AQA – Force, energy and momentum – AS Physics P2

1. June/2021/Paper_7407_02/No. 04

0 4 **Figure 10** shows a conveyor used to raise concrete blocks on a building site. The blocks do not slip on the belt at any time.

Figure 10

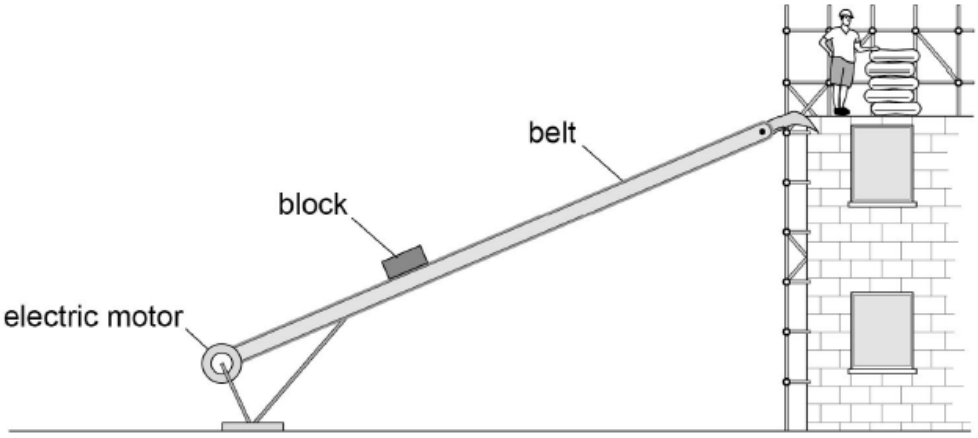
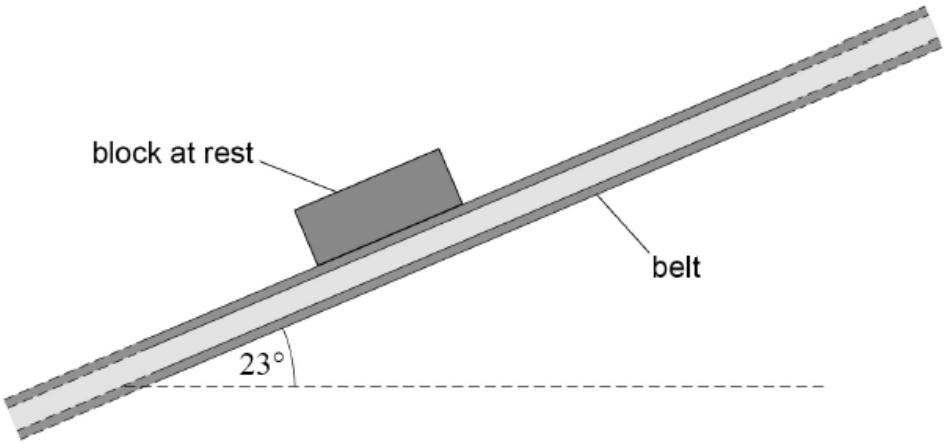


Figure 11 shows an enlarged view of one block on the belt. The belt is inclined at 23° to the horizontal. The mass of the block is 19 kg.

Figure 11



The belt exerts a frictional force F on the block when the block is at rest.

0 4 . 1 Draw an arrow on **Figure 11** to show the line of action of F.

[1 mark]

0 4 . 2 Show that the magnitude of F is approximately $70\ \text{N}$.

[1 mark]

0 4 . 3 The belt is driven by an electric motor. When the motor is switched on, the belt and the block accelerate uniformly from rest to a speed of $0.32\ \text{m s}^{-1}$ in a time of $0.50\ \text{s}$.

Calculate the magnitude of the frictional force of the belt on the block during this acceleration.

[3 marks]

frictional force = _____ N

0 4 . 4 The motor is connected to a 110 V dc supply that has negligible internal resistance. The maximum operating current in the motor is 5.0 A.

The efficiency of the motor and drive system of the conveyor is 28%. The belt travels at 0.32 m s^{-1} and is 8.0 m long.

Deduce the maximum number of blocks that can be moved on the belt at one time.

[4 marks]

maximum number of blocks = _____

2. June/2021/Paper_7407_02/No. 11

An object of mass m is accelerated from rest to a velocity v by a constant resultant force F.

What is the work done on the object during this acceleration?

[1 mark]

A $\frac{Fv}{2}$ ⬭

B Fv ⬭

C mv^2 ⬭

D $\frac{mv^2}{2}$ ⬭

3. June/2021/Paper_7407_02/No. 16

Which row describes the nature of the strong nuclear force between two nucleons at separations of 0.25 fm, 2.0 fm and 8.0 fm?

[1 mark]

	At a separation of 0.25 fm	At a separation of 2.0 fm	At a separation of 8.0 fm	
A	attractive	repulsive	negligible	⬭
B	repulsive	attractive	attractive	⬭
C	negligible	repulsive	attractive	⬭
D	repulsive	attractive	negligible	⬭

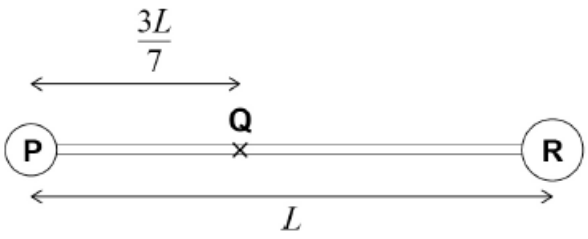
4. June/2021/Paper_7407_02/No. 22

P and **R** are uniform spheres of mass $3\ \text{kg}$ and $4\ \text{kg}$ respectively.
P and **R** are joined by a rod of negligible mass.
The distance between their centres is L.
The centre of mass of this system is at **Q**.

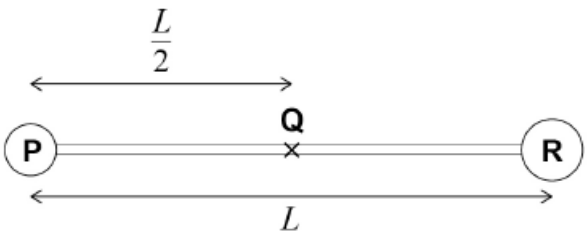
Which diagram shows the position of the centre of mass?

[1 mark]

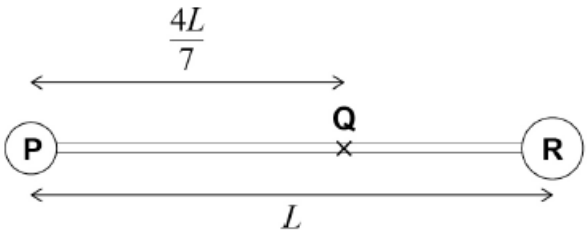
A



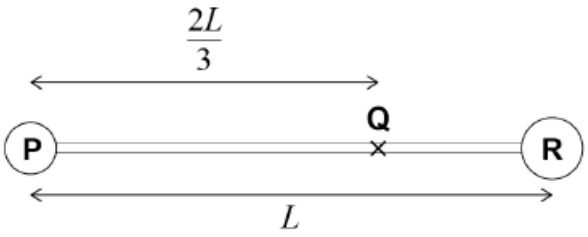
B



C



D



A ⬭

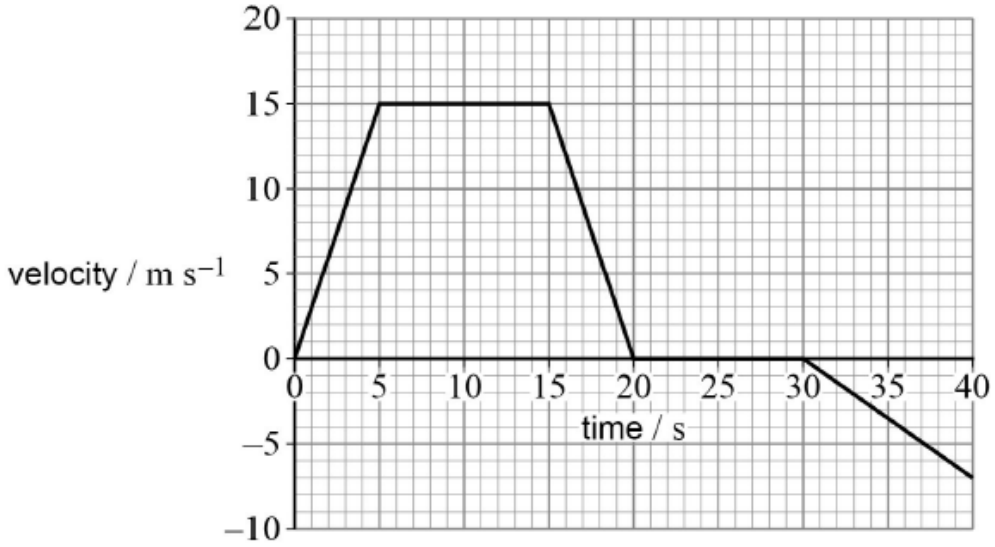
B ⬭

C ⬭

D ⬭

5. June/2021/Paper_7407_02/No. 23

A vehicle travels on a straight road, starting at time $t = 0$
The graph shows how its velocity varies with time.



What is the distance of the vehicle from its start position when $t = 40$ s?

[1 mark]

A 115 m ⬭

B 190 m ⬭

C 260 m ⬭

D 370 m ⬭

6. June/2021/Paper_7407_02/No. 24

A suitcase weighing 200 N is placed on a weighing scale in a lift.
The scale reads 180 N when the lift is moving.

The lift is

[1 mark]

A moving down at a constant velocity. ⬭

B moving down with a decreasing velocity. ⬭

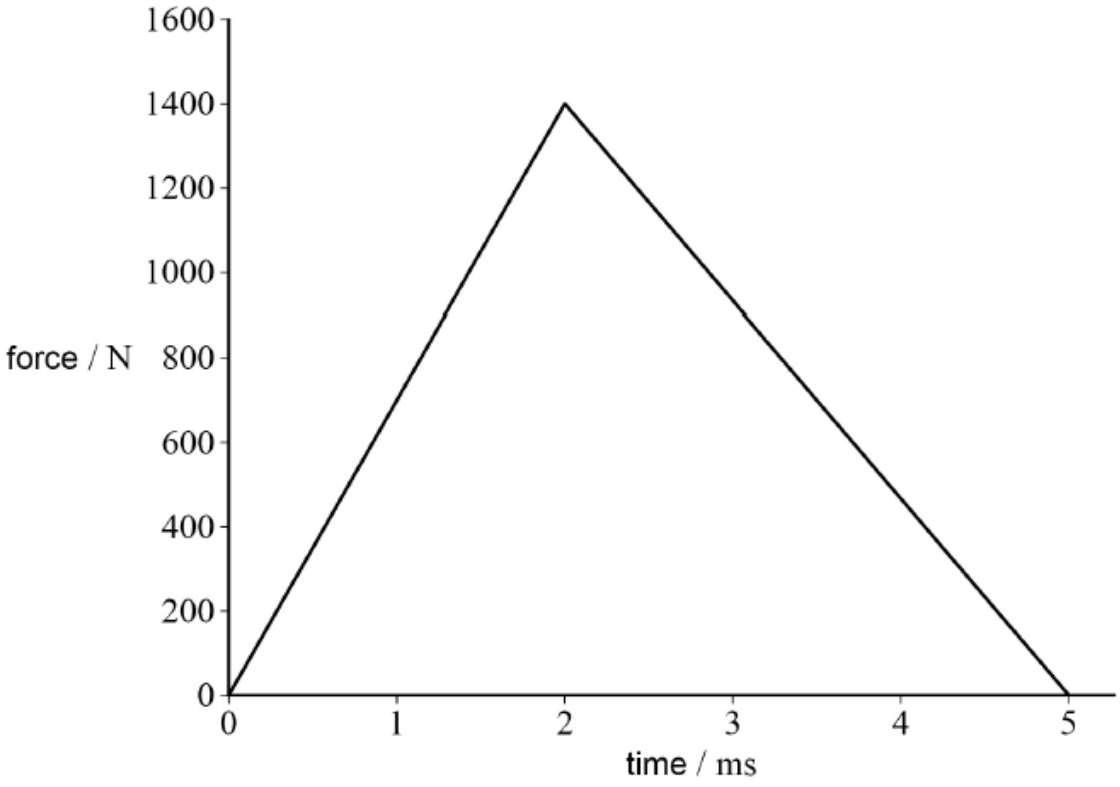
C moving up at a constant velocity. ⬭

D moving up with a decreasing velocity. ⬭

7. June/2021/Paper_7407_02/No. 25

A stationary ball is free to move. The ball is hit with a bat.

The graph shows how the force of the bat on the ball changes with time.



The ball has a mass of 0.044 kg.

What is the speed of the ball immediately after being hit?

[1 mark]

A 13 m s^{-1} ⬭

B 60 m s^{-1} ⬭

C 80 m s^{-1} ⬭

D 160 m s^{-1} ⬭

8. June/2021/Paper_7407_02/No. 26

A mass m is added to a vertical spring that is initially unextended, as shown in **Diagram 1**.

The mass is then lowered until it hangs stationary on the spring, as shown in **Diagram 2**.

The extension of the spring is now ΔL.

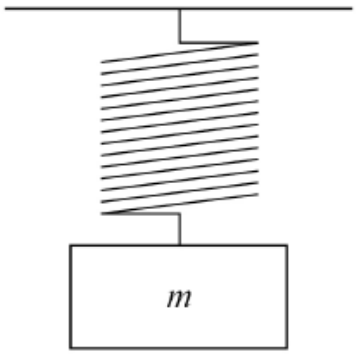


Diagram 1

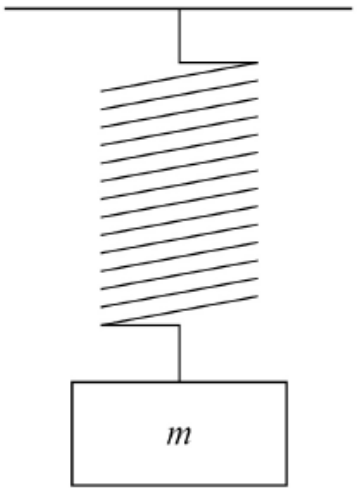


Diagram 2

How much energy is transferred from the mass–spring system?

[1 mark]

A $\frac{mg\Delta L}{2}$ ⬭

B $mg\Delta L$ ⬭

C $\frac{3mg\Delta L}{2}$ ⬭

D $2mg\Delta L$ ⬭

9. June/2021/Paper_7407_02/No. 27

The relative mass and relative diameter of each sphere are given in the table.

	X	Y	Z
relative mass	1	5	1
relative diameter	1	1	5

Each sphere is dropped from rest and accelerates to its terminal speed.

What is true about the accelerations of the spheres at the instant they are released?

[1 mark]

A The acceleration of **X** is less than that of **Y**. ⬭

B The acceleration of **X** is greater than that of **Z**. ⬭

C The acceleration of **X** is the same as that of **Y**. ⬭

D The acceleration of **Y** is less than that of **Z**. ⬭

10. June/2021/Paper_7407_02/No. 28

What is true about the terminal speeds?

[1 mark]

A The terminal speed of **X** is greater than that of **Y**. ⬭

B The terminal speed of **X** is the same as that of **Y**. ⬭

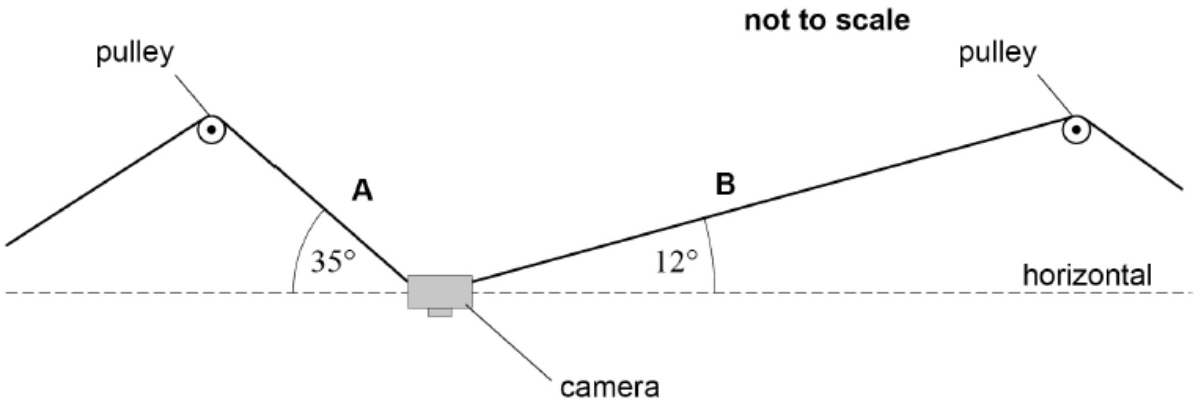
C The terminal speed of **Y** is greater than that of **Z**. ⬭

D The terminal speed of **X** is less than that of **Z**. ⬭

11. June/2020/Paper_7407_02/No. 03_ 0.33

0 3 **Figure 6** shows a camera filming a sports event from above. The position of the camera is controlled by two steel cables, **A** and **B**, that pass over fixed, smooth pulleys.

Figure 6



0 3 . 1 In **Figure 6** the camera is stationary. The tension in **A** is 430 N and **A** makes an angle of 35° to the horizontal. **B** makes an angle of 12° to the horizontal.

Calculate the tension in **B**.

[2 marks]

tension in **B** = _____ N

0 3 . 2 The cross-sectional area of **A** is $7.0 \times 10^{-6}\ \text{m}^2$. The unstretched length of **A** is $150\ \text{m}$.

Calculate the extension of **A** when the tension in it is $430\ \text{N}$.

Young modulus of steel = $210\ \text{GPa}$

[2 marks]

extension = _____ m

0 3 . 3 The camera is moved horizontally to the right to a new stationary position.
The tension in **A** is now different from that in **Figure 6**.

Deduce whether the tension in **A** has increased or decreased.

[3 marks]

12. June/2020/Paper_7407_02/No. 18

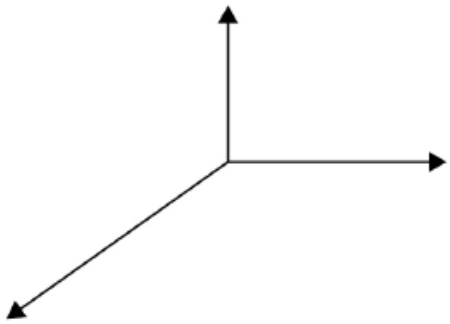
An object is in equilibrium when acted on by three coplanar forces.

Which free-body diagram is correct?

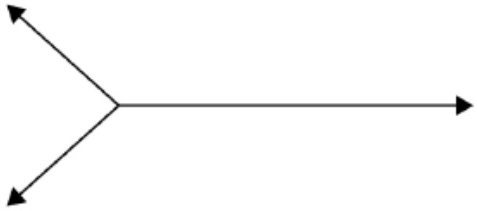
Each diagram is drawn to scale.

[1 mark]

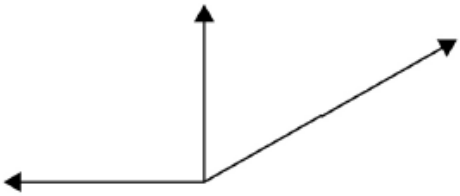
A



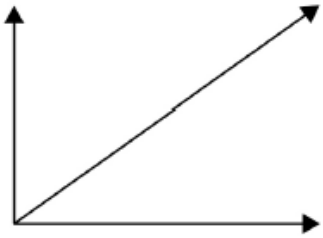
B



C



D



A ⬭

B ⬭

C ⬭

D ⬭

13. June/2020/Paper_7407_02/No. 19

Which quantity is represented by the area under a force–time graph?

[1 mark]

A average power ⬭

B elastic strain energy stored ⬭

C momentum change ⬭

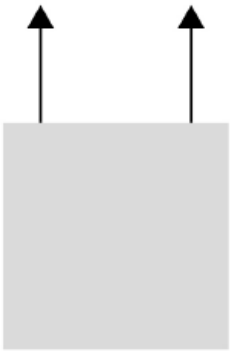
D work done ⬭

14. June/2020/Paper_7407_02/No. 20

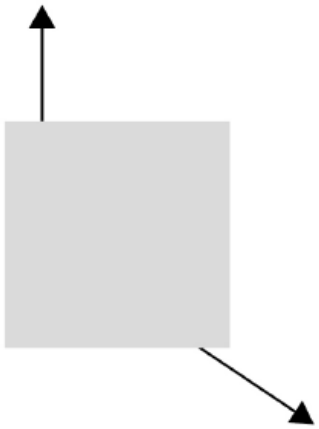
Each diagram shows two horizontal forces acting on a solid square object seen from above.

All the forces have the same magnitude.

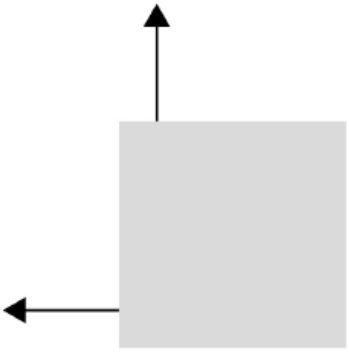
A



B



C



D

Which system produces a couple about any point inside the object?

[1 mark]

A ⬭

B ⬭

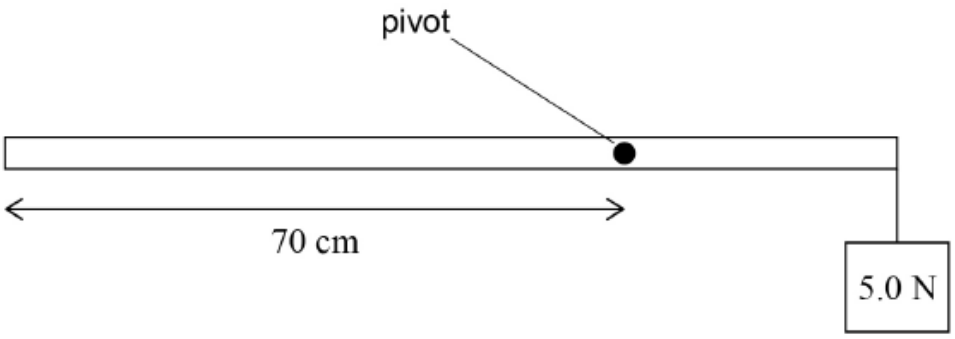
C ⬭

D ⬭

15. June/2020/Paper_7407_02/No. 21

A uniform metre ruler of weight 2.0 N is freely pivoted at the 70 cm mark.

A student holds the ruler in a horizontal position and suspends a 5.0 N weight from the 100 cm end.



What is the magnitude of the resultant moment when the student releases the ruler?

[1 mark]

A 0.15 N m ⬭

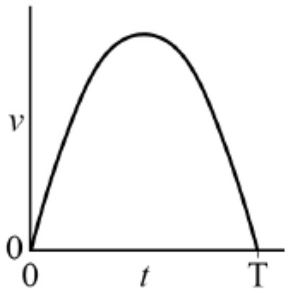
B 0.19 N m ⬭

C 1.1 N m ⬭

D 1.9 N m ⬭

16. June/2020/Paper_7407_02/No. 22

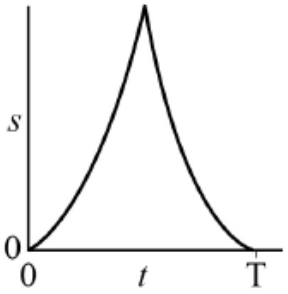
The diagram shows how the speed v of an object varies with time t.



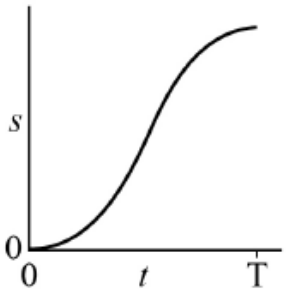
Which graph shows the variation of distance s with t for the object?

[1 mark]

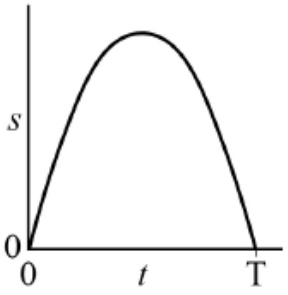
A



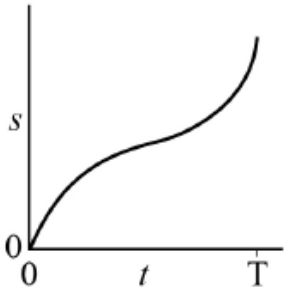
B



C



D



A ⬭

B ⬭

C ⬭

D ⬭

17. June/2020/Paper_7407_02/No. 23

Two ball bearings **X** and **Y** are projected from horizontal ground at the same time.

X has mass $2m$ and is projected vertically upwards with speed u.

Y has mass m and is projected at $30°$ to the horizontal with speed $2u$.

Air resistance is negligible.

Which statement is correct?

[1 mark]

A **X** and **Y** have the same initial momentum. ⬭

B **X** and **Y** reach their maximum heights at different times. ⬭

C The maximum height reached by **Y** is half that reached by **X**. ⬭

D **X** and **Y** reach the ground at the same time. ⬭

18. June/2020/Paper_7407_02/No. 24

Which row is true for an elastic collision between two objects in an isolated system?

[1 mark]

	Kinetic energy	Momentum	
A	conserved	conserved	⬭
B	not conserved	conserved	⬭
C	conserved	not conserved	⬭
D	not conserved	not conserved	⬭

19. June/2020/Paper_7407_02/No. 25

The drag force on a boat is kv^2, where v is the speed and $k = 64\ \text{kg m}^{-1}$.

The boat's engine has a useful power output of $8000\ \text{W}$.

What is the maximum speed of the boat?

[1 mark]

A $0.2\ \text{m s}^{-1}$ ⬭

B $5\ \text{m s}^{-1}$ ⬭

C $11\ \text{m s}^{-1}$ ⬭

D $125\ \text{m s}^{-1}$ ⬭