Forces – 2021/20 GCSE Gateway Physics A

1. Nov/2021/Paper_J249/01/No.3

A student does an experiment to measure the acceleration in free fall of an object.

Which of their results is closest to the accepted value?

A $8.8\,m/s^2$

B $9.8\,m/s^2$

C $10.8\,m/s^2$

D $11.8\,m/s^2$

Your answer ☐ **[1]**

2. Nov/2021/Paper_J249/01/No.4

Which row in the table correctly identifies a scalar and a vector?

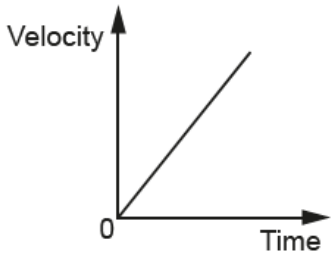
	Scalar	Vector
A	Displacement	Distance
B	Displacement	Velocity
C	Distance	Speed
D	Speed	Velocity

Your answer ☐ **[1]**

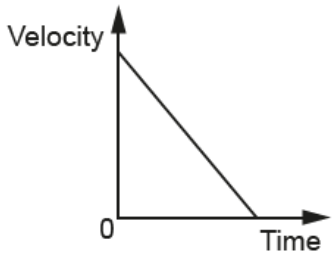
3. Nov/2021/Paper_J249/01/No.9

Four velocity–time graphs are shown for a moving ball.

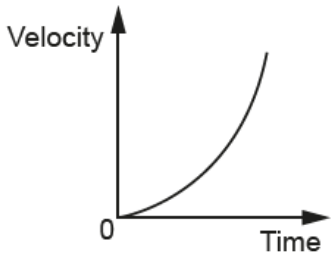
A



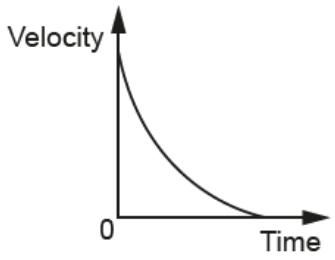
B



C



D

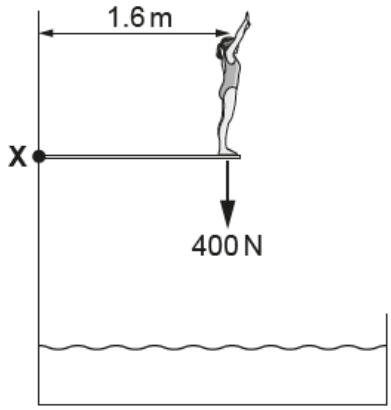


Which graph shows the ball being dropped from a height? Ignore the effects of air resistance.

Your answer ☐ **[1]**

4. Nov/2021/Paper_J249/01/No.10

A girl, of weight 400 N, is standing on the end of a horizontal diving board.



Calculate the moment of the girl's weight about point **X**.

Use the equation: moment of a force = force x distance

A 250 Nm anti-clockwise

B 250 Nm clockwise

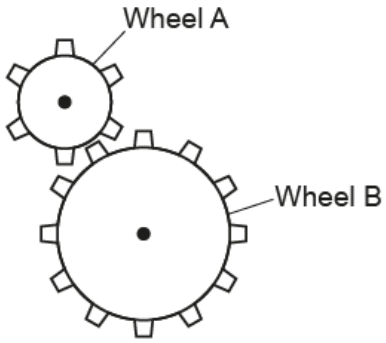
C 640 Nm anti-clockwise

D 640 Nm clockwise

Your answer ☐ **[1]**

5. Nov/2021/Paper_J249/01/No.11

Gears can be used to transmit forces.



Wheel A is turned clockwise.

Which statement explains how these gears transmit forces?

A Wheel B has a bigger rotational effect and turns more quickly than wheel A.

B Wheel B has a bigger rotational effect and turns more slowly than wheel A.

C Wheel B has a smaller rotational effect and turns more quickly than wheel A.

D Wheel B has a smaller rotational effect and turns more slowly than wheel A.

Your answer ☐ **[1]**

6. Nov/2021/Paper_J249/01/No.12

A book of mass 3 kg is lifted vertically onto a shelf 1.5 m high.

Calculate the gain in potential energy of the book.

Assume gravitational field strength = 10 N / kg.

Use the equation: potential energy = mass × height × gravitational field strength

A 0.45 J

B 5.0 J

C 20 J

D 45 J

Your answer ☐ **[1]**

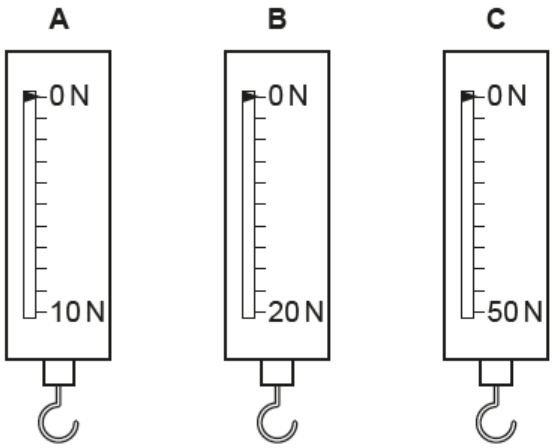
7. Nov/2021/Paper_J249/01/No.19

Newton-meters are used for measuring forces. Each newton-meter contains a spring.

(a) What is the minimum number of forces needed to stretch a spring?

..... **[1]**

(b) A student has three different newton-meters.



(i) Which newton-meter would be best to use to measure a force of about 11 N?

.....

Explain your answer.

.....

..... **[2]**

(ii) Explain what could happen if a 50 N weight was put on newton-meter **A**.

.....

.....

..... **[2]**

(iii) Which newton-meter has the **largest** spring constant?

.....

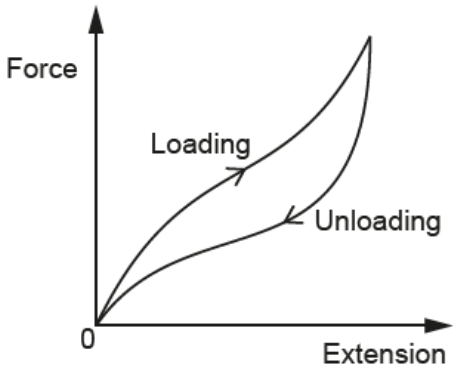
Explain your answer.

.....

..... **[2]**

(c) Another student suggests that an elastic band could be used instead of a spring in a newton-meter.

Look at the force-extension graph for an elastic band.



Explain why the elastic band would **not** make a good replacement for a spring.

.....

.....

.....

..... **[2]**

(d) A spring has a spring constant of 30 N / m.

Calculate the energy transferred when the spring is extended by 4.0 cm.

Use an equation from the data sheet to help you.

Energy transferred = ... J **[3]**

8. Nov/2021/Paper_J249/01/No.21

Different planets have different gravitational field strengths at their surface.

Planet	Gravitational field strength (N/kg)
Earth	10
Mars	3.7
Venus	8.8

(a) (i) On which planet's surface would an astronaut have the greatest weight?

Surface .....

Explanation .....

.....

[2]

(ii) Which property of a planet affects its gravitational field strength?

..... **[1]**

(b) (i) On Earth the astronaut has a weight of 600 N. Their feet have a total area of 0.3 m^2 in contact with the ground.

Calculate the pressure they exert on the ground.

Pressure = ...N/m^2 **[3]**

(ii) The astronaut is standing on the ground. Two forces acting on them are:

- The force exerted by the Earth (their weight).
- The force exerted by the ground (normal contact force).

Draw and label a free body force diagram for the astronaut.

[3]

9. Nov/2021/Paper_J249/01/No.22

(a) A delivery driver is loading boxes onto a lorry. The boxes are moved from the ground to the lorry using an electric lift.

(i) Calculate the work done when boxes with a weight of 0.6 kN are lifted a vertical distance of 0.8 m from the ground to the lorry.

Use the equation: work done = force × distance

Work done = ... J **[3]**

(ii) The power of the lift is 50 W.

Calculate the time taken for the lift to move these boxes from ground to lorry level.

Use the equation: power = work done / time taken

Time taken = ... s **[3]**

(iii) The lorry uses a 24 V battery to power the 50 W lift.

Calculate the current which flows while the lift is in use.

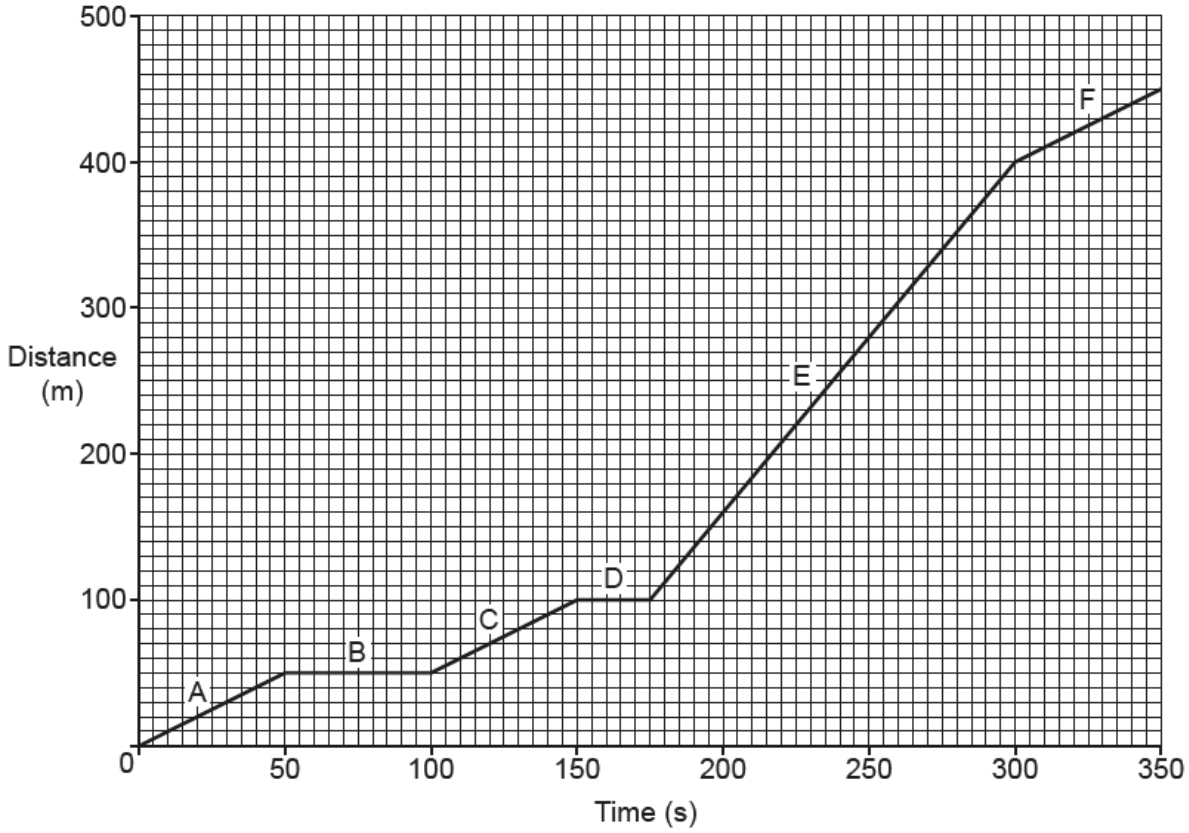
Use the equation: power = potential difference × current

Give your answer to **2** significant figures.

Current = ... A **[4]**

10. Nov/2021/Paper_J249/01/No.23

A student travels to a friend's house. This is a distance–time graph of their journey.



(a) (i) State the total distance travelled by the student to their friend's house.

..... **[1]**

(ii) State the total time it takes the student to get to their friend's house.

..... **[1]**

(iii) Calculate the student's average speed during their journey.

Use the equation: distance travelled = speed × time

Average speed = ... m/s **[3]**

(iv) State which section of the journey, **A–F**, is where the student travels fastest. Explain your answer.

Section .....

Explanation .....

.....

[2]

(v) Suggest what happens at sections **B** and **D** on the journey.

..... **[1]**

(b) Suggest which equipment the student can use to measure the time and distance on their journey.

Time .....

Distance .....

.....

[1]

11. Nov/2021/Paper_J249/02/No.1

Estimate the reaction time of a student.

A 0.02 s

B 0.2 s

C 2 s

D 20 s

Your answer ☐ **[1]**

12. Nov/2021/Paper_J249/02/No.3

Which factor can affect the **braking** distance of a car?

A Age of driver

B Consumption of alcohol

C Mass of car

D Tiredness

Your answer ☐ **[1]**

13. Nov/2021/Paper_J249/02/No.5

The table shows the stopping distances for a car travelling at two different speeds.

Speed (miles per hour)	Stopping distance (metres)
30	23
70	96

The car now travels at 50 miles per hour.

Estimate the stopping distance.

A 28 m

B 53 m

C 73 m

D 88 m

Your answer ☐ **[1]**

14. Nov/2021/Paper_J249/02/No.8

A force of 6 N moves through a distance of 3 m in the direction of the force.

Calculate the work done.

A 0.5 J

B 2 J

C 9 J

D 18 J

Your answer ☐ **[1]**

15. Nov/2021/Paper_J249/02/No.17

A 20 kg concrete block is lifted by a crane. The mass of **one** block is 20 kg.

(a) (i) Calculate the kinetic energy of the 20 kg block when it moves at 0.3 m/s.

Use the equation: kinetic energy = 0.5 × mass × (speed)^2

Kinetic energy = ... J **[2]**

(ii) The 20 kg block is lifted through a height of 16 m.

Calculate the gravitational potential energy gained by the 20 kg block.

Gravitational field strength is 10 N/kg.

Gravitational potential energy = ... J **[3]**

(b) The crane lifts blocks through a different height using an electric motor:

- The gravitational potential energy gained by the blocks is 0.6 MJ.
- The input energy of the motor is 1.5 MJ.

(i) Calculate the efficiency of the motor.

Use the equation: efficiency = useful output energy transfer / input energy transfer

Efficiency = ... **[2]**

(ii) Explain why the efficiency of the motor is **not** 100%.

.....

.....

.....

..... **[2]**

(iii) The crane's lifting equipment contains moving parts. A workman suggests adding oil to these moving parts.

Explain how this will affect the efficiency.

.....

.....

.....

..... **[2]**

16. Nov/2020/Paper_J249/01/No.2

A skydiver falls from a plane.

What is the name of the **downward** force in the diagram?

A Drag

B Electrostatic

C Mass

D Weight

Your answer ☐ **[1]**

17. Nov/2020/Paper_J249/01/No.3

A cyclist travels 750 m in 50 seconds.

Calculate the speed of the cyclist.

Use the equation: speed = distance / time

A 0.015 m/s

B 15 m/s

C 37.5 m/s

D 375 m/s

Your answer ☐ **[1]**

18. Nov/2020/Paper_J249/01/No.6

On the Moon the gravitational field strength is 1.6 N/kg.

Calculate the gravity force for an 80 kg astronaut.

Use the equation: gravity force = mass × gravitational field strength

A 50 N

B 128 N

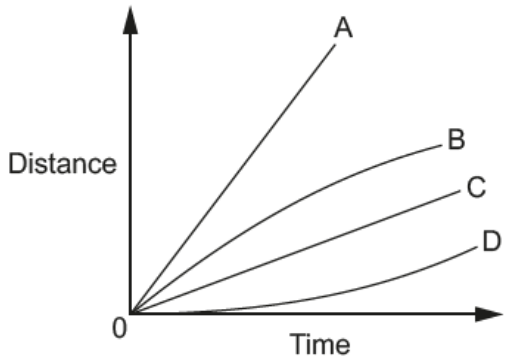
C 800 N

D 1280 N

Your answer ☐ **[1]**

19. Nov/2020/Paper_J249/01/No.8

Look at the distance-time graph.



Which line shows the largest average speed?

Your answer ☐ **[1]**

20. Nov/2020/Paper_J249/01/No.9

A girl runs twice around a 400 m circular track.

What is the final displacement of the girl from her starting point?

A 0 m

B 200 m

C 400 m

D 800 m

Your answer ☐ **[1]**

21. Nov/2020/Paper_J249/01/No.11

Four cars of the same mass are shown here.

A

B

C

D

Which car will accelerate?

Your answer ☐ **[1]**

22. Nov/2020/Paper_J249/01/No.13

A student measures the weight of four boxes and the area in contact with the ground.

Box	Weight (N)	Area (cm^2)
A	50	100
B	75	250
C	90	400
D	100	500

Which box exerts the greatest pressure on the ground?

Your answer ☐ **[1]**

23. Nov/2020/Paper_J249/01/No.19

A toy car travels around a race track. After one lap it is back at the start position.

(a) Explain why the velocity of the toy car is different from its speed as it travels around the track.

.....

.....

..... **[2]**

(b) The mass of the toy car is 5 kg and it has an acceleration of 4 m/s^2.

(i) Calculate the force needed to accelerate the toy car.

Use the equation: force = mass × acceleration

Force = ... N **[2]**

(ii) Suggest why the **actual** force needed would be more than in part **(b)(i)**.

..... **[1]**

(c) **(i)** Another toy car requires a constant force of 30 N to move it along a surface.

Calculate the work done on the car when it moves a distance of 50 m.

Use the equation: work done = force × distance

Work done = ... J **[2]**

(ii) Calculate the power output of this toy car if the work is done over 75 seconds.

Use your answer from **(c)(i)**.

Power = ... W **[3]**

24. Nov/2020/Paper_J249/01/No.21

A student investigates how a spring stretches.

She measures the original length of the spring, adds a 2.0 N weight, and then measures the extended length of the spring.

Look at her data in the table.

Force used	2.0 N
Original length	3.0 cm
Extended length	7.0 cm
Extension	4.0 cm

(a) (i) Calculate the spring constant for the spring.

Use the equation: force = spring constant × extension

Spring constant = ... N/cm **[3]**

(ii) Suggest **two** ways that the student could improve and develop their method to find the spring constant.

.....

.....

..... **[2]**

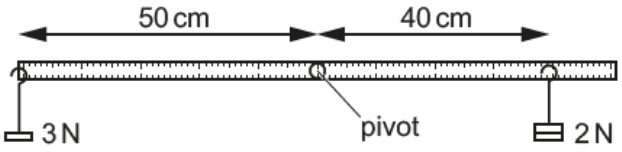
(b) The spring constant of a different spring is 40 N/m.

Calculate the energy stored in the spring when it is stretched 0.20 m.

Use an equation from the data sheet to help you.

Energy stored = ... J **[2]**

(c) The diagram shows an experiment a student set up to study moments.



The student:
- holds the metre rule so that it is horizontal
- adds weights to the metre rule at different distances from the pivot.

(i) Calculate the moments of the 2 N weight and the 3 N weight about the pivot.

Use the equation: moment = force × distance from pivot

Moment of 2 N weight = ... N cm

Moment of 3 N weight = ... N cm
[2]

(ii) Which way will the metre rule rotate when it is released by the student?

..... **[1]**

25. Nov/2020/Paper_J249/01/No.23

A student drops a paper ball from a balcony 4.00 m high. Her friend measures the time taken for the paper ball to reach the ground.

(a) Suggest the equipment used to measure the height of the balcony and the time taken for the paper ball to reach the ground.

Height .....

Time taken .....

[1]

(b) They record their results in a table.

Attempt	**1**	**2**	**3**	**4**	**5**
Time taken (s)	1.84	2.08	2.02	2.08	1.98

(i) Use the data in the table to calculate the mean, median and mode of their results.

Mean = ...

Median = ...

Mode = ...

[3]

(ii) The results are not very precise. Explain how you can tell from the data in the table.

.....

..... **[1]**

(iii) Suggest a possible source of error in the experimental method **and** how it could be improved.

Source of error .....

Improvement .....

.....

[2]

26. Nov/2020/Paper_J249/02/No.7

The speed of the wind is measured to be 5.555 m/s.

What is 5.555 m/s written to **2** significant figures?

A 5.5 m/s

B 5.55 m/s

C 5.56 m/s

D 5.6 m/s

Your answer ☐ **[1]**

27. Nov/2020/Paper_J249/02/No.9

A car travels at a speed of 60 mph (miles per hour).

1 mph = 0.45 m/s.

Convert 60 mph into m/s (metres per second).

A 0.45 m/s

B 7.5 m/s

C 27 m/s

D 130 m/s

Your answer ☐ **[1]**

28. Nov/2020/Paper_J249/02/No.12

A boy of mass 65 kg climbs a ladder of height 3.0 m.

Calculate the gain in potential energy of the boy.

Use the equation: potential energy = mass × height × gravitational field strength

Gravitational field strength = 10 N/kg.

A 30 J

B 195 J

C 650 J

D 1950 J

Your answer ☐ **[1]**

29. Nov/2020/Paper_J249/02/No.13

The kinetic energy of motorbike **X** is 10 kJ.

Motorbike **Y** has the same speed but double the mass.

What is the kinetic energy of motorbike **Y**?

Use the equation: kinetic energy = 0.5 × mass × $(\text{speed})^2$

A 5 kJ

B 10 kJ

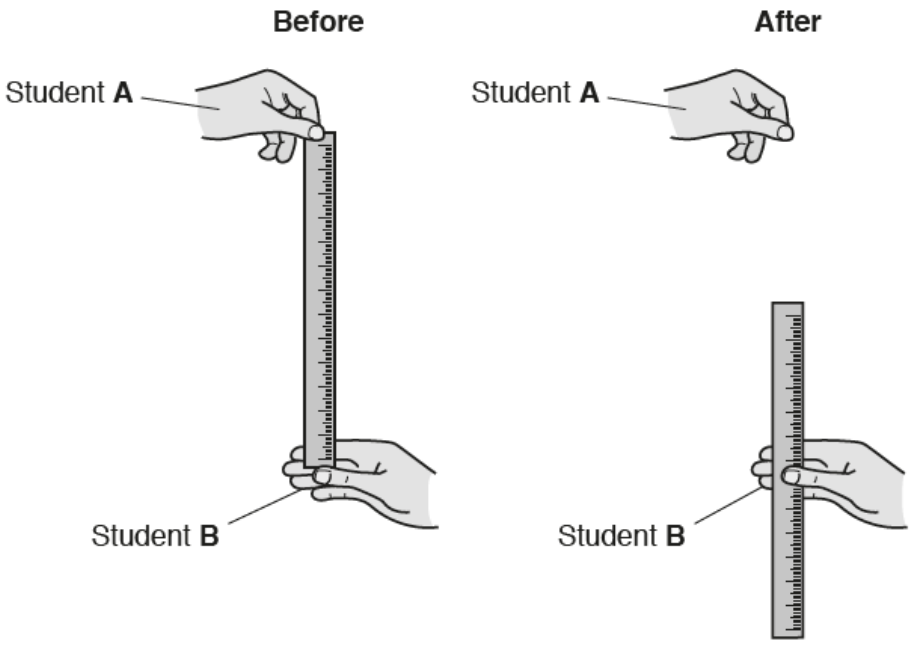
C 20 kJ

D 40 kJ

Your answer ☐ **[1]**

30. Nov/2020/Paper_J249/02/No.19

(a) The diagram shows a ruler being used to estimate a student's reaction time.



(i) Describe how the ruler can be used to estimate student **B**'s reaction time.

.....

.....

.....

..... **[2]**

(ii) Why do the students repeat the experiment several times?

.....

..... **[1]**

(iii) Student **B** is very tired when they try this experiment.

Suggest how this might affect student **B**'s reaction time.

.....

..... **[1]**

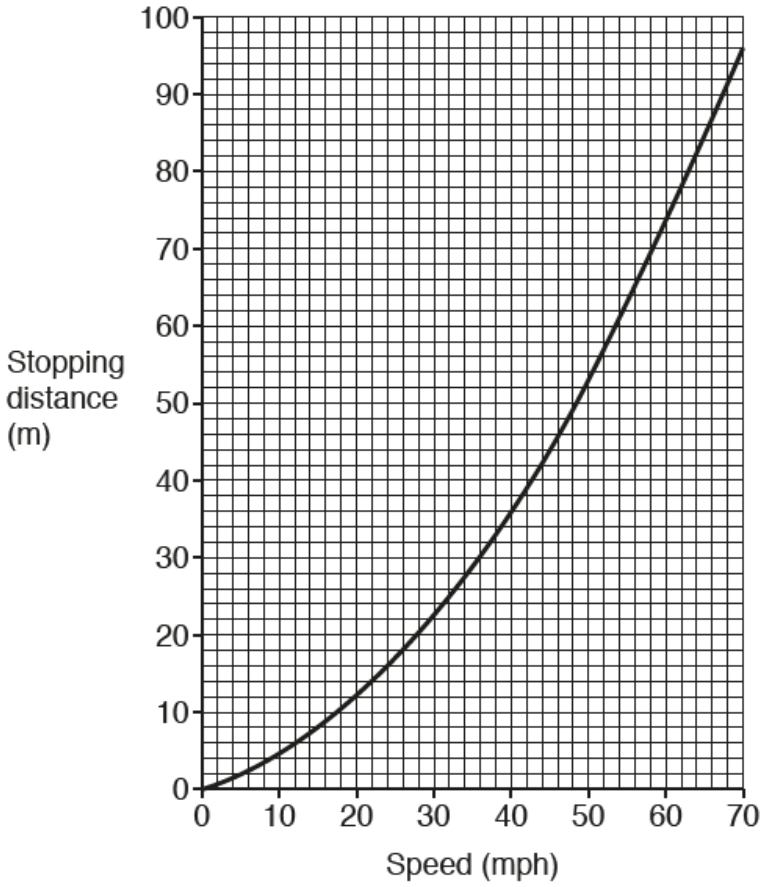
(b) The driver of a car makes an emergency stop.

The thinking distance is 9 m. The braking distance is 14 m.

(i) Calculate the total stopping distance of the car.

Stopping distance = ... m **[1]**

(ii) This graph shows how this driver's stopping distance changes with speed.



- A car is travelling at 50 mph.
- There is a barrier in the road 40 m in front of the car.
- The driver makes an emergency stop.

Use the graph to work out if the car hits the barrier.

Explain how you obtained your answer.

.....

.....

.....

..... **[2]**

(iii) State one factor, other than speed, that affects braking distance.

Explain how this factor changes braking distance.

Factor .....

Explanation .....

.....

.....

[3]

(c) (i) A car travels at a speed of 13 m/s. The car takes 4 s to stop after the brakes are applied.

Calculate the deceleration of the car.

Use the equation: acceleration = change in velocity ÷ time

Deceleration = ... m/s^2 **[2]**

(ii) The braking system of the car in **(c)(i)** is changed. The same car travelling at 13 m/s now takes 0.4 s to stop after the brakes are applied.

The driver says, 'The new braking system is ten times safer.'

Do you agree with the driver? Explain your answer.

Yes ☐

No ☐

.....

.....

.....

..... **[2]**

(iii) Suggest **one** safety feature in a car that can reduce injury in a crash.

..... **[1]**

31. Nov/2020/Paper_J249/02/No.19

A toy car travels around a race track. After one lap it is back at the start position.

(a) Explain why the velocity of the toy car is different from its speed as it travels around the track.

.....

.....

..... **[2]**

(b) The mass of the toy car is 5 kg and it has an acceleration of $4\,m/s^2$.

(i) Calculate the force needed to accelerate the toy car.

Use the equation: force = mass × acceleration

Force = ... N **[2]**

(ii) Suggest why the **actual** force needed would be more than in part **(b)(i)**.

..... **[1]**

(c) **(i)** Another toy car requires a constant force of 30 N to move it along a surface.

Calculate the work done on the car when it moves a distance of 50 m.

Use the equation: work done = force × distance

Work done = ... J **[2]**

(ii) Calculate the power output of this toy car if the work is done over 75 seconds.

Use your answer from **(c)(i)**.

Power = ... W **[3]**

32. Nov/2021/Paper_J249/03/No.1

Which row in the table correctly describes gravitational fields?

	Type of field	Strength of field
A	Attractive	Greater for massive objects
B	Attractive	Less for massive objects
C	Repulsive	Greater for massive objects
D	Repulsive	Less for massive objects

Your answer ☐ **[1]**

33. Nov/2021/Paper_J249/03/No.5

A stopwatch is used by a student for timing how long it takes a toy car to travel down a ramp.

The student repeats the experiment four times during a lesson, using the same equipment and method.

Attempt	**1**	**2**	**3**	**4**
Time taken (s)	2.6	2.4	2.5	2.5

Which words describe the student's results?

A Repeatable and precise

B Repeatable and reproducible

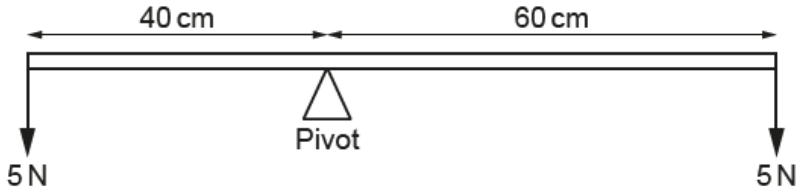
C Reproducible and accurate

D Reproducible and precise

Your answer ☐ **[1]**

34. Nov/2021/Paper_J249/03/No.7

A student sets up a balance using a ruler and a pivot.



Which statement is correct?

A There is a resultant turning force anti-clockwise of 200 N cm.

B There is a resultant turning force clockwise of 100 N cm.

C There is a resultant turning force clockwise of 300 N cm.

D There is a resultant turning force of 0 N cm.

Your answer ☐ **[1]**

35. Nov/2021/Paper_J249/03/No.9

A fluid under pressure causes a force.

In which direction does the net force always act?

A At right angles to any surface.

B In the opposite direction to the gravitational force.

C In the same direction as the gravitational force.

D Parallel to any surface.

Your answer ☐ **[1]**

36. Nov/2021/Paper_J249/03/No.10

What is the work done when a car is pushed a distance of 0.60 km using a force of 90 N?

A 0.15 J

B 54 J

C 150 J

D 54 000 J

Your answer ☐ **[1]**

37. Nov/2021/Paper_J249/03/No.11

Which statement is an explanation of **inertia**?

A It is a measure of how difficult it is to change the velocity of an object.

B It is a measure of how difficult it is to electrically charge an object.

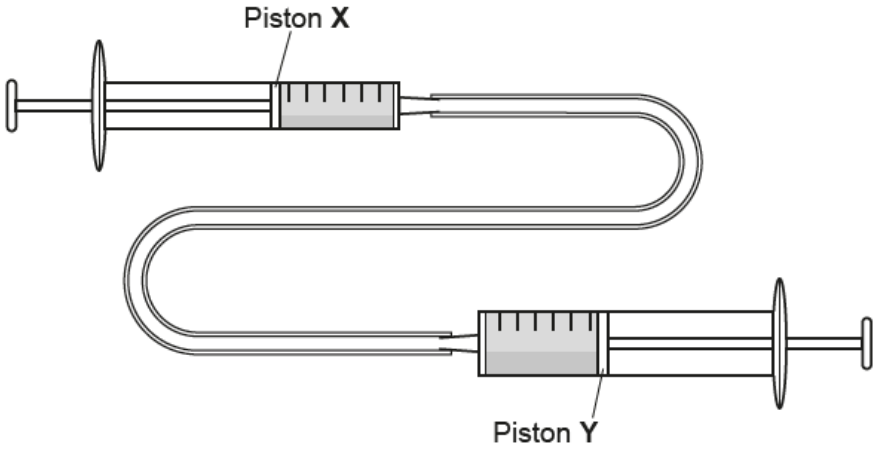
C It is a measure of the energy of an object.

D It is a measure of the power of an object.

Your answer ☐ **[1]**

38. Nov/2021/Paper_J249/03/No.15

A simple hydraulic machine containing water is made from two pistons connected together with plastic tubing. The cross-sectional area of piston **Y** is **twice** the cross-sectional area of piston **X**.



A force of 2 N is exerted on piston **X**.

What is the force exerted on piston **Y**?

A 1 N

B 2 N

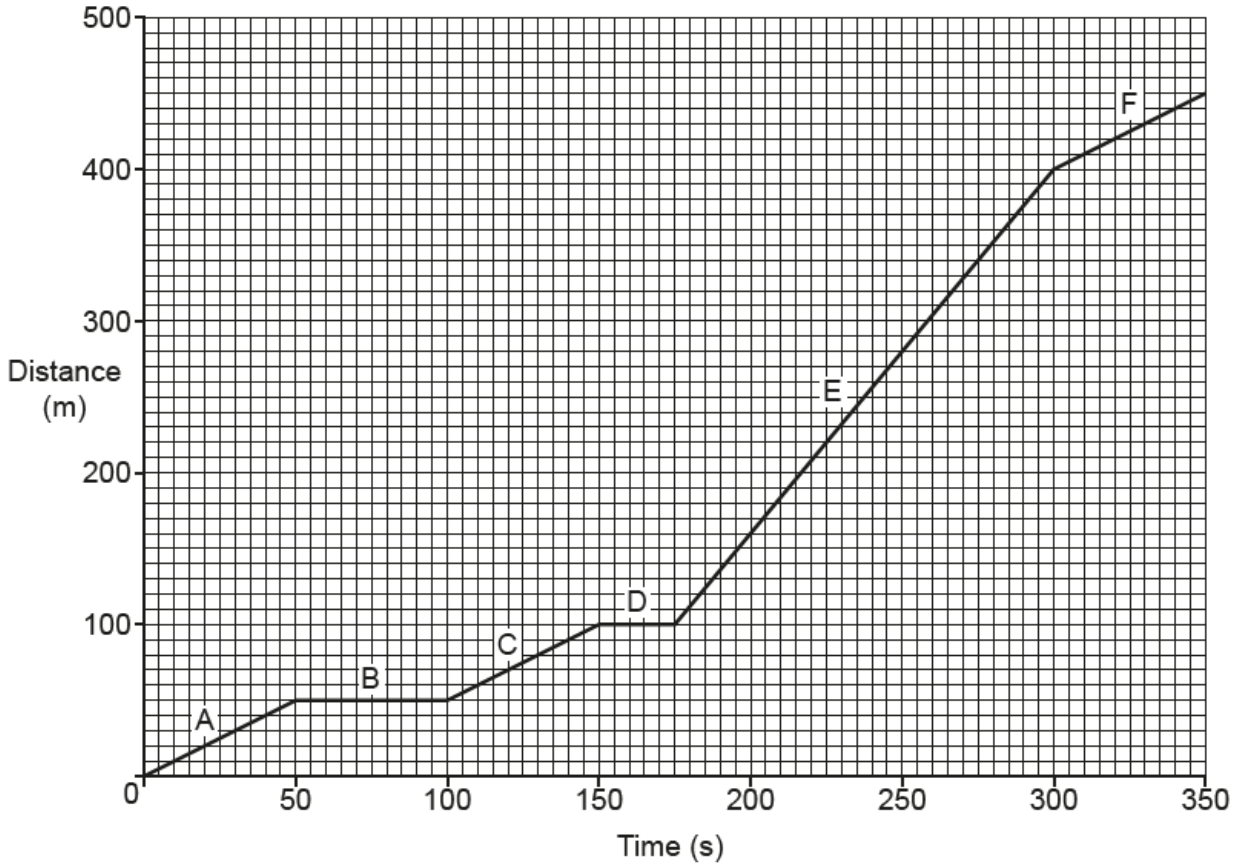
C 4 N

D 8 N

Your answer ☐ **[1]**

39. Nov/2021/Paper_J249/03/No.16

A student travels to a friend's house. This is a distance–time graph of their journey.



(a) (i) State the total distance travelled by the student to their friend's house.

..... **[1]**

(ii) State the total time it takes the student to get to their friend's house.

..... **[1]**

(iii) Calculate the student's average speed during their journey.

Use the equation: distance travelled = speed × time

Average speed = ... m/s **[3]**

(iv) State which section of the journey, **A–F**, is where the student travels fastest. Explain your answer.

Section .....

Explanation .....

.....

[2]

(v) Suggest what happens at sections **B** and **D** on the journey.

..... **[1]**

(b) Suggest which equipment the student can use to measure the time and distance on their journey.

Time .....

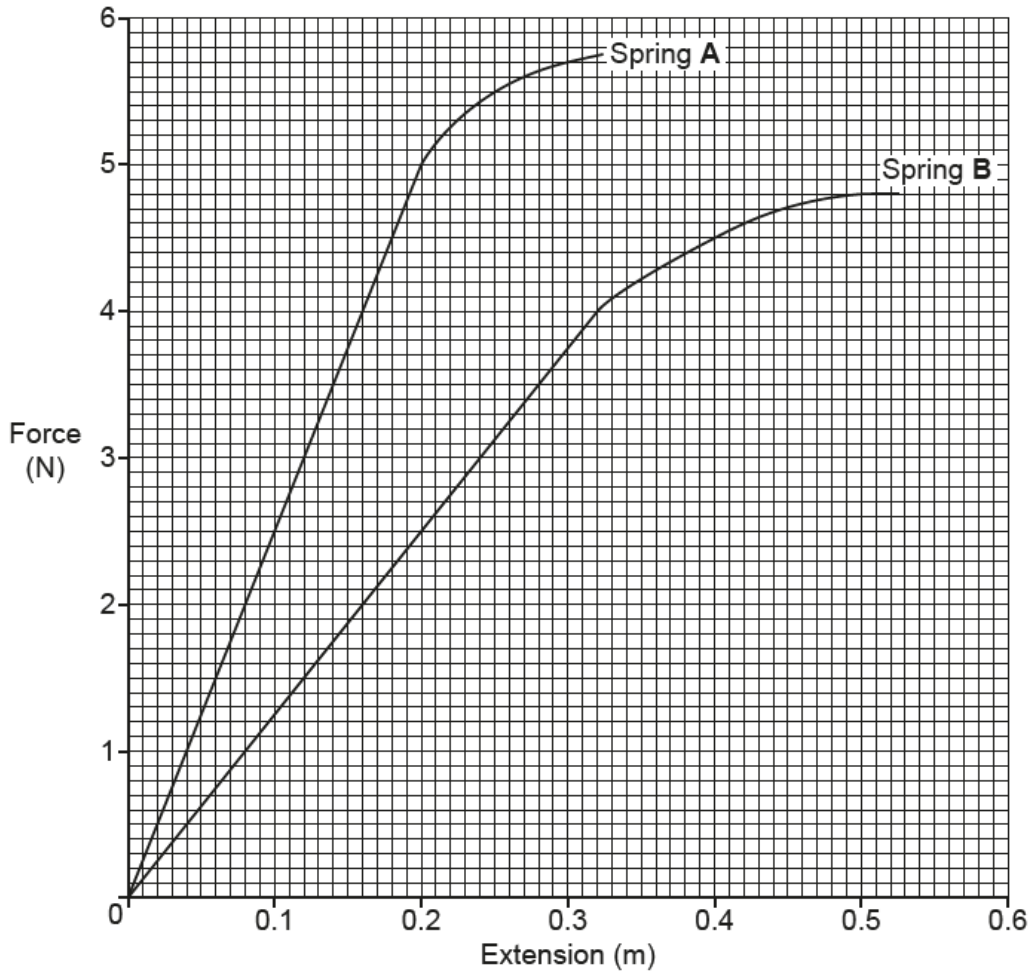
Distance .....

.....

[1]

40. Nov/2021/Paper_J249/03/No.19

A student stretches two different springs and measures their extensions for different forces. They plot the results on a graph.



Describe and explain the behaviour of spring **A** and spring **B**.

Use data from the graph and calculations in your answer.

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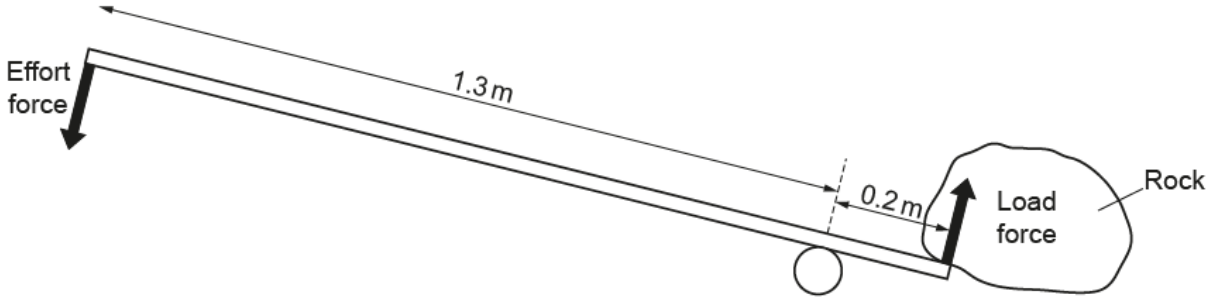
..... **[6]**

41. Nov/2021/Paper_J249/03/No.21

(a) A builder uses a lever to lift a rock.



(i) Explain why the effort force needed to lift the rock is **less** than the load force.

.....

.....

..... **[2]**

(ii) The effort force needed to lift the rock is 100 N.

Calculate the load force.

Load force = ... N **[4]**

(b) The builder places a mug on a table.

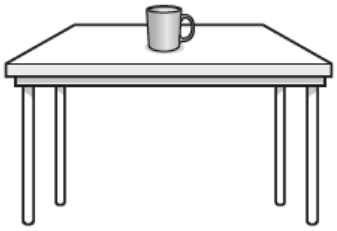
(i) Describe the **two** forces in the interaction pair when the mug is placed on the table.

Force 1 .....

Force 2 .....

[2]

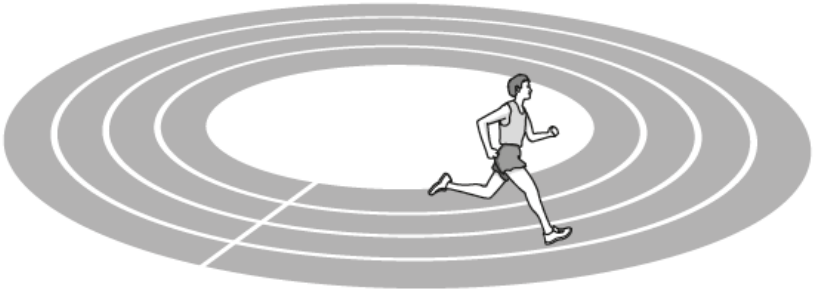
(ii) Draw and label the free body force diagram for the mug placed on the table.



[3]

42. Nov/2021/Paper_J249/03/No.22

An athlete runs around a circular running track at a constant speed.



(a) Explain why the athlete's velocity is not constant.

.....

..... **[1]**

(b) The work done by the athlete after completing one lap of the track is 3000 J. It takes the athlete 60 s to complete one lap.

Calculate the power of the athlete.

Power = ... W **[3]**

(c) After the lap, the athlete slows down from a velocity of 5 m/s to a velocity of 1 m/s. The deceleration of the athlete is 0.4 m/s^2.

Calculate the time taken for the athlete to change velocity.

Use the equation: acceleration = change in velocity / time

Time taken = ... s **[3]**

43. Nov/2021/Paper_J249/04/No.4

Estimate the force needed to accelerate a car at $1\,m/s^2$.

A 10 N

B 100 N

C 1000 N

D 10 000 N

Your answer ☐ **[1]**

44. Nov/2021/Paper_J249/04/No.14

Two students, **A** and **B**, climb some steps.

- Student **A** has twice the mass of student **B**.
- Student **B** climbs four times higher than student **A**.

Which statement about gravitational potential energy (GPE) is correct?

Use the equation: potential energy = mass × height × gravitational field strength

A GPE gain of student **B** = ¼ × GPE gain of student **A**

B GPE gain of student **B** = ½ × GPE gain of student **A**

C GPE gain of student **B** = 2 × GPE gain of student **A**

D GPE gain of student **B** = 4 × GPE gain of student **A**

Your answer ☐ **[1]**

45. Nov/2021/Paper_J249/04/No.15

A student calculates braking distance using this equation:

$(\text{final velocity})^2 - (\text{initial velocity})^2 = 2 \times \text{acceleration} \times \text{distance}$

What is the correct equation for braking distance?

A Braking distance = $(\text{final velocity})^2 - (\text{initial velocity})^2 - 2 \times \text{acceleration}$

B Braking distance = $\dfrac{(\text{final velocity})^2}{(\text{initial velocity})^2} - 2 \times \text{acceleration}$

C Braking distance = $2 \times \text{acceleration} \times ((\text{final velocity})^2 - (\text{initial velocity})^2)$

D Braking distance = $\dfrac{(\text{final velocity})^2 - (\text{initial velocity})^2}{2 \times \text{acceleration}}$

Your answer ☐ **[1]**

46. Nov/2021/Paper_J249/04/No.22

A van travels along a road at a constant speed.

(a) The van brakes and decelerates at a constant rate:

- The initial speed of the van is 18 m/s.
- The deceleration of the van is 1.5 m/s^2.

Calculate the time taken for the van to stop.

Use the equation: acceleration = change in velocity/time taken

Time = ... s **[3]**

(b) The same van travels on an **icy** road at 18 m/s.

Explain how the **stopping** distance changes.

Write about thinking and braking in your answer.

.....

.....

.....

.....

..... **[3]**

(c) If the van crashes, the time taken to stop is much smaller.

Explain why this is dangerous for the people in the van.

.....

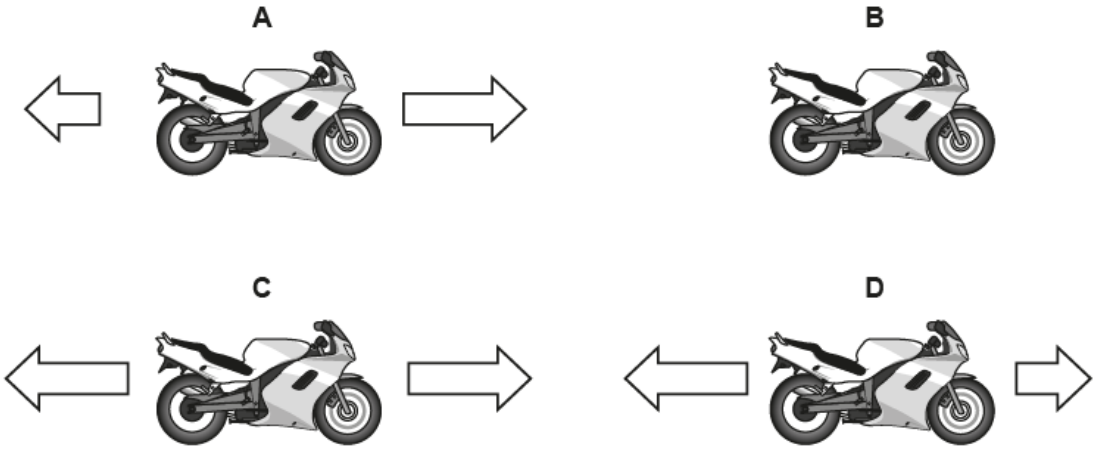
.....

..... **[2]**

47. Nov/2020/Paper_J249/03/No.3

A motorbike travels along a straight flat road.

The arrows represent the horizontal forces acting on the motorbike.



Which motorbike is travelling at a uniform velocity?

Your answer ☐ [1]

48. Nov/2020/Paper_J249/03/No.4

An elephant has a weight of 60 kN. Its four feet have a total area of 0.75 m^2 in contact with the ground.

Calculate the total pressure the elephant exerts on the ground.

Use the equation: pressure = force normal to a surface / area of that surface

A 45 Pa

B 80 Pa

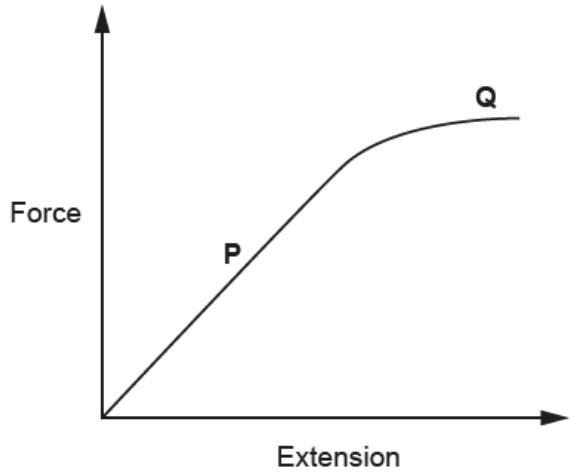
C 45 000 Pa

D 80 000 Pa

Your answer ☐ [1]

49. Nov/2020/Paper_J249/03/No.5

A student plots a force-extension graph for a material.



Which row in the table correctly identifies part **P** and part **Q** of the graph?

	Part P	Part Q
A	Elastic	Elastic
B	Elastic	Plastic
C	Plastic	Elastic
D	Plastic	Plastic

Your answer ☐ **[1]**

50. Nov/2020/Paper_J249/03/No.6

Which statement explains why atmospheric pressure changes as you climb up a mountain?

A Number of air molecules above you decrease the further you move from the centre of the Earth.

B Density of air increases the further you move from the centre of the Earth.

C Gravity increases the further you move from the centre of the Earth.

D Temperature decreases the further you move from the centre of the Earth.

Your answer ☐ **[1]**

51. Nov/2020/Paper_J249/03/No.7

Which statement is an example of Newton's third law?

A Doubling the engine force on a car doubles its acceleration.

B Doubling the engine force on a car halves its acceleration.

C When a ball is rolling on a table it continues rolling at a steady speed.

D When you clap your hands each hand experiences a force from the other hand.

Your answer ☐ **[1]**

52. Nov/2020/Paper_J249/03/No.15

An astronaut on the Moon lifts a 5.5 kg object a vertical distance of 50 cm.

Calculate the potential energy gained by the object.

Gravitational field strength on the Moon = 1.6 N/kg.

A 4.4 J

B 8.8 J

C 17.6 J

D 440 J

Your answer ☐ **[1]**

53. Nov/2020/Paper_J249/03/No.17

A student drops a paper ball from a balcony 4.00 m high. Her friend measures the time taken for the paper ball to reach the ground.

(a) Suggest the equipment used to measure the height of the balcony and the time taken for the paper ball to reach the ground.

Height .....

Time taken .....

[1]

(b) They record their results in a table.

Attempt	**1**	**2**	**3**	**4**	**5**
Time taken (s)	1.84	2.08	2.02	2.08	1.98

(i) Use the data in the table to calculate the mean, median and mode of their results.

Mean = ...

Median = ...

Mode = ...

[3]

(ii) The results are not very precise. Explain how you can tell from the data in the table.

.....

..... **[1]**

(iii) Suggest a possible source of error in the experimental method **and** how it could be improved.

Source of error .....

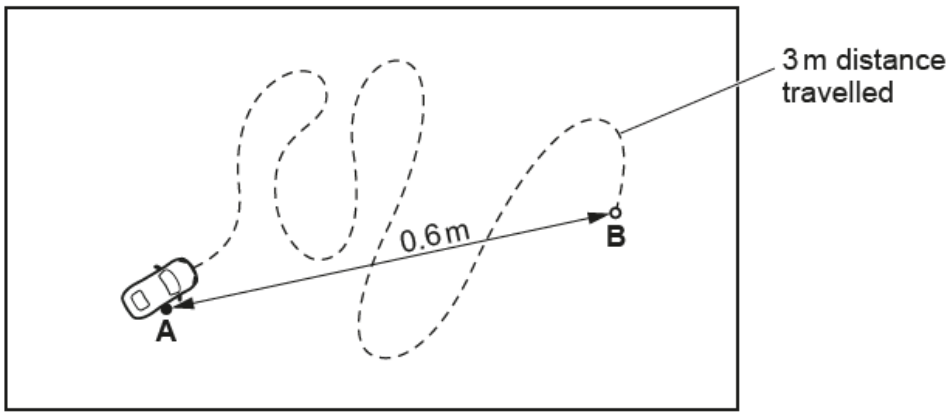
Improvement .....

.....

[2]

54. Nov/2020/Paper_J249/03/No.18

A toy car moves randomly on a table.



It moves from position **A** to position **B** in 0.5 minutes, covering a distance of 3.0 m. The start and finish positions are 0.6 m apart.

Explain why the average speed and average velocity of the moving toy car are different from one another.

You should include calculations in your answer.

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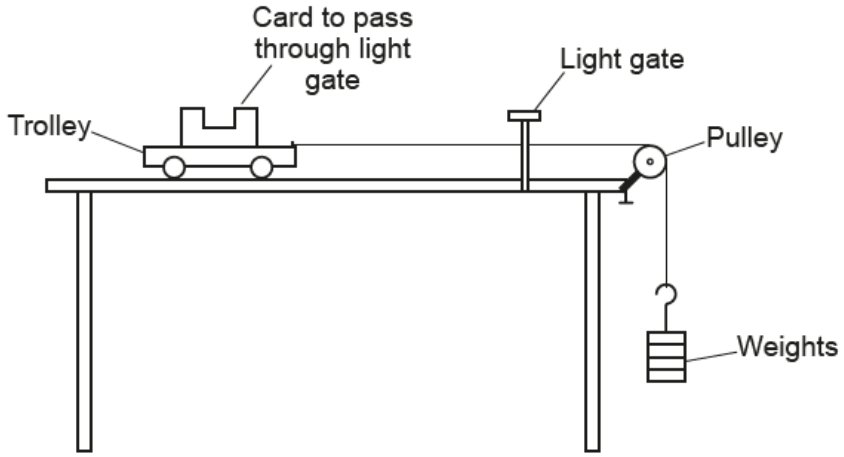
..... **[6]**

55. Nov/2020/Paper_J249/03/No.21

A student investigates the acceleration of a trolley.



The trolley is released from a fixed position and accelerates.

The accelerating force is provided by the weights attached to the trolley with string.

Acceleration is measured using a light gate and data logging equipment.

Look at the results from the experiment.

Force (N)	Acceleration
1.0	1.3
2.0	2.9
3.0	4
4.0	5.7
5.0	6.9

(a) The student has made **two** mistakes in their results table. Identify the two mistakes and suggest corrections to them.

Mistake 1: .....

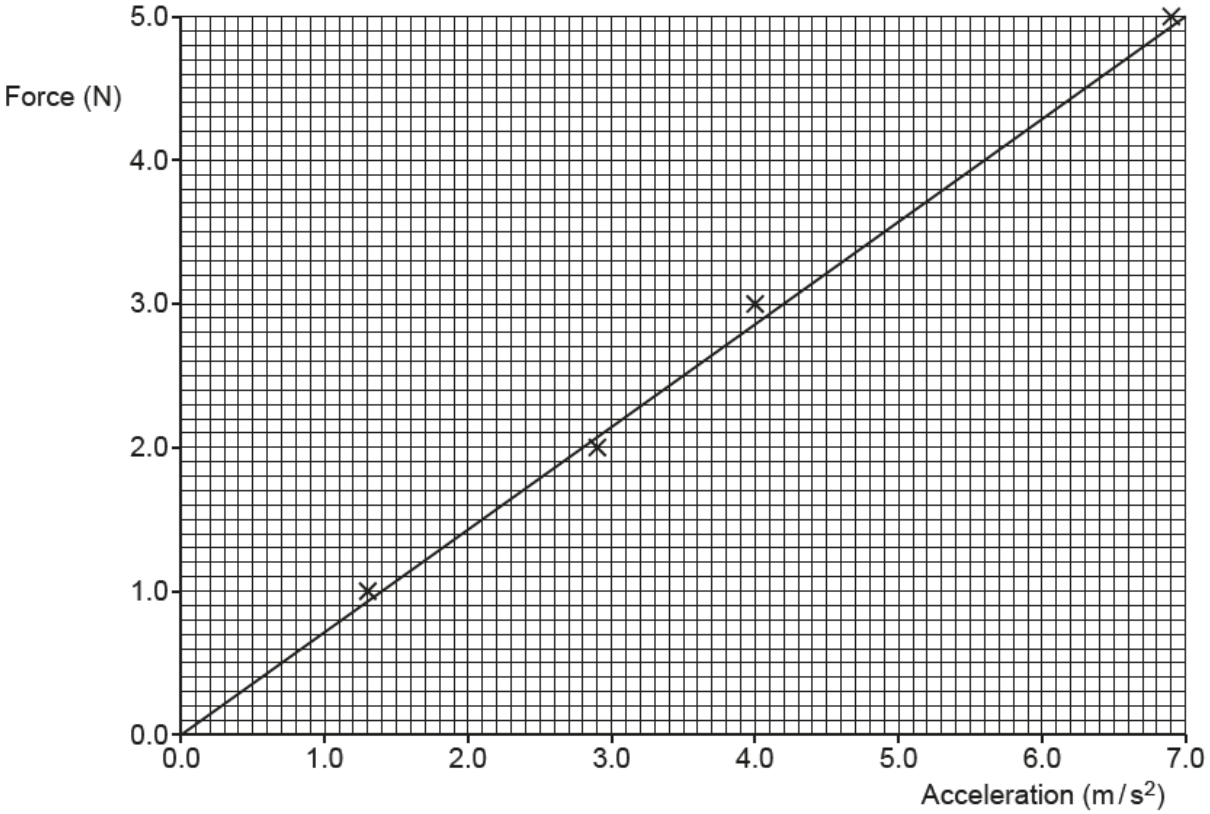
Correction 1: .....

Mistake 2: .....

Correction 2: .....

[4]

(b) The student plots the results on a graph.



(i) One point has not been plotted on the graph. Plot the missing point on the graph. **[1]**

(ii) Describe the relationship between the two variables on the graph.

.....

.....

..... **[2]**

(iii) Calculate the gradient of the graph and use this to determine the mass of the trolley.

Mass = ... kg **[2]**

(iv) The actual mass of the trolley is lower than that found in the experiment. Suggest **two** reasons why.

Use ideas about forces and energy in your answer.

1 .....

.....

2 .....

.....

[2]

(v) Suggest **two** ways the experiment could be improved.

1 .....

.....

2 .....

.....

[2]

(c) (i) Describe the energy transfer as the trolley accelerates on the desk.

.....

..... **[1]**

(ii) The trolley moves a distance of 86 cm along the desk.

Calculate the work done when a force of 3.0 N is applied.

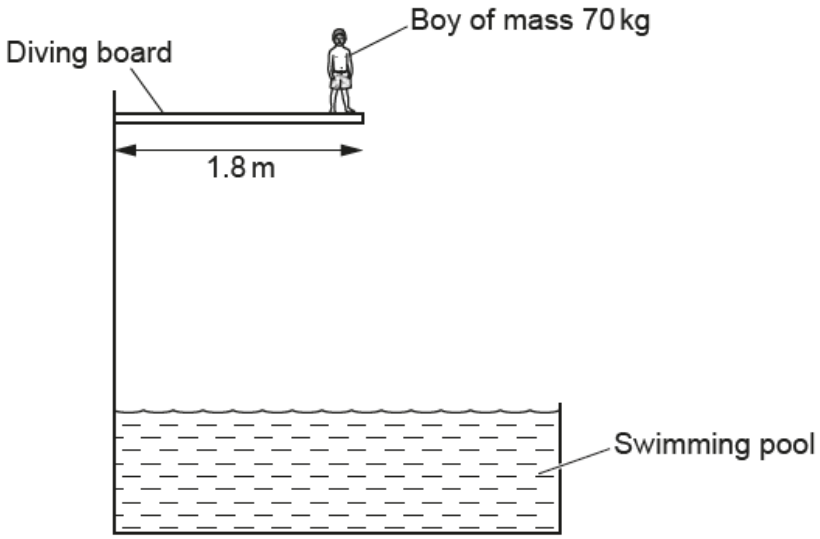
Use the equation: work done = force × distance

Give your answer to **2** significant figures.

Work done = ... J **[4]**

56. Nov/2020/Paper_J249/03/No.22

A boy of mass 70 kg stands on the end of a diving board at a distance of 1.8 m from the wall.



(a) Calculate the moment of the boy standing on the diving board.
Gravitational field strength on Earth = 10 N / kg.

Moment = ... N m **[4]**

(b) The boy dives vertically into the swimming pool. The water in the pool is 3.2 m below the diving board.

Calculate the velocity of the boy when he enters the water.

Use an equation from the data sheet to help you.

Gravitational field strength on Earth = 10 N / kg.

Velocity = ... m / s **[4]**

57. Nov/2020/Paper_J249/04/No.11

A car travels at a speed of 70 mph (miles per hour).

1 mile is approximately 1600 metres.

Convert 70 mph into m/s (metres per second).

A 2.6 m/s

B 31 m/s

C 112 m/s

D 160 m/s

Your answer ☐ **[1]**