Past-paper walk-through

Motion ▪ 1.2

eXercise

Questions in this set

- 0625/21 N25 Q2 ▪ 1 mark
- 0625/22 N25 Q2 ▪ 1 mark
- 0625/23 N25 Q2 ▪ 1 mark
- 0625/23 N25 Q3 ▪ 1 mark
- 0625/43 N25 Q1 ▪ 11 marks
- 0625/21 J25 Q1 ▪ 1 mark
- 0625/21 J24 Q7 ▪ 1 mark
- 0625/41 J24 Q1 ▪ 10 marks
- 0625/21 N23 Q2 ▪ 1 mark
- 0625/21 J23 Q3 ▪ 1 mark

Questions in this set

- 0625/41 J23 Q2 ▪ 8 marks

Reading the mark scheme

- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- // separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = "or words to that effect" – the wording need not match.

Question 2

0625/21 N25 ▪ Q2 ▪ 1 mark

2 An athlete runs at a speed of 8 m/s for 10 s, and then at a speed of 6 m/s for 12 s.

Which calculation gives the average speed of the athlete in m/s?

A $\dfrac{8+6}{2}$

B $\dfrac{(8\times10)+(6\times12)}{22}$

C $\dfrac{(8\div10)+(6\div12)}{22}$

Question 2

D $$\frac{(10 \div 8) + (12 \div 6)}{22}$$

Solution 2

Answer: **B**

Why

- Average speed is *total distance* divided by *total time* – never the average of the two speeds.
- Distance $= (8 \times 10) + (6 \times 12)$.
- Total time $= 10 + 12 = 22$ s, so divide that distance by 22.

Question 2

0625/22 N25 ▪ Q2 ▪ 1 mark

2 How is the deceleration of an object calculated from a speed–time graph?

A It is the area under the graph.

B It is the gradient of the graph.

C It is the difference between two readings on the horizontal (x) axis.

D It is the difference between two readings on the vertical (y) axis.

Solution 2

Answer: **B**

Why

- A speed–time graph's *gradient* is the rate at which speed changes – the acceleration.
- A negative gradient is a deceleration.
- The *area* under the graph gives the distance travelled instead.

Question 2

0625/23 N25 ▪ Q2 ▪ 1 mark

2 A car driver applies the brakes to bring a car to rest with a constant deceleration of 4.0 m/s^2 in a time of 8.0 s.

What is the average speed of the car during this time?

A 4.0 m/s **B** 8.0 m/s **C** 16 m/s **D** 32 m/s

Solution 2

Answer: **C**

Why

- The car comes to rest, so the final speed is zero.
- Its initial speed was $at = 4.0 \times 8.0 = 32$ m/s.
- With constant deceleration the average speed is $(32 + 0)/2 = 16$ m/s.

Question 3

0625/23 N25 ▪ Q3 ▪ 1 mark

3 An object is falling in a uniform gravitational field.

After a certain time, it reaches terminal velocity.

Which row is correct?

	velocity of object	acceleration of object
A	increases then decreases	positive then negative
B	increases then decreases	positive then zero
C	increases then constant	positive then negative

Question 3

D	increases then constant	positive then zero

Solution 3

Answer: **D**

Why

- Released from rest, the object speeds up, so its velocity increases.
- As it speeds up the air resistance grows, so the resultant force – and the acceleration – falls.
- At terminal velocity the forces balance: the velocity is constant and the acceleration is zero.

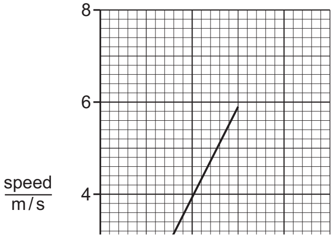
Question 1

0625/43 N25 ▪ Q1 ▪ 11 marks

1 **(a)** A hard ball is dropped vertically downwards.

Fig. 1.1 shows the speed–time graph for the ball from when it is dropped until it hits the ground.

Air resistance is ignored.



Question 1

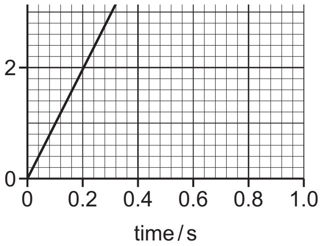


Fig. 1.1

(i) Describe the motion of the ball in Fig. 1.1.

Question 1

(ii) Show that the distance travelled by the ball is 1.8 m.

[2]

(iii) The mass of the ball is 0.54 kg. Calculate the gravitational potential energy stored in the ball immediately before it is dropped.

Question 1

(iv) Determine the kinetic energy of the ball when it has fallen half way to the ground.

Question 1

(b) The same ball is dropped from an aeroplane. Air resistance acts on the ball.

Explain how the vertical motion of the ball changes, from when it is dropped to just before it hits the ground.

Use the idea of forces in your answer.

Question 1

(c) A soft ball is dropped by a student so that it bounces on the ground.

Fig. 1.2 shows the height–time graph for the ball. The height is measured from the ground.

The ball bounces four times.

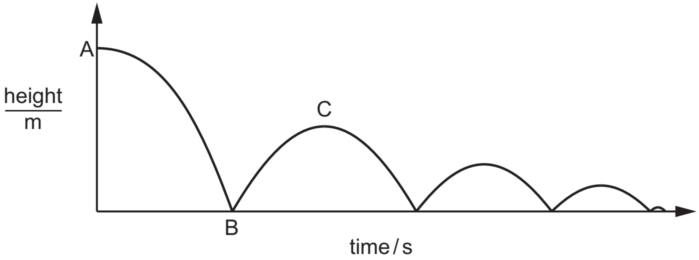


Fig. 1.2

Question 1

Fig. 1.2

Question 1

Explain why the change in height of the ball between B and C is less than the change in height between A and B.

Question 1

[Total: 11]

Solution 1

(a)(i)

Mark scheme

- constant acceleration

(a)(ii)

Mark scheme

- area under the graph OR ½ bh OR average speed $\times$ time
- $0.5 \times 5.9 \times 0.6$ OR 1.77 (to 3 sf)

Solution 1

(a)(iii)

Mark scheme

- 9.5 J
- (ΔEp =) mg(Δ)h OR $0.54 \times 9.8 \times 1.8$

(a)(iv)

Mark scheme

- candidate's 1(a)(iii) value $\times$ 0.5 (2sf)

Solution 1

(b) Mark scheme

- any three from:
- ▪
- (initially there is acceleration due to) an unbalanced force OR resultant force OR downward force OR weight OR
- gravitational force acting on the ball
- ▪
- as speed increases the air resistance increases
- ▪

Solution 1

- (as air resistance increases) resultant force downwards decreases
- OR acceleration decreases
- ▪
- (eventually) ball falls with constant speed when air resistance = weight OR ball falls with terminal velocity when air
- resistance = weight

Solution 1

(c) Mark scheme

- (some of the) energy is:
- transferred to the thermal energy (store) of the ground (when ball hits ground)
- OR converted / transferred to thermal energy (store) of the air
- OR used to deform ball / transferred to the elastic energy (store) of the ball (as it contacts the ground)
- gravitational potential energy (in the store at C) will be less (than at A)
- OR
- (ball has) less kinetic energy (in its store just after B)

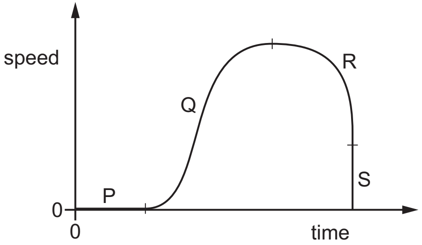
Solution 1

- 0625/43
- October/November 2025

Question 1

0625/21 J25 ▪ Q1 ▪ 1 mark

1 The speed–time graph for a racing car is divided into four sections, P, Q, R and S. The car starts the race but soon crashes into a wall of tyres.



Which sections of the graph show that there is an acceleration that is changing?

Question 1

A P, Q, R and S

B Q, R and S only

C Q and R only

D R and S only

Solution 1

Answer: **C**

Why

- On a speed–time graph a rising line is acceleration and a falling line is deceleration.
- A horizontal line is constant speed, and the graph touching zero means at rest.
- A crash shows as a very steep fall to zero, so look for the steepest downward section.

Question 7

0625/21 J24 ▪ Q7 ▪ 1 mark

7 A stone is dropped from a tall tower and falls a distance of 50 m to the ground.

The stone has a mass of 3.0 kg.

At which speed does the stone hit the ground?

A 17 m/s **B** 31 m/s **C** 54 m/s **D** 150 m/s

Solution 7

Answer: **B**

Why

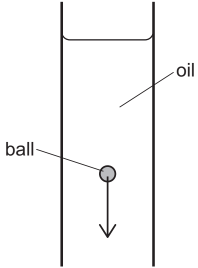
- Use $v^2 = 2gh$; the mass is irrelevant for a falling object.
- $v^2 = 2 \times 9.8 \times 50 = 980$.
- $v = 31$ m/s.

Question 1

0625/41 J24 ▪ Q1 ▪ 10 marks

1 A long tube contains oil. A small ball is held at rest at the surface of the oil. At time t = 0, the ball is released and begins to fall vertically through the oil.

Fig. 1.1 shows the ball falling through the oil.



Question 1

Fig. 1.1

As the ball begins to fall through the oil, it accelerates.

(a) Define acceleration.

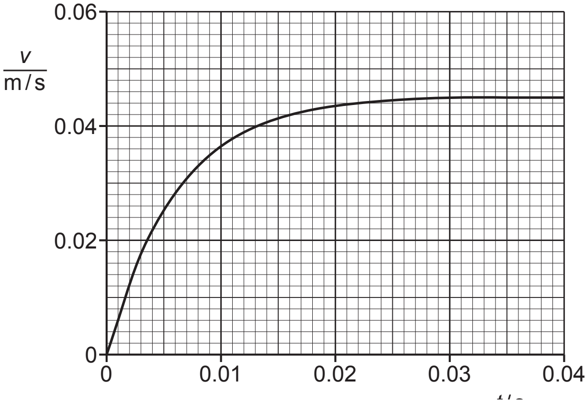
Question 1

(b) The mass of the ball is 0.0075 kg.

Calculate the resultant force acting on the ball when it is accelerating downwards at 2.8 m / s^2.

Question 1

(c) As the ball falls, its speed v is recorded. Fig. 1.2 is the speed–time graph for the falling ball.



Question 1

t / s

Fig. 1.2

(i) Describe what happens to the acceleration between $t = 0$ and $t = 0.040$ s.

Explain why this happens.

Question 1

(ii) By drawing a tangent on Fig. 1.2, determine a value for the acceleration of the ball at $t = 0.010\,\text{s}$.

Question 1

[Total: 10]

Solution 1

(a)

Mark scheme

- (acceleration is) rate of change in velocity OR change in velocity per unit time OR (a =) v / t

Solution 1

(b)

Mark scheme

- 0.021 N
- $F = ma$ OR $(F =)$ ma OR 0.0075×2.8

Solution 1

(c)(i) Mark scheme

- any four from:
- ▪
- (acceleration) decreases
- ▪
- (acceleration decreases) to zero (at approximately 0.03 s)
- ▪
- resistive force increases / resistance increases (as speed / velocity increases)
- ▪

Solution 1

- resultant force (downwards) decreases
- ▪
- (until) terminal velocity / constant speed (is reached)
- ▪
- (when) resistive force = weight OR resultant force is zero OR forces are balanced

Solution 1

(c)(ii)

Mark scheme

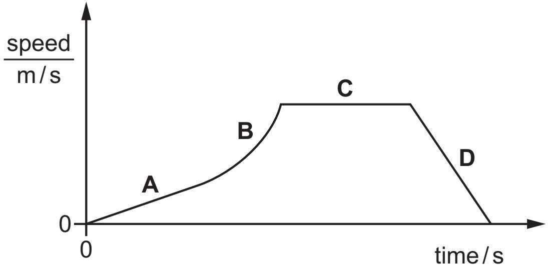
- tangent drawn at $t = 0.010$ s
- 1.2 m / s2 acceleration 1.8 m / s2
- $(a =)$ gradient of tangent OR $(a =)$ $\{\Delta y \,/\, \Delta x\}$
- 0625/41
- May/June 2024

Question 2

0625/21 N23 ▪ Q2 ▪ 1 mark

2 The graph shows the speed of a car travelling through a town.

Which section of the graph represents a period when the car is decelerating?



Question 2

Solution 2

Answer: **D**

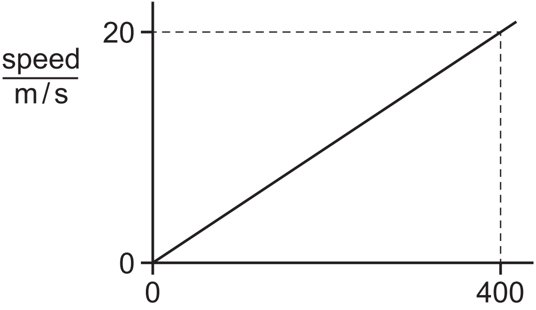
Why

- Deceleration means the speed is falling.
- On a speed–time graph that is a section sloping *downwards*.
- A horizontal section is constant speed and an upward slope is acceleration.

Question 3

0625/21 J23 ▪ Q3 ▪ 1 mark

3 The graph represents the motion of a vehicle.



Question 3

time / s

What is the distance travelled by the vehicle in 400 s?

A 20 m

B 400 m

C 4000 m

D 8000 m

Solution 3

Answer: **C**

Why

- Distance travelled is the *area* under a speed–time graph.
- The line rises from rest to 20 m/s over 400 s, so that area is a triangle.
- $\frac{1}{2} \times 400 \times 20 = 4000$ m; 8000 m would be the area if the speed had been 20 m/s throughout.

Question 2

0625/41 J23 ▪ Q2 ▪ 8 marks

2 Fig. 2.1 shows a motorcyclist accelerating along a straight horizontal section of track.

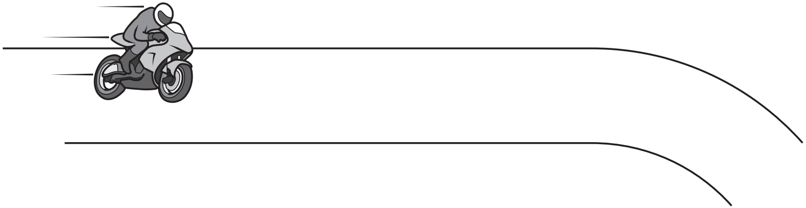


Fig. 2.1

The motorcyclist and motorcycle have a combined mass of 240 kg.

Question 2

(a) On the straight horizontal section of the track, the motorcyclist accelerates from rest at $7.2\,\text{m/s}^2$.

(i) The motorcyclist reaches the end of the straight section of track in $5.3\,\text{s}$.

Calculate the speed of the motorcyclist at the end of the straight section.

Question 2

(ii) Calculate the resultant force on the motorcyclist and motorcycle on the straight section of track.

Question 2

(b) At the end of the straight section, the track remains horizontal but bends to the right, as shown in Fig. 2.1.

When the motorcyclist reaches the bend, she travels around the bend in a circular path at a constant speed.

(i) Velocity is a vector quantity.

State how a vector quantity differs from a scalar quantity.

Question 2

(ii) Describe what happens to the velocity of the motorcyclist as she travels around the bend at constant speed.

Question 2

(iii) Explain why there must be a resultant force on the motorcyclist as she travels around the bend.

Question 2

[Total: 8]

Solution 2

(a)(i)

Mark scheme

- (speed =) 38 m / s
- a = v / t OR (v =) a t OR (v =) 7.2×5.3

(a)(ii)

Mark scheme

- (resultant force =) 1 700 N
- F = ma OR (F =) ma OR (F =) 240×7.2

Solution 2

(b)(i)

Mark scheme

- (vector) has direction (as well as magnitude) OR scalar does not have direction
- 0625/41
- May/June 2023

(b)(ii)

Mark scheme

- (velocity) changes (as direction of motion changes) OR direction (of velocity) changes

Solution 2

(b)(iii) Mark scheme

- any two from:
- ▪
- because there is an acceleration / change in velocity / change in direction / change in momentum (which needs a
- resultant force)
- ▪
- motorcyclist accelerates / changes momentum (because velocity / direction changes)

Solution 2

- ▪
- (resultant) force is perpendicular to the motion (of the motorcycle) OR a F