

**Dynamics**

**May 02**

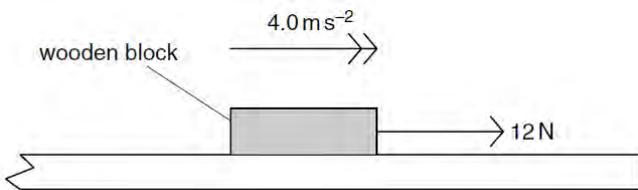
1. Two similar spheres, each of mass  $m$  and travelling with speed  $v$ , are moving towards each other.



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  $2mv$ .

2. A wooden block of mass 0.60 kg is on a rough horizontal surface. A force of 12 N is applied to the block and it accelerates at  $4.0 \text{ ms}^{-2}$



What is the magnitude of the frictional force acting on the block?  
**A** 2.4 N      **B** 9.6 N      **C** 14 N      **D** 16 N

3. 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  $v_1/v_2$ ?

- A  $\frac{M_1}{M_2}$
- B  $\frac{M_2}{M_1}$
- C  $\left(\frac{M_1}{M_2}\right)^{\frac{1}{2}}$
- D  $\left(\frac{M_2}{M_1}\right)^{\frac{1}{2}}$

4. A submarine descends vertically at constant velocity. The three forces acting on the submarine are viscous drag, upthrust and weight.

- Which relationship between their magnitudes is correct?
- A weight < drag
  - B weight = drag
  - C weight < upthrust
  - D weight > upthrust

**Nov 02**

5. What is meant by the weight of an object?

- A the gravitational field acting on the object
- B the gravitational force acting on the object
- C the mass of the object multiplied by gravity
- D the object's mass multiplied by its acceleration

6. Two spheres A and B approach each other along the same straight line with speeds  $u_A$  and  $u_B$ . The spheres collide and move off with speeds  $v_A$  and  $v_B$ , both in the same direction as the initial direction of sphere A, as shown below.

Which equation applies to an elastic collision?

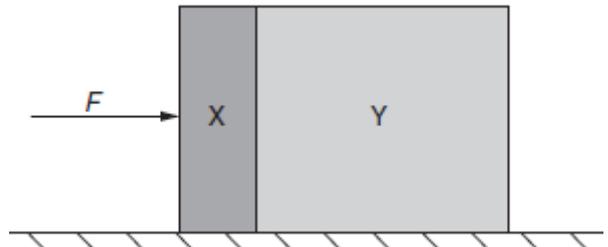
- A  $u_A + u_B = v_B - v_A$
- B  $u_A - u_B = v_B - v_A$
- C  $u_A - u_B = v_B + v_A$
- D  $u_A + u_B = v_B + v_A$

7 Two equal masses travel towards each other on a frictionless air track at speeds of  $60 \text{ cm s}^{-1}$  and  $30 \text{ cm s}^{-1}$ . They stick together on impact.

What is the speed of the masses after impact?  
**A**  $15 \text{ cm s}^{-1}$    **B**  $20 \text{ cm s}^{-1}$    **C**  $30 \text{ cm s}^{-1}$    **D**  $45 \text{ cm s}^{-1}$

**June 03**

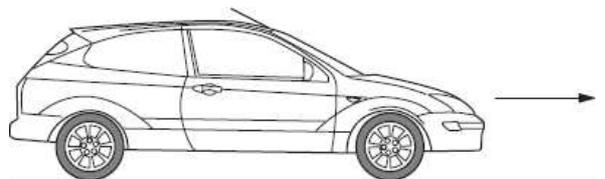
8. Two blocks X and Y, of masses  $m$  and  $3m$  respectively, are accelerated along a smooth horizontal surface by a force  $F$  applied to block X as shown.



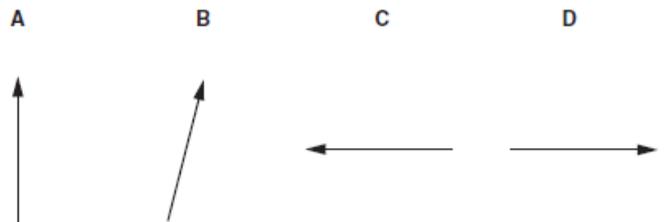
What is the magnitude of the force exerted by block X on block Y during this acceleration?

- A  $\frac{F}{4}$
- B  $\frac{F}{3}$
- C  $\frac{F}{2}$
- D  $\frac{3F}{4}$

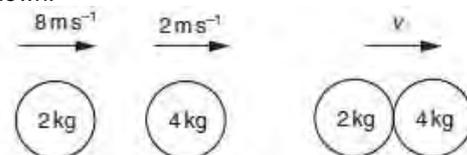
9. A car with front-wheel drive accelerates in the direction shown.



Which diagram best shows the direction of the total force exerted by the road on the front wheels?



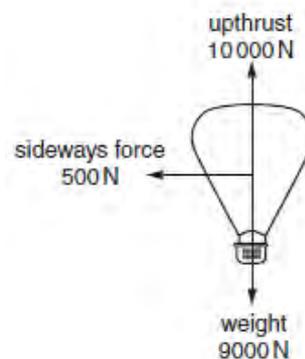
10. A ball of mass 2 kg travelling at  $8 \text{ ms}^{-1}$  strikes a ball of mass 4 kg travelling at  $2 \text{ ms}^{-1}$ . Both balls are moving along the same straight line as shown.



After collision, both balls move at the same velocity  $v$ . What is the magnitude of the velocity  $v$ ?

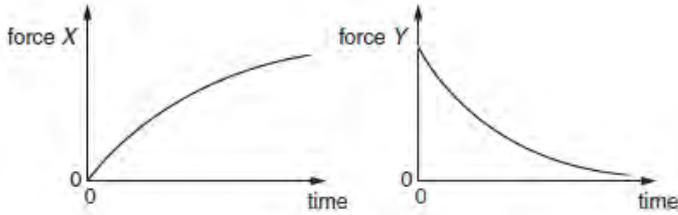
- A  $4 \text{ ms}^{-1}$
- B  $5 \text{ ms}^{-1}$
- C  $6 \text{ ms}^{-1}$
- D  $8 \text{ ms}^{-1}$

11. A balloon is acted upon by three forces, weight, upthrust and sideways force due to the wind, as shown in the diagram.



What is the vertical component of the resultant force on the balloon?  
**A** 500 N   **B** 1000 N   **C** 10 000 N   **D** 10 500 N

12. A ball falls from rest through air and eventually reaches a constant velocity. For this fall, forces X and Y vary with time as shown.



What are forces X and Y?

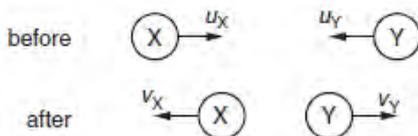
	force X	force Y
A	air resistance	resultant force
B	air resistance	weight
C	upthrust	resultant force
D	upthrust	weight

**Nov 03**

13. 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.

14. A molecule of mass  $m$  travelling horizontally with velocity  $u$  hits a vertical wall at right angles to the wall. It then rebounds horizontally with the same speed. What is its change in momentum?  
**A** zero      **B**  $mu$       **C**  $-mu$       **D**  $-2mu$

15. Two balls X and Y approach each other along the same straight line and collide elastically. Their speeds are  $u_X$  and  $u_Y$  respectively. After the collision they move apart with speeds  $v_X$  and  $v_Y$  respectively. Their directions are shown on the diagram.



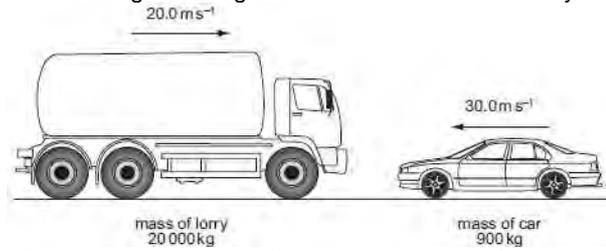
Which of the following equations is correct?

- A**  $u_X + u_Y = v_X + v_Y$
- B**  $u_X + u_Y = v_X - v_Y$
- C**  $u_X - u_Y = v_X + v_Y$
- D**  $u_X - u_Y = v_X - v_Y$

16. 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  $a$

17. A ball falls vertically and bounces on the ground. The following statements are about the forces acting while the ball is in contact with the ground. Which statement is correct?  
**A** The force that the ball exerts on the ground is always equal to the weight of the ball.  
**B** The force that the ball exerts on the ground is always equal in magnitude and opposite in direction to the force the ground exerts on the ball.  
**C** The force that the ball exerts on the ground is always less than the weight of the ball.  
**D** The weight of the ball is always equal in magnitude and opposite in direction to the force that the ground exerts on the ball.

18. The diagram shows a situation just before a head-on collision. A lorry of mass 20 000 kg is travelling at 20.0 m s<sup>-1</sup> towards a car of mass 900 kg travelling at 30.0 m s<sup>-1</sup> towards the lorry.

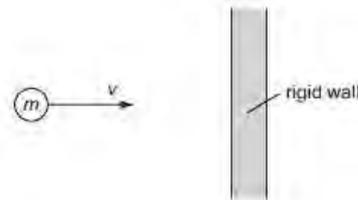


What is the magnitude of the total momentum?  
**A** 373 kN s   **B** 427 kN s   **C** 3600 kN s   **D** 4410 kN s

**Nov 04.**

19. A constant mass undergoes uniform acceleration. Which of the following is a correct statement about the resultant force acting on the mass?  
**A** It increases uniformly with respect to time.  
**B** It is constant but not zero.  
**C** It is proportional to the displacement from a fixed point.  
**D** It is proportional to the velocity.

20. A particle of mass  $m$  strikes a vertical rigid wall perpendicularly from the left with velocity  $v$ .



If the collision is perfectly elastic, the total change in momentum of the particle that occurs as a result of the collision is  
**A**  $2mv$  to the right.      **B**  $2mv$  to the left.  
**C**  $mv$  to the right.      **D**  $mv$  to the left.

**June 05**

21. Which is not one of Newton's laws of motion?  
**A** The total momentum of a system of interacting bodies remains constant, providing no external force acts.  
**B** The rate of change of momentum of a body is directly proportional to the external force acting on the body and takes place in the direction of the force.  
**C** If body A exerts a force on body B, then body B exerts an equal and oppositely-directed force on body A.  
**D** A body continues in a state of rest or of uniform motion in a straight line unless acted upon by some external force.

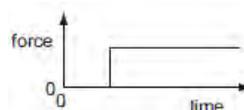
22. Two equal masses travel towards each other on a frictionless air track at speeds of 60 cm s<sup>-1</sup> and 40 cm s<sup>-1</sup>. They stick together on impact.



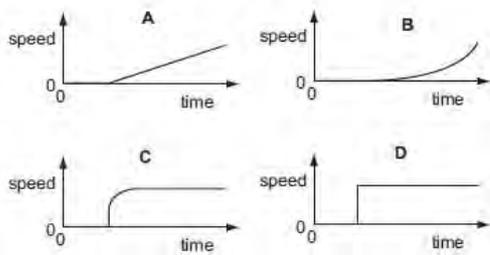
What is the speed of the masses after impact?  
**A** 10 cm s<sup>-1</sup>   **B** 20 cm s<sup>-1</sup>   **C** 40 cm s<sup>-1</sup>   **D** 50 cm s<sup>-1</sup>

**Nov 05**

23. A car driver sharply presses down the accelerator when the traffic lights go green. 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?



24. Which is a statement of the principle of conservation of momentum?

- A A force is equal to the rate of change of momentum of the body upon which it acts.
- B In a perfectly elastic collision, the relative momentum of the bodies before impact is equal to their relative momentum after impact.
- C The momentum of a body is the product of the mass of the body and its velocity.
- D The total momentum of a system of interacting bodies remains constant, providing no external force acts.

25. 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 its mass measured to be 1.0 kg and its weight measured to be 1.0 N. What results are obtained for measurements of the mass and weight of the same body on the surface of planet Q?

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

**June 06**

26. A cyclist is riding at a steady speed on a level road. According to Newton's third law of motion, what is equal and opposite to the backward push of the back wheel on the road?

- A the force exerted by the cyclist on the pedals
- B the forward push of the road on the back wheel
- C the tension in the cycle chain
- D the total air resistance and friction force

27. In perfectly elastic collisions between two atoms, it is always true to say that

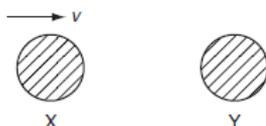
- A the initial speed of one atom will be the same as the final speed of the other atom.
- B the relative speed of approach between the two atoms equals their relative speed of separation.
- C the total momentum must be conserved, but a small amount of the total kinetic energy may be lost in the collision.
- D whatever their initial states of motion, neither atom can be stationary after the collision.

28. 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  $\frac{5v}{4}$

**Nov 06**

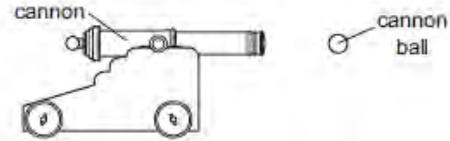
29. The diagram shows two identical spheres X and Y.



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

30. The diagram shows a cannon fired from cannon.



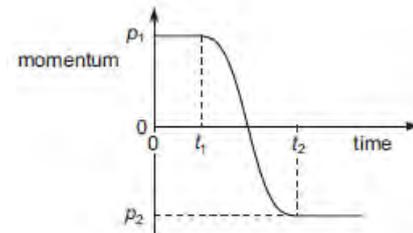
The mass of the cannon is 1000 kg and the mass of the cannon ball is 10 kg. The recoil velocity of the cannon is  $5 \text{ m s}^{-1}$  horizontally. What is the horizontal velocity of the cannon ball?  
 A  $200 \text{ m s}^{-1}$  B  $500 \text{ m s}^{-1}$  C  $2000 \text{ m s}^{-1}$  D  $5000 \text{ m s}^{-1}$

**June 07**

31. What is meant by the weight of an object?

- A the gravitational field acting on the object
- B the gravitational force acting on the object
- C the mass of the object multiplied by gravity
- D the object's mass multiplied by its acceleration

32. The graph shows the variation with time of the momentum of a ball as it is kicked in a straight line.

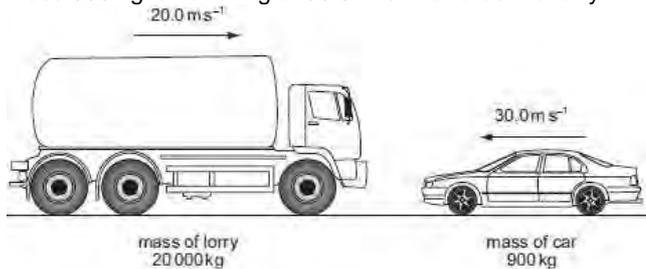


Initially, the momentum is  $p_1$  at time  $t_1$ . At time  $t_2$  the momentum is  $p_2$ .

What is the magnitude of the average force acting on the ball between times  $t_1$  and  $t_2$ ?

- A  $\frac{p_1 - p_2}{t_2}$
- B  $\frac{p_1 - p_2}{t_2 - t_1}$
- C  $\frac{p_1 + p_2}{t_2}$
- D  $\frac{p_1 + p_2}{t_2 - t_1}$

33. A lorry of mass 20 000 kg is travelling at  $20.0 \text{ m s}^{-1}$ . A car of mass 900 kg is travelling at  $30.0 \text{ m s}^{-1}$  towards the lorry.



What is the magnitude of the total momentum?

- A 209 kN s
- B 373 kN s
- C 427 kN s
- D 1045 kN s

34. The diagram shows the masses and velocities of two trolleys about to collide.



After the impact they move off together.

What is the total kinetic energy of the trolleys after the collision?

- A 1.3 J
- B 12 J
- C 18 J
- D 19 J

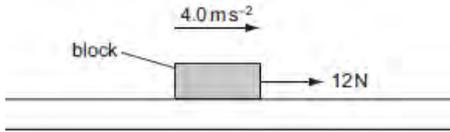
**Nov. 07**

35. The symbol  $g$  represents the acceleration of free fall.

Which of these statements is correct?

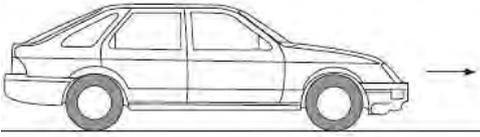
- A  $g$  is gravity.
- B  $g$  is reduced by air resistance.
- C  $g$  is the ratio weight / mass.
- D  $g$  is the weight of an object.

36. A block of mass 0.60 kg is on a rough horizontal surface. A force of 12 N is applied to the block and it accelerates at  $4.0 \text{ m s}^{-2}$ .



What is the magnitude of the frictional force acting on the block?  
 A 2.4 N B 5.3 N C 6.7 N D 9.6 N

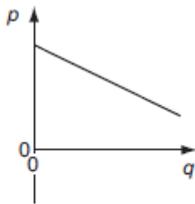
37. A car with front-wheel drive accelerates in the direction shown.



Which diagram best shows the direction of the total force exerted by the road on the front wheels?



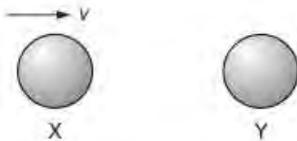
38. The graph shows how a certain quantity  $p$  varies with another quantity  $q$  for a parachutist falling at terminal speed.



What are the quantities  $p$  and  $q$ , and what is represented by the magnitude of the gradient of the graph?

	quantity $p$	quantity $q$	magnitude of gradient
A	height	time	terminal speed
B	momentum	time	weight of parachutist
C	height	potential energy	mass of parachutist
D	velocity	time	acceleration of free fall

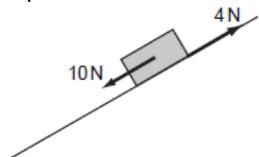
39. The diagram shows two identical spheres X and Y.



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

40. 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  $10 \text{ m s}^{-2}$ .  
 A  $0.3 \text{ m s}^{-2}$  B  $0.8 \text{ m s}^{-2}$  C  $3.0 \text{ m s}^{-2}$  D  $8.0 \text{ m s}^{-2}$

June 08

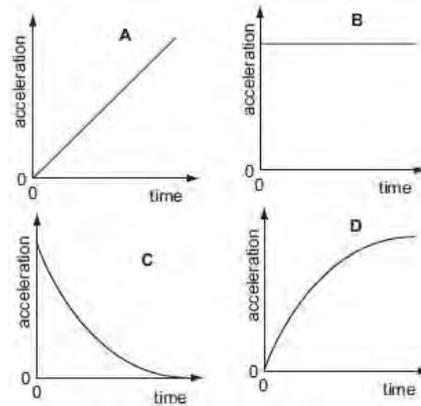
41. An object accelerates in a direction that is always perpendicular to its motion. What is the effect, if any, of the acceleration on the object's speed and direction?

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

42. The acceleration of free fall on a planet P is  $\frac{1}{6}$  th of the acceleration of free fall on Earth.

The mass of a body on planet P is 30 kg.  
 What is its weight on planet P?  
 A 4.9 N B 49 N C 180 N D 290 N

43. A football is dropped from the top of a tall building. Which acceleration-time graph best represents the motion of the football through the air?



44. Which is a statement of the principle of conservation of momentum?

- A Momentum is the product of mass and velocity.
- B Momentum is conserved only in elastic collisions.
- C Momentum is conserved by all bodies in a collision.
- D Momentum is conserved providing no external forces act.

45. Two equal masses X and Y are moving towards each other on a frictionless air track as shown.

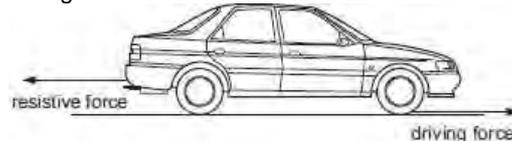
The masses make an elastic collision.



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

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

46. A car of mass 750 kg has a horizontal driving force of 2.0 kN acting on it. It has a forward horizontal acceleration of  $2.0 \text{ m s}^{-2}$ .



What is the resistive force acting horizontally?

- A 0.5 kN B 1.5 kN C 2.0 kN D 3.5 kN

47. A ball is falling at terminal speed in still air. The forces acting on the ball are upthrust, viscous drag and weight.

What is the order of increasing magnitude of these three forces?

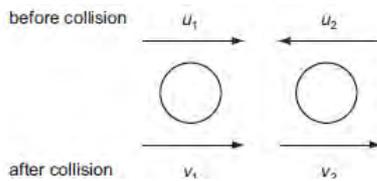
- A upthrust  $\rightarrow$  viscous drag  $\rightarrow$  weight
- B viscous drag  $\rightarrow$  upthrust  $\rightarrow$  weight
- C viscous drag  $\rightarrow$  weight  $\rightarrow$  upthrust
- D weight  $\rightarrow$  upthrust  $\rightarrow$  viscous drag

48. Which quantities are conserved in an inelastic collision?  
 kinetic energy total energy linear momentum  
 A conserved not conserved conserved  
 B conserved not conserved not conserved  
 C not conserved conserved conserved  
 D not conserved conserved not conserved

**Nov. 08**

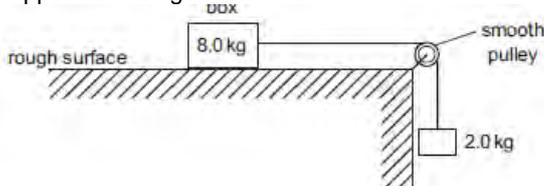
49. A ball falls vertically and bounces on the ground. The following statements are about the forces acting while the ball is in contact with the ground. Which statement is correct?  
 A The force that the ball exerts on the ground is always equal to the weight of the ball.  
 B The force that the ball exerts on the ground is always equal in magnitude and opposite in direction to the force the ground exerts on the ball.  
 C The force that the ball exerts on the ground is always less than the weight of the ball.  
 D The weight of the ball is always equal in magnitude and opposite in direction to the force that the ground exerts on the ball.

50. Two spheres approach each other along the same straight line. Their speeds are  $u_1$  and  $u_2$  before collision, and  $v_1$  and  $v_2$  after collision, in the directions shown below.



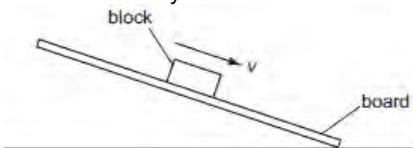
- Which equation is correct if the collision is perfectly elastic?  
 A  $u_1 - u_2 = v_2 + v_1$       B  $u_1 - u_2 = v_2 - v_1$   
 C  $u_1 + u_2 = v_2 + v_1$       D  $u_1 + u_2 = v_2 - v_1$

51. 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 friction force of 6.0 N acts on it. What is the acceleration of the box?  
 A  $1.4 \text{ m s}^{-2}$     B  $1.7 \text{ m s}^{-2}$     C  $2.0 \text{ m s}^{-2}$     D  $2.5 \text{ m s}^{-2}$

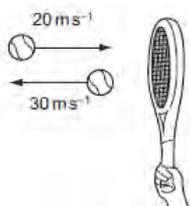
52. A wooden block rests on a rough board. The end of the board is then raised until the block slides down the plane of the board at constant velocity  $v$ .



- Which row describes the forces acting on the block when sliding with constant velocity?  
 frictional force on block      resultant force on block  
 A down the plane                      down the plane  
 B down the plane                      zero  
 C up the plane                          down the plane  
 D up the plane                          zero

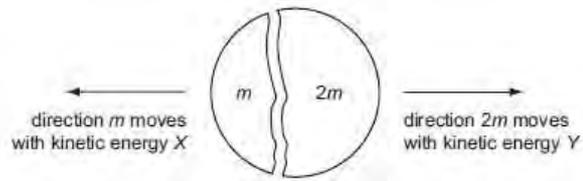
**June 09**

53. A tennis ball of mass 100 g is struck by a tennis racket. The velocity of the ball is changed as shown.



- What is the magnitude of the change in momentum of the ball?  
 A  $1 \text{ kg m s}^{-1}$     B  $5 \text{ kg m s}^{-1}$     C  $1000 \text{ kg m s}^{-1}$     D  $5000 \text{ kg m s}^{-1}$

54. 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  $\frac{4}{1}$

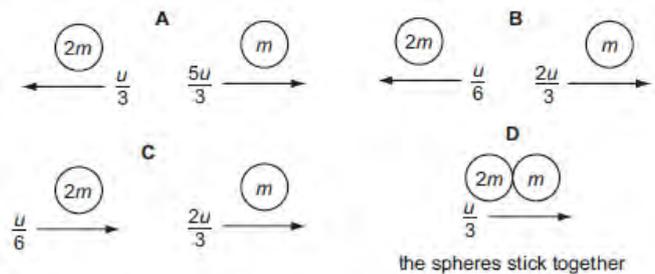
**Nov 09.**

55. Which statement about a ball that strikes a tennis racket and rebounds is always correct?  
 A Total kinetic energy of the ball is conserved.  
 B Total kinetic energy of the system is conserved.  
 C Total momentum of the ball is conserved.  
 D Total momentum of the system is conserved.

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

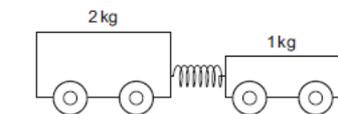


Which diagram, showing the situation after the collision, shows the result of an elastic collision?



57. A supermarket trolley, total mass 30 kg, is moving at  $3.0 \text{ ms}^{-1}$ . A retarding force of 60 N is applied to the trolley for 0.50 s in the opposite direction to the trolley's initial velocity. What is the trolley's new velocity after the application of the force?  
 A  $1.0 \text{ m s}^{-1}$     B  $1.5 \text{ m s}^{-1}$     C  $2.0 \text{ m s}^{-1}$     D  $2.8 \text{ m s}^{-1}$

58. Two trolleys are placed together on a horizontal runway with a compressed spring between them.



When they are released, the 2 kg trolley moves to the left at  $2 \text{ m s}^{-1}$ . How much energy was stored in the spring?

- A 4 J      B 6 J      C 8 J      D 12 J

- |      |      |      |      |      |      |
|------|------|------|------|------|------|
| 1 b  | 11 b | 21 a | 31 b | 41 c | 51 a |
| 2 b  | 12 a | 22 a | 32 b | 42 b | 52 d |
| 3 b  | 13 b | 23 a | 33 b | 43 c | 53 b |
| 4 d  | 14 d | 24 d | 34 b | 44 d | 54 c |
| 5 b  | 15 a | 25 b | 35 c | 45 d | 55 d |
| 6 a  | 16 b | 26 b | 36 d | 46 a | 56 a |
| 7 a  | 17 b | 27 b | 37 b | 47 a | 57 c |
| 8 d  | 18 a | 28 a | 38 a | 48 c | 58 d |
| 9 b  | 19 b | 29 d | 39 d | 49 b |      |
| 10 a | 20 b | 30 b | 40 c | 50 d |      |

