1 The units of physical quantities can be expressed in terms of the fundamental (base) units of the SI system. In which line in the table are the fundamental units correctly matched to the physical quantity?

	Physical quantity	**Fundamental units**	
A	charge	$A\ s^{-1}$	☐
B	power	$kg\ m^2\ s^{-3}$	☐
C	potential difference	$kg\ m^2\ s\ A^{-1}$	☐
D	energy	$kg\ m^2\ s^{-1}$	☐

(Total 1 mark)

2 Which of the following is a scalar quantity?

A kinetic energy ☐

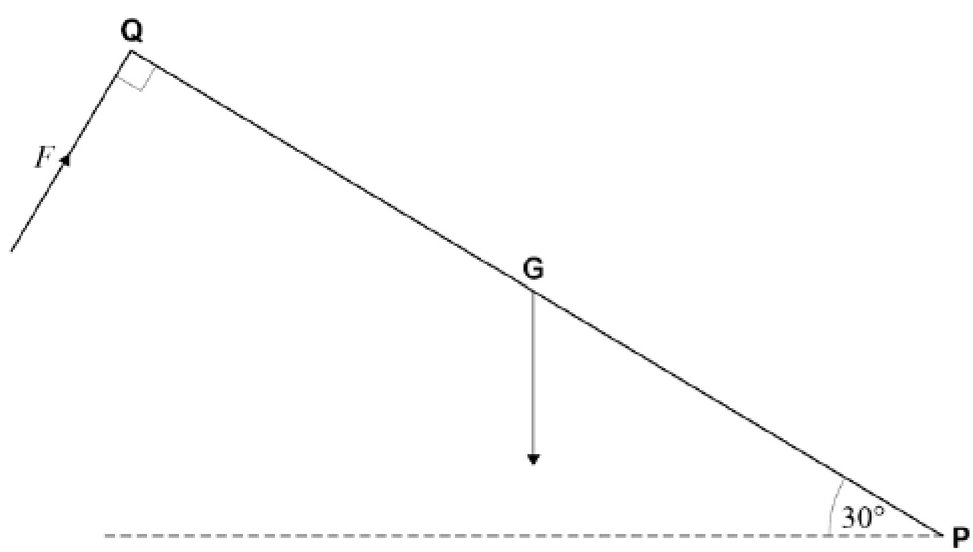
B momentum ☐

C force ☐

D acceleration ☐

(Total 1 mark)

3 A car bonnet, represented by **QP**, of mass 12 kg is pivoted at **P**. Its weight acts at **G** where **QG** = **GP** = 1.0 m.



What force, F, acting perpendicular to **QP** as shown, is required to hold the bonnet at 30° to the horizontal?

A 29 N

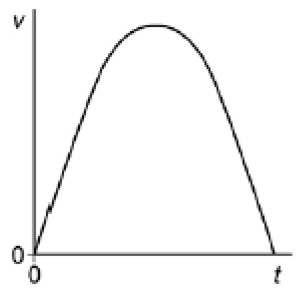
B 51 N

C 59 N

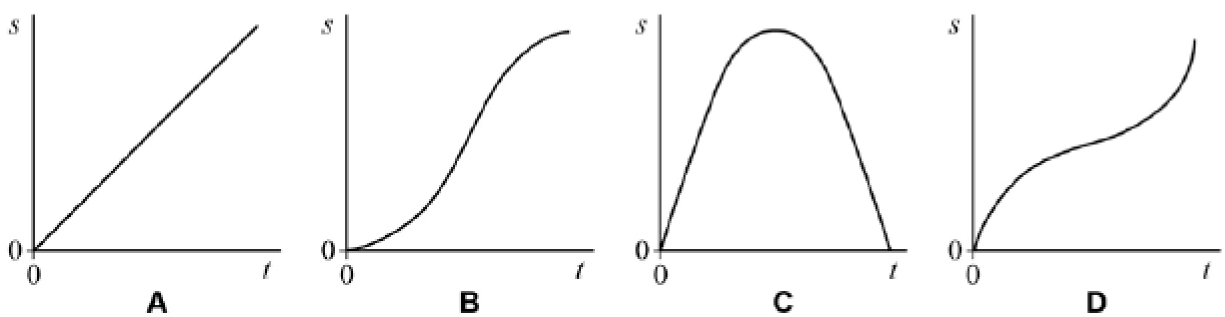
D 136 N

(Total 1 mark)

4 A body travels with speed *v*, which varies with time *t* as shown in the graph.



Which one of the graphs, **A** to **D**, shows how the distance *s* covered by the body varies with time *t*?



A

B

C

D

(Total 1 mark)

5 A body of mass 4 kg falls vertically through the air.

What is the acceleration of the body when the magnitude of the air resistance is 30 N?

A 17.3 m s^{-2} ○

B 7.7 m s^{-2} ○

C 2.3 m s^{-2} ○

D 0.4 m s^{-2} ○

(Total 1 mark)

6 A stone of mass 0.4 kg is projected horizontally at a speed of 6.0 m s^{-1} from the top of a wall, 5.0 m above the surrounding ground. When it arrives at the ground its speed is 10 m s^{-1}.

How much energy is lost by the stone in falling through the air?

A 2.4 J ○

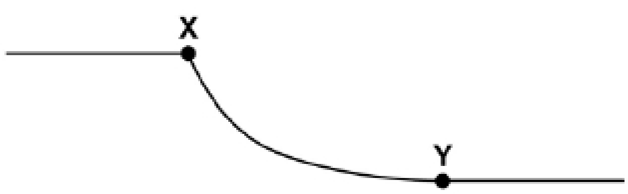
B 6.8 J ○

C 12.8 J ○

D 14.4 J ○

(Total 1 mark)

7 Two unpowered toy cars, **P** and **Q**, are released from rest from **X** and travel down the track to **Y**. Car **P** has twice the mass of car **Q**. There is negligible friction.



What quantity is the same for car **P** and car **Q**?

A The gravitational potential energy at **X**.

B The accelerating force at **X**.

C The velocity when they arrive at **Y**.

D The momentum when they arrive at **Y**.

(Total 1 mark)

8 Which of the following is a scalar quantity?

A velocity

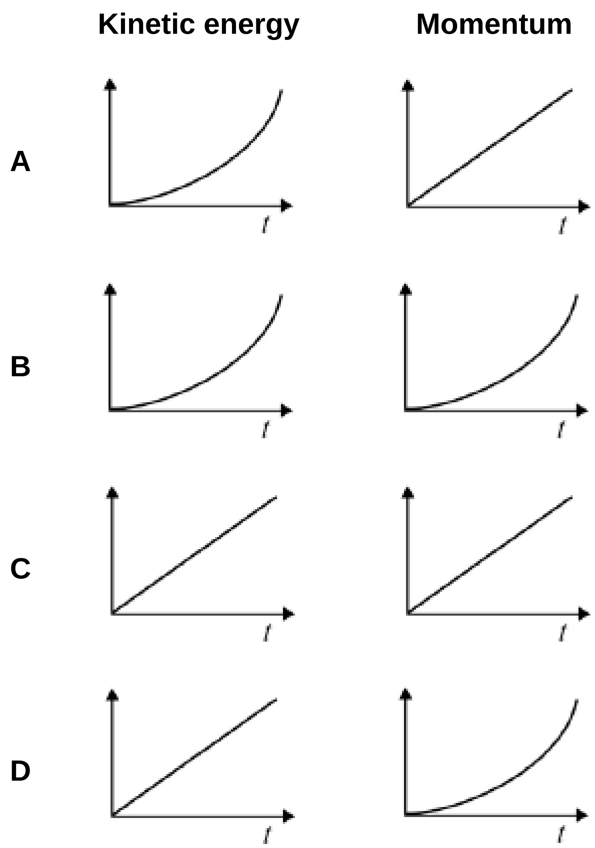
B kinetic energy

C force

D momentum

(Total 1 mark)

9 An object is accelerated from rest by a constant force F for a time t. Which graphs represent the variation of time with the change in the kinetic energy and the change in momentum of the object?



A

B

C

D

(Total 1 mark)

10 An object is dropped from a cliff. How far does the object fall in the third second? Assume that g = 10 m s^{-2}.

A 10 m

B 20 m

C 25 m

D 45 m

(Total 1 mark)

11 A body falls freely, with negligible air resistance. What quantity of the body is its rate of change of momentum?

A mass ○

B power ○

C kinetic energy ○

D weight ○

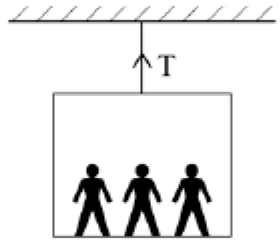
(Total 1 mark)

12 A firework rocket is fired vertically into the air and explodes at its highest point. What are the changes to the total kinetic energy of the rocket and the total momentum of the rocket as a result of the explosion?

	total kinetic energy of rocket	**total momentum of rocket**	
A	unchanged	unchanged	○
B	unchanged	increased	○
C	increased	unchanged	○
D	increased	increased	○

(Total 1 mark)

13 A lift and its passengers with a total mass of 500 kg accelerates upwards at 2 m s^{-2} as shown.
Assume that g = 10 m s^{-2}.



What is the tension in the cable?

A	1000 N	☐
B	4000 N	☐
C	5000 N	☐
D	6000 N	☐

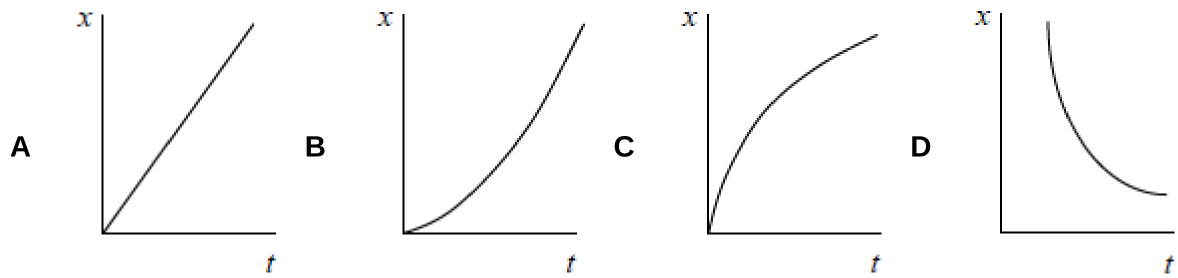
(Total 1 mark)

14 Which of the following is **not** a unit of power?

A	N m s^{-1}	☐
B	kg m^2 s^{-3}	☐
C	J s^{-1}	☐
D	kg m^{-1} s^{-1}	☐

(Total 1 mark)

15 A car accelerates uniformly from rest along a straight road. Which graph shows the variation of displacement *x* of the car with time *t*?



A

B

C

D

(Total 1 mark)

16 Which of the following statements is correct?

The force acting on an object is equivalent to

A its change of momentum.

B the impulse it receives per second.

C the energy it gains per second.

D its acceleration per metre.

(Total 1 mark)

17 Two forces of 6 N and 10 N act at a point. Which of the following could **not** be the magnitude of the result?

A 16 N

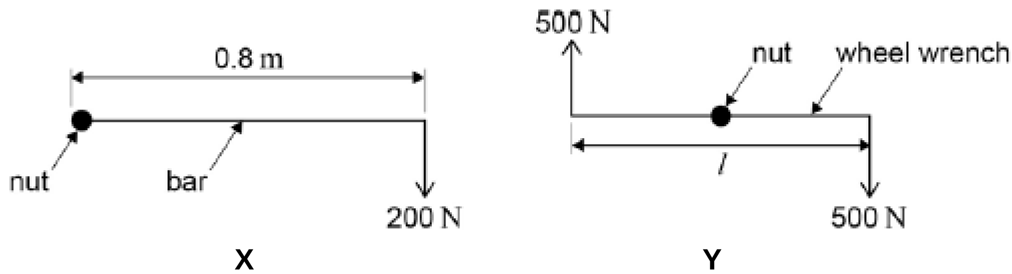
B 8 N

C 5 N

D 3 N

(Total 1 mark)

18 A car wheel nut can be loosened by applying a force of 200 N on the end of a bar of length 0.8 m as in **X**. A car mechanic is capable of applying forces of 500 N simultaneously in opposite directions on the ends of a wheel wrench as in **Y**.



What is the minimum length l of the wrench which would be needed for him to loosen the nut?

A 0.16 m

B 0.32 m

C 0.48 m

D 0.64 m

(Total 1 mark)

19 A ballbearing **X** of mass $2m$ is projected vertically upwards with speed u. A ballbearing **Y** of mass m is projected at 30° to the horizontal with speed $2u$ at the same time. Air resistance is negligible. Which of the following statements is correct?

A The horizontal component of **Y**'s velocity is u.

B The maximum height reached by **Y** is half that reached by **X**

C **X** and **Y** reach the ground at the same time.

D **X** reaches the ground first.

(Total 1 mark)

20 A car exerts a driving force of 500 N when travelling at a constant speed of 72 km h^{-1} on a level track. What is the work done in 5 minutes?

A 3.0×10^6 J

B 2.0×10^6 J

C 2.0×10^5 J

D 1.1×10^5 J

(Total 1 mark)

21 What is the relationship between the distance y travelled by an object falling freely from rest and the time x the object has been falling?

A y is proportional to x^2

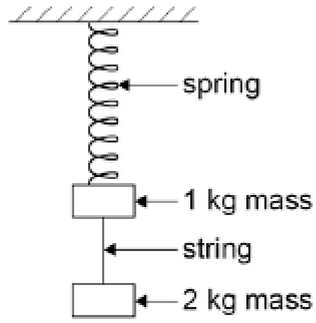
B y is proportional to $\sqrt{x}$

C y is proportional to $\frac{1}{x}$

D y is proportional to $\frac{1}{x^2}$

(Total 1 mark)

22 Two masses hang at rest from a spring, as shown in the diagram. The string separating the masses is burned through.



Which of the following gives the accelerations of the two masses as the string breaks?

acceleration of free fall = g

	acceleration of 1 kg mass upwards in m s^{-2}	acceleration of 2 kg mass downwards in m s^{-2}	
A	3 g	1 g	☐
B	2 g	2 g	☐
C	2 g	1 g	☐
D	1 g	1 g	☐

(Total 1 mark)

23 An object falls freely from rest. After falling a distance d its velocity is v. What is its velocity after it has fallen a distance $2d$?

A $2\,v$ ☐

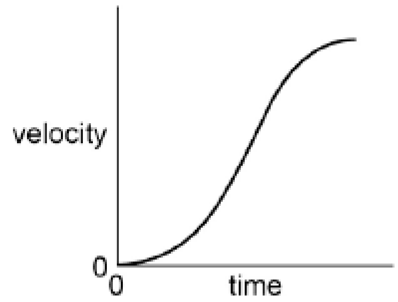
B $4\,v$ ☐

C $2\,v^2$ ☐

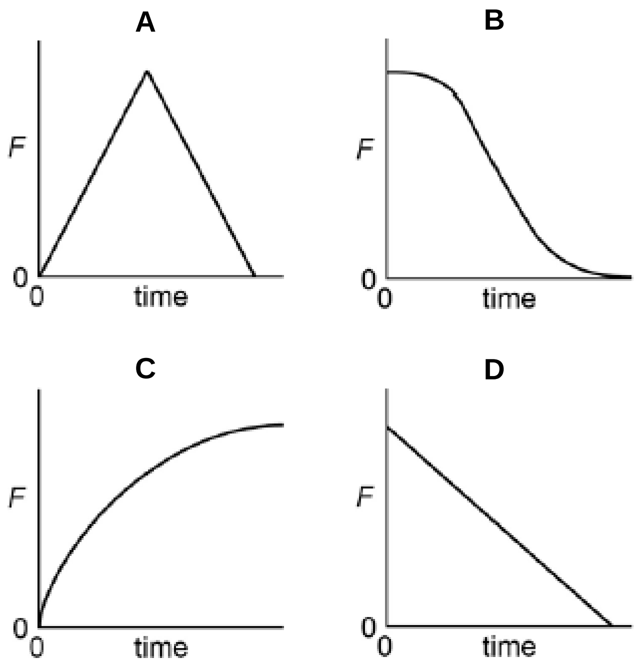
D $\sqrt{2}\,v$ ☐

(Total 1 mark)

24 The velocity of a vehicle varies with time as shown by the following graph.



Which graph below represents how the resultant force F on the car varies during the same time?



A ☐

B ☐

C ☐

D ☐

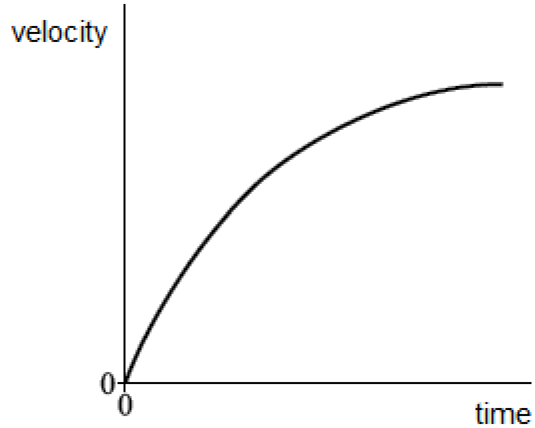
(Total 1 mark)

25 Which is a scalar quantity?

A	momentum	☐
B	weight	☐
C	power	☐
D	moment	☐

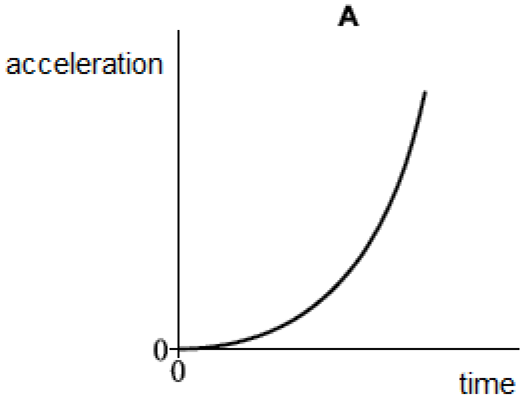
(Total 1 mark)

26 The velocity–time graph for a falling object is shown.

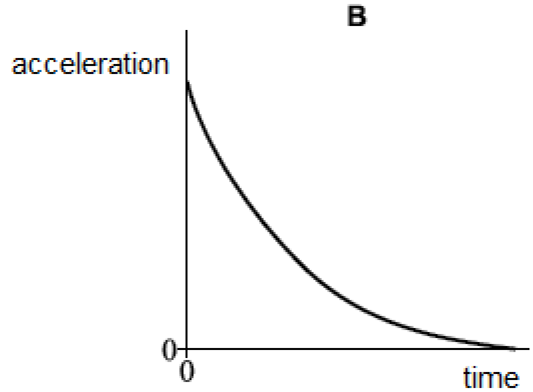


Which of the following shows the corresponding acceleration–time graph?

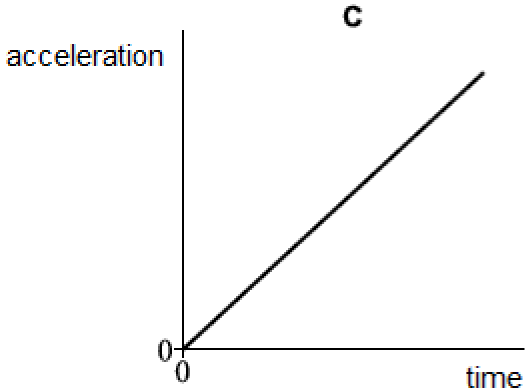
A



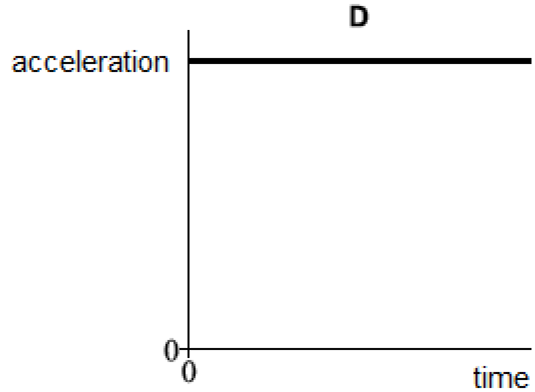
B



C



D



A ☐

B ☐

C ☐

D ☐

(Total 1 mark)

27 A girl jogs at 2.0 m s^{-1} in a straight line for 30 seconds, turns around and returns to her starting point 20 seconds later.

What is her average velocity and average speed?

	Average velocity/m s^{-1}	Average speed/m s^{-1}	
A	0 m s^{-1}	2.4 m s^{-1}	⬭
B	0 m s^{-1}	2.5 m s^{-1}	⬭
C	1.0 m s^{-1}	2.0 m s^{-1}	⬭
D	2.5 m s^{-1}	2.5 m s^{-1}	⬭

(Total 1 mark)

28 A golf ball was hit from the surface of the Moon. The time of flight was 4.0 s.

What is the best estimate for the maximum height reached by the ball?

acceleration due to gravity on the Moon = 1.6 m s^{-2}

A 3 m ⬭

B 15 m ⬭

C 40 m ⬭

D 80 m ⬭

(Total 1 mark)

29 A deep-space probe travelling forward at constant speed is briefly acted on by a force at right angles to its motion.

What is the effect of this force on the forward speed and sideways speed of this probe?

A its forward speed increases and sideways speed increases ⬭

B its forward speed decreases and sideways speed increases ⬭

C its forward speed is unchanged and sideways speed increases ⬭

D its forward speed decreases and sideways speed is unchanged ⬭

(Total 1 mark)

30 The mass of fuel in a racing car decreases during a race. As a result the lap time decreases.

Which of the following could explain this decrease?

A there is less friction on the race track

B the maximum speed of the car has increased

C the maximum acceleration and deceleration are greater

D the engine is more efficient

(Total 1 mark)

31 What is represented by the area under a force–displacement graph?

A rate of change of kinetic energy

B change in momentum

C work done

D acceleration

(Total 1 mark)

32 A roller coaster car is raised to a height of 65 m and released from rest.

What is the maximum possible speed of the car?

A 11 m s^{-1}

B 25 m s^{-1}

C 36 m s^{-1}

D 130 m s^{-1}

(Total 1 mark)

33 In a test a 500 kg car travelling at 10 m s^{-1} hits a wall. The front 0.30 m of the car crumples as the car is brought to rest.

What is the average force on the car during the impact?

A	830 N	⬭
B	7500 N	⬭
C	8300 N	⬭
D	83 000 N	⬭

(Total 1 mark)

34 Which of the following is **not** a unit of power?

A	N m s^{-1}	⬭
B	J s	⬭
C	W	⬭
D	kg m^2 s^{-3}	⬭

(Total 1 mark)

35 An electric motor of input power 100 W raises a mass of 10 kg vertically at a steady speed of 0.5 m s^{-1}. What is the efficiency of the system?

A	5%	⬭
B	12%	⬭
C	50%	⬭
D	100%	⬭

(Total 1 mark)

Mark schemes

1 B **[1]**

2 A **[1]**

3 B **[1]**

4 B **[1]**

5 C **[1]**

6 B **[1]**

7 C **[1]**

8 B **[1]**

9 A **[1]**

10 C **[1]**

11 D **[1]**

12 C **[1]**

13 D **[1]**

14 D **[1]**

15 B **[1]**

16 B **[1]**

17 D **[1]**

18 B

[1]

19 C

[1]

20 A

[1]

21 A

[1]

22 C

[1]

23 D

[1]

24 A

[1]

25 C

[1]

26 B

[1]

27 A

[1]

28 A

[1]

29 C

[1]

30 C

[1]

31 C

[1]

32 C

[1]

33 D

[1]

34 B

[1]

35 C

[1]

Examiner reports

25 Surprisingly the most popular distractor here was B, perhaps highlighting students' confusion with mass and weight. 70% were able to identify the correct answer.

26 Being able to interpret graphs is another important skill commonly tested by multiple choice questions. 67% of students were able to spot that graph B correctly represented the variation of the gradient of the velocity-time graph with time. The most popular distractor was A, perhaps due to students eliminating C and D as being obviously incorrect, and being able to go no further.

27 Students should be warned about multiple-choice questions that have an apparently very straightforward solution. Approximately the same number of students gave the incorrect response B as gave the correct response in this question. Presumably they calculated the speed for the second half of the journey, and took the average of the two speeds rather than calculating the total distance divided by the total time.

28 This question is a fairly demanding projectiles problem, requiring students to realise that at half the time of flight (2s) the ball would be at its highest point, and using $s = ut + \frac{1}{2}at^2$ for the remainder of the vertical motion, with $u = 0\ ms^{-1}$ and $a = 1.6\ ms^{-2}$. Only 32% of the students were able to do this, with approximately half of the answers being B, which may have been a guess as it seemed feasible.

29 68% of students identified the correct answer to this question. The most popular distractor was B, given by students believing that the sideways force must somehow reduce the forward speed.

30 The correct answer was given by 43% of students. Unsurprisingly perhaps, A was the most popular distractor.

31 Over 68% of students were able to recall, or work out, the significance of the area under a force-displacement graph. Those who chose B (approximately 20%) were probably confusing force-displacement with force-time.

32 This calculation proved to be very accessible, with 84% of students giving the correct answer. It should be noted that, in a written paper, students who use the suvat equations would not get the same credit as those who correctly equate GPE and KE, despite the two approaches giving the same answer.

33 This proved to be a very demanding question with only 29% of students giving the correct answer, although it proved to be quite discriminating. Students were required to calculate the kinetic energy of the car, and divide this by the distance to find the average decelerating force. The same answer could be obtained by calculating the acceleration using the suvat equations, and using $F = ma$. Slightly more students gave the answer C than gave the correct answer, perhaps neglecting to square the speed when calculating the kinetic energy.

34 Occasionally students are presented with multiple choice questions which require them to work out the "incorrect" answer. This will be highlighted by a bold "not" in the question. The fact that only 40% of students managed to find the correct answer may indicate that this could have caused difficulties, although this is contradicted by the small number (2%) of students choosing the watt. The most popular distractor, D, may have been chosen because of its apparent complexity.