Motion-practice-1-MC *[60 marks]*

1. A student wants to determine the angular speed ω of a rotating object. *[1 mark]*
The period T is 0.50 s ±5 %. The angular speed ω is

$$\omega = \frac{2\pi}{T}$$

What is the percentage uncertainty of ω?

A. 0.2 %

B. 2.5 %

C. 5 %

D. 10 %

2. A student models the relationship between the pressure p of a gas and its *[1 mark]*
temperature T as $p = x + y$T.

The units of p are pascal and the units of T are kelvin. What are the fundamental SI units of x and y?

	x	y
A.	$kgm^{-1}s^{-2}$	$kgm^{-1}s^{-2}K^{-1}$
B.	$kgm^{-1}s^{-2}$	K^{-1}
C.	K	$kg^{-1}ms^{-2}K^{-1}$
D.	K	K^{-1}

3. A sky diver is falling at terminal speed when she opens her parachute. *[1 mark]*
What are the direction of her velocity vector and the direction of her acceleration vector before she reaches the new terminal speed?

	Direction of velocity vector	Direction of acceleration vector
A.	upwards	upwards
B.	upwards	downwards
C.	downwards	upwards
D.	downwards	downwards

4. A stone is thrown downwards from the edge of a cliff with a speed of 5.0 m s^{-1}. It hits the ground 2.0 s later. What is the height of the cliff? *[1 mark]*

A. 20 m

B. 30 m

C. 40 m

D. 50 m

5. A ball is thrown upwards at an angle to the horizontal. Air resistance is negligible. Which statement about the motion of the ball is correct? *[1 mark]*

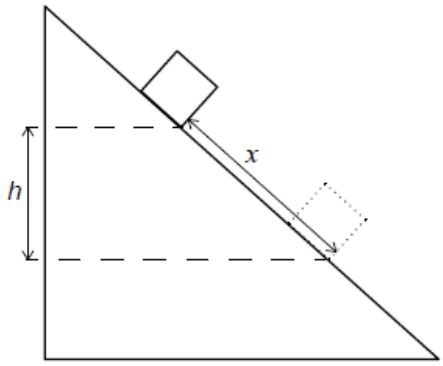
A. The acceleration of the ball changes during its flight.

B. The velocity of the ball changes during its flight.

C. The acceleration of the ball is zero at the highest point.

D. The velocity of the ball is zero at the highest point.

6. An object of mass *m* is sliding down a ramp at constant speed. During the motion it travels a distance x along the ramp and falls through a vertical distance *h*. The coefficient of dynamic friction between the ramp and the object is μ. What is the total energy transferred into thermal energy when the object travels distance x? *[1 mark]*



A. *mgh*

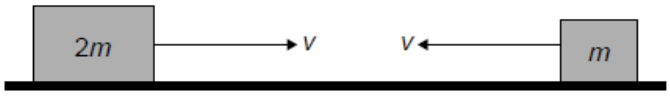
B. *mgx*

C. *μmgh*

D. *μmgx*

7. Two blocks of masses m and $2m$ are travelling directly towards each other. Both are moving at the same constant speed v. The blocks collide and stick together. *[1 mark]*

What is the total momentum of the system before and after the collision?



	Momentum before	Momentum after
A.	mv	mv
B.	mv	$-mv$
C.	$3mv$	$-3mv$
D.	$3mv$	$3mv$

8. The graph shows the variation with time of the resultant net force acting on an object. The object has a mass of 1kg and is initially at rest. *[1 mark]*

What is the velocity of the object at a time of 200 ms?

A. 8 m s^{-1}

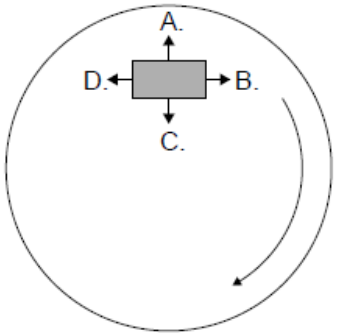
B. 16 m s^{-1}

C. 8 km s^{-1}

D. 16 km s^{-1}

9. A block is on the surface of a horizontal rotating disk. The block is at rest relative to the disk. The disk is rotating at constant angular velocity. *[1 mark]*

What is the correct arrow to represent the direction of the frictional force acting on the block at the instant shown?



10. A student measures the radius R of a circular plate to determine its area. The absolute uncertainty in R is ΔR. *[1 mark]*

What is the **fractional** uncertainty in the area of the plate?

A. $\frac{2\Delta R}{R}$

B. $\left(\frac{\Delta R}{R}\right)^2$

C. $\frac{2\pi\Delta R}{R}$

D. $\pi\left(\frac{\Delta R}{R}\right)^2$

11. What is the unit of electrical potential difference expressed in fundamental SI units? *[1 mark]*

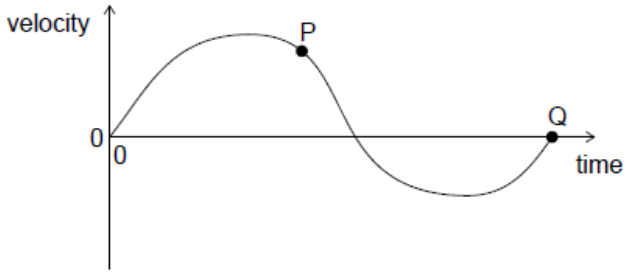
A. kg m s^{-1} C^{-1}

B. kg m^2 s^{-2} C^{-1}

C. kg m^2 s^{-3} A^{-1}

D. kg m^2 s^{-1} A

12. The graph shows the variation of velocity of a body with time along a straight line. *[1 mark]*



What is correct for this graph?

A. The maximum acceleration is at P.

B. The average acceleration of the body is given by the area enclosed by the graph and time axis.

C. The maximum displacement is at Q.

D. The total displacement of the body is given by the area enclosed by the graph and time axis.

13. Two forces of magnitude 12 N and 24 N act at the same point. Which force **cannot** be the resultant of these forces? *[1 mark]*

A. 10 N

B. 16 N

C. 19 N

D. 36 N

14. An object has a weight of 6.10×10^2 N. What is the change in gravitational potential energy of the object when it moves through 8.0 m vertically? *[1 mark]*

A. 5 kJ

B. 4.9 kJ

C. 4.88 kJ

D. 4.880 kJ

15. A boat with an output engine power of 15 kW moves through water at a speed of 10 m s^{-1}. What is the resistive force acting on the boat? *[1 mark]*

A. 0.15 kN

B. 0.75 kN

C. 1.5 kN

D. 150 kN

16. An astronaut is moving at a constant velocity in the absence of a gravitational field when he throws a tool away from him. *[1 mark]*

What is the effect of throwing the tool on the total kinetic energy of the astronaut and the tool and the total momentum of the astronaut and the tool?

	Total kinetic energy of the astronaut and tool	Total momentum of the astronaut and tool
A.	no change	increases
B.	no change	no change
C.	increases	increases
D.	increases	no change

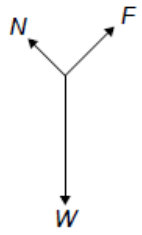
17. A table-tennis ball of mass 3 g is fired with a speed of 10 m s^{-1} from a stationary toy gun of mass 0.600 kg. The gun and ball are an isolated system. *[1 mark]*

What are the recoil speed of the toy gun and the total momentum of the system immediately after the gun is fired?

	Recoil speed of the toy gun / m s^{-1}	Total momentum of the system / kg m s^{-1}
A.	0.05	0
B.	0.05	0.03
C.	0.5	0
D.	0.5	0.03

18. A block of weight W slides down a ramp at constant velocity. A friction force F acts between the bottom of the block and the surface of the ramp. A normal reaction N acts between the ramp and the block. What is the free-body diagram for the forces that act on the block? *[1 mark]*

A.



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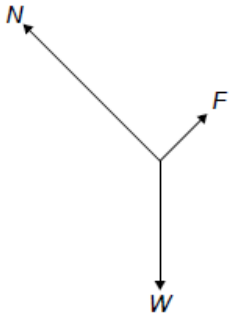

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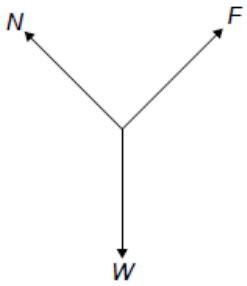
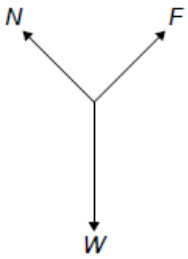


D.



19. What is the unit of power expressed in fundamental SI units? *[1 mark]*

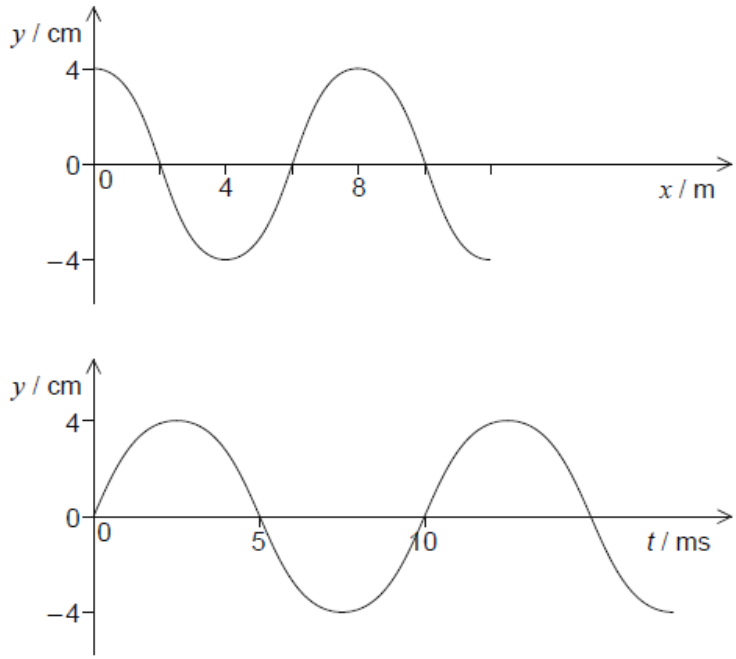
A. $\mathrm{kg\,m\,s^{-2}}$

B. $\mathrm{kg\,m^2\,s^{-2}}$

C. $\mathrm{kg\,m\,s^{-3}}$

D. $\mathrm{kg\,m^2\,s^{-3}}$

20. The graphs show the variation of the displacement y of a medium with distance x and with time t for a travelling wave. *[1 mark]*



What is the speed of the wave?

A. $0.6\ \text{m s}^{-1}$

B. $0.8\ \text{m s}^{-1}$

C. $600\ \text{m s}^{-1}$

D. $800\ \text{m s}^{-1}$

21. The length of the side of a cube is 2.0 cm ± 4 %. The mass of the cube is 24.0 g ± 8 %. What is the percentage uncertainty of the density of the cube? *[1 mark]*

A. ± 2 %

B. ± 8 %

C. ± 12 %

D. ± 20 %

22. A truck has an initial speed of 20 m s^{-1}. It decelerates at 4.0 m s^{-2}. What is the distance taken by the truck to stop? *[1 mark]*

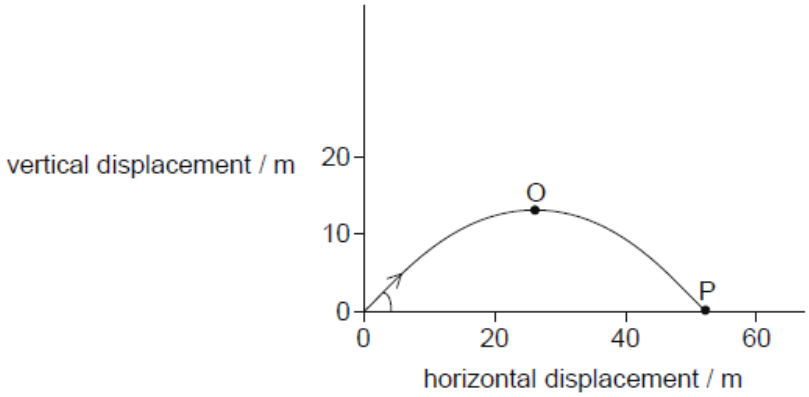
A. 2.5 m

B. 5.0 m

C. 50 m

D. 100 m

23. A projectile is fired at an angle to the horizontal. Air resistance is negligible. The path of the projectile is shown. *[1 mark]*

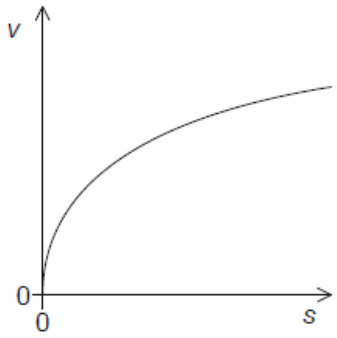


Which gives the magnitude of the horizontal component and the magnitude of the vertical component of the velocity of the projectile between O and P?

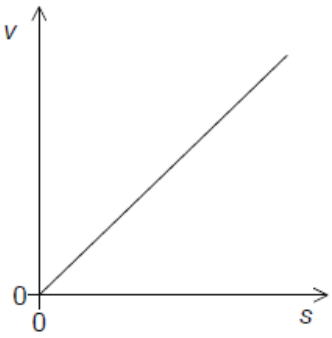
	Magnitude of horizontal component of velocity	Magnitude of vertical component of velocity
A.	constant	increases
B.	constant	constant
C.	increases	increases
D.	increases	constant

24. A runner starts from rest and accelerates at a constant rate throughout a race. Which graph shows the variation of speed v of the runner with distance travelled s? *[1 mark]*

A.



B.



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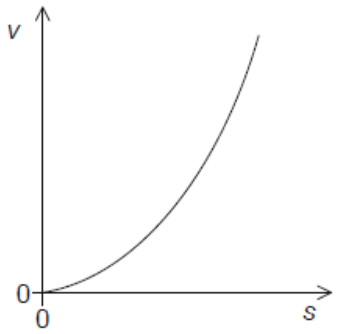
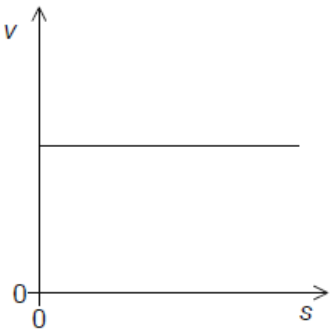
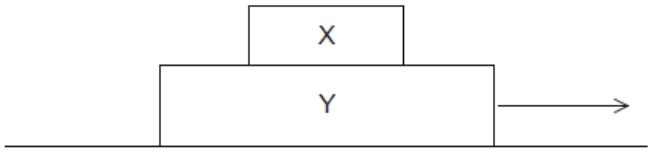


D.

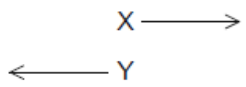


25. Two blocks X and Y rest on a frictionless horizontal surface as shown. A horizontal force is now applied to the larger block and the two blocks move together with the same speed and acceleration. *[1 mark]*

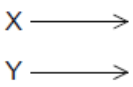


Which free-body diagram shows the frictional forces between the two blocks?

A.



B.



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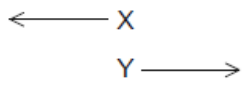
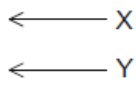
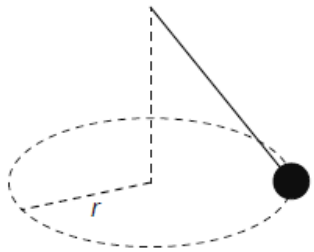


D.



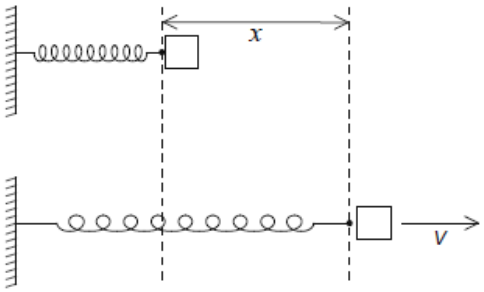
26. The mass at the end of a pendulum is made to move in a horizontal circle *[1 mark]* of radius *r* at constant speed. The magnitude of the net force on the mass is *F*.



What is the direction of *F* and the work done by *F* during half a revolution?

	Direction of *F*	Work done by *F*
A.	towards centre of circle	zero
B.	towards centre of circle	πrF
C.	away from centre of circle	zero
D.	away from centre of circle	πrF

27. A compressed spring is used to launch an object along a horizontal frictionless surface. When the spring is compressed through a distance x and released, the object leaves the spring at speed v. What is the distance through which the spring must be compressed for the object to leave the spring at $\frac{v}{2}$? *[1 mark]*



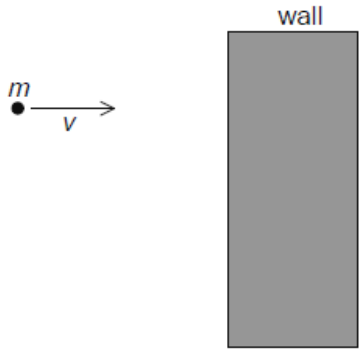
A. $\frac{x}{4}$

B. $\frac{x}{2}$

C. $\frac{x}{\sqrt{2}}$

D. $x\sqrt{2}$

28. A ball of mass *m* collides with a wall and bounces back in a straight line. The ball loses 75 % of the initial energy during the collision. The speed before the collision is *v*. *[1 mark]*



What is the magnitude of the impulse on the ball by the wall?

A. $\left(1-\frac{\sqrt{3}}{2}\right)mv$

B. $\frac{1}{2}mv$

C. $\frac{5}{4}mv$

D. $\frac{3}{2}mv$

29. A student measures the radius *r* of a sphere with an absolute uncertainty Δ*r*. What is the fractional uncertainty in the volume of the sphere? *[1 mark]*

A. $\left(\frac{\Delta r}{r}\right)^3$

B. $3\frac{\Delta r}{r}$

C. $4\pi\frac{\Delta r}{r}$

D. $4\pi\left(\frac{\Delta r}{r}\right)^3$

30. An object is projected vertically upwards at time $t = 0$. Air resistance is negligible. The object passes the same point above its starting position at times 2 s and 8 s. *[1 mark]*

If g = 10 m s^{-2}, what is the initial speed of the object?

A. 50

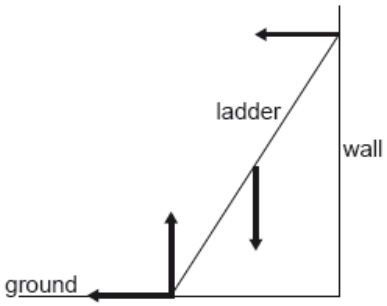
B. 30

C. 25

D. 4

31. A uniform ladder resting in equilibrium on rough ground leans against a smooth wall. Which diagram correctly shows the forces acting on the ladder? *[1 mark]*

A.



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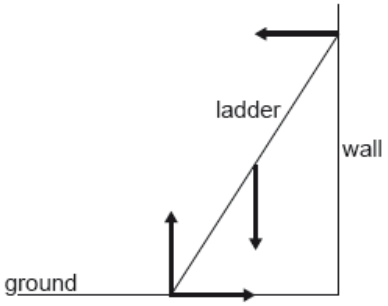
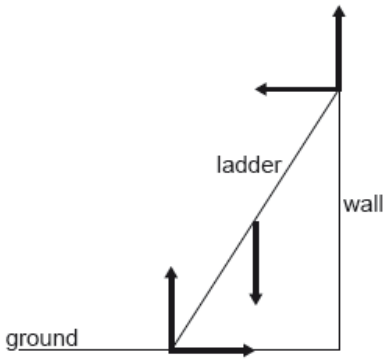
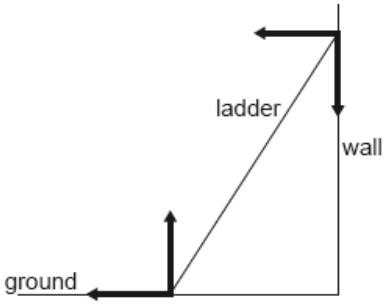


C.



D.



32. An object falls from rest from a height *h* close to the surface of the Moon. *[1 mark]* The Moon has no atmosphere.

When the object has fallen to height $\frac{h}{4}$ above the surface, what is

$$\frac{\text{kinetic energy of the object at } \frac{h}{4}}{\text{gravitational potential energy of the object at } h}?$$

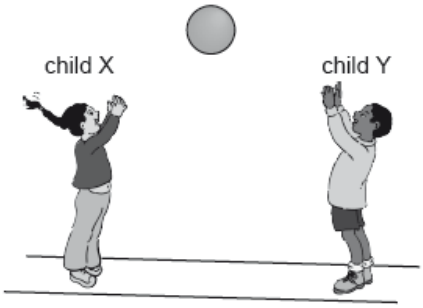
A. $\frac{3}{4}$

B. $\frac{4}{3}$

C. $\frac{9}{16}$

D. $\frac{16}{9}$

33. Child X throws a ball to child Y. The system consists of the ball, the children and the Earth. What is true for the system when the ball has been caught by Y? *[1 mark]*



[Source: https://pixabay.com/en/playing-ball-kids-boy-girl-31339/]

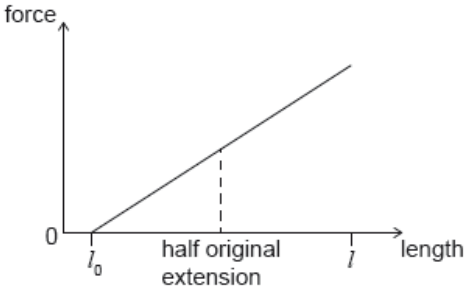
A. The momentum of child Y is equal and opposite to the momentum of child X.

B. The speed of rotation of the Earth will have changed.

C. The ball has no net momentum while it is in the air.

D. The total momentum of the system has not changed.

34. An increasing force acts on a metal wire and the wire extends from an initial length l_0 to a new length l. The graph shows the variation of force with length for the wire. The energy required to extend the wire from l_0 to l is E. *[1 mark]*



The wire then contracts to half its original extension.

What is the work done by the wire as it contracts?

A. $0.25E$

B. $0.50E$

C. $0.75E$

D. E

35. The distances between successive positions of a moving car, measured at equal time intervals, are shown. *[1 mark]*

The car moves with

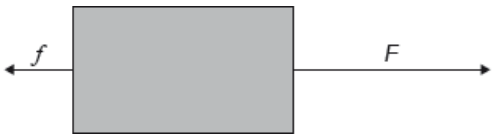
A. acceleration that increases linearly with time.

B. acceleration that increases non-linearly with time.

C. constant speed.

D. constant acceleration.

36. An object is moving in a straight line. A force F and a resistive force f act on the object along the straight line. *[1 mark]*



Both forces act for a time t.

What is the rate of change of momentum with time of the object during time t?

A. $F + f$

B. $F - f$

C. $(F + f)t$

D. $(F - f)t$

37. What is the best estimate for the diameter of a helium nucleus? *[1 mark]*

A. 10^{-21} m

B. 10^{-18} m

C. 10^{-15} m

D. 10^{-10} m

38. Which is a unit of force? *[1 mark]*

A. J m

B. J m^{-1}

C. J m s^{-1}

D. J m^{-1} s

39. A motor of input power 160 W raises a mass of 8.0 kg vertically at a constant speed of 0.50 m s^{-1}. *[1 mark]*

What is the efficiency of the system?

A. 0.63%

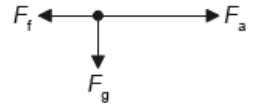
B. 25%

C. 50%

D. 100%

40. A box is accelerated to the right across rough ground by a horizontal force F_a. The force of friction is F_f. The weight of the box is F_g and the normal reaction is F_n. Which is the free-body diagram for this situation? *[1 mark]*

A.



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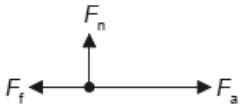
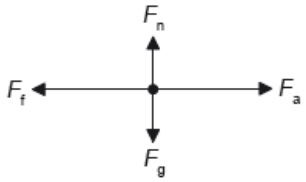
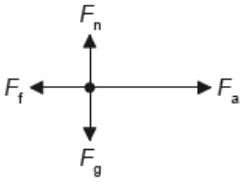


C.

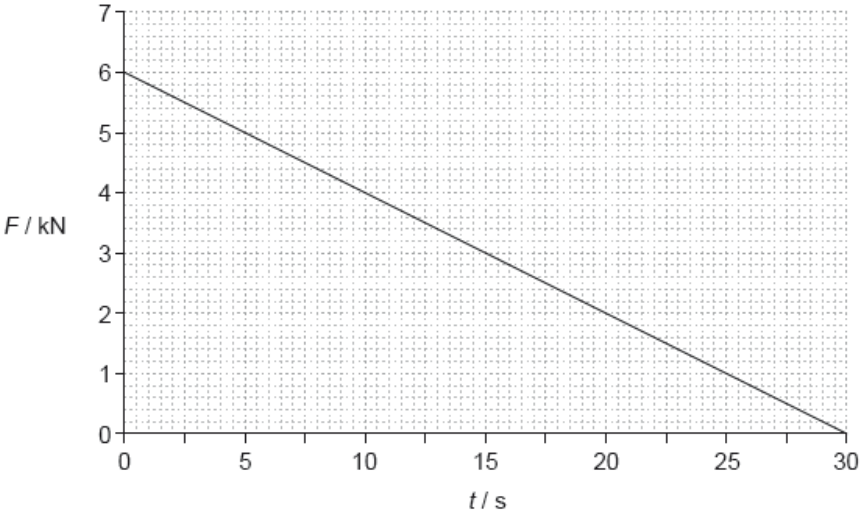


D.



41. The graph shows the variation with time t of the force F acting on an object of mass 15 000 kg. *[1 mark]*

The object is at rest at $t = 0$.



What is the speed of the object when $t = 30$ s?

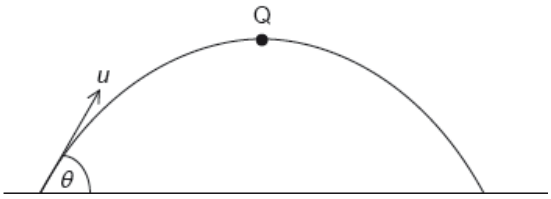
A. 0.18 m s^{-1}

B. 6 m s^{-1}

C. 12 m s^{-1}

D. 180 m s^{-1}

42. A ball of mass m is thrown with an initial speed of u at an angle θ to the horizontal as shown. Q is the highest point of the motion. Air resistance is negligible. *[1 mark]*



What is the momentum of the ball at Q?

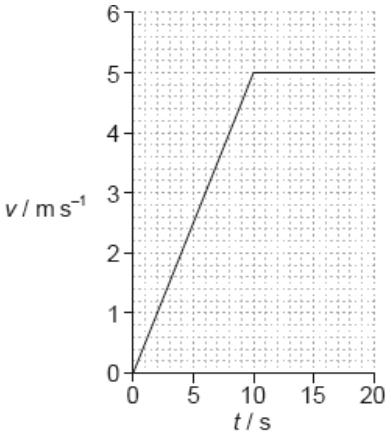
A. zero

B. $mu\cos\theta$

C. mu

D. $mu\sin\theta$

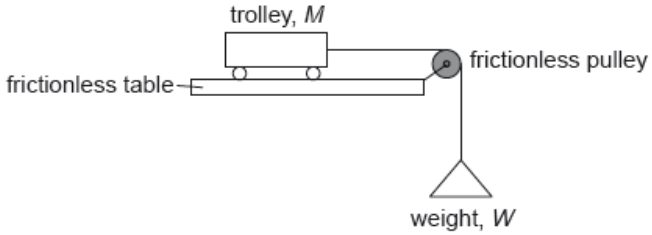
43. A boy runs along a straight horizontal track. The graph shows how his speed v varies with time t. *[1 mark]*



After 15 s the boy has run 50 m. What is his instantaneous speed and his average speed when $t = 15$ s?

	Instantaneous speed / m s^{-1}	Average speed / m s^{-1}
A.	3.3	3.3
B.	3.3	5.0
C.	5.0	3.3
D.	5.0	5.0

44. A weight *W* is tied to a trolley of mass *M* by a light string passing over a frictionless pulley. The trolley has an acceleration *a* on a frictionless table. The acceleration due to gravity is *g*. *[1 mark]*



What is *W*?

A. $\frac{Mag}{(g-a)}$

B. $\frac{Mag}{(g+a)}$

C. $\frac{Ma}{(g-a)}$

D. $\frac{Ma}{(g+a)}$

45. Two balls X and Y with the same diameter are fired horizontally with the same initial momentum from the same height above the ground. The mass of X is greater than the mass of Y. Air resistance is negligible. *[1 mark]*

What is correct about the horizontal distances travelled by X and Y and the times taken by X and Y to reach the ground?

	Horizontal distances	Time to reach ground
A.	X and Y the same	X and Y times the same
B.	X and Y the same	X takes a shorter time than Y
C.	X less than Y	X and Y times the same
D.	X less than Y	X takes a shorter time than Y

46. How many significant figures are there in the number 0.0450? *[1 mark]*

A. 2

B. 3

C. 4

D. 5

47. An object is positioned in a gravitational field. The measurement of gravitational force acting on the object has an uncertainty of 3 % and the uncertainty in the mass of the object is 9 %. What is the uncertainty in the gravitational field strength of the field? *[1 mark]*

A. 3 %

B. 6 %

C. 12 %

D. 27 %

48. The variation of the displacement of an object with time is shown on a graph. What does the area under the graph represent? *[1 mark]*

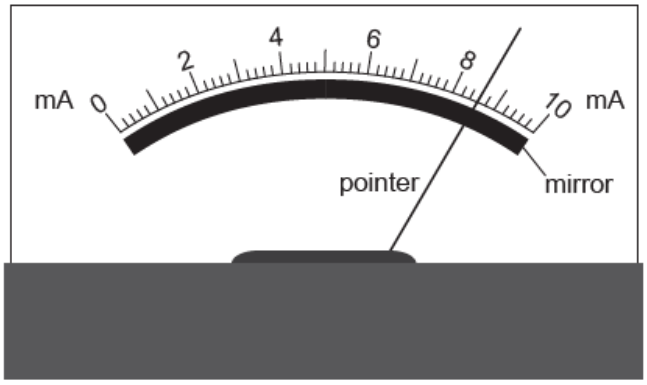
A. No physical quantity

B. Velocity

C. Acceleration

D. Impulse

49. The diagram shows an analogue meter with a mirror behind the pointer. *[1 mark]*



What is the main purpose of the mirror?

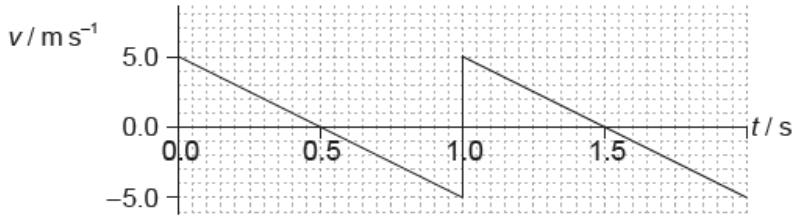
A. To provide extra light when reading the scale

B. To reduce the risk of parallax error when reading the scale

C. To enable the pointer to be seen from different angles

D. To magnify the image of the pointer

50. An object is thrown upwards. The graph shows the variation with time t of the velocity v of the object. *[1 mark]*



What is the total displacement at a time of 1.5 s, measured from the point of release?

A. 0 m

B. 1.25 m

C. 2.50 m

D. 3.75 m

---

51. An object is released from a stationary hot air balloon at height h above the ground. *[1 mark]*

An identical object is released at height h above the ground from another balloon that is rising at constant speed. Air resistance is negligible. What does **not** increase for the object released from the rising balloon?

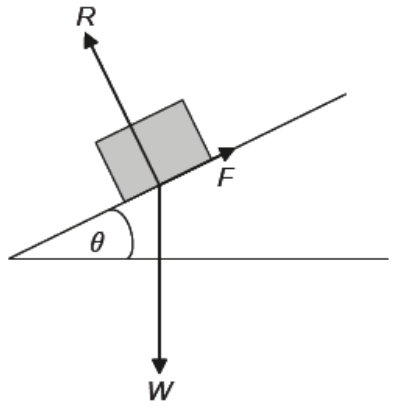
A. The distance through which it falls

B. The time taken for it to reach the ground

C. The speed with which it reaches the ground

D. Its acceleration

52. The diagram shows the forces acting on a block resting on an inclined plane. The angle θ is adjusted until the block is just at the point of sliding. R is the normal reaction, W the weight of the block and F the maximum frictional force. *[1 mark]*



not to scale

What is the maximum coefficient of static friction between the block and the plane?

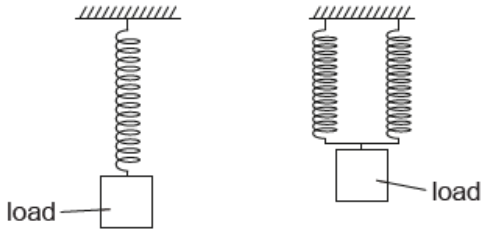
A. sin θ

B. cos θ

C. tan θ

D. $\frac{1}{\tan\theta}$

53. A system that consists of a single spring stores a total elastic potential energy E_p when a load is added to the spring. Another identical spring connected in parallel is added to the system. The same load is now applied to the parallel springs. *[1 mark]*



single spring parallel springs

What is the total elastic potential energy stored in the changed system?

A. E_p

B. $\frac{E_p}{2}$

C. $\frac{E_p}{4}$

D. $\frac{E_p}{8}$

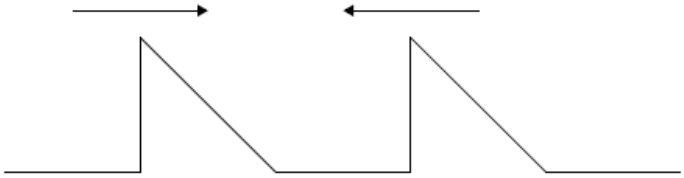
54. A moving system undergoes an explosion. What is correct for the momentum of the system and the kinetic energy of the system when they are compared immediately before and after the explosion? *[1 mark]*

	Momentum	Kinetic energy
A.	conserved	increased
B.	conserved	conserved
C.	increased	conserved
D.	increased	increased

55. What is the unit of electrical energy in fundamental SI units? *[1 mark]*

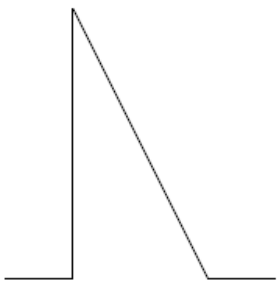
A. kg m^2 C^{-1} s
B. kg m s^{-2}
C. kg m^2 s^{-2}
D. kg m^2 s^{-1} A

56. Two pulses are travelling towards each other. *[1 mark]*

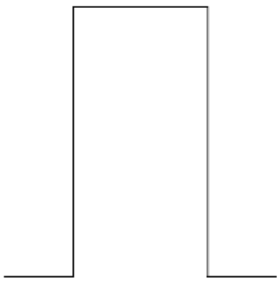


What is a possible pulse shape when the pulses overlap?

A.

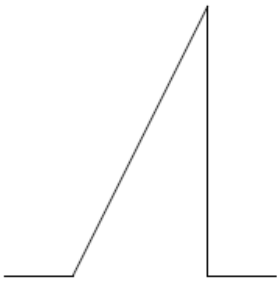


B.



C.

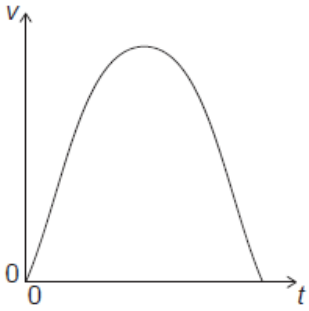
D.



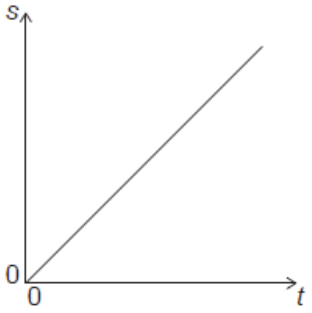
57. An object is released from rest in the gravitational field of the Earth. Air resistance is negligible. How far does the object move during the fourth second of its motion? *[1 mark]*

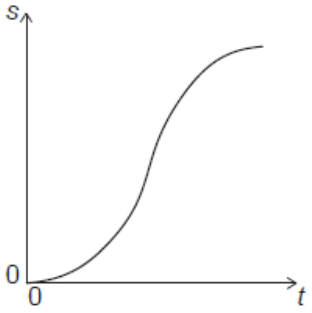
A. 15 m
B. 25 m
C. 35 m
D. 45 m

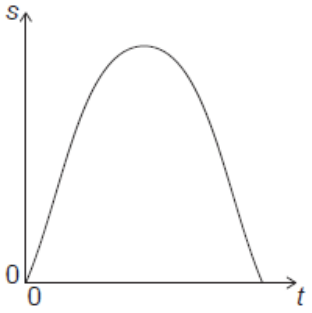
58. The graph shows the variation of speed *v* of an object with time *t*. *[1 mark]*

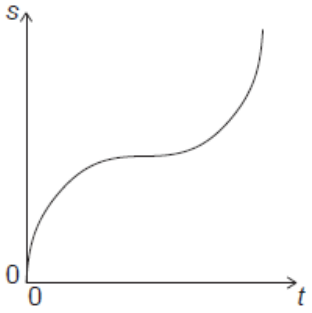


Which graph shows how the distance *s* travelled by the object varies with *t*?

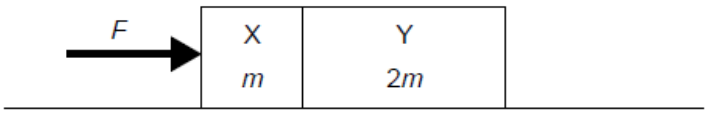
A.


B.


C.


D.


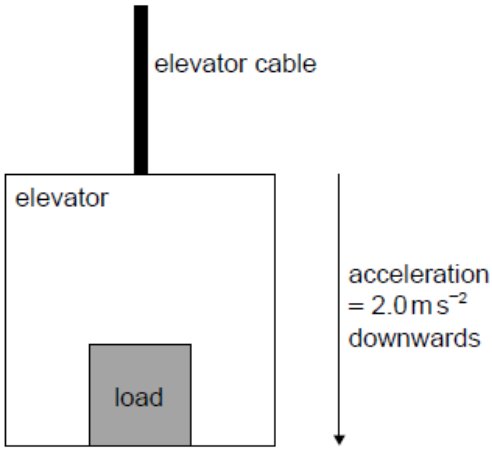
59. Two boxes in contact are pushed along a floor with a force *F*. The boxes move at a constant speed. Box X has a mass *m* and box Y has a mass 2*m*. *[1 mark]*



What is the resultant force acting on Y?

A. 0
B. $\frac{F}{2}$
C. *F*
D. 2*F*

60. An elevator (lift) and its load have a total mass of 750 kg and accelerate vertically downwards at 2.0 m s^{-2}. *[1 mark]*



What is the tension in the elevator cable?

A. 1.5 kN
B. 6.0 kN
C. 7.5 kN
D. 9.0 kN