X	Y
A	moves with speed $\frac{1}{2}v$ to the right	moves with speed $\frac{1}{2}v$ to the right
B	moves with speed v to the left	remains stationary
C	moves with speed $\frac{1}{2}v$ to the left	moves with speed $\frac{1}{2}v$ to the right
D	stops	moves with speed v to the right

13 Forces of 3 N, 4 N and 5 N act at one point on an object. The angles at which the forces act can vary.

What is the value of the **minimum** resultant force of these forces?

A 0

B between 0 and 2 N

C 2 N

D between 2 N and 4 N

May/June 2010 (12)

10 The diagram shows two identical spheres X and Y.

Initially, X moves with speed v directly towards Y. Y is stationary. The spheres collide elastically.

What happens?

	X	Y
A	moves with speed $\frac{1}{2}v$ to the right	moves with speed $\frac{1}{2}v$ to the right
B	moves with speed v to the left	remains stationary
C	moves with speed $\frac{1}{2}v$ to the left	moves with speed $\frac{1}{2}v$ to the right
D	stops	moves with speed v to the right

11 Two equal masses travel towards each other on a frictionless air track at speeds of $60\,cm\,s^{-1}$ and $40\,cm\,s^{-1}$. They stick together on impact.

What is the speed of the masses after impact?

A $10\,cm\,s^{-1}$ **B** $20\,cm\,s^{-1}$ **C** $40\,cm\,s^{-1}$ **D** $50\,cm\,s^{-1}$

October/November 2010 (11)

10 The gravitational field strength on the surface of planet P is one tenth of that on the surface of planet Q.

On the surface of P, a body has a mass of 1.0 kg and a weight of 1.0 N.

What are the mass and weight of the same body on the surface of planet Q?

	mass on Q / kg	weight on Q / N
A	1.0	0.1
B	1.0	10
C	10	10
D	10	100

11 A body, initially at rest, explodes into two masses M_1 and M_2 that move apart with speeds v_1 and v_2 respectively.

What is the ratio $\frac{v_1}{v_2}$?

A $\frac{M_1}{M_2}$ **B** $\frac{M_2}{M_1}$ **C** $\sqrt{\frac{M_1}{M_2}}$ **D** $\sqrt{\frac{M_2}{M_1}}$

12 Two experiments are carried out using two trolleys of equal mass. All moving parts of the trolleys are frictionless, as is the surface that the trolleys move over. In both experiments, trolley X moves towards trolley Y, which is initially stationary.

After the collision in experiment 1, X is stationary and Y moves off to the right.

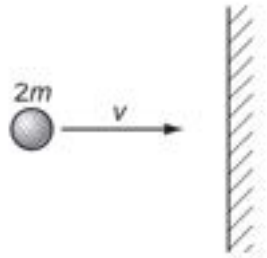
After the collision in experiment 2, the trolleys join and move off together.

What types of collision occur in these experiments?

	experiment 1	experiment 2
A	elastic	elastic
B	elastic	inelastic
C	inelastic	elastic
D	inelastic	inelastic

October/November 2010 (12)

9 A particle of mass $2m$ and velocity v strikes a wall.



The particle rebounds along the same path after colliding with the wall. The collision is inelastic.

What is a possible change in the momentum of the ball during the collision?

A mv **B** $2mv$ **C** $3mv$ **D** $4mv$

10 Which defines the weight of a body?

A the amount of matter in the body

B the force of gravity on the body

C the number of particles in the body

D the product of the body's volume and density

May/June 2011 (11)

8 A body has a weight of 58.9 N when on the Earth. On the Moon, the acceleration of free fall is $1.64\,m\,s^{-2}$.

What are the weight and the mass of the body when it is on the Moon?

	weight / N	mass / kg
A	9.85	1.00
B	9.85	6.00
C	58.9	1.00
D	58.9	6.00

9 A body of mass m, moving at velocity v, collides with a stationary body of the same mass and sticks to it.

Which row describes the momentum and kinetic energy of the two bodies after the collision?

	momentum	kinetic energy
A	mv	$\frac{1}{4}mv^2$
B	mv	$\frac{1}{8}mv^2$
C	$2mv$	$\frac{1}{2}mv^2$
D	$2mv$	mv^2

10 A molecule of mass m travelling horizontally with velocity u hits a vertical wall at right-angles to its velocity. It then rebounds horizontally with the same speed.

What is its change in momentum?

A zero **B** mu **C** $-mu$ **D** $-2mu$

May/June 2011 (12)

10 A force F is applied to a freely moving object. At one instant of time, the object has velocity v and acceleration a.

Which quantities **must** be in the same direction?

A a and v only

B a and F only

C v and F only

D v, F and a

11 The momentum of an object changes from 160 kg m s^{-1} to 240 kg m s^{-1} in 2 s.

What is the mean resultant force on the object during the change?

A 40 N **B** 80 N **C** 200 N **D** 400 N

12 A car accelerates in a straight line.

A graph of the momentum of the car is plotted against time.

What is evaluated by finding the gradient of the graph at a particular time?

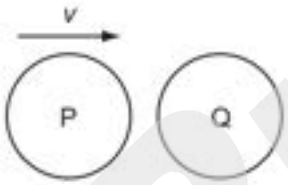
A the acceleration of the car

B the resultant force on the car

C the kinetic energy of the car

D the power supplied to the car

13 The diagram shows a particle P, travelling at speed v, about to collide with a stationary particle Q of the same mass. The collision is perfectly elastic.



Which statement describes the motion of P and of Q immediately after the collision?

A P rebounds with speed $\frac{1}{2}v$ and Q acquires speed $\frac{1}{2}v$.

B P rebounds with speed v and Q remains stationary.

C P and Q both travel in the same direction with speed $\frac{1}{2}v$.

D P comes to a standstill and Q acquires speed v.

October/November 2011 (11)

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

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

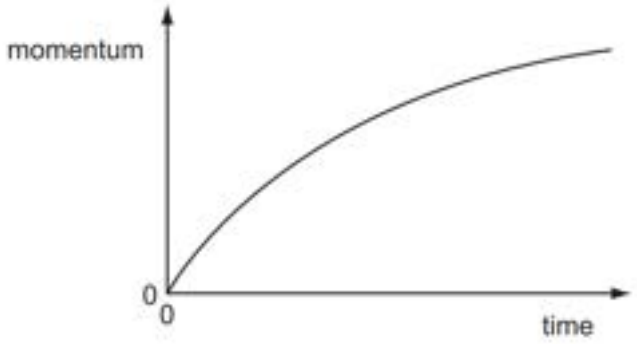
A the density of the air

B the height from which the body falls

C the mass of the body

D the shape of the body

11 A car accelerates from rest. The graph shows the momentum of the car plotted against time.



What is the meaning of the gradient of the graph at a particular time?

A the resultant force on the car

B the velocity of the car

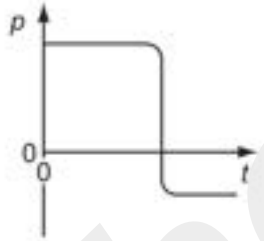
C the kinetic energy of the car

D the rate of change of kinetic energy of the car

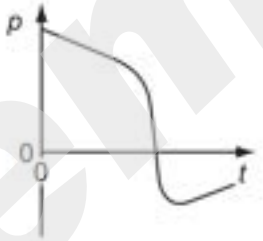
12 An ice-hockey puck slides along a horizontal, frictionless ice-rink surface. It collides inelastically with a wall at right angles to its path, and then rebounds along its original path.

Which graph shows the variation with time *t* of the momentum *p* of the puck?

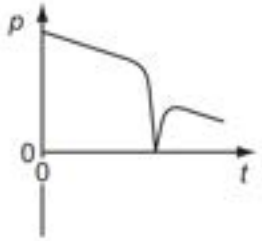
A



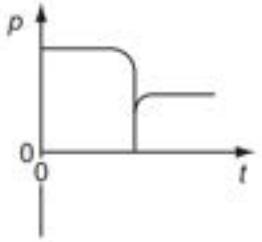
B



C



D



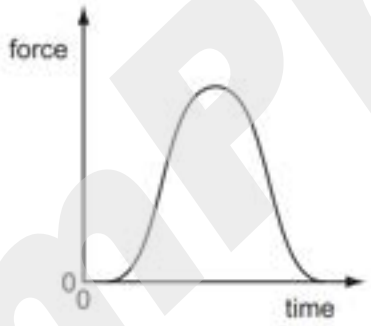
October/November 2011 (12)

7 A stone of mass m is dropped from a tall building. There is significant air resistance. The acceleration of free fall is g.

When the stone reaches its terminal velocity, which information is correct?

	magnitude of the acceleration of the stone	magnitude of the force of gravity on the stone	magnitude of the force of air resistance on the stone
A	g	mg	mg
B	zero	mg	mg
C	zero	zero	mg
D	zero	zero	zero

9 A golf ball is hit by a club. The graph shows the variation with time of the force exerted on the ball by the club.



Which quantity, for the time of contact, **cannot** be found from the graph?

A the average force on the ball

B the change in momentum of the ball

C the contact time between the ball and the club

D the maximum acceleration of the ball

10 A group of students investigating the principle of conservation of momentum use a small truck travelling over a frictionless surface.

Sand is dropped into the truck as it passes X. At Y, a trapdoor in the bottom of the truck opens and the sand falls out.

How does the velocity of the truck change when the sand is added to the truck at X and then leaves the truck at Y?

	at X	at Y
A	decreases	increases
B	decreases	stays the same
C	stays the same	increases
D	stays the same	stays the same

11 An object of mass 20 kg is travelling at a constant speed of $6.0\,m\,s^{-1}$.

It collides with an object of mass 12 kg travelling at a constant speed of $15\,m\,s^{-1}$ in the opposite direction. The objects stick together.

What is the speed of the objects immediately after the collision?

A $1.9\,m\,s^{-1}$ **B** $9.0\,m\,s^{-1}$ **C** $9.4\,m\,s^{-1}$ **D** $21\,m\,s^{-1}$

May/June 2012 (11)

10 Each option gives a correct word equation involving force.

Which option gives the definition of force?

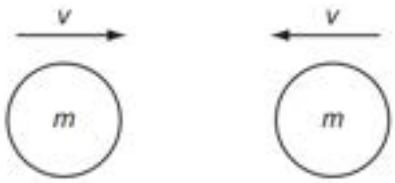
A force = energy divided by displacement

B force = mass × acceleration

C force = pressure × area

D force = rate of change of momentum

11 Two similar spheres, each of mass m and travelling with speed v, are moving towards each other.



The spheres have a head-on elastic collision.

Which statement is correct?

A The spheres stick together on impact.

B The total kinetic energy after impact is mv^2.

C The total kinetic energy before impact is zero.

D The total momentum before impact is $2mv$.

May/June 2012 (12)

11 Which row correctly states whether momentum and kinetic energy are conserved in an inelastic collision in which there are no external forces?

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

12 Two spheres approach each other along the same straight line. Their speeds are u_1 and u_2 before collision. After the collision, the spheres separate with speeds v_1 and v_2 in the directions shown below.

Which equation must be correct if the collision is perfectly elastic?

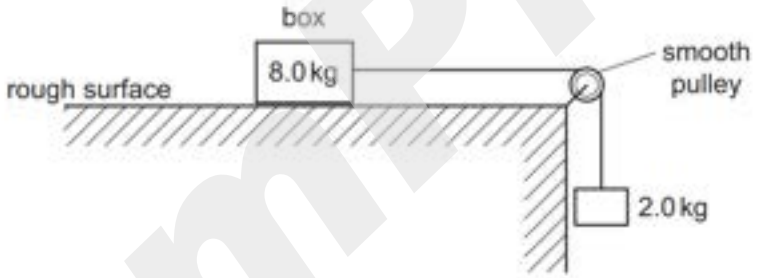
A $u_1 - u_2 = v_2 + v_1$

B $u_1 - u_2 = v_2 - v_1$

C $u_1 + u_2 = v_2 + v_1$

D $u_1 + u_2 = v_2 - v_1$

13 A box of mass 8.0 kg rests on a horizontal, rough surface. A string attached to the box passes over a smooth pulley and supports a 2.0 kg mass at its other end.



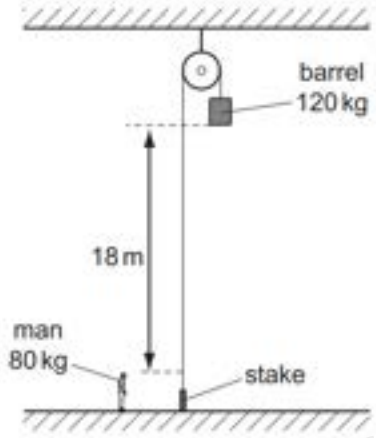
When the box is released, a frictional force of 6.0 N acts on it.

What is the acceleration of the box?

A $1.4\,ms^{-2}$ **B** $1.7\,ms^{-2}$ **C** $2.0\,ms^{-2}$ **D** $2.5\,ms^{-2}$

May/June 2012 (13)

10 The diagram shows a barrel suspended from a frictionless pulley on a building. The rope supporting the barrel goes over the pulley and is secured to a stake at the bottom of the building.



A man stands close to the stake. The bottom of the barrel is 18 m above the man's head. The mass of the barrel is 120 kg and the mass of the man is 80 kg.

The man keeps hold of the rope after untying it from the stake and is lifted upwards as the barrel falls.

What is the man's upward speed when his head is level with the bottom of the barrel? (Use $g = 10\,m\,s^{-2}$.)

A $6\,m\,s^{-1}$ **B** $8\,m\,s^{-1}$ **C** $13\,m\,s^{-1}$ **D** $19\,m\,s^{-1}$

11 Each option gives a correct word equation involving force.

Which option gives the definition of force?

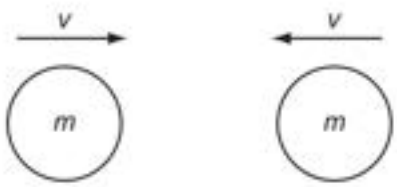
A force = energy divided by displacement

B force = mass × acceleration

C force = pressure × area

D force = rate of change of momentum

12 Two similar spheres, each of mass m and travelling with speed v, are moving towards each other.



The spheres have a head-on elastic collision.

Which statement is correct?

A The spheres stick together on impact.

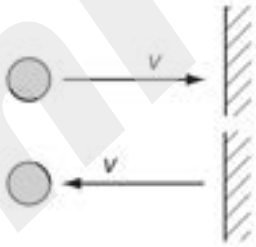
B The total kinetic energy after impact is mv^2.

C The total kinetic energy before impact is zero.

D The total momentum before impact is $2mv$.

October/November 2012 (11)

11 An object travelling with velocity v strikes a wall and rebounds as shown.



Which property of the object is **not** conserved?

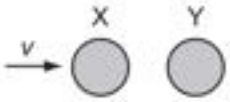
A kinetic energy

B mass

C momentum

D speed

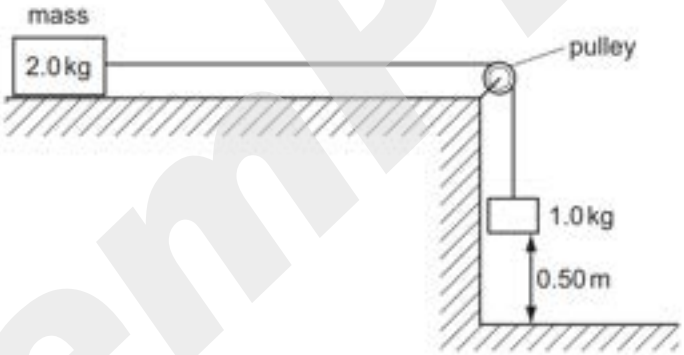
12 A particle X has speed v and collides with a stationary identical particle Y. The collision is perfectly elastic.



What are the speed and direction of motion of each of the two particles after the collision?

	X	Y
A	stationary	v to the right
B	$\frac{v}{2}$ to the right	$\frac{v}{2}$ to the right
C	$\frac{v}{2}$ to the left	$\frac{v}{2}$ to the right
D	v to the left	stationary

13 A mass of 2.0 kg rests on a frictionless surface. It is attached to a 1.0 kg mass by a light, thin string which passes over a frictionless pulley. The 1.0 kg mass is released and it accelerates downwards.

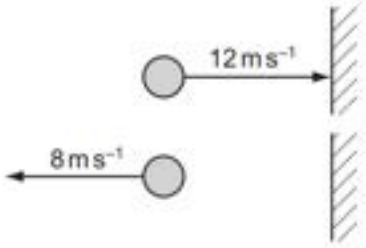


What is the speed of the 2.0 kg mass as the 1.0 kg mass hits the floor, having fallen a distance of 0.50 m?

A 1.8 ms^{-1} **B** 2.2 ms^{-1} **C** 3.1 ms^{-1} **D** 9.8 ms^{-1}

October/November 2012 (12)

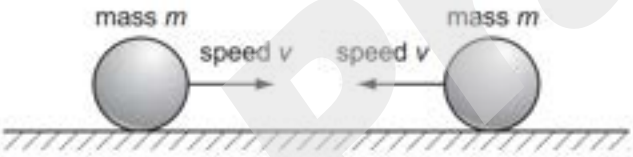
12 A ball of mass 0.5 kg is thrown against a wall at a speed of 12 m s^{-1}. It bounces back with a speed of 8 m s^{-1}. The collision lasts for 0.10 s.



What is the average force on the ball due to the collision?

A 0.2 N **B** 1 N **C** 20 N **D** 100 N

13 Two identical, perfectly elastic spheres have the same mass m. They travel towards each other with the same speed v along a horizontal frictionless surface.



Which statement about the sum of the kinetic energies of the spheres is correct?

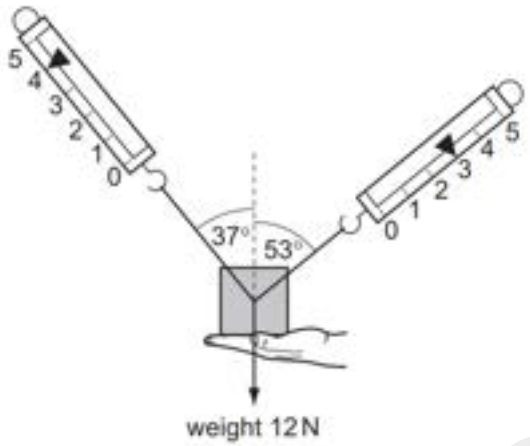
A The sum of their kinetic energies before impact is zero.

B The sum of their kinetic energies before impact is $\frac{1}{2}mv^2$.

C The sum of their kinetic energies after impact is zero.

D The sum of their kinetic energies after impact is mv^2.

14 A 1.2 kg mass is supported by a person's hand and two newton-meters as shown.



When the person's hand is removed, what is the initial vertical acceleration of the mass?

A $0.6\,m\,s^{-2}$ **B** $2\,m\,s^{-2}$ **C** $4\,m\,s^{-2}$ **D** $6\,m\,s^{-2}$

15 A lorry of mass 20 000 kg has a constant resultant force F acting on it.

It accelerates from $6.0\,m\,s^{-1}$ to $30.0\,m\,s^{-1}$ in a time of 300 s.

What is the change in momentum of the lorry and the value of F?

	change in momentum / N s	force F / N
A	48 000	160
B	480 000	1600
C	600 000	2000
D	600 000	20 000

October/November 2012 (13)

11 The diagram shows two spherical masses approaching each other head-on at an equal speed u. One is of mass m and the other of mass $2m$.

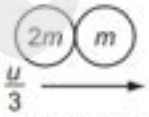
Which diagram, showing the situation after the collision, is **not** consistent with the principle of conservation of momentum?

A

B

C

D



the spheres stick together

12 A molecule of mass m travelling at speed v hits a wall in a direction perpendicular to the wall. The collision is elastic.

What are the changes in the kinetic energy and in the momentum of the molecule caused by the collision?

	change in momentum	change in kinetic energy
A	0	0
B	0	mv^2
C	$2mv$	0
D	mv^2	0

13 The IKAROS satellite has mass 320 kg and moves through space using a solar sail of area 20 m^2. The average solar wind pressure is 1.0×10^{-5} $N m^{-2}$.

What is the acceleration of the satellite caused by the solar wind?

A 3.1×10^{-8} $m s^{-2}$

B 6.3×10^{-7} $m s^{-2}$

C 3.2×10^{-3} $m s^{-2}$

D 6.4×10^{-2} $m s^{-2}$

May/June 2013 (11)

9 A car is stationary at traffic lights. When the traffic lights go green, the driver presses down sharply on the accelerator. The resultant horizontal force acting on the car varies with time as shown.

Which graph shows the variation with time of the speed of the car?

A

B

C

D

10 Which of the following is a statement of the principle of conservation of momentum?

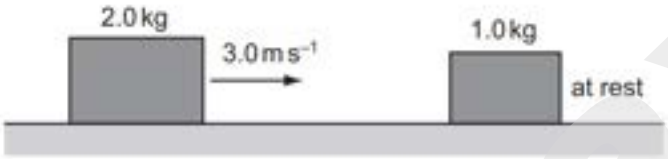
A In an elastic collision momentum is constant.

B Momentum is the product of mass and velocity.

C The force acting on a body is proportional to its rate of change of momentum.

D The momentum of an isolated system is constant.

11 A 2.0 kg mass travelling at $3.0\,m\,s^{-1}$ on a frictionless surface collides head-on with a stationary 1.0 kg mass. The masses stick together on impact.



How much kinetic energy is lost on impact?

A zero **B** 2.0 J **C** 2.4 J **D** 3.0 J

May/June 2013 (12)

10 Two bodies travelling in a straight line collide in a perfectly elastic collision. Which of the following statements **must** be correct?

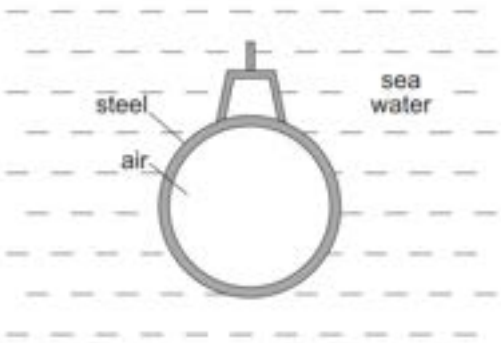
A The initial speed of one body will be the same as the final speed of the other body.

B The relative speed of approach between the two bodies equals their relative speed of separation.

C The total momentum is conserved but the total kinetic energy will be reduced.

D One of the bodies will be stationary at one instant.

11 A submarine is in equilibrium in a fully submerged position.



What causes the upthrust on the submarine?

A The air in the submarine is less dense than sea water.

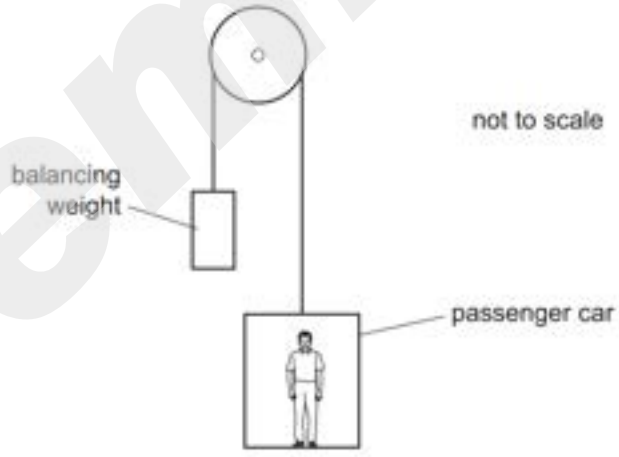
B The sea water exerts a greater upward force on the submarine than the weight of the steel.

C The submarine displaces its own volume of sea water.

D There is a difference in water pressure acting on the top and on the bottom of the submarine.

May/June 2013 (13)

9 A lift (elevator) consists of a passenger car supported by a cable which runs over a light, frictionless pulley to a balancing weight. The balancing weight falls as the passenger car rises.



Some masses are shown in the table.

	mass / kg
passenger car	520
balancing weight	640
passenger	80

What is the magnitude of the acceleration of the car when carrying just one passenger and when the pulley is free to rotate?

A $0.032\,m\,s^{-2}$ **B** $0.32\,m\,s^{-2}$ **C** $0.61\,m\,s^{-2}$ **D** $0.65\,m\,s^{-2}$

10 A stationary nucleus has nucleon number A.

The nucleus decays by emitting a proton with speed v to form a new nucleus with speed u. The new nucleus and the proton move away from one another in opposite directions.

Which equation gives v in terms of A and u?

A $v = (\frac{A}{4} - 1)u$

B $v = (A - 1)u$

C $v = Au$

D $v = (A + 1)u$

,

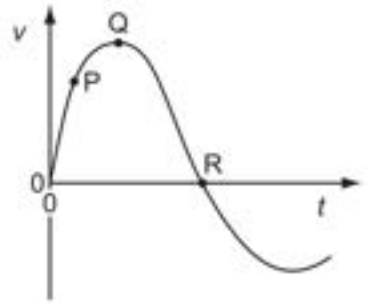
11 Two spheres travel along the same line with velocities u_1 and u_2. They collide and after collision their velocities are v_1 and v_2.

Which collision is not elastic?

	u_1 / $m\,s^{-1}$	u_2 / $m\,s^{-1}$	v_1 / $m\,s^{-1}$	v_2 / $m\,s^{-1}$
A	2	–5	–5	–2
B	3	–3	0	6
C	3	–2	1	6
D	5	2	3	6

October/November 2013 (11)

7 The graph shows how velocity v varies with time t for a bungee jumper.



At which point is the bungee jumper momentarily at rest and at which point does she have zero acceleration?

	jumper at rest	jumper with zero acceleration
A	Q	P
B	Q	R
C	R	Q
D	R	R

9 What is meant by the mass and by the weight of an object on the Earth?

	mass	weight
A	its momentum divided by its velocity	the work done in lifting it one metre
B	the gravitational force on it	the property that resists its acceleration
C	the pull of the Earth on it	its mass divided by the acceleration of free fall
D	the property that resists its acceleration	the pull of the Earth on it

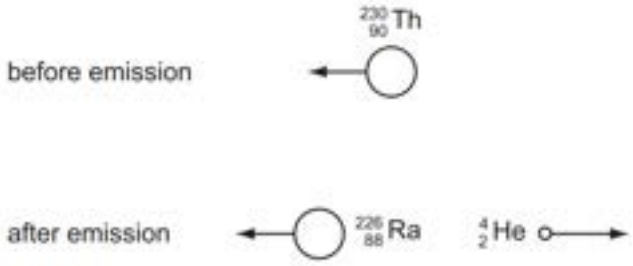
10 An astronaut of mass m in a spacecraft experiences a gravitational force $F = mg$ when stationary on the launchpad.

What is the gravitational force on the astronaut when the spacecraft is launched vertically upwards with an acceleration of $0.2g$?

A $1.2mg$ **B** mg **C** $0.8mg$ **D** 0

October/November 2013 (13)

10 A moving thorium nucleus $^{230}_{90}Th$ spontaneously emits an α-particle. The nucleus formed is a radium nucleus $^{226}_{88}Ra$, as shown.



Which statement is correct?

A The kinetic energy of the α-particle equals the kinetic energy of the radium nucleus.

B The momentum of the α-particle equals the momentum of the radium nucleus.

C The total momentum before the emission equals the total momentum after the emission.

D The velocity of the α-particle equals the velocity of the radium nucleus.

11 An isolated system consists of two bodies on which no external forces act. The two bodies collide with each other and stick together on impact.

Which row correctly compares the total kinetic energy and the total momentum of the bodies before and after the collision?

	total kinetic energy before and after the collision	total momentum before and after the collision
A	different	different
B	different	the same
C	the same	different
D	the same	the same

12 A mass accelerates uniformly when the resultant force acting on it

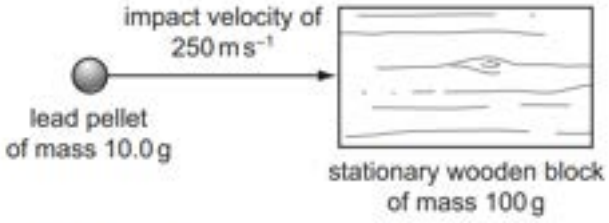
A is zero.

B is constant but not zero.

C increases uniformly with respect to time.

D is proportional to the displacement from a fixed point.

13 A lead pellet of mass 10.0 g is shot horizontally into a stationary wooden block of mass 100 g. The pellet hits the block with an impact velocity of 250 $m s^{-1}$. It embeds itself in the block and it does not emerge.



What will be the speed of the block immediately after the pellet is embedded?

A 23 $m s^{-1}$ **B** 25 $m s^{-1}$ **C** 75 $m s^{-1}$ **D** 79 $m s^{-1}$

May/June 2014 (11)

9 An object of mass 4.0 kg moving with a speed of 3.0 $m s^{-1}$ strikes a stationary object in an inelastic collision.

Which statement is correct?

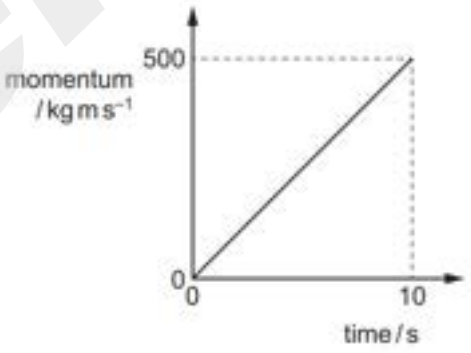
A After collision, the total kinetic energy is 18 J.

B After collision, the total kinetic energy is less than 18 J.

C Before collision, the total kinetic energy is 12 J.

D Before collision, the total kinetic energy is less than 12 J.

10 The graph shows how the momentum of a motorcycle changes with time.



What is the resultant force on the motorcycle?

A 50 N **B** 500 N **C** 2500 N **D** 5000 N

May/June 2014 (12)

8 A resultant force causes a body to accelerate.

What is equal to the resultant force?

A the acceleration of the body per unit mass

B the change in kinetic energy of the body per unit time

C the change in momentum of the body per unit time

D the change in velocity of the body per unit time

9 A ship of mass 8.4×10^7 kg is approaching a harbour with speed $16.4\,m\,s^{-1}$. By using reverse thrust it can maintain a constant total stopping force of 920 000 N.

How long will it take to stop?

A 15 seconds

B 150 seconds

C 25 minutes

D 250 minutes

10 A tractor of mass 1000 kg is connected by a tow-bar to a trailer of mass 1000 kg. The total resistance to motion has a constant value of 4000 N. One quarter of this resistance acts on the trailer.

When the tractor and trailer are moving along horizontal ground at a constant speed of $6\,m\,s^{-1}$, what is the force exerted on the tractor by the tow-bar?

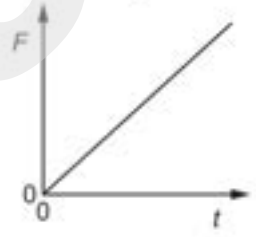
A 0 N **B** 1000 N **C** 3000 N **D** 4000 N

May/June 2014 (13)

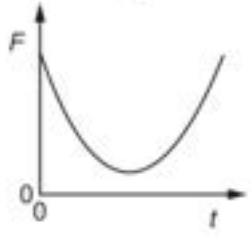
10 A tennis ball is dropped onto a table and bounces back up. The table exerts a force F on the ball.

Which graph best shows the variation with time t of the force F while the ball is in contact with the table?

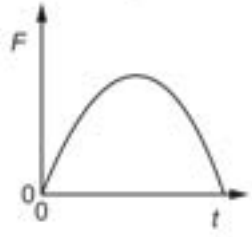
A



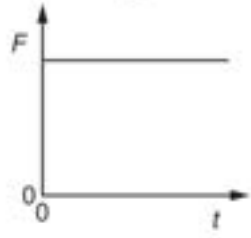
B



C

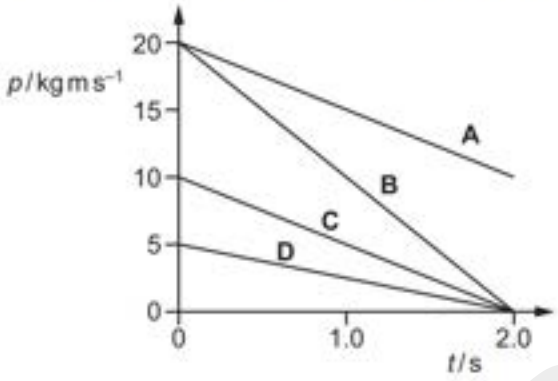


D



11 A resultant force of 10 N acts on a body for a time of 2.0 s.

Which graph could show the variation with time t of the momentum p of the body?



12 A stationary body explodes into two components of masses m and $2m$.

The components gain kinetic energies X and Y respectively.

What is the value of the ratio $\frac{X}{Y}$?

A $\frac{1}{4}$ **B** $\frac{1}{2}$ **C** $\frac{2}{1}$ **D** $\frac{4}{1}$

October/November 2014 (11)

7 What is the principle of conservation of momentum?

A Force is equal to the rate of change of momentum.

B Momentum is the product of mass and velocity.

C The total momentum of a system remains constant provided no external force acts on it.

D The total momentum of two bodies after collision is equal to their total momentum before collision.

8 Water is pumped through a hose-pipe at a rate of 90 kg per minute. It emerges from the hose-pipe horizontally with a speed of 20 m s^{-1}.

Which force is required from a person holding the hose-pipe to prevent it moving backwards?

A 30 N **B** 270 N **C** 1800 N **D** 10 800 N

9 Two railway trucks of masses m and $3m$ move towards each other in opposite directions with speeds $2v$ and v respectively. These trucks collide and stick together.

What is the speed of the trucks after the collision?

A $\frac{v}{4}$ **B** $\frac{v}{2}$ **C** v **D** $\frac{5v}{4}$

October/November 2014 (12)

7 What is the principle of conservation of momentum?

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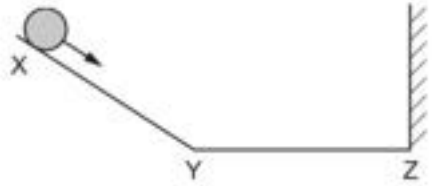
What is the speed of the trucks after the collision?

A $\frac{v}{4}$ **B** $\frac{v}{2}$ **C** v **D** $\frac{5v}{4}$

October/November 2014 (13)

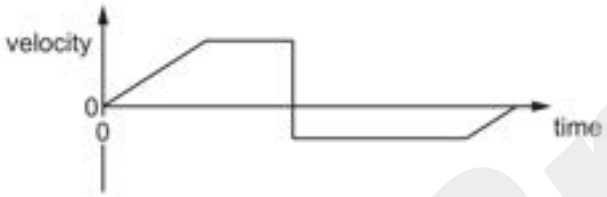
8 A ball is released from rest on a smooth slope XY.

It moves down the slope, along a smooth horizontal surface YZ and rebounds inelastically at Z. Then it moves back to Y and comes to rest momentarily somewhere on XY.



Which velocity-time graph represents the motion of the ball?

A



B

C

D

9 A man weighs 240 N on Mars where the acceleration of free fall g is $4\,m\,s^{-2}$. On the Moon, g is $2\,m\,s^{-2}$.

Which statement is correct?

A The man has a mass on Mars of 60 N.

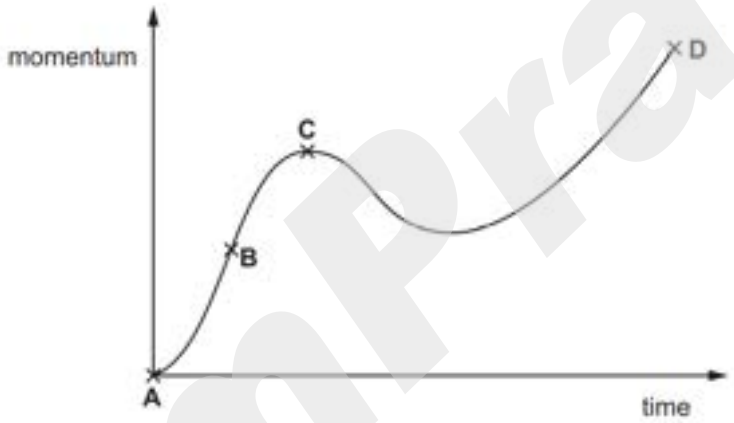
B The man has a mass on the Moon of 120 kg.

C The man weighs 120 N on the Moon.

D The man weighs 240 N on the Moon.

10 A body experiences a varying resultant force that causes its momentum to vary, as shown in the graph.

At which point does the resultant force have the largest value?



11 A golf ball of mass m is dropped onto a hard surface from a height h_1 and rebounds to a height h_2.

The momentum of the golf ball just as it reaches the surface is different from its momentum just as it leaves the surface.

What is the total change in the momentum of the golf ball between these two instants? (Ignore air resistance.)

A $m\sqrt{2gh_1} - m\sqrt{2gh_2}$

B $m\sqrt{2gh_1} + m\sqrt{2gh_2}$

C $m\sqrt{2g(h_1 - h_2)}$

D $m\sqrt{2g(h_1 + h_2)}$

May/June 2015 (11)

11 A molecule of mass m travelling at speed v hits a wall in a direction perpendicular to the wall. The collision is elastic.

What are the changes in the momentum and in the kinetic energy of the molecule caused by the collision?

	change in momentum	change in kinetic energy
A	0	0
B	0	mv^2
C	$2mv$	0
D	mv^2	0

May/June 2015 (12)

10 A firework rocket is fired vertically upwards. The fuel burns and produces a constant upwards force on the rocket. After 5 seconds there is no fuel left. Air resistance is negligible.

What is the acceleration before and after 5 seconds?

	before 5 seconds	after 5 seconds
A	constant	constant
B	constant	zero
C	increasing	constant
D	increasing	zero

11 Trolley X, moving along a horizontal frictionless track, collides with a stationary trolley Y. The two trolleys become attached and move off together.

Which statement about this interaction is correct?

A Some of the kinetic energy of trolley X is changed to momentum in the collision.

B Some of the momentum of trolley X is changed to kinetic energy in the collision.

C Trolley X loses some of its momentum as heat in the collision.

D Trolley X shares its momentum with trolley Y but some of its kinetic energy is lost.

12 An astronaut throws a stone with a horizontal velocity near to the Moon's surface.

Which row describes the horizontal and vertical forces acting on the stone after release?

	horizontal force	vertical force
A	constant	constant
B	constant	decreasing
C	zero	constant
D	zero	decreasing

13 Newton's third law of motion is often summarised as 'Every action (force) has an equal and opposite reaction.'

A book rests on a table.

If the weight of the book is the 'action' force, what is the 'reaction' force?

A the pull of the book on the Earth

B the pull of the Earth on the book

C the push of the book on the table

D the push of the table on the book

May/June 2015 (13)

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

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

A the density of the air

B the height from which the body falls

C the mass of the body

D the shape of the body

10 Which of the following is a statement of the principle of conservation of momentum?

A Momentum is the product of mass and velocity.

B In an elastic collision, momentum is constant.

C The momentum of an isolated system is constant.

D The force acting on a body is proportional to its rate of change of momentum.

11 A moving object strikes a stationary object. The collision is inelastic. The objects move off together.

Which row shows the possible values of total momentum and total kinetic energy for the system before and after the collision?

	total momentum before collision / kg m s^{-1}	total momentum after collision / kg m s^{-1}	total kinetic energy before collision / J	total kinetic energy after collision / J
A	6	2	90	30
B	6	6	30	90
C	6	6	90	30
D	6	6	90	90

12 Two balls X and Y are moving towards each other with speeds of 5 m s^{-1} and 15 m s^{-1} respectively.

They make a perfectly elastic head-on collision and ball Y moves to the right with a speed of 7 m s^{-1}.

What is the speed and direction of ball X after the collision?

A 3 m s^{-1} to the left

B 13 m s^{-1} to the left

C 3 m s^{-1} to the right

D 13 m s^{-1} to the right

October/November 2015 (11)

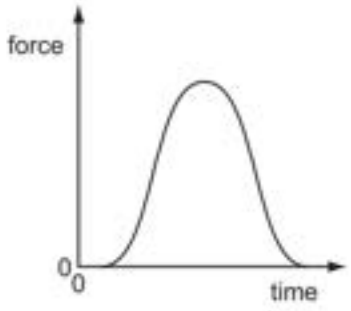
9 The water surface in a deep well is 78.0 m below the top of the well. A person at the top of the well drops a heavy stone down the well.

Air resistance is negligible. The speed of sound in the air is 330 m s^{-1}.

What is the time interval between the person dropping the stone and hearing it hitting the water?

A 3.75 s **B** 3.99 s **C** 4.19 s **D** 4.22 s

10 A golf ball is hit by a club. The graph shows the variation with time of the force exerted on the ball by the club.



Which quantity, for the time of contact, **cannot** be found from the graph?

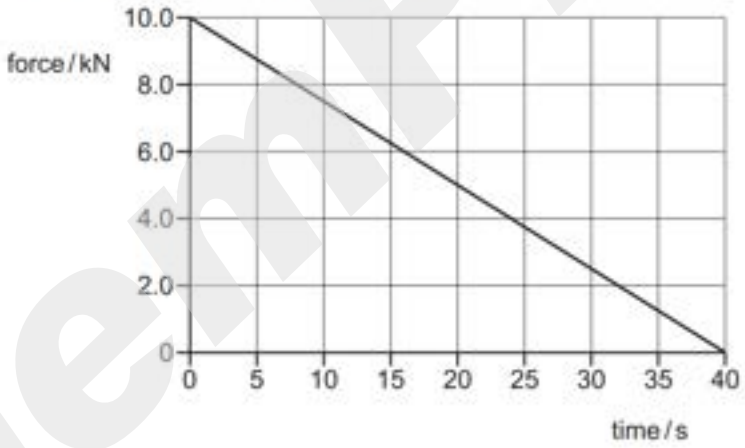
A the average force on the ball

B the change in momentum of the ball

C the contact time between the ball and the club

D the maximum acceleration of the ball

11 A glider of mass 1500 kg is launched from rest on a straight and level track using a catapult. The graph shows the variation with time of the resultant force.



What is the speed of the glider when the resultant force acting on it reaches zero?

A 133 ms^{-1} **B** 200 ms^{-1} **C** 250 ms^{-1} **D** 267 ms^{-1}

12 Which statement about a ball that strikes a tennis racket and rebounds is **always** correct?

A The total kinetic energy of the ball is conserved.

B The total kinetic energy of the system is conserved.

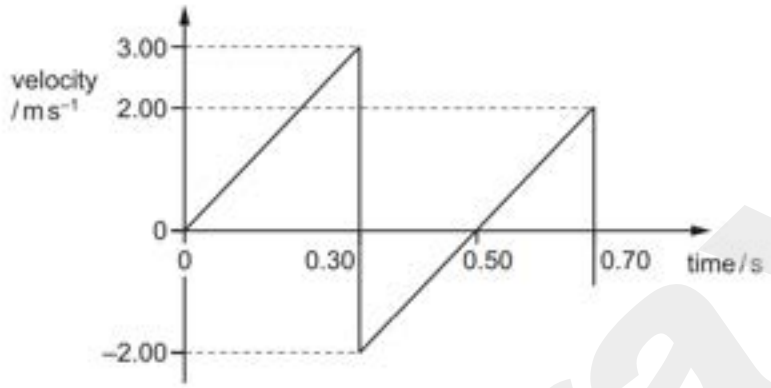
C The total momentum of the ball is conserved.

D The total momentum of the system is conserved.

October/November 2015 (12)

9 A ball is released from rest above a horizontal surface. It strikes the surface and bounces several times.

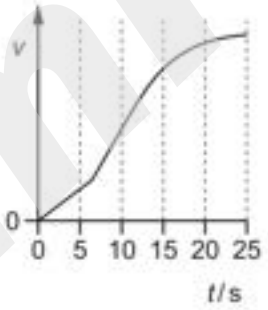
The velocity-time graph for the first two bounces is shown.



What is the maximum height of the ball after the first bounce?

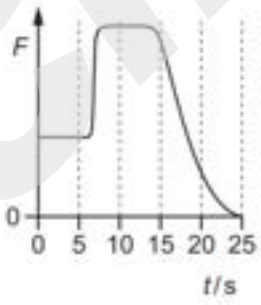
A 0.20 m **B** 0.25 m **C** 0.45 m **D** 0.65 m

10 A bus takes a time of 25 s to reach a constant speed while travelling in a straight line. A graph of speed *v* against time *t* is shown.

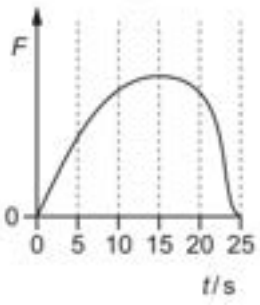


Which graph shows the variation with *t* of the resultant force *F* on the bus?

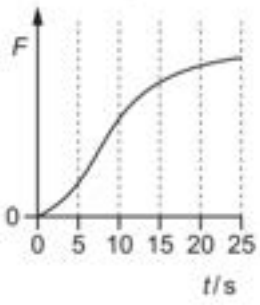
A



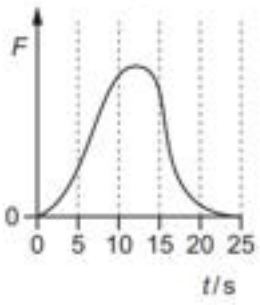
B



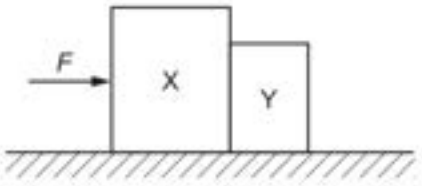
C



D



11 A single horizontal force F is applied to a block X which is in contact with a separate block Y as shown.



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

Which statement is correct?

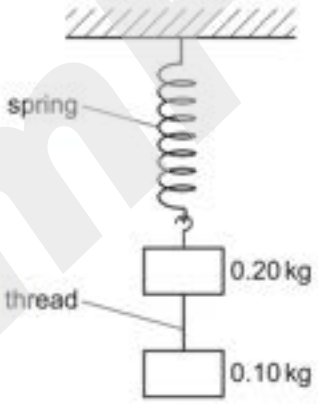
A The acceleration of X is equal to force F divided by the mass of X.

B The force that X exerts on Y is equal to F.

C The force that X exerts on Y is less than F.

D The force that X exerts on Y is less than the force that Y exerts on X.

12 A mass of 0.20 kg is suspended from the lower end of a light spring. A second mass of 0.10 kg is suspended from the first mass by a thread. The arrangement is allowed to come into static equilibrium and then the thread is burned through.



At this instant, what is the upward acceleration of the 0.20 kg mass? (Assume $g = 10\,m\,s^{-2}$.)

A $5.0\,m\,s^{-2}$ **B** $6.7\,m\,s^{-2}$ **C** $10\,m\,s^{-2}$ **D** $15\,m\,s^{-2}$

13 An object of mass m travelling with speed v has a head-on collision with another object of mass m travelling with speed v in the opposite direction. The two objects stick together after the collision.

What is the total loss of kinetic energy in the collision?

A 0 **B** $\frac{1}{2}mv^2$ **C** mv^2 **D** $2mv^2$

14 Two identical spheres X and Y approach each other with the speeds shown and undergo a head-on elastic collision.

What are the velocities of the spheres after the collision?

	sphere X	sphere Y
A	0 m s^{-1}	2 m s^{-1} →
B	2 m s^{-1} →	4 m s^{-1} →
C	2 m s^{-1} ←	4 m s^{-1} →
D	4 m s^{-1} ←	2 m s^{-1} →

October/November 2015 (13)

12 Two equal masses X and Y are moving towards each other on a frictionless air track as shown. The masses make an elastic collision.

Which row gives possible velocities for the two masses after the collision?

	velocity of X	velocity of Y
A	zero	20 cm s^{-1} to the right
B	10 cm s^{-1} to the right	10 cm s^{-1} to the right
C	20 cm s^{-1} to the left	zero
D	30 cm s^{-1} to the left	50 cm s^{-1} to the right

13 Which statement is correct with reference to perfectly elastic collisions between two bodies?

A Neither total momentum nor total kinetic energy need be conserved but total energy must be conserved.

B Total momentum and total energy are conserved but total kinetic energy may be changed into some other form of energy.

C Total kinetic energy and total energy are both conserved but total momentum is conserved only if the two bodies have equal masses.

D Total momentum, total kinetic energy and total energy are all conserved.

14 Which statement best describes a couple?

A a pair of forces of equal magnitude acting in opposite directions which produce rotational motion but not translational motion

B a pair of forces of equal magnitude acting in opposite directions which produce translational motion but not rotational motion

C a pair of forces of equal magnitude acting in the same direction which produce rotational motion but not translational motion

D a pair of forces of equal magnitude acting in the same direction which produce translational motion but not rotational motion