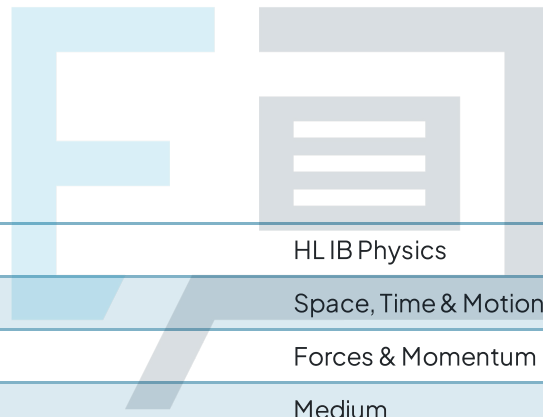




Forces & Momentum

Question Paper



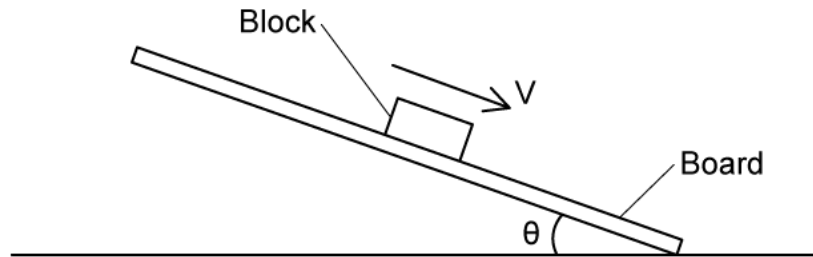
Course	HL IB Physics
Section	Space, Time & Motion
Topic	Forces & Momentum
Difficulty	Medium

Exam Papers Practice

To be used by all students preparing for HL IB Physics
Students of other boards may also find this useful

Question 1

A wooden block of weight W rests on a rough board that produces a friction force F . The end of the board is then raised up to angle θ until the block slides down the plane of the board at constant velocity v .



Which row describes the forces acting on the block as it slides down the board?

	Frictional force on block	Resultant force on block
A.	$W \sin \theta$	0
B.	$W \cos \theta$	$W \sin \theta - F$
C.	$W \cos \theta$	0
D.	$W \sin \theta$	$F - W \sin \theta$

[1 mark]

Question 2

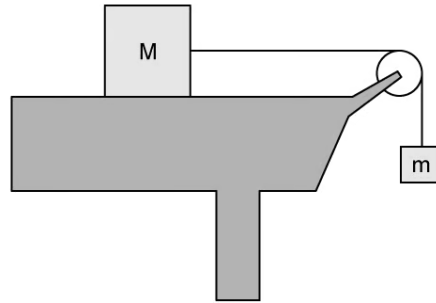
Which row gives the correct Newton's third law force pair for a book on a table?

	Force A	Force B
A.	Weight of the book	Force of book on the table
B.	Gravitational force of the Earth pulling on the book	Gravitational force of the book pulling on the Earth
C.	Weight of the book	Reaction force from the table surface
D.	Gravitational force of the Earth pulling on the book	Gravitational force of the table pulling on the Earth

[1 mark]

Question 3

An object of mass m is connected via a frictionless pulley to an object of mass M , where $M > m$. M rests on a horizontal rough surface with a frictional force f .



What is the acceleration of the system?

- A. 0
- B. $\frac{mg + f}{M + m}$
- C. $\frac{mg - f}{M + m}$
- D. g



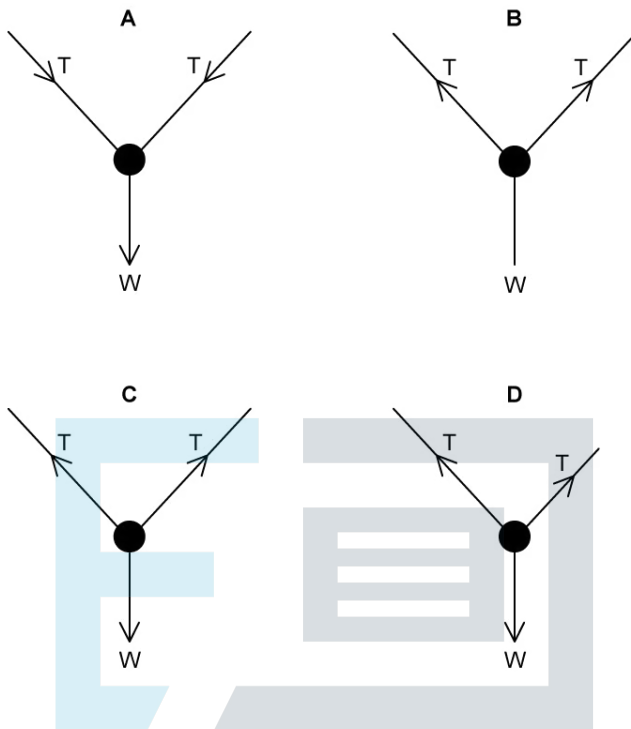
[1 mark]

Exam Papers Practice

Question 4

A photo hangs from two strings. It has a weight W and the two strings have equal tension T .

What is the free-body diagram for this situation?



[1 mark]

Question 5

Which of the following are possible values for the maximum coefficient of static friction, μ_s and dynamic friction, μ_d ?

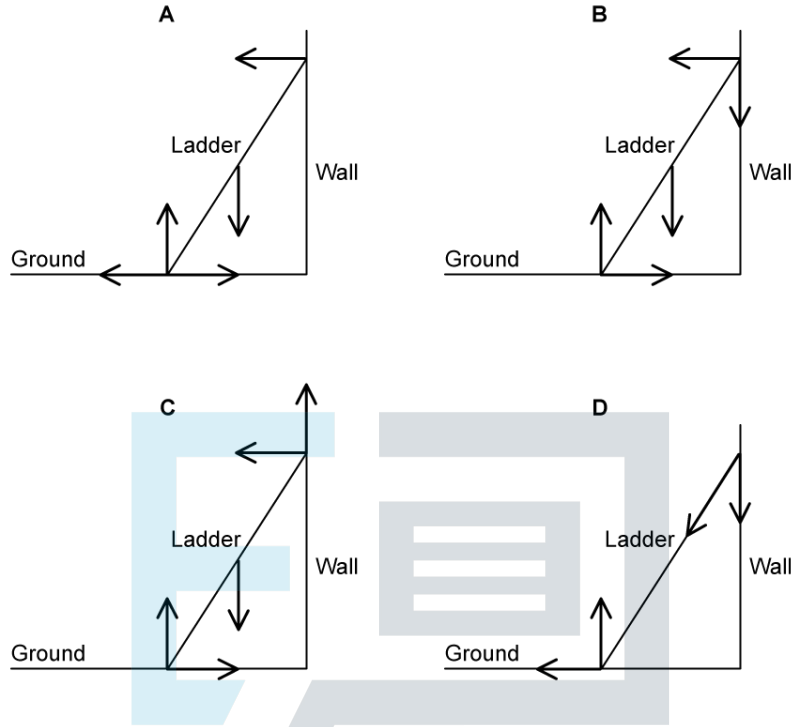
	μ_s	μ_d
A.	0.012	0.78
B.	0.35	0.12
C.	1.50	0.90
D.	0.26	-0.77

[1 mark]

Question 6

A uniform ladder resting in equilibrium on rough ground leans against a smooth wall.

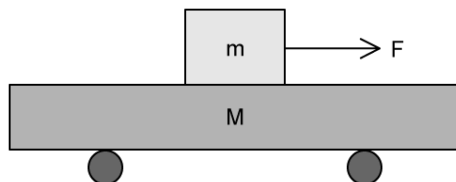
Which diagram correctly shows the forces acting on the ladder?



[1 mark]

Question 7

A block of mass m rests on a trolley of mass M . The coefficient of dynamic friction between the block and the trolley is μ .



A horizontal force F acts on the block causing it to slide over the trolley. What is the acceleration of the trolley?

- A. $\frac{F - \mu mg}{M}$
- B. $\frac{\mu mg}{(M + m)}$
- C. $\frac{F - \mu Mg}{m}$
- D. $\frac{\mu mg}{M}$

[1 mark]

Question 8

A sled with a child has a combined weight of 400 N and rests on a horizontal surface. The coefficient of static friction between the sled and the surface is 0.50 and the coefficient of dynamic friction is 0.30.

A horizontal force F is applied to the sled and its magnitude increases uniformly from zero. Once the sled starts moving, the pulling force no longer increases.

What is the minimum resultant force required on the moving sled?

- A. 80 N
- B. -80 N
- C. 320 N
- D. 0 N

[1 mark]

Question 9

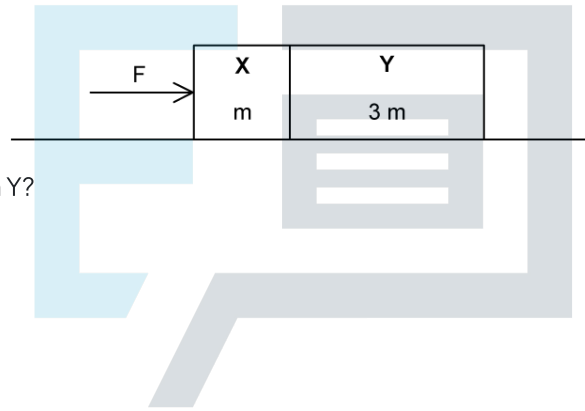
Two coplanar forces of 11 N and 7 N act on an object. Which force could **not** be the resultant for these two forces?

- A. 18 N
- B. 1 N
- C. 9 N
- D. 4 N

[1 mark]

Question 10

Two boxes in contact are pushed in a line along a floor with a force F . The boxes are moving at a constant speed. Box X has a mass m and box Y has a mass $3m$.



What is the resultant force acting on Y?

- A. F
- B. $\frac{F}{3}$
- C. $3F$
- D. 0

[1 mark]

Question 11

A particle of mass m moves in a circle of radius r at uniform speed, taking time T for each revolution. What is the kinetic energy of the particle?

- A. $2mr\pi f^2$
- B. $mr^2\pi^2 f^2$
- C. $2mr^2\pi^2 f^2$
- D. $4mr^2\pi^2 f^2$

[1 mark]

Question 12

A 0.05 kg ball is attached to an inextensible string and whirled overhead such that it rotates in a horizontal circle.

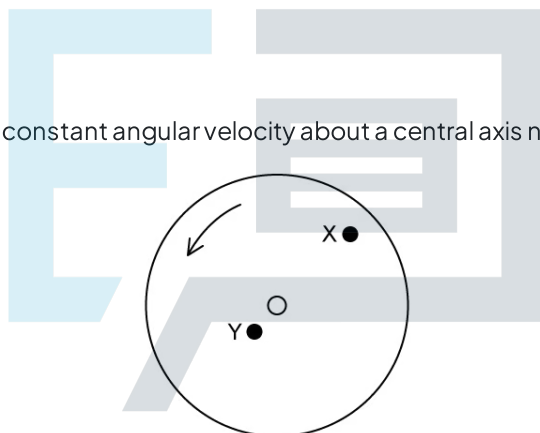
What is the centripetal force on the ball if the string is 0.1 m long and the ball has a time period of $\frac{\pi}{10}$ s?

- A. 1.0 N
- B. 0.1 N
- C. 8.0 N
- D. 2.0 N

[1 mark]

Question 13

A horizontal disc rotates uniformly at a constant angular velocity about a central axis normal to the plane of the disc.



Point X is on a distance $3L$ from the centre of the disc. Point Y is a distance L from the centre of the disc. Point Y has a linear speed v and a centripetal acceleration a .

What is the linear speed and centripetal acceleration of point X?

	Linear Speed of X	Acceleration of X
A.	$3v$	a
B.	v	a
C.	$3v$	$3a$
D.	$2v$	$2a$

[1 mark]

Question 14

A spinning top makes twenty revolutions in five minutes in a clockwise direction.

What is the angular velocity of the spinning top?

- A. $\frac{2\pi}{15}$
- B. $\frac{\pi}{150}$
- C. 10π
- D. $\frac{1}{15}$

[1 mark]

Question 15

A body moves in a circle with increasing angular velocity. At times t , the angles θ swept out by the body added cumulatively from the same reference point and its angular velocities ω are as follows:

t/s	θ/rad	$\omega/\text{rad s}^{-1}$
5	2	0.4
15	16	2.4
25	42	4.4
35	80	6.4

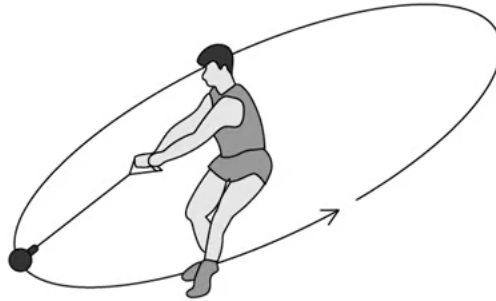
The angular acceleration of the body:

- A. is constant at 0.2 rad s^{-2}
- B. gradually decreases and is 6.25 rad s^{-2} when $t = 15 \text{ s}$
- C. is constant at 0.4 rad s^{-2}
- D. increases at a constant rate and is 0.2 rad s^{-2} when $t = 15 \text{ s}$

[1 mark]

Question 16

A hammer thrower rotates a ball on a string in a circular path gradually increasing its angular velocity with each rotation.



When the hammer releases the ball, the subsequent path taken by the ball is

- A. a vertical circle
- B. a parabola in a horizontal plane
- C. a parabola in a vertical plane
- D. a straight line along a radius of the circle

[1 mark]

Question 17

An object at the end of a steel rod rotates in a vertical circle at a constant angular velocity. Which of the following statements correctly describes the tension in the rod?

- A. it is greatest when the object is halfway up the circle
- B. it is greatest when the object is at the bottom of the circle
- C. it is unchanged throughout the motion
- D. it is greatest when the object is at the top of the circle

[1 mark]

Question 18

For a particle moving in a circle with uniform speed, which of the following statements is incorrect?

- A. The speed of the particle is constant
- B. The acceleration of the particle is perpendicular to its direction of motion
- C. The momentum of the particle is constant
- D. The particle is accelerating

[1 mark]

Question 19

A satellite X of mass m orbits the Earth with a period T and radius r and linear speed v . What will be the orbital period of satellite Y

with mass m occupying an orbit with radius $\frac{r}{2}$ and speed $2v$ as X?

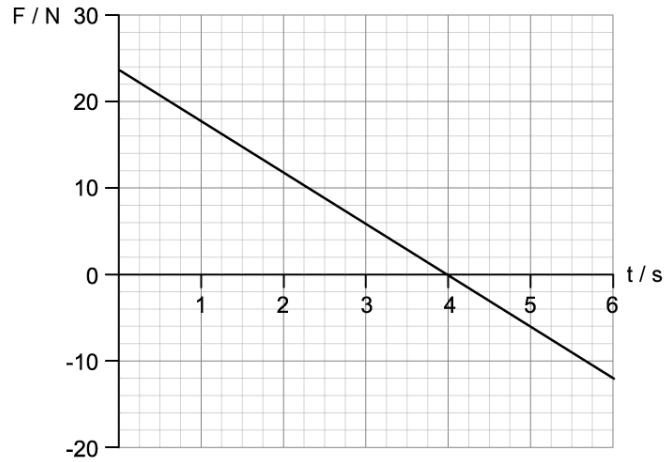
- A. $2T$
- B. T
- C. $\frac{T}{2}$
- D. $\frac{T}{4}$

[1 mark]

Exam Papers Practice

Question 20

A force acts on a mass of 5.0 kg and it is initially at rest.



What is the time taken for the mass to reach an acceleration of 2 m s^{-2} ?

- A. 2.50 s
- B. 2.20 s
- C. 2.25 s
- D. 2.00 s

[1 mark]

Question 21

A body of mass $3M$ at rest explodes into two pieces of mass $2M$ and M .

What is the ratio $\frac{\text{kinetic energy of } 2M}{\text{kinetic energy of } M}$ and $\frac{\text{momentum of } 2M}{\text{momentum of } M}$?

	$\frac{\text{kinetic energy of } 2M}{\text{kinetic energy of } M}$	$\frac{\text{momentum of } 2M}{\text{momentum of } M}$
A.	$\frac{1}{2}$	-1
B.	1	-1
C.	$\frac{1}{4}$	2
D.	$\frac{1}{2}$	-2

[1 mark]

Question 22

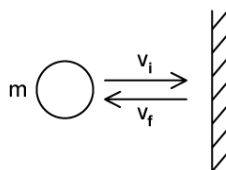
Which of the following is an elastic collision?

- A. A ball dropped from a height and bouncing up to a lower height
- B. Two railway trucks colliding and they link together
- C. Two gas molecules collide and a bond is formed between them
- D. Two gas molecules collide and then travel perpendicular to each other

[1 mark]

Question 23

A ball of mass m travels horizontally and strikes a vertical wall with a speed of $v_i \text{ ms}^{-1}$. It then rebounds horizontally at speed $v_f \text{ ms}^{-1}$. The ball is in contact with the wall for time Δt .



What is if the ball rebounds after an impulse of magnitude I ?

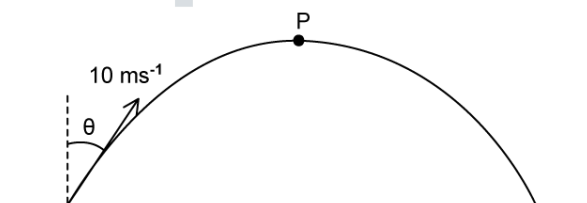
- A. $v_{final} = \frac{I + v_{initial}}{m}$
- B. $v_{final} = \frac{I + mv_{initial}}{m}$
- C. $v_{final} = \frac{I - mv_{initial}}{m}$
- D. $v_{final} = \frac{I - v_{initial}}{m}$



[1 mark]

Question 24

A stone of mass 0.5 kg is thrown with an initial speed of 10 ms^{-1} at an angle θ to the vertical. P is the highest point of the motion and air resistance is negligible.



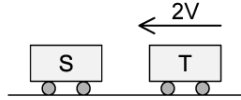
What is the momentum of the stone at P?

- A. $5 \sin \theta$
- B. 5
- C. $5 \cos \theta$
- D. 0

[1 mark]

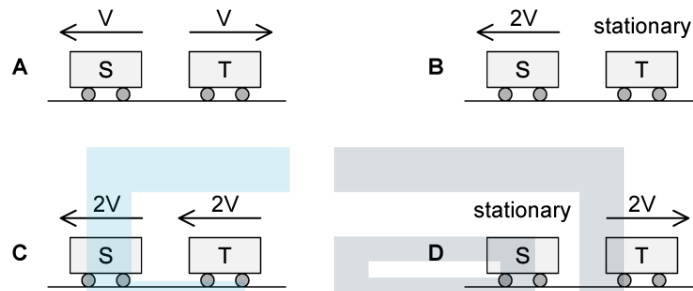
Question 25

A truck T moving horizontally collides with an identical truck S that is at rest.



T strikes S with speed $2v$.

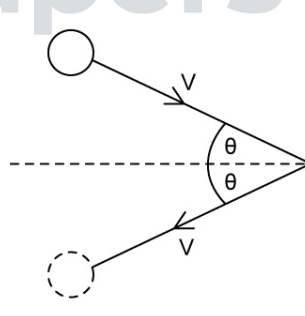
What is a possible outcome of the collision?



[1 mark]

Question 26

A ball of mass m strikes a vertical wall with a speed v at an angle of θ to the wall. The ball rebounds at the same speed and angle in time t . What is the magnitude of the impulse on the wall?

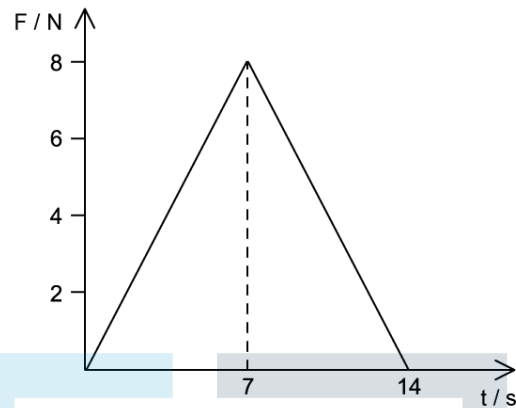


- A. zero
- B. $2mv$
- C. $2mv \sin \theta$
- D. $2mv \cos \theta$

[1 mark]

Question 27

A ball of mass 4.0 kg , initially at rest, is acted on by a force F which varies with t .



What is the velocity of the ball after 14 s ?

- A. 7 m s^{-1}
- B. 56 m s^{-1}
- C. 14 m s^{-1}
- D. 28 m s^{-1}

[1 mark]

Exam Papers Practice

Question 28

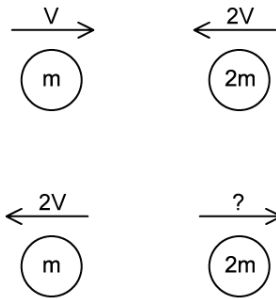
Which of the following is true for momentum and impulse?

- A. Momentum is conserved in an inelastic collision
- B. Impulse is the momentum
- C. The direction in which an object is travelling in doesn't affect its impulse
- D. A heavier object always experiences a greater impulse than a lighter one

[1 mark]

Question 29

Two balls m and $2m$ collide elastically with speeds v and $2v$ respectively. After the collision, they both move in opposite directions.



What speed does the $2m$ ball move with after the collision?

- A. $\sqrt{\frac{5}{2}}v$
- B. $\frac{5}{2}v$
- C. $\sqrt{\frac{1}{2}}v$
- D. $\frac{1}{2}v$



[1 mark]

Exam Papers Practice