Dynamics

(Newton's Law of Motion)

TOPIC QUESTIONS (1)

Level	AS Level
Subject	Physics
Exam Board	CIE
Paper Type	Multiple Choice

Time Allowed : 1Hour 10Min

1 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?

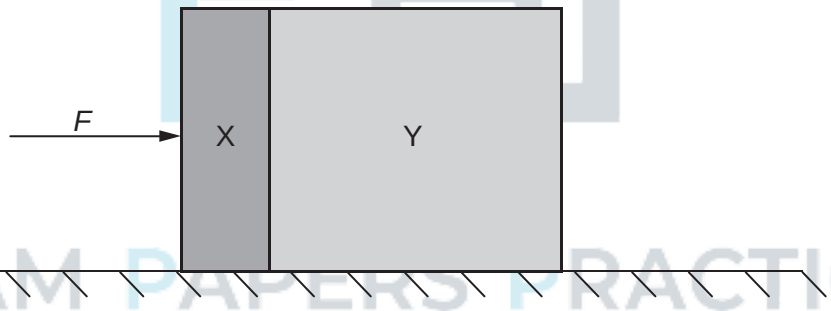
A *a* and *v* only

B *a* and *F* only

C *v* and *F* only

D *v*, *F* and *a*

2 Two blocks X and Y, of masses *m* and 3*m* 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** $\frac{F}{3}$ $\frac{F}{2}$ $\frac{3F}{4}$

3 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

4 What is a reasonable estimate of the average gravitational force acting on a fully grown woman standing on the Earth?

A 60 N B 250 N C 350 N D 650 N

5 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

6. A stone of mass *m* is dropped from a tall building. There is significant air resistance. Theacceleration 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

7. 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	mas / kg
A	9.85	1.00
B	9.85	6.00
C	58.9	1.00
D	58.9	6.00

8. A force *F* is applied to a freely moving object. At one instant of time, the object has velocity *v* andacceleration *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*

9. A ball is thrown horizontally in still air from the top of a very tall building. The ball is affected by airresistance.

   What happens to the horizontal and to the vertical components of the ball's velocity?

	horizontal component of velocity	vertical component of velocity
A	decreases to zero	increases at a constant rate
B	decreases to zero	increases to a constant value
C	remains constant	increases at a constant rate
D	remains constant	increases to a constant value

10. The gravitational field strength on the surface of planet P is one tenth of that on the surface ofplanet 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	weigh on Q / N
A	1.0	0.1
B	1.0	10
C	10	10
D	10	100

11. What is the centre of gravity of an object?

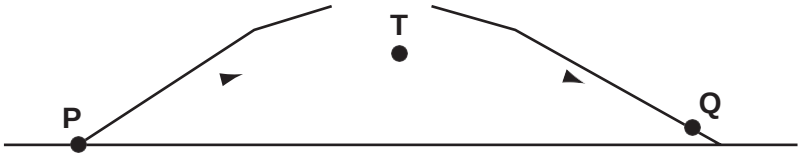
    A the geometrical centre of the object

    B the point about which the total torque is zero

    C the point at which the weight of the object may be considered to act

D the point through which gravity acts

12. In the absence of air resistance, a stone is thrown from P and follows a parabolic path in which the highest point reached is T. The stone reaches point Q just before landing.



The vertical component of acceleration of the stone is

A zero at T.

B greatest at T.

C greatest at Q.

D the same at Q as at T.

13. A constant mass undergoes uniform acceleration.

Which of the following is a correct statement about the resultant force acting on the mass?

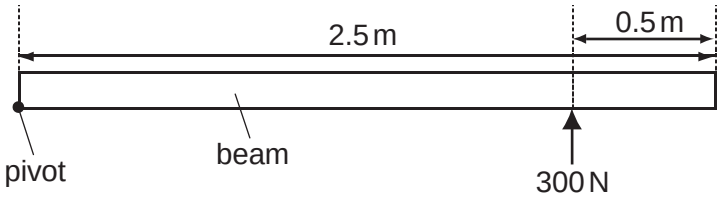
A It increases uniformly with respect to time.

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.

14. A long uniform beam is pivoted at one end. A force of 300 N is applied to hold the beam horizontally.



What is the weight of the beam?

A 300 N B 480 N C 600 N D 960 N

15. 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.

16. A football is dropped from the top of a three-storey building. It falls through air until it reaches the ground.

What remains constant throughout the fall?

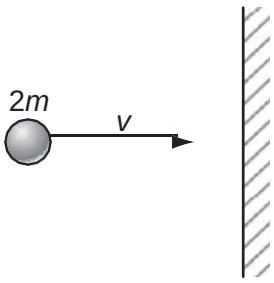
A acceleration of the football

B air resistance on the football

C velocity of the football

D weight of the football

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

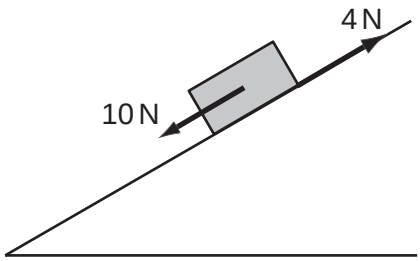


The particle rebounds along the same path after colliding with the wall. The collision is inelastic.

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

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

18. 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 $8.0\,m\,s^{-2}$

19. A supermarket trolley, total mass 30 kg, is moving at 3.0 m s^{-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 m s^{-1} B 1.5 m s^{-1} C 2.0 m s^{-1} D 2.8 m s^{-1}

20. What is the centre of gravity of an object?

    A the geometrical centre of the object

    B the point about which the total torque is zero

    C the point at which the weight of the object may be considered to act

    D the point through which gravity acts

21. Which statement about Newton's laws of motion is correct?

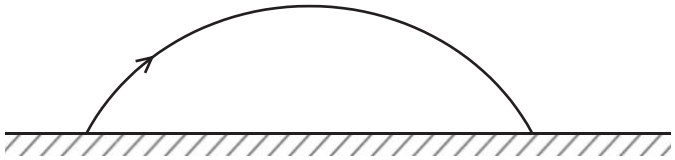
    A The first law follows from the second law.

    B The third law follows from the second law.

    C Conservation of energy is a consequence of the third law.

    D Conservation of linear momentum is a consequence of the first law.

22. The diagram shows the path of a golf ball.



Which row describes changes in the horizontal and vertical components of the golf ball's velocity, when air resistance forces are ignored?

	horizontal	vertical
A	constant deceleration	constant acceleration downwards
B	constant deceleration	acceleration decreases upwards then increases downwards
C	constant velocity	constant acceleration downwards
D	constant velocity	acceleration decreases upwards then increases downwards

23. 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?

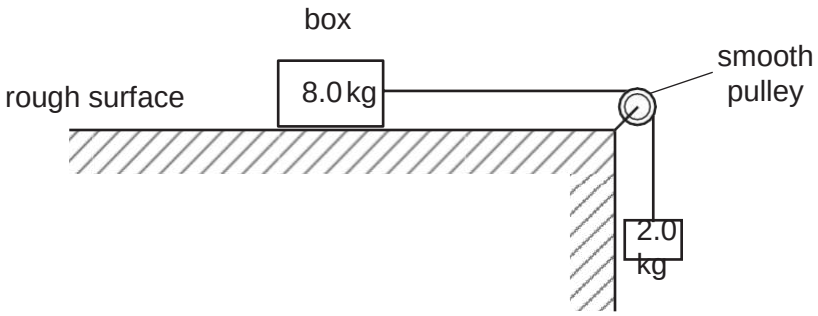
A The force that the ball exerts on the ground is always equal to the weight of the ball.

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.

24. 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.

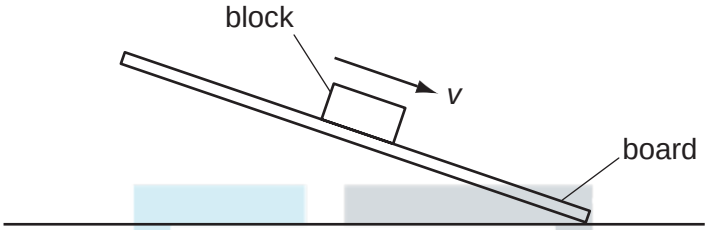


When the box is released, a friction force of 6.0 N acts on it.

What is the acceleration of the box?

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

25. A wooden block rests on a rough board. The end of the board is then raised until the block slidesdown 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

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. 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?

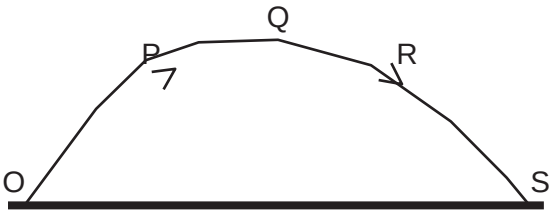
	mass on Q	weight on Q
A	1.0 kg	0.1 N
B	1.0 kg	10 N
C	10 kg	10 N
D	10 kg	100 N

28. A boy throws a ball vertically upwards. It rises to a maximum height, where it is momentarily at rest, and falls back to his hands.

Which of the following gives the acceleration of the ball at various stages in its motion? Take vertically upwards as positive. Neglect air resistance.

	rising	at maximum height	falling
A	$-9.8\ ms^{-2}$	0	$+9.81\ ms^{-2}$
B	$-9.8\ ms^{-2}$	$-9.81\ ms^{-2}$	$-9.81\ ms^{-2}$
C	$+9.8\ ms^{-2}$	$+9.81\ ms^{-2}$	$+9.81\ ms^{-2}$
D	$+9.8\ ms^{-2}$	0	$-9.81\ ms^{-2}$

29. A projectile is launched at point O and follows the path OPQRS, as shown. Air resistance may be neglected.



Which statement is true for the projectile when it is at the highest point Q of its path?

A The horizontal component of the projectile's acceleration is zero.

B The horizontal component of the projectile's velocity is zero.

C The kinetic energy of the projectile is zero.

D The momentum of the projectile is zero.

30. Which is not one of Newton's laws of motion?

A The total momentum of a system of interacting bodies remains constant, providing noexternal 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.

31. A particle is in a uniform field. The particle experiences a force in the opposite direction to the field.

Which field is the particle in, and on which property of the particle is the field acting?

	field	property of particle on which the field acts
A	electric	charge
B	electric	current
C	gravitational	mass
D	gravitational	weight

32. 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

33. The acceleration of free fall on a planet P is $\frac{1}{6}$ 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

34. A ball is thrown vertically in air.

Neglecting air resistance, which property of the ball can never be zero at any time during the flight?

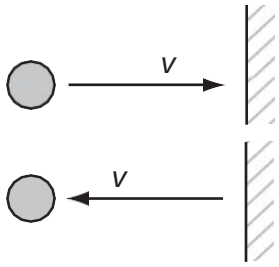
A acceleration

B kinetic energy

C speed

D velocity

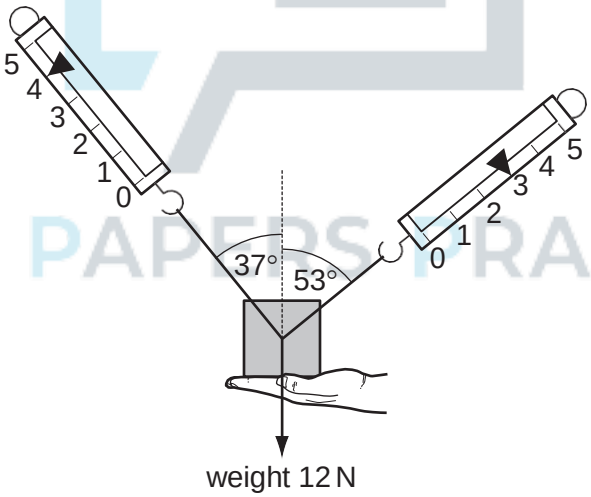
35. An object travelling with velocity v strikes a wall and rebounds as shown.



Which property of the object is not conserved?

a. kinetic energy
b. mass
c. momentum
d. speed

36. 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 $6\,m\,s^{-2}$

37. 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?

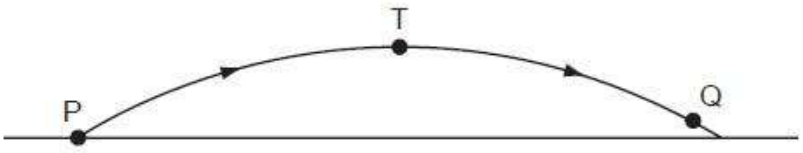
A 3.1×10^{-8} m s^{-2}

B 6.3×10^{-7} m s^{-2}

C 3.2×10^{-3} m s^{-2}

D 6.4×10^{-2} m s^{-2}

38. In the absence of air resistance, a stone is thrown from P and follows a parabolic path in which the highest point reached is T. The stone reaches point Q just before landing.



The vertical component of acceleration of the stone is

A zero at T.

B larger at T than at Q.

C larger at Q than at T.

D the same at Q as at T.

39. Each option gives a correct word equation involving force.Which option gives the definition of force?

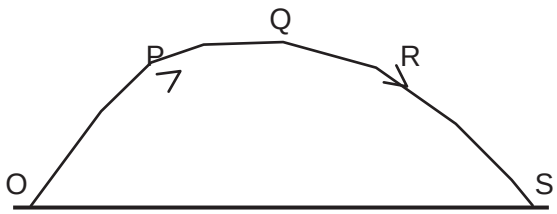
A force = energy divided by displacement

B force = mass × acceleration

C force = pressure × area

D force = rate of change of momentum

40. A projectile is launched at point O and follows the path OPQRS, as shown. Air resistance may be neglected.



Which statement is true for the projectile when it is at the highest point Q of its path?

a. The horizontal component of the projectile's acceleration is zero.

b. The horizontal component of the projectile's velocity is zero.

c. The kinetic energy of the projectile is zero.

d. The momentum of the projectile is zero.

41. A boy throws a ball vertically upwards. It rises to a maximum height, where it is momentarily at rest, and then falls back to his hands.

Which row gives the acceleration of the ball at various stages in its motion? (Take vertically upwards as positive. Ignore air resistance.)

	rising	at maximum height	falling
A	$-9.81\,m\,s^{-2}$	0	$+9.81\,m\,s^{-2}$
B	$-9.81\,m\,s^{-2}$	$-9.81\,m\,s^{-2}$	$-9.81\,m\,s^{-2}$
C	$+9.81\,m\,s^{-2}$	$+9.81\,m\,s^{-2}$	$+9.81\,m\,s^{-2}$
D	$+9.81\,m\,s^{-2}$	0	$-9.81\,m\,s^{-2}$

42. 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

43. What is the definition of the force on a body?

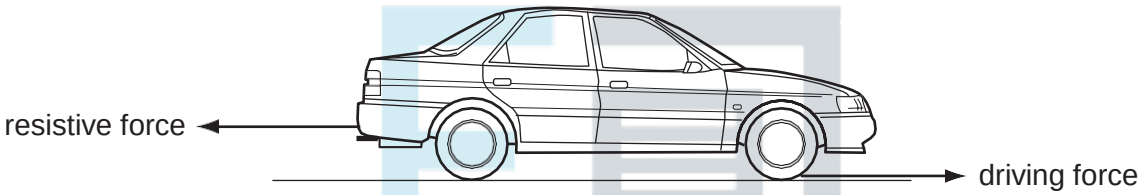
A the mass of the body multiplied by its acceleration

B the power input to the body divided by its velocity

C the rate of change of momentum of the body

D the work done on the body divided by its displacement

44. 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 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

45. The symbol *g* represents the acceleration of free fall.

Which of these statements is correct?

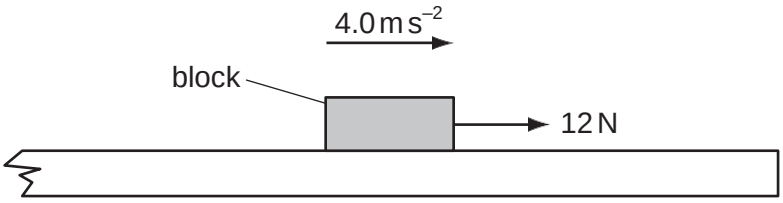
a. *g* is gravity.

b. *g* is reduced by air resistance.

c. *g* is the ratio weight / mass.

d. *g* is the weight of an object.

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

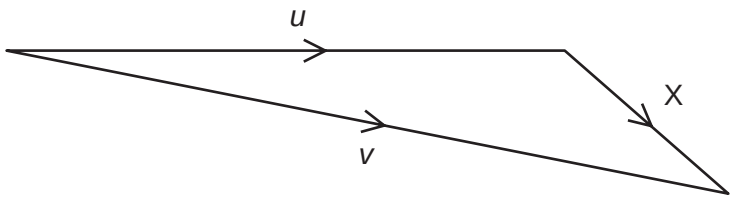


What is the magnitude of the frictional force acting on the block?

A 2.4N B 5.3 N C 6.7 N D 9.6 N

47. An object has an initial velocity *u*. It is subjected to a constant force *F* for *t* seconds, causing a constant acceleration *a*. The force is not in the same direction as the initial velocity.

A vector diagram is drawn to find the final velocity *v*.



What is the length of side X of the vector diagram?

A *F* B *Ft* C *at* D *u* + *at*

48. 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

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

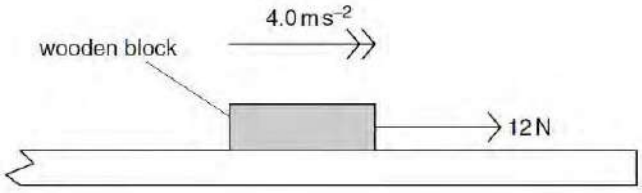
Which quantities must be in the same direction?

A *a* and *v* only B *a* and *F* only C *v* and *F* only D *v*, *F* and *a*

50. Two similar spheres, each of mass *m* and travelling withspeed *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 $2mv$.

51. 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 $4.0 ms^{-2}$



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

52. A body, initially at rest, explodes into two masses $M1$ and $M2$ that move apart with speeds $v1$ and $v2$ respectively. What is the ratio v1/v2?

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

53. 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

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54. 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

55. Two spheres A and B approach each other along the same straight line with speeds uA and uB.
The spheres collide and move off with speeds vA and vB, both in the same direction as the initial direction of sphere A, as shown below.
Which equation applies to an elastic collision?
A uA + uB = vB - vA **B** uA - uB = vB - vA **C** uA - uB = vB + vA **D** uA + uB = vB + vA

56. Two equal masses travel towards each other on a frictionless air track at speeds of 60 cm s^{-1} and 30 cm s^{-1}. They stick together on impact.
What is the speed of the masses after impact?
A 15 cm s^{-1} **B** 20 cm s^{-1} **C** 30 cm s^{-1} **D** 45 cm s^{-1}

57. What is the definition of the force on a body?

A the mass of the body multiplied by its acceleration

B the power input to the body divided by its velocity

C the rate of change of momentum of the body

D the work done on the body divided by its displacement

58. 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

59. Newton's third law of motion is often summarised as 'Every action (force) has an equal andopposite 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

tableD the push of the table

on the book

60. A 0.10 kg mass is taken to Mars and then weighed on a spring balance and on a lever balance.The acceleration due to gravity on Mars is 38% of its value on Earth.

What are the readings on the two balances on Mars? (Assume that on Earth g = 10 m s^{-2}.)

	spring balance / N	lever balance / kg
A	0.38	0.038
B	0.38	0.10
C	1.0	0.038
D	1.0	0.10