

National 5 Physics

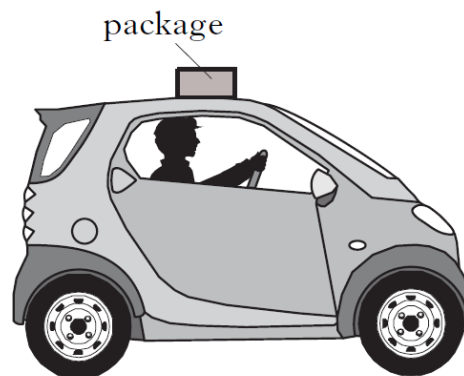


St Kentigern's Academy

Dynamics and Space

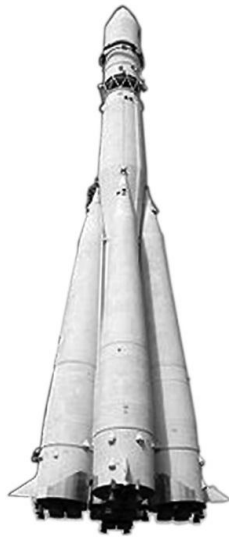
Identified Past Paper Questions

1. A car driver exits a car park having accidentally left a package resting on the roof of the car. The car is travelling at a constant speed of 15 ms^{-1} when the driver brakes suddenly and the car stops. The package continues to move forward.



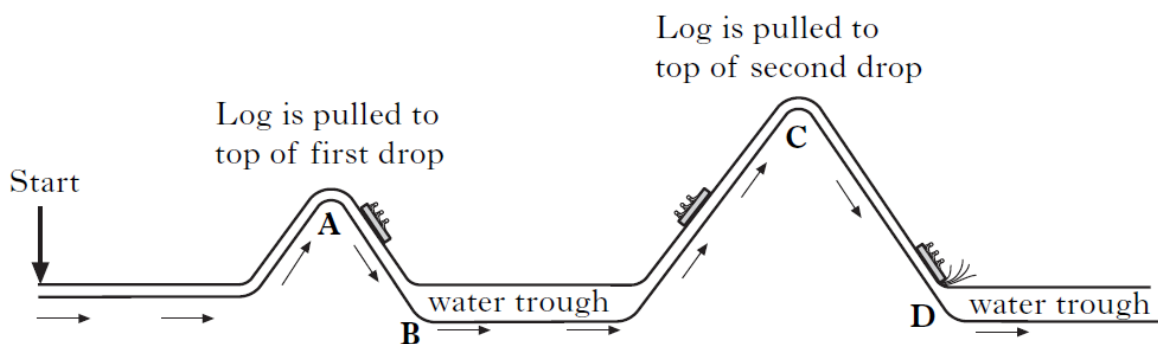
- (a) (i) On the above diagram sketch the path taken by the package. 1
- (ii) Explain why the package follows this path. 2
- (b) The package takes 0.55 s to fall to the ground.
Calculate its vertical speed as it reaches the ground. 4

2. The first manned space flights took place 50 years ago. Spacecraft were launched into space using powerful rockets.



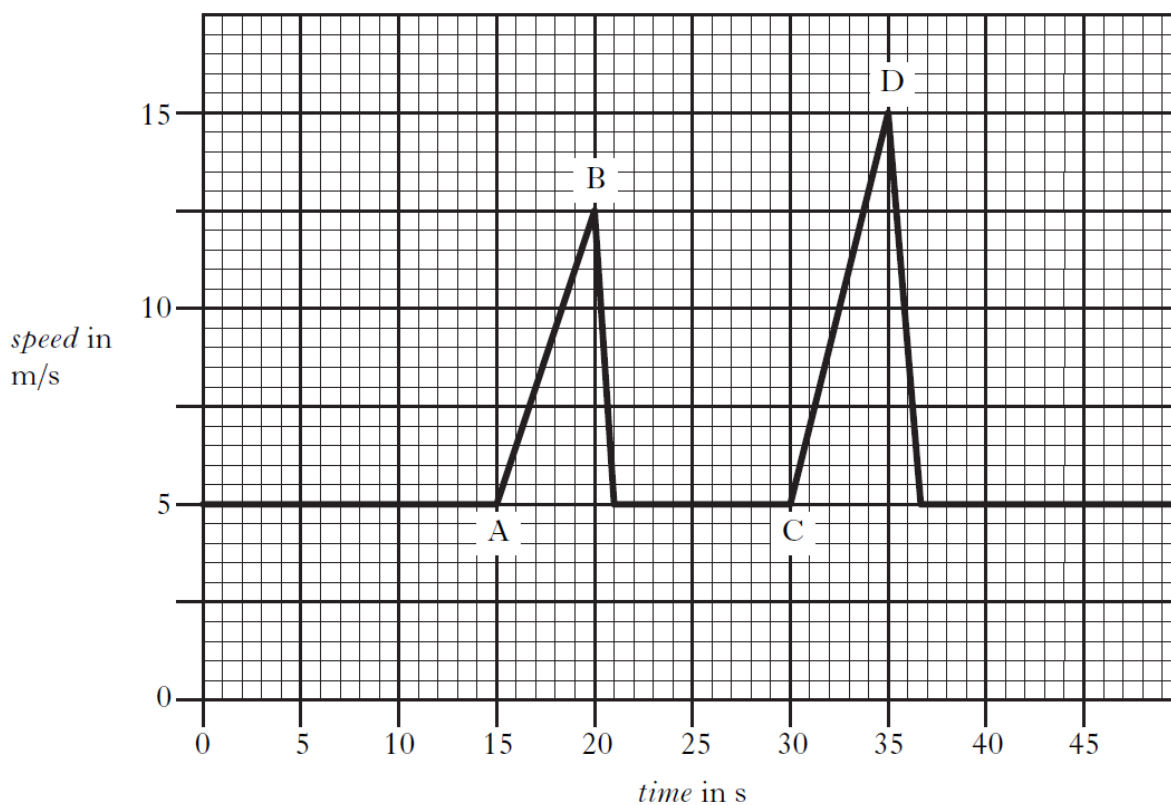
- (a) The operation of a rocket engine can be explained using Newton's Third Law of Motion.
- (i) State Newton's Third Law of Motion. 1
 - (ii) Explain, in terms of Newton's Third Law, how the rocket engines propel the rocket upwards. 2
- (b) At lift-off, one rocket has a total mass of 2.05×10^6 kg. The resultant force acting upwards on the rocket is 8.2×10^6 N.
- Calculate the acceleration of the rocket at lift-off. 3

3. On a visit to a theme park, four students ride the log flume.



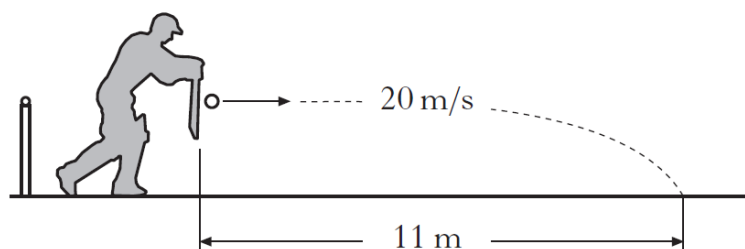
Not to scale

- (a) The graph shows how the speed of the log varies during the ride.



- (i) Describe the motion of the log during **AB** on the graph. 1
- (ii) Calculate the distance travelled by the log from the start of the ride to the bottom of the first drop. 3
- (iii) Calculate the log's acceleration as it goes down the second drop. 3
- (b) Describe how the instantaneous speed of the log could be measured at position **D** on the log flume. 3

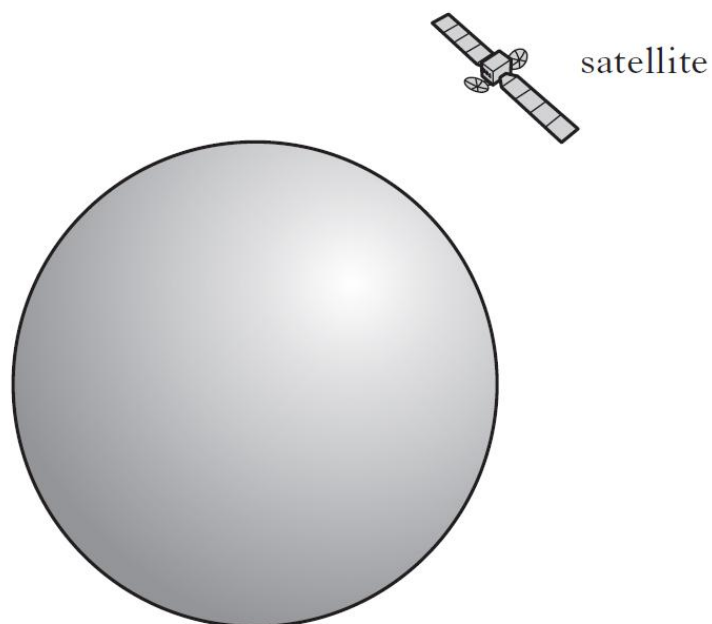
4. A cricketer strikes a ball. The ball leaves the bat horizontally at 20 m s^{-1} . It hits the ground at a distance of 11 m from the point where it was struck.



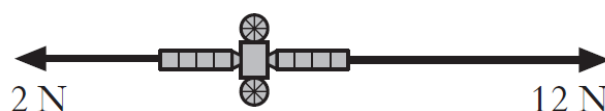
Assume that air resistance is negligible.

- | | |
|---|---|
| (a) Calculate the time of flight of the ball. | 3 |
| (b) Calculate the vertical speed of the ball as it reaches the ground. | 3 |
| (c) Sketch a graph of vertical speed against time for the ball. Numerical values are required on both axes. | 2 |
| (d) Calculate the vertical distance travelled by the ball during its flight. | 3 |

5. A satellite moves in a circular orbit around a planet. The satellite travels at a constant speed whilst accelerating.



- (a) (i) Define the term *acceleration*. 1
- (ii) Explain how the satellite can be accelerating when it is travelling at a constant speed. 1
- (b) At one particular point in its orbit the satellite fires two rockets. The forces exerted on the satellite by these rockets are shown on the diagram.



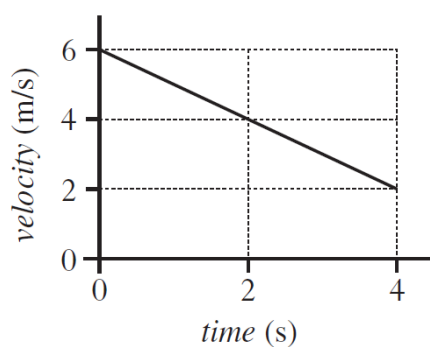
The satellite has a mass of 50 kg. Calculate the resultant acceleration due to these forces.

4

6. During training an athlete sprints 30 m East and then 40 m West.
Which row shows the distance travelled and the displacement from the starting point?

	<i>Distance travelled</i>	<i>Displacement</i>
A	10 m	10 m East
B	10 m	10 m West
C	10 m	70 m East
D	70 m	10 m West
E	70 m	10 m East

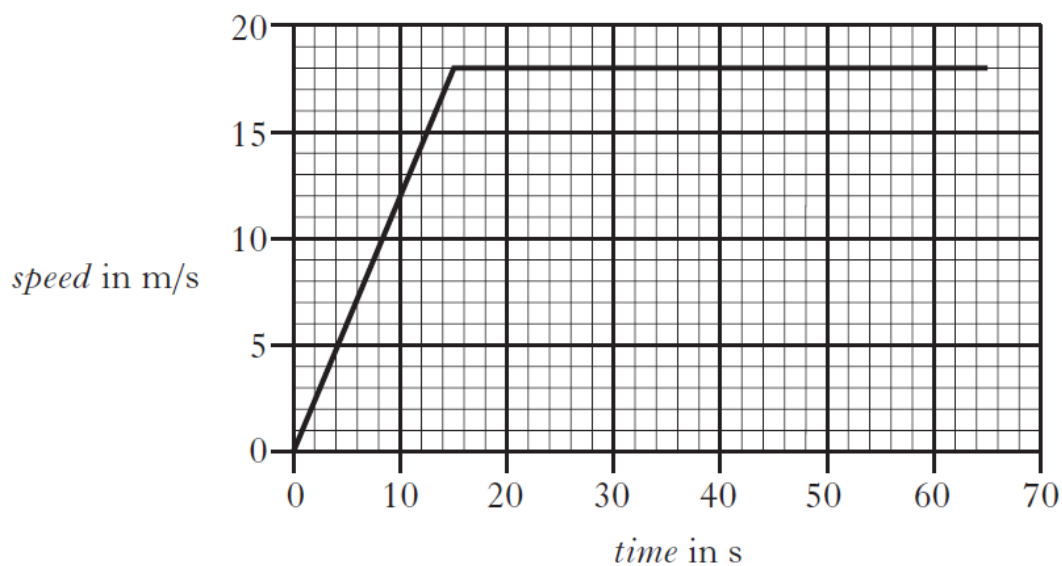
7. The graph shows how the velocity of a ball changes with time.



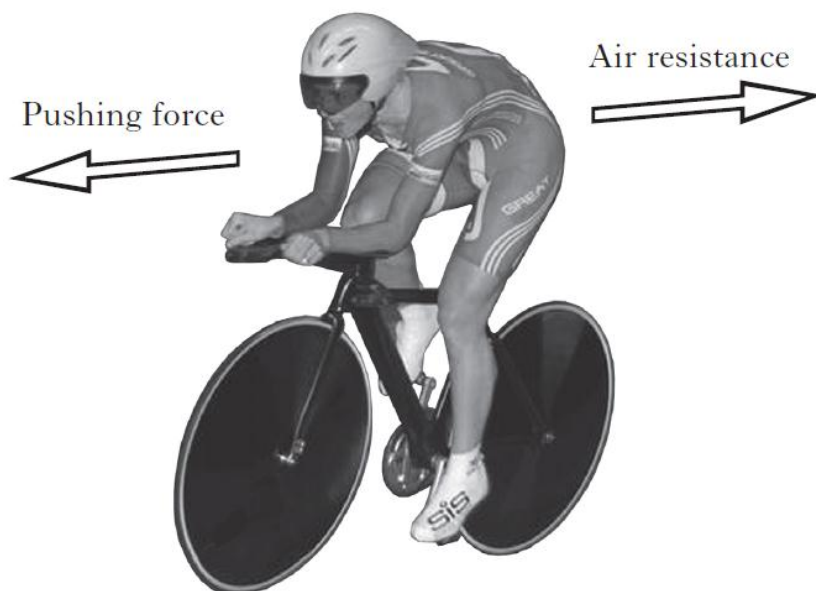
The acceleration of the ball is

- A -8 m s^{-2}
 B -1 m s^{-2}
 C 1 m s^{-2}
 D 8 m s^{-2}
 E 24 m s^{-2} .
8. An engine applies a force of 2000 N to move a lorry at a constant speed.
The lorry travels 100 m in 16 s.
The power developed by the engine is
- A 0.8 W
 B 12.5 W
 C 320 W
 D 12 500 W
 E 3 200 000 W.

9. A competitor takes part in a speed cycling event.
The cyclist takes 65 s to complete the race.
The graph below shows how the cyclist's speed changes with time during the race.

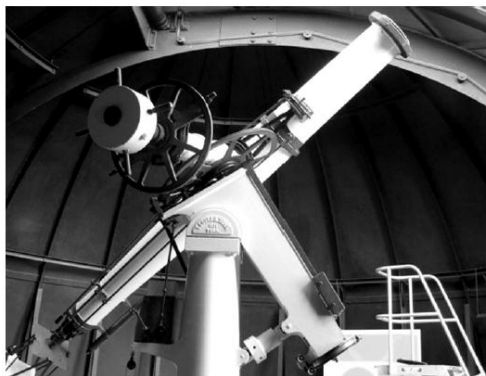


- (a) Calculate the acceleration of the cyclist during the first 15 s of the race. 3
- (b) Calculate the distance travelled by the cyclist during the race. 3
- (c) The diagram shows some of the forces acting on the cyclist during the race.

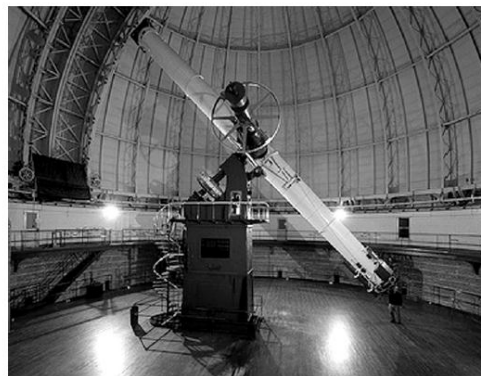


- (i) Suggest **one** way in which the cyclist reduces air resistance. 1
- (ii) Suggest **one** place where the cyclist requires friction. 1

10. The Mills Observatory in Dundee and the Yerkes Observatory in Wisconsin, USA both have refracting telescopes.



Mills Observatory Telescope



Yerkes Observatory Telescope

Astronomers in both observatories are studying the Andromeda galaxy which is approximately 2.2 million light years away.

- (a) A light year is defined as “*the distance that light travels in one year*”.

Show by calculation that 1 light year = 9.4608×10^{15} m.

3

- (b) Not all telescopes detect visible light.

Why are different kinds of telescope used to detect signals from space?

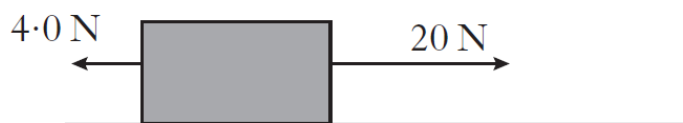
1

11. Near the Earth’s surface, a mass of 6 kg is falling with a constant velocity.

The air resistance and the unbalanced force acting on the mass are:

	<i>air resistance</i>	<i>unbalanced force</i>
A	60 N upwards	0 N
B	10 N upwards	10 N downwards
C	10 N downwards	70 N downwards
D	10 N upwards	0 N
E	60 N upwards	60 N downwards

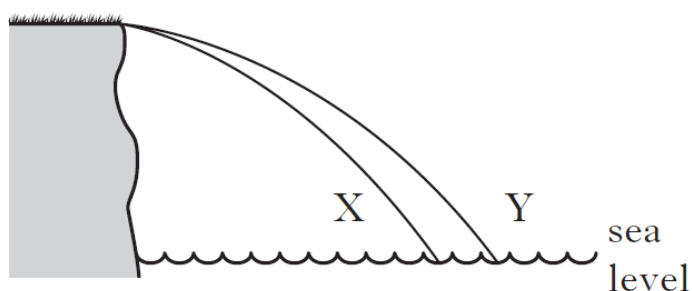
12. The diagram shows the horizontal forces acting on a box.



The box accelerates at 1.6 ms^{-2}

The mass of the box is

- A 0.10 kg
 - B 10.0 kg
 - C 15.0 kg
 - D 25.6 kg
 - E 38.4 kg.
13. Two identical balls X and Y are projected horizontally from the edge of a cliff. The path taken by each ball is shown.



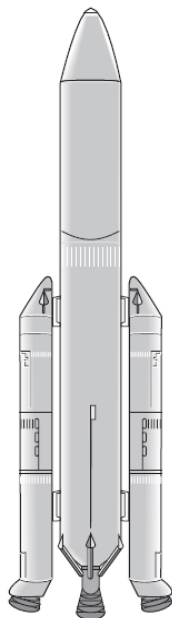
A student makes the following statements about the motion of the two balls.

- I They take the same time to reach sea level.
- II They have the same vertical acceleration.
- III They have the same horizontal velocity.

Which of these statements is/are correct?

- A I only
- B II only
- C I and II only
- D I and III only
- E II and III only

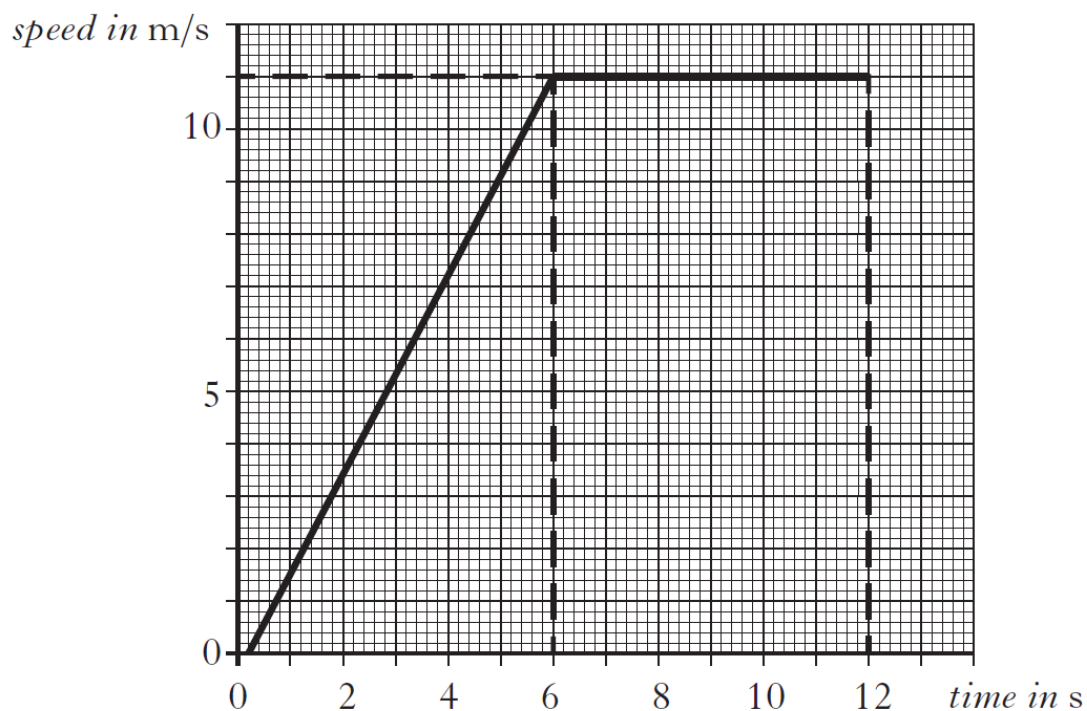
14. In 2014 the European Space Agency will fly a manned mission to the International Space Station (ISS).



A spacecraft with booster rockets attached will be launched.

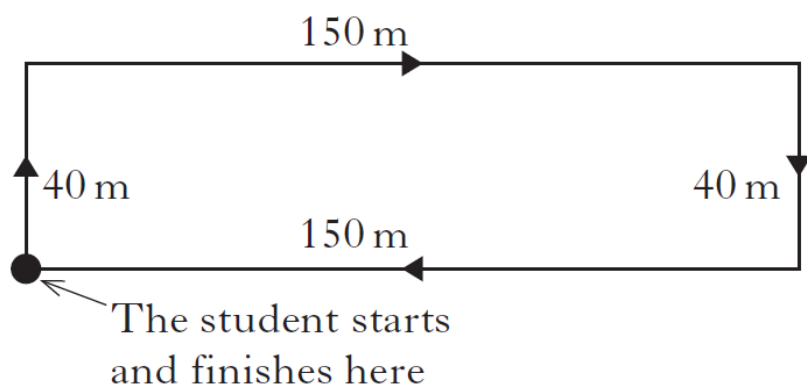
- | | | |
|-----|--|---|
| (a) | On the diagram above draw and label the two forces acting on the spacecraft at lift off. | 1 |
| (b) | The combined mass of the spacecraft and booster rockets is 3.08×10^5 kg and the initial thrust on the rocket at lift off is 3352 kN. The frictional forces acting on the rocket at lift off are negligible. | |
| | (i) Calculate the weight of the spacecraft and booster rockets at lift off. | 3 |
| | (ii) Calculate the acceleration of the spacecraft and booster rockets at lift off. | 4 |
| (c) | The ISS orbits at a height of approximately 360 km above the Earth. Explain why the ISS stays in orbit around the Earth. | 2 |
| (d) | An astronaut on board the ISS takes part in a video link-up with a group of students. The students see the astronaut floating. | |
| | (i) Explain why the astronaut appears to float. | 1 |
| | (ii) The astronaut then pushes against a wall and moves off. Explain in terms of Newton's Third Law why the astronaut moves. | 1 |

15. The graph shows the motion of a runner during the first 12 s of a race.



- (a) Calculate the acceleration of the runner. 3
- (b) Calculate the distance travelled by the runner in the first 12 s. 3
16. Which row contains two scalar quantities and one vector quantity?
- A Distance, displacement, velocity
 - B Speed, mass, weight
 - C Distance, weight, force
 - D Speed, weight, displacement
 - E Velocity, force, mass

17. A student follows the route shown in the diagram and arrives back at the starting point.

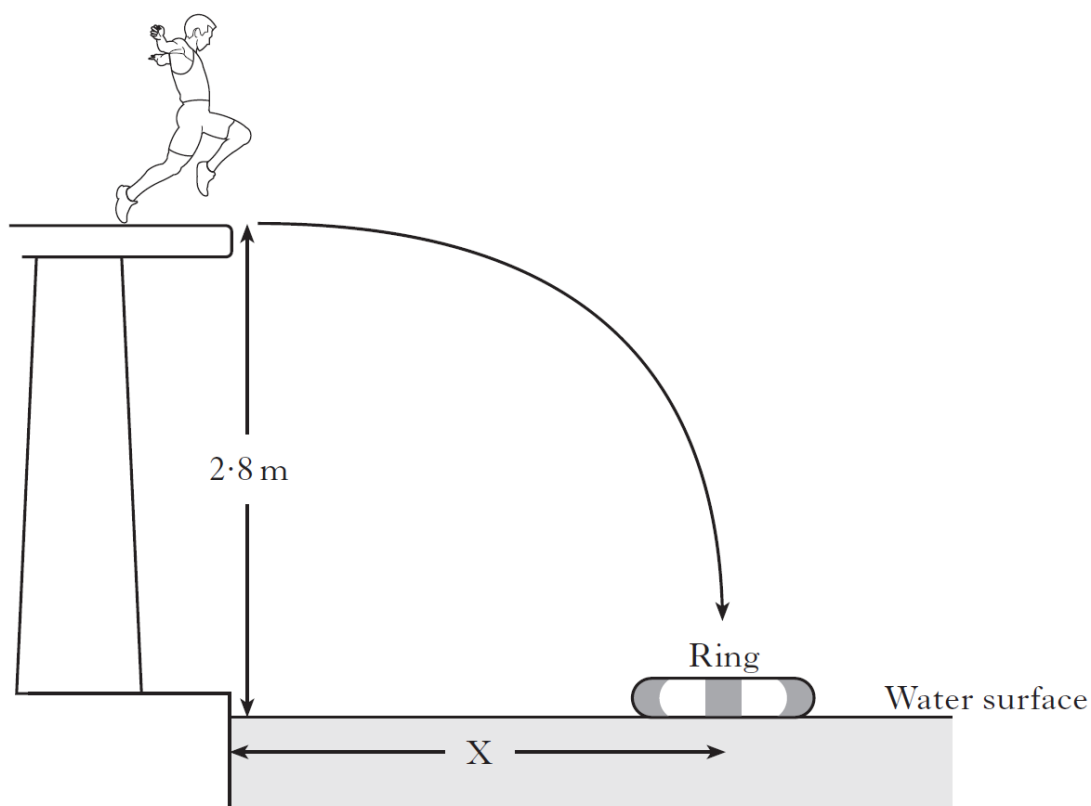


Which row in the table shows the total distance walked and the magnitude of the final displacement?

	<i>Total distance (m)</i>	<i>Final displacement (m)</i>
A	0	80
B	0	380
C	190	0
D	380	0
E	380	380

18. In a TV game show contestants are challenged to run off a horizontal platform and land in a rubber ring floating in a swimming pool.

The platform is 2.8 m above the water surface.

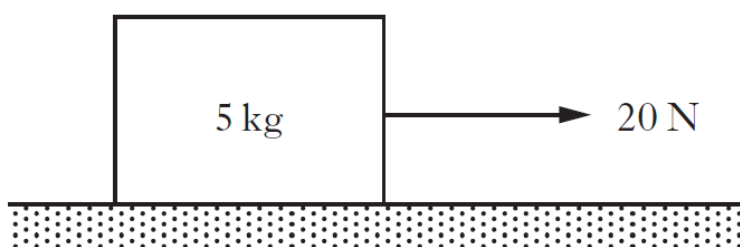


- (a) A contestant has a mass of 60 kg.
He runs off the platform with a horizontal velocity of 2 m s^{-1} . He takes 0.75 s to reach the water surface in the centre of the ring.
- (i) Calculate the horizontal distance X from the poolside to the centre of the ring. 3
- (ii) Calculate the vertical velocity of the contestant as he reaches the water surface. 3
- (b) Another contestant has a mass of 80 kg.
Will she need to run faster, slower or at the same horizontal speed as the first contestant to land in the ring?
You **must** explain your answer. 2

19. A space probe has a mass of 60 kg.
The weight of the space probe at the surface of a planet in our solar system is 720 N.
The planet is

A Venus
B Mars
C Jupiter
D Saturn
E Neptune.

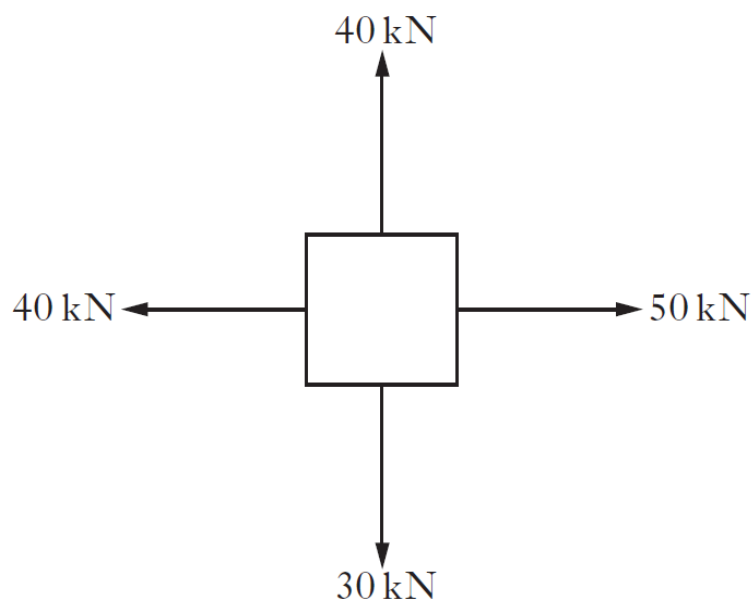
20. A block is pulled across a horizontal surface as shown.



The mass of the block is 5 kg.
The block is travelling at a constant speed.
The force of friction acting on the block is

A 0 N
B 4 N
C 15 N
D 20 N
E 25 N.

21. Four tugs apply forces to an oil-rig in the directions shown.



Which of the following could represent the direction of the resultant force?

A 

B 

C 

D 

E 

Sources

<u>Question</u>	<u>Source</u>
1	SG - Credit - 2011 - Q13
2	SG - Credit - 2011 - Q15
3	SG - Credit - 2011 - Q9
4	I2 - 2011 - Q21
5	I2 - 2011 - Q22
6	I2 - 2011 - Q1 MC
7	I2 - 2011 - Q2 MC
8	I2 - 2011 - Q4 MC
9	SG - Credit - 2012 - Q10
10	SG - Credit - 2012 - Q14 (b) & (d)
11	I2 - 2012 - Q2 MC
12	I2 - 2012 - Q4 MC
13	I2 - 2012 - Q5 MC
14	SG - Credit - 2013 - Q13
15	SG - Credit - 2013 - Q9
16	I2 - 2013 - Q1 MC [AMENDED]
17	I2 - 2013 - Q2 MC
18	I2 - 2013 - Q23
19	I2 - 2013 - Q3 MC
20	I2 - 2013 - Q4 MC
21	I2 - 2013 - Q5 MC